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LABORATORY VERIFICATION OF PREDICTED PERMANENT DEFORMATION IN ASPHALT MATERIALS FOLLOWING CLIMATE CHANGE

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ABSTRACT

In the past a change in temperature of 5°C most often occurred over intervals of thousands of years. According to estimates by the IPCC, in the XXI century is expected an increase in average temperatures in Europe between 1.8 and 4.0°C in the best case caused by emissions of carbon dioxide and other GHG from human activities.

As well as on the environment and economic context, global warming will have effects even on road safety. Several studies have already shown how increasing temperature may cause a worsening of some types of road surface damages, especially rutting, a permanent deformation of the road structures consisting in the formation of a longitudinal depression in the wheelpath, mostly due to the rheological behavior of bitumen. This deformation evolves during the hot season because of the heating capacity of the asphalt layers, in fact, the road surface temperature is up to 24°C higher than air.

In this thesis, through the use of Wheeltrack test, it was studied the behavior of some types of asphalt concrete mixtures subjected to fatigue testing at different temperatures. The objectives of this study are: to determine the strain variation of different bituminous mixture subjected to fatigue testing at different temperature conditions; to investigate the effect of aggregates, bitumen and mixtures' characteristics on rutting.

Samples were made in the laboratory mostly using an already prepared mixtures, the others preparing the asphalt concrete from the grading curve and bitumen content. The same procedure was performed for each specimen: preparation, compaction using the roller compactor, cooling and heating before the test.

The tests were carried out at 40 - 50 - 60°C in order to obtain the evolution of deformation with temperature variation, except some mixtures for which the tests were carried out only at 50°C. In the elaboration of the results were considered testing parameters, component properties and the characteristics of the mixture. Among the

testing parameters, temperature was varied for each sample. The mixtures responded to this variation with a different behavior (linear logarithmic and exponential) not directly correlated with the asphalt characteristics; the others parameters as load, passage frequency and test condition were kept constant. According to the results obtained, the main contribution to deformation is due to the type of binder used, it was found that the modified bitumen have a better response than the same mixtures containing traditional bitumen; to the porosity which affects negatively the behavior of the samples and to the homogeneity ceteris paribus. The granulometric composition did not seem to have interfered with the results.

Overall has emerged at working temperature, a decisive importance of bitumen composition, than the other characteristics of the mixture, that tends to disappear with heating in favor of increased dependence of rutting resistance from the granulometric composition of the sample considered. In particular it is essential, rather than the mechanical characteristics of the binder, its chemical properties given by the polymeric modification.

To confirm some considered results, the maximum bulk density and the air voids content were determined.

Tests have been conducted in the laboratories of the Civil Engineering Department at NTNU in Trondheim according to European Standards.

ESTRATTO

Nel passato un cambiamento della temperatura di 5°C avveniva durante intervalli di migliaia di anni. Secondo le stime pubblicate dall'IPCC, nel XXI secolo è previsto un aumento della temperatura medi in Europa tra 1.8 e 4.0°C negli migliori ipotesi a causa delle emissioni di biossido di carbonio e altri GHG dalle attività umane.

Il riscaldamento globale oltre ad avere effetti sul contesto ambientale ed economico, si ripercuote anche sulla sicurezza stradale. Numerosi studi hanno già illustrato come ad un incremento di temperatura ambientale possa seguire un peggioramento di alcuni tipi di deformazione del manto stradale, in particolare l'ormaiamento, una deformazione permanente della struttura stradale consistente nella formazione di depressioni longitudinali, corrispondenti al percorso delle ruote dei veicoli, dovute principalmente al comportamento reologico del bitume. Questo tipo di deformazione si sviluppa durante la stagione calda grazie alla capacità termica dello strato di asfalto, infatti, la temperatura della superficie stradale può essere fino a 24°C superiore della temperatura dell'aria.

In questa tesi, tramite l'analisi dei risultati ottenuti dal Wheeltrack test, è stato studiato il comportamento di alcuni tipi di conglomerato bituminoso sottoposto al test di fatica a temperature diverse. Questa tesi si prefigge gli obiettivi di determinare il comportamento deformativo di diverse miscele bituminose sottoposte a test di fatica a diverse temperature e, di determinare il grado di influenza degli aggregati, del bitume e delle caratteristiche della miscela sull'ormaiamento.

I campioni sono stati preparati in laboratorio, soprattutto utilizzando materiale premiscelato, negli altri casi preparando la miscela a partire dalle indicazioni fornite dal produttore di bitume sia per quanto riguarda la granulometria degli aggregati che per la composizione della miscela. Per ogni campione è stata seguita la medesima procedura:

preparazione, compattazione tramite il Roller Compactor, raffreddamento e riscaldamento prima del test.

I test sono stati svolti a 40 – 50 – 60°C con lo scopo di ottenere l'evoluzione della deformazione rispetto all'incremento di temperatura, salvo alcune miscele per le quali i test sono stati effettuati a soli 50°C. Durante l'elaborazione dei risultati sono stati considerati i parametri dei test, le proprietà dei componenti, e le caratteristiche delle miscele. Tra i parametri dei test, la temperatura è stata variata per ogni campione. Le miscele hanno risposto a questa variazione con un comportamento differente (lineare, logaritmico e esponenziale) non direttamente correlato con le caratteristiche del conglomerato.; gli altri parametri come il carico, la frequenza del passaggio e le condizione del test sono state mantenute costanti. Secondo i risultati ottenuti, il contributo maggiore alla deformazione è dato dal tipo di legante utilizzato, in particolare l'uso di bitume modificato ha effetti migliori su una miscela rispetto all'utilizzo di bitumi tradizionali; dalla porosità che influenza negativamente il comportamento dei campioni e, dall'omogeneità. La composizione granulometrica non sembra aver interferito significativamente sui risultati.

Complessivamente è emerso, alle temperature di esercizio, un importanza fondamentale della composizione del bitume, piuttosto che delle altre caratteristiche della miscela, che tende ad estinguersi con il riscaldamento a favore di una maggiore dipendenza della resistenza all'ormaiamento dovuta alla composizione granulometrica del campione considerato. In particolare risultano essenziali le caratteristiche chimiche del bitume dovute alla modifica polimerica piuttosto che le caratteristiche meccaniche dello stesso.

Per confermare alcuni risultati considerati, sono stati determinati la massa volumica apparente e la porosità dei campioni.

I test sono stati svolti nei laboratori del Civil Engineering Department presso la Norwegian University of Science and Technology di Trondheim secondo la normativa Europea vigente.

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1 INTRODUCTION

Generally, rutting is caused by the accumulation of irreversible and permanent deformation in all pavement layers under the action of repeated traffic loadings. The cumulative permanent deformation in asphalt layers is known to be responsible for a major portion of the final rut depth measured on the pavement surface.

1.1 Background

Most of the latest scenarios predict an increase of global average temperatures in the next century, caused by emissions of carbon dioxide and other GHG from human activities. As well as on the environment and economic context, global warming will have effects even on road safety. Several studies have already shown how increasing temperature may cause a worsening of some types of road surface damages, especially rutting.

1.2 Problem statement

In the project of a road structure, generally designers take into account a static climatic condition referring to the variability of data recorded in the previous 10 – 30 years. The assumption of a future warming climate should rise the possibility that the frequency, duration and severity of asphalt permanent deformation may be altered leading to premature deterioration because weather and climate factors directly influence the planning, design, construction and maintenance of transport infrastructures because of the exponential ratio between air and surface temperature.

Among the types of deformation affecting the adhesion and regularity of the road surface, rutting, the formation of preferential channels for the passage of vehicle wheels, influences the safety and comfort driving. In several studies, which will be analyzed in the following chapters, have observed a direct temperature dependence of the phenomenon.

Although rutting is the sum, of a process that affects the entire road structure, the wear layer is considered the most influential. Therefore it is necessary to give attention to the choice of the mixture composition considering the effects of the component materials. Consequently it is important to determine which parameters will condition the rutting resistance of a mixture subjected to a temperature increase of 10 - 20°C.

This thesis, through laboratory tests, attempt to determine the influence of factors as binder, mineral materials and mixture characteristics on the behavior of the asphalt concrete samples.

1.3 Objectives

The purpose of this thesis is to study the behavior of asphalt concrete subjected to an increase in temperature. The objectives of this study are:

1. to determine the strain variation of different bituminous mixture subjected to fatigue testing at different temperature conditions;
2. to investigate the effect of aggregates, bitumen and mixtures characteristics on rutting.

1.4 Methodology

The methodology adopted in this study encloses a review of literature and a laboratory investigation. The literature review is conducted to identify important material properties, that influence the permanent deformation response of mixtures at high temperatures.

The laboratory investigation was conducted on different mixtures of asphalt concrete used in the wear course of road pavement structure. In particular in this thesis have been considered mixtures produced according to Norwegian standards (Ab, Agb, SKA), modified and not; and three types of Italian blends modified with SBS. The mixtures specifications are reported in the receipts in ‘’. The samples, prepared in the laboratory of the Civil Engineering Department at NTNU in Trondheim, have been subjected to the Wheeltrack test, using a device that simulates the effect of the vehicular traffic on a portion of road structure. Samples were subsequently subjected to a test to determine the bulk density and the void characteristics in order to verify the correspondence of samples with data provided by the producer. Some mixtures have also been subjected to the procedure for determining the maximum density.

The analysis of results will be carried out, step by step, considering the effect of the single feature of the material, all the other things being equal, on the rutting resistance comparing the results obtained from the different mixtures. For the analysis it was considered useful employing graphs and tables to represent in a concisely and comprehensively the results allowing, at the same time, to analyze the individual quantitative data.

1.5 Organization

This thesis is divided in 7 chapters. Following the first introductory chapter, Chapter 2 discusses the problem of permanent deformation in flexible pavements with emphasis on rutting. Initially will be described the types of road structures, in particular will be examined the flexible pavement and the stress states within it in order to establish the stress – strain state induced by the traffic, starting from the static scheme which it reproduces. Hereafter will be exhibited the rheological properties of asphalt concrete to have a description of the visco – elastic behavior. Will also be described the causes of rutting, the rutting process and related issues.

Various factors could cause the rutting formation on asphalt pavements and temperature is one of the main significant factor due to the visco – elastic properties of asphalt. In Chapter 3 will be described the mean temperature increment in Europe due to the climate change in progress as it is predicted from the Intergovernmental Panel on Climate Change. This increase in temperature will be correlated with the heat properties of asphalt concrete.

In Chapter 4 will be described the testing and experimental procedure used in this study. In particular, for each test, will be shown the obtainable results according to European Standards. Besides, in the same section, samples will be characterized both as regards materials and as the phases of their preparation.

The final results and the main graphs arising the Wheel track test are reported in Chapter 0. Wheeltrack test results will be shown using a graphical presentation to observe the evolution of the deformation over time.

Chapter 6 discusses the results of the laboratory tests comparing the values of the accumulated strain of various mixtures considering the effect of temperature related to the intrinsic characteristics of the mixtures and of their ingredients. Then will be studied in deep the bitumen influence in relation to the ability to achieve a set deformation through a data regression analysis. Then will be considered the variation of volumetric characteristics of the samples This chapter will refer to data resulting in the three tests and to mixtures specifications arising from the accompanying receipts attached in appendix.

Finally in Chapter 7 are summarized all the reflections made in the thesis and will be offered some ideas and suggestions for future work that have grown out from observations made during the work and the difficulties encountered.

At the end of this thesis are attached five appendix containing data considered in the elaborate. In particular, in ‘APPENDIX A: Receipts’, there are the scanned accompanying receipts of the mixtures used to produce samples; in ‘APPENDIX B: Mechanical characteristics of DRENOVAL HM, DRENOVAL HARD M and LOWVAM HM 40’, are reported the mechanical characteristics of the Italian bitumen; in ‘APPENDIX C: Wheeltrack test results’, there are the Wheeltrack test results for each couple of samples tested simultaneously; and in ‘APPENDIX D: Determination of bulk density and void characteristics’ and ‘APPENDIX E: Maximum density’, are presented the determinated bulk density and void characteristics for all samples and the determination of the maximum density for four specimens.

2 RUTTING

This chapter presents a brief discussion about permanent deformation in road structures. Different kinds of structures have a different response to load application depending on stresses distribution. It is not easy to define flexible pavement behavior because of the mechanical properties of bituminous binders. The binder plays an important role in the performance of the corresponding asphalt mix, and the most failure mechanism in asphalt is beloved related to a rheological aspect of the corresponding bituminous binder.

Under the wheel loading, rutting is the main deformation of road pavements, it occurs as longitudinal depression in the road surface. This loss in regularity will influence the safety and the comfort driving. It would be demonstrated that rutting depends on materials properties and environmental factors.

2.1 Permanent deformation

2.1.1 Road structure

Road pavement is the suitable structure to ensure vehicular or pedestrian traffic. The basic purposes that should belong to the road pavement for good service throughout the full life are:

- to ensure a not much deformable, smooth riding and non skidding surface with the respect safety targets and comfortable ride;
- to share, on the ground below, almost static (vehicle’s weight, grip) and dynamic actions (shove due to discontinuity) transmitted from vehicles without causing deformations of the pavement, very harmful to the ride comfort, damage of the vehicle and without injuring transport security;

- to protect the stability of underlying layers from weather including the effect of surface water so as to maintain over time the value of uniformity and load - bearing conferred at the moment of construction.

Road structure consists of many layer laid one on the top of the other made up of different materials (stony aggregates and binder). The sequence of layers is generally composed of a stony skeleton with the size of the elements decreasing and mixture’s mechanical characteristics increasing from the bottom to up. This is because an uneven surface will be uncomfortable for vehicle occupants and will wear more quickly.

Each layer has specific dimensional characteristics (thickness) and a physical composition (materials) that ensures the mechanical performance: the stress, transmitted through the road structure from the vehicles above, spreads and lessens with depth.

Layers in the road structure are:

- surface/wearing layer: it is the top layer of a pavement, in direct contact with the wheel of vehicles. As well as ensuring a good grip for traffic safety and being waterproof to protect lower layers, it must absorbs horizontal actions arising from traffic and transmits the vertical actions to the layers below;
- base layer: it lies close under the pavement surface and it is subjected to severe loading. Its purpose is to transfer loads to the underlying layers;
- sub base layer: it is the layer of aggregate material laid on the subgrade, generally natural gravel. Its primarily function is as structural support enabling traffic stresses to be reduced to an acceptable level in the subgrade. It can also minimize the intrusion of fines from the subgrade into the pavement structure, improve drainage, minimize frost action damage and provide as a working platform for construction.

There are two main types of road structures: rigid and flexible. They differ because of the constituent materials and the behavior with which they react to the traffic loads transferring them in depth.

Flexible pavements has surface and base layer made with a mixture of aggregates and bitumen. The bitumen is used as the binder material. This kind of pavements are called flexible since the total pavement structure deflects due to traffic loads. A flexible pavement is generally composed of several layers of material which can accommodate this flexing.

Rigid pavements consists of a thick concrete layer who performs the function of the surface and base layer. These structures are stiffer than flexible ones due to the high modulus of elasticity of the material. Because of the high stiffness the load is distribute over a wider area of subgrade than rigid pavements. The two pavement types differ because of the construction cost, the maintenance time (flexible: 10-15 years, rigid: 20-40 years) and the more expensive rehabilitation of rigid pavements.

Composite pavements are where a concrete layer exists below a bitumen top surface. It is used in roads with high traffic.

2.1.2 Stress distribution

Stress distribution in a road structure is studied in order to know how phenomena develops in the road structure, below the tire contact, and in particular to determine the behavior of the asphalt layers.

Road pavement's primary function is to provide a breakdown of traffic loads on the laying ground through several horizontal layers with a defined thickness. Bituminous layers, when present, are wear, binder and base course. Depending on their position in the package, layers are stressed differently. In particular, surface layers (wear and binder course) are subjected to vertical loads and especially to horizontal loads. The vertical forces are due to the weight applied on the wheel, the horizontal shear stresses, occurring on the pavement surface during accelerating and breaking phases, are due to the adherence between tire and wear course during rolling.

The upper layers (wear and binder) are subjected to bending stresses while the lower layers (base and sub base) are subjected to vertical forces, mainly compression (Figure 2.1).

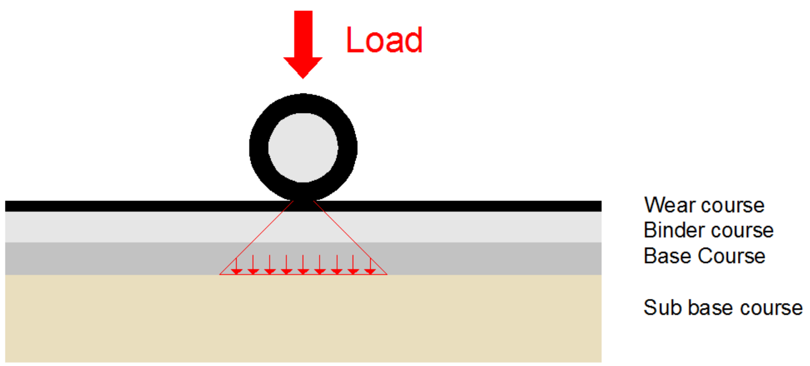


Figure 2.1 Flexible pavement load distribution.

Numerous studies undertaken in recent years have revealed that, indeed, stress distribution is very complex because the tensile stress progress does not only affect surfaces layers, but also the layers immediately below [1].

In Figure 2.2 is represented a breaking scheme of a flexible pavement. The development of surface cracks is due to the presence of tensile stress, caused by both the tangential action (which is due to the wheel rolling) and the compressive stress (generated by the vertical load). Considering infinitesimal elements next to the contact point between the tire and the pavement, according to a two dimensional representation, it is possible to represent the state of compression and tension as in Figure 2.3. The load applied by a tire can be illustrated with a concentrated force that determines a compression zone, immediately below, and two traction areas in the adjacent sides. Obviously, because of the connection between the layers, the stresses at the intrados are opposite to those of the extrados.

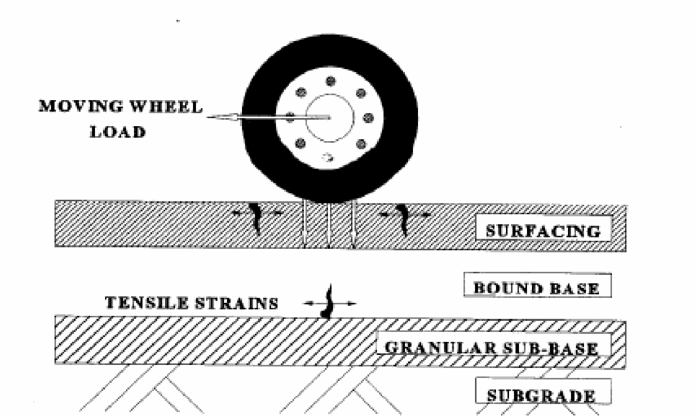


Figure 2.2 Effects of a loaded rolling wheel on the road structure [2].

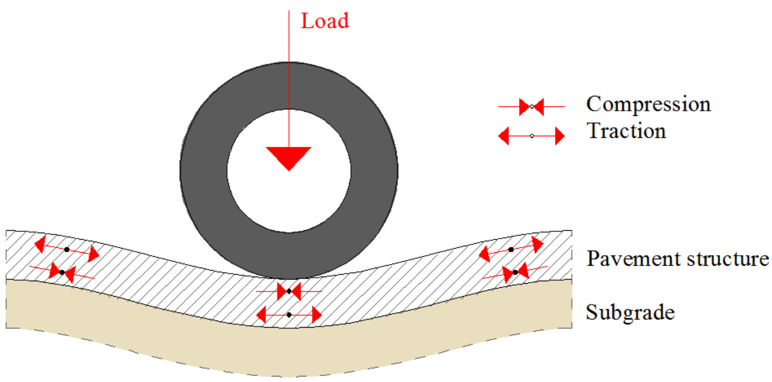


Figure 2.3 Stresses in surface's layers [2].

Schematizing a three – dimensional portion of a pavement, it is possible to represent the stress states that occur below the tire. In Figure 2.4 the pavement structure is schematized as a double clamped beam to which is applied a load.

Trough a structural analysis of the pavement structure, it is possible to identify three main areas with a different stress state. In Figure 2.4 there are the first two pavement layers directly in contact with the action of the wheel (wear and binder course). It is assumed that between these two layers there is not relative slip and grip.

The static scheme, for a fixed instant, is a doubly clamped beam where the upper layer is subjected to horizontal compression (case 1) and the lower to horizontal traction (case

2). In lateral areas the stress is reversed, the upper layer is subjected to tension (case 3) and the lower to compression (case 4).

Figure 2.4 represents an instantaneous load condition. In reality stress distribution depends on loading – unloading cycles, speed of traffic and tensile stresses transmitted from the vehicles to the road during acceleration and deceleration phases.

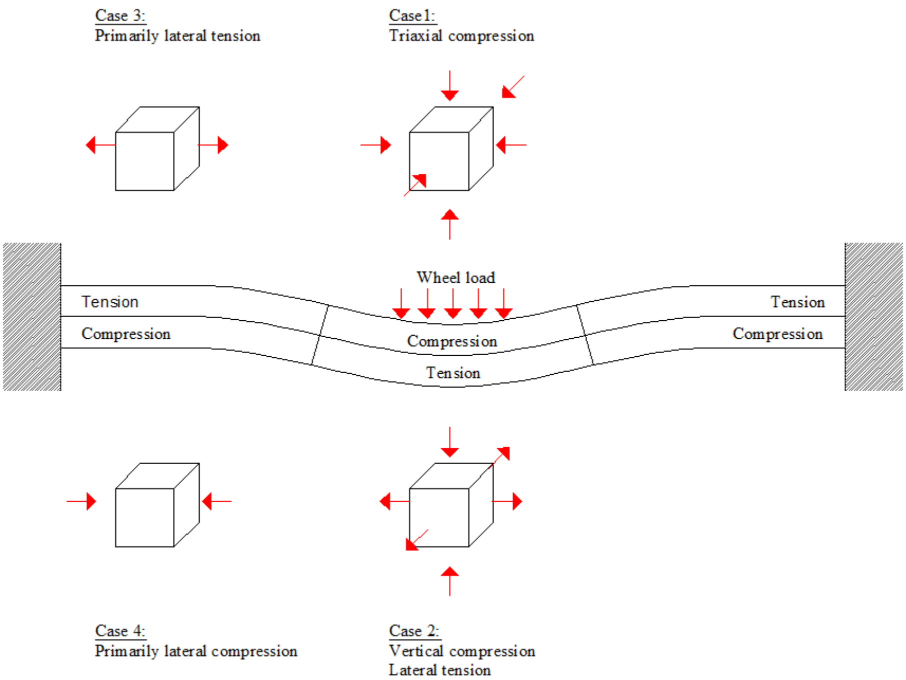


Figure 2.4 Schematization of the road pavement as doubly clamped beam subjected to a concentrate load [2].

It is important to know asphalt characteristics not only during the design of the road structure, before construction, but also for subsequent maintenance because of the development of road transport and the increase of traffic intensity [3].

2.1.3 Rheology of asphalt concrete mixtures

Rheology is the mechanical behavior of materials that do not obey to the classical laws of viscosity and elasticity.

It arises from the need to represent the visco – elastic behavior of some materials, such as asphalt, which answer to stress both in a viscous and elastic way, with a different proportion depending on the condition under which these stresses are applied. In fact, the real behavior of bituminous mixtures is an intermediate type, it is a visco - elastic behavior. The main mechanical property of visco – elastic material is to be sensitive to the speed of load application. Temperature can significantly affect.

The behavior of bituminous binders can be described according to the representation of Olard F. [4] (Figure 2.5), which, depending upon the strain and test temperature for a given frequency, there may be different rheological domains for the same material. This representation it is useful to identify the different kind of bitumen's behavior in relation to the different conditions.

In Figure 2.5 it is possible to identify the following elements (the meaning of E and G will be explained subsequently):

- brittle and ductile domains for which it is possible measure the breakdown stress σ_p;
- brittle breakdown, characterized by the tenacity K_c;
- the linear elastic field, characterized by the modules E and G;
- the visco – elastic field, characterized by the modules E^* and G^*;
- the purely viscous field (Newtonian), characterized by the dynamic viscosity η;
- the non – linear field, characterized by significant strains.

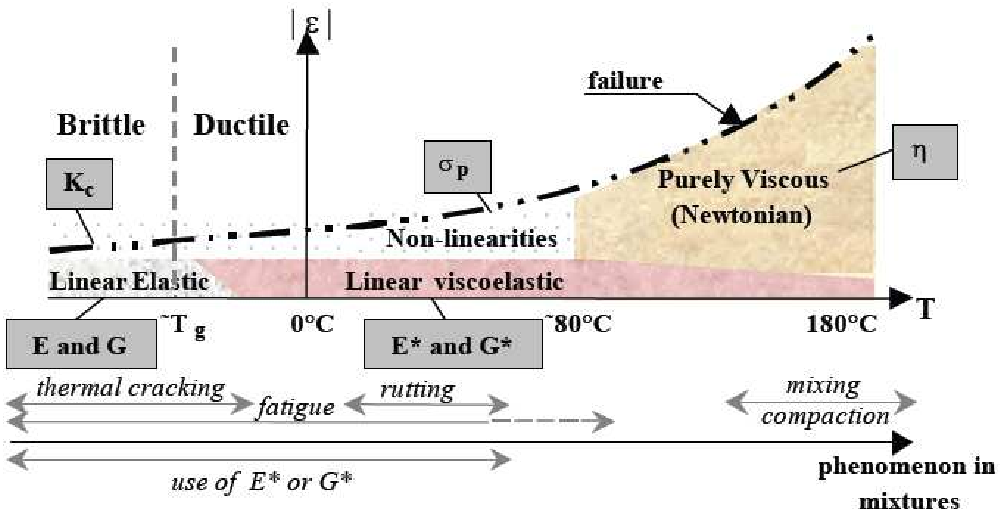


Figure 2.5 Bitumen behavior as function of strain (Ɛ) and temperature (T) [4].

Several studies have shown that bituminous binders can be analyzed referring to the linear visco – elastic field that reproduce the typical conditions in which these materials are subjected in work, due to traffic loads and temperature [4]. For this reason, most models that describe the rheological behavior of bituminous binders are confined to the analysis of the liner visco – elastic field.

It is possible to schematize the material behavior using the theory of linear elasticity. In this case, at each load application corresponds a particular strain which is directly proportional to the load according to a ratio called coefficient of elasticity or Young modulus (E). It can be modeled as a spring of elastic constant E.

Figure 2.6 shows the trend of tension in the spring. It is ruled by the Hooke's law

$$\sigma = E \cdot \varepsilon$$

Where:

σ is the stress;

E is the elastic modulus of the material;

ε is the strain that occurs under the given stress.

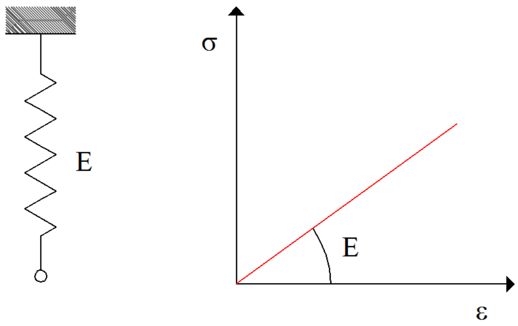


Figure 2.6 Linear elastic model.

The elastic model represents an extreme case where the deformations are not time - dependent but simply due to the value of the applied load.

On the other hand it is possible to have a perfectly viscous material. In this case, the schematization is dashpot of viscosity η (Figure 2.7). The stress-strain rate relationship can be given as

$$\sigma = \eta \cdot \frac{d\varepsilon}{dt}$$

Where:

σ is the stress;

η is the viscosity of the material;

$d\varepsilon/dt$ is the time derivative of strain.

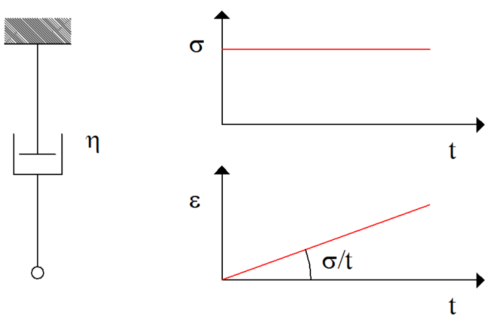


Figure 2.7 Viscous model.

To outline bituminous materials it is necessary to combine the elastic and viscous model. Possible examples are Maxwell model, Kelvin – Voigt model and the generalized Maxwell model.

The Maxwell model consists of two elements in series: a spring with elastic constant E and a dashpot with viscosity η as shown in Figure 2.8. When a stress is applied, it will be the same on both the spring and the dashpot, the total strain of the model will be equal to the sum of the two components. Using this model the result is an instantaneous elastic deformation due to the elastic component (spring) and a secondary linear deformation due to the viscous component (dashpot). Since the non – linear behavior of bituminous materials, this model can be used only considering a very short period of time in which the approximation is valid.

The Kelvin – Voigt model consists of a Newtonian damper and Hookean elastic spring connected in parallel (Figure 2.8). In this case the stress is divided between the spring and the dashpot while the strain is the same for both. Using this model it is possible to show the viscous behavior but not the instant elastic one.

A more detailed description of the rheological behavior can be given by the generalized Maxwell model. It allows to define uniquely the instantaneous and asymptotic response. In this case the schematization are many spring – dashpot Maxwell elements in parallel (Figure 2.8).

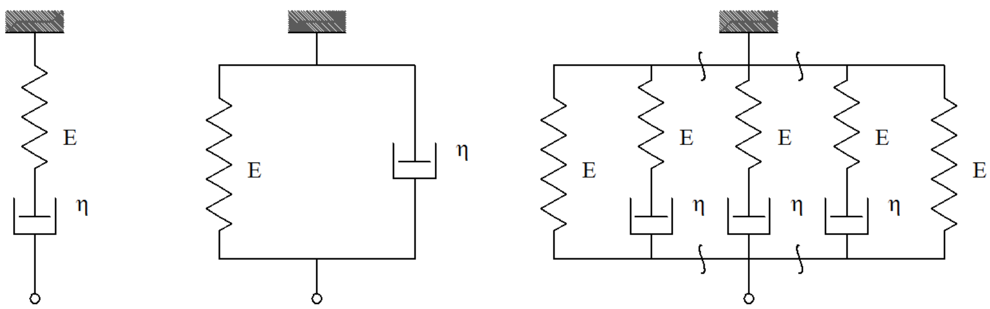


Figure 2.8 The Maxwell model, the Kelvin – Voigt model and the generalized Maxwell model.

2.2 Rutting in flexible pavements

2.2.1 Road damages

Road pavement, like any other infrastructure, is designed to ensure adequate structural and functional characteristics during all its lifetime. It happens that before reaching the end of the service life, the infrastructure may need rehabilitation or maintenance.

The reduction of adhesion and regularity of the surface layer and thermal crack are road main damages. The first phenomenon is characterized by rounding of the aggregates that reduces ginning and adhesion, or by the loss of elasticity of the binder that breaks down and leads to the formation of holes through all the thickness. It is mostly evident in flexible pavements because the bitumen is an organic material, it degrades quickly when it is subjected to climatic variations and aging. It is more critical in a rigid pavement but usually it advances slower.

Another superficial degradation is cracking due to fatigue which arises at the interface between the superficial layer and the base and it propagates up to the rolling surface. When cracks reach the surface thicken and give rise to the phenomenon of reflective cracking. Thermal cracking instead, leads a state of tension between the layers associated with the asphalt. It produces widespread fractures characterized by regular and equidistant intervals from each other.

The phenomenon considered in this thesis is the formation of rutting (Figure 2.9 Ruts in the wheelpath.). It is a surface deformation defined as a longitudinal depression in the wheelpath, with or without transverse displacement. Rutting as physical distortion of the surface, is sometimes called grooving or channeling, it also prevents the cross drainage of water during rains, leading to accumulation of water in ruts and increasing the potential of hydroplaning and related accidents (Figure 2.10). It can be measured with a straight edge or a profiler at regular intervals.

Figure 2.9 Ruts in the wheelpath.

Figure 2.10 Water accumulation in ruts.

According to Doré and Zubeck [5] rutting can be

1. low to moderate severity rutting: one dimensional densification or vertical compression near the center of wheelpath, caused by densification of mixes with excessive air voids in the in place mix under traffic;
2. moderate to high severity rutting: a depression in the wheelpath along with humps on either side of the depression, caused by lateral flow due to plastic deformation, resulting from shear failure of the mix under traffic, and generally associated with very low air voids in the mix;
3. rutting accompanied by cracks on the surface of the pavement: caused by rutting in underlying layers, such as the subgrade or sub base [6].

In moderate or severe rutting, the surface of the pavement may be uplift along the slides f the channel.

Rutting can occur on any type of pavement including high and low volume roads even if it is most frequently on high volume roadways. It typically does not occur on parking lots with the exception of location such as drivers or vehicle entrances or exits. The random movement of vehicles through parking stalls etc., usually does not provide enough repeated tire movement to develop the rut.

2.2.2 Causes of rutting

The passage of a wheel on the road pavement generates tensions due to the load variations which are transmitted to the sub base through the layers. The tension acts in three dimensions depending on the material (Figure 2.11).

A cylindrical element within the pavement is subjected, during the whole life, to a stress generated by the passage of loads (Figure 2.12). The intensity of this stress will vary depending on the weight of the vehicle and on the contact surface between the wheel – pavement. The cylinder deforms radially and axially for each wheel passage with an elasto – plastic strain. When the load cycle leads the material behavior from an elastic to an elasto – plastic model, the strain will not return to the initial conditions. It will maintain a small permanent deformation. With the succession of the number of cycles, the accumulation of permanent deformation will lead to an alteration of the road.

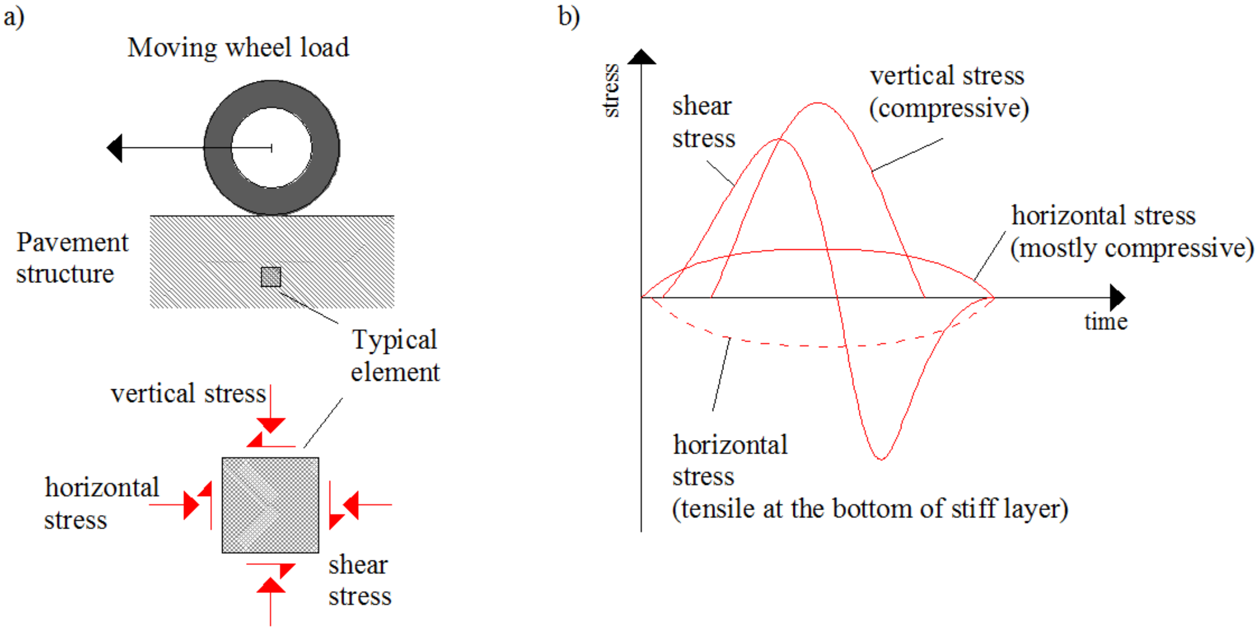


Figure 2.11 Stress conditions under a moving wheel load. a) Stress on pavement element; b) variation of stresses with time [6].

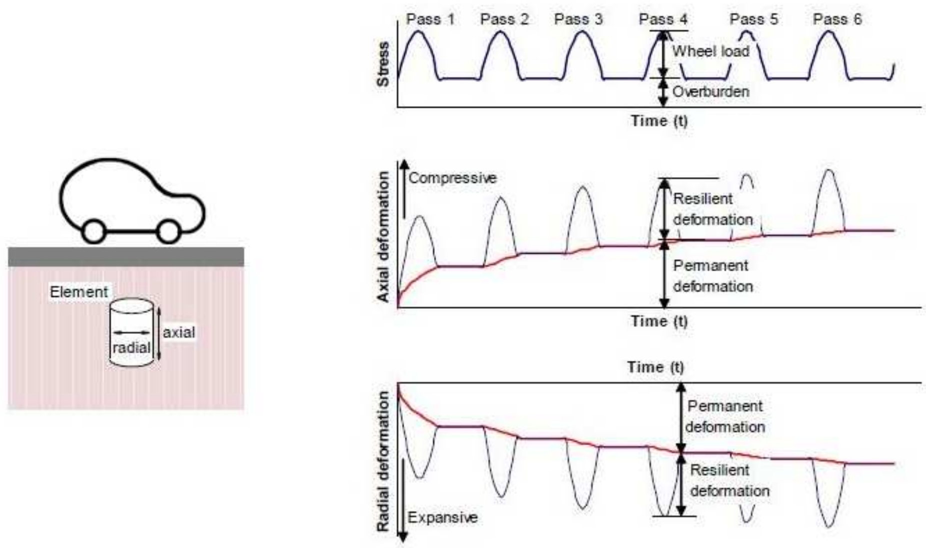


Figure 2.12 Loading in pavements under traffic [6].

It is possible to define stresses and strains in each point of the road structure to analyze the causes of cracking and deformation even if it is not easy to distinguish the plastic deformation from the simply viscous. The first are those that remain after removing the load; the second are time – dependent, the pavement continue to deform even when the load is removed.

Under a repeated load, a bituminous mixtures behaves in two different ways:

- with a reversible deformation;
- with a visco – elastic deformation with an increase of residual strain.

Bituminous materials' response to the application of a load in fact has an elastic and a viscous part.

Figure 2.13 shows the response of a bituminous mixture to a pressure with rectangular trend ($\sigma - t$ graph). The application of a load for a Δt period (from A to B) on a cylindrical specimen of asphalt causes time – dependent strains that coincide with the loading phases:

- D - A: load application and instantaneous strain ε_0;
- A - B: after the instant strain, the deformation evolves in a not definable way. This store of elastic and plastic deformation persists throughout the loading time;
- B – C: instantaneous elastic deformation recovery;
- C – E: gradual recovery of the visco – elastic deformation during the period (t ; < 3t);
- E: after the removal of the load and a period of adjustment, remain the accumulated plastic strain corresponding to the irreversible deformation.

Asphalt concrete's behavior is similar to that of the bitumen, depending on the temperature and loading speed. The graph in Figure 2.13 corresponds to a state of stress at constant temperature. Therefore, even though road pavement's materials do not have a properly elastic behavior, it is possible to consider them as elastic materials considering only the recoverable deformation.

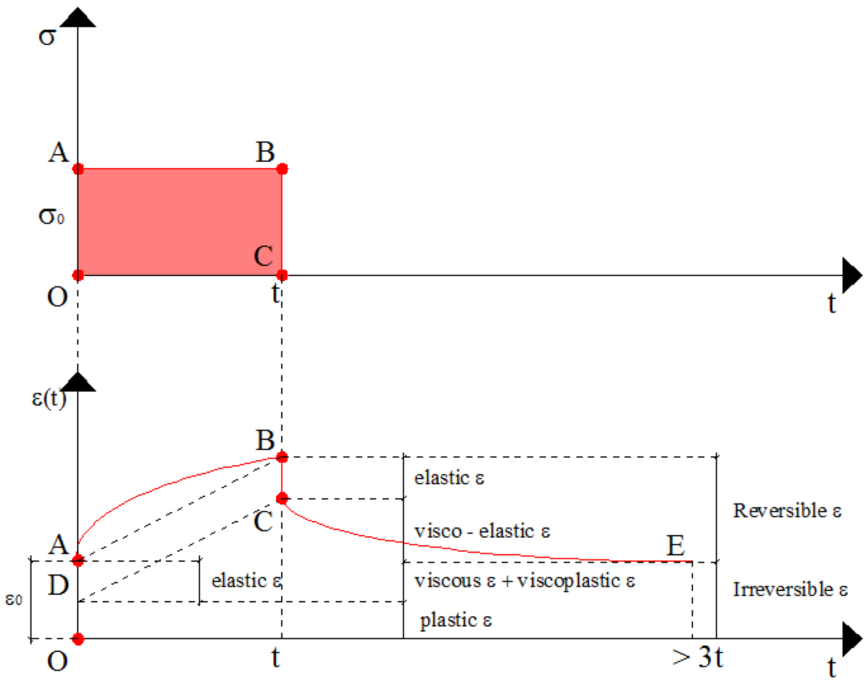


Figure 2.13 Ideal response of a bituminous mixture to an applied load [2].

2.2.3 Rutting process

The accumulation of plastic strain, as effect of the repeated loading because of the passage of heavy vehicles, is named rutting. In fact A. T. Papagiannakis, E. A. Masad, Eyad Masad [7] define rutting as a longitudinal depression in the wheel – paths caused by the compaction or plastic deformation of the asphalt concrete and a granular layers/subgrade under the action of axle loads [7].

Rutting in paving materials develops gradually with increasing numbers of load applications usually appearing as longitudinal depressions in the wheel paths accompanied by small upheavals to the sides (Figure 2.14). It depends on the visco – elastic behavior of bituminous mixtures that exposes the pavement's surface layers to the risk of permanent deformation because of the action of both heavy vehicles and environmental conditions. It is caused by a combination of densification (decrease in volume and, hence, increase in density) and shear deformation and can occur in any one or more pavement layers as well as in the subgrade [8-9]. This deformation occurs in the areas most affected by the rolling tire (wheel path).

Figure 2.14 Rutting.

These permanent deformations can affect the safety of the road and cause discomfort suggesting a forced path to vehicles. Moreover, the rut depth can also be filled with rainwater and cause the phenomenon of hydroplaning.

Rutting develops gradually with the increase of vehicle passages and it is usually sum of two different phenomena:

- Rutting with decreasing volume: it consists of a second compaction due to the passage of heavy vehicles. Depressions grow along the wheel path causing a decrement of volume with small phenomena of ebb.
- Rutting with constant volume: it happens after the first without any change in volume. The decrement of volume in the rut is equal to the increase in the upheaval zones. It occurs when the asphalt layer has a low shear strength, especially with high temperatures (summer).

Sousa, Craus and Monismith [10] infer from this that compaction under traffic is completed in a short term an further rutting is caused essentially by a displacement with constancy of volume.

Eisenmann and Hilmer in a study conducted in 1987, deduced that rutting is caused mainly by deformation without volume change. During their study they have measured the mean rut depth and the volume of the moved material of sample (a pavement section of about

23 cm of asphalt concrete: 5 cm wear course, 18 cm base course) subjected to the passage of a wheel. Monismith reports the results (Figure 2.15).

From Figure 2.15 Eisenman and Himler have drawn two conclusions:

- In the initial stage of trafficking, the increase of deformation below tires is irreversible and distinctly greater than the increase in the upheaval zones. In this initial phase traffic compaction has an important influence on rutting.
- In the second stage, the volume decreases beneath the tires as it increases in the adjacent upheaval zones. This shows that compaction under traffic is completed and that further rutting is caused essentially by a displacement of material with constant volume. The second phase continues in all the pavement lifetime.

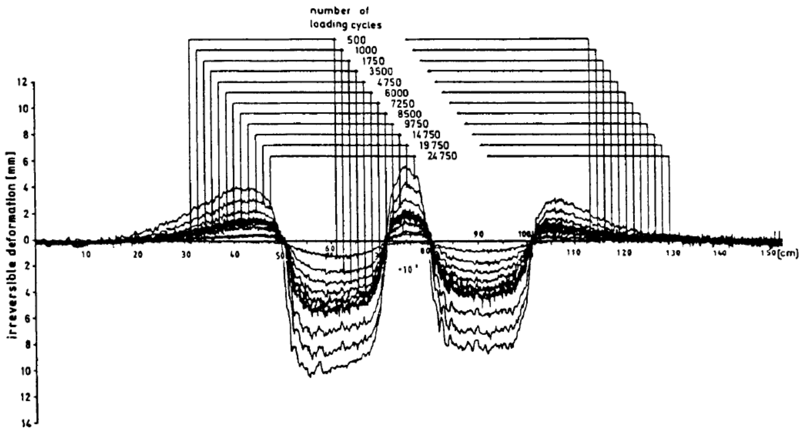


Figure 2.15 Effect of number of passes on transverse surface profile [10].

2.2.4 Problems caused by rutting

Decays due to rutting is an explicit manifestation of a different condition of the road pavement. Usually it can be due to lack of performance of materials, to mistakes in design or construction stage, to environmental factors and climate conditions or to particularly heavy traffic.

These damages could be superficial or structural. Superficial damage are related to the wear course and it consists in a reduced functionality in terms of adherence and regularity of the road pavement. It is caused mainly by the viscous ebb of the mix at constant volume because of the accumulation of shear stresses transmitted from the traffic. Structural damage involves load – bearing layers of the structure. It is due to a decrease of the load – bearing characteristics and it could have serious consequences.

Rutting is followed by the loss of regularity of the road. As a result of deformation it reduces the road‘s lifetime and influences the safety and comfort driving.

The loss of regularity is a vertical variation of a portion of the pavement's real surface compared to an ideal plane of reference. The lack of regularity results in higher stresses in the structural parts of vehicles and causes a variation of the dynamic loads transmitted from the vehicle to the road structure. It will cause a reduction of the pavement's fatigue resistance and of the forces that generate adhesion. Even road users are affected by a lack of regularity on physical level, and if it persists for several kilometers, or irregular routes are frequent, it increases the stress of driving and the driver can manifest physical discomfort.

2.2.5 Factors affecting rutting

Vehicular traffic, as a stress and frequency of application, is the primary cause whose effect is the trigger of permanent deformation on asphalt concrete pavements. The phenomenon is strongly influenced not only by the properties of the pavement layers, the intrinsic characteristics of materials used in the asphalt mixture and mixture composition, but also by environmental conditions (Table 2.1).

- Aggregates. Dense aggregates gradations are desirable to mitigate the effects of rutting.
- Binder. Sousa, Craus and Monismith [10] considered that less viscous asphalts make the mixture less stiff and therefore more susceptible to irrecoverable deformations.
- Mixture. The binder content also affects the mixture's ability to resist permanent deformation.
- Extrinsic conditions. Temperature and the state of stress and strain caused by traffic loading have significant effects on rutting. A strong influence is also given by the wheel load and tire inflation pressure.

		Factor	***Change in factor***	***Effect of change in factor on rutting resistance***
INTRINSIC CONDITIONS	**AGGREGATE**	Surface texture	Smooth to rough	Increase
		Gradation	Gap to continuous	Increase
		Shape	Rounded to angular	Increase

		Size	Increase in maximum size	Increase
	BINDER	Stiffness	Increase	Increase
	MIXTURE	Binder content	Increase	Decrease
		Air void content	Increase	Decrease
		Voids in the mineral aggregate	Increase	Decrease
EXTRINSIC CONDITIONS		Temperature	Increase	Decrease
		Load: strain	Increase in tire contact pressure	Decrease
		Load: repetition	Increase	Decrease
		Water	Dry to wet	Decrease if mix is water sensitive

Table 2.1 Factors affecting rutting of asphalt concrete mixtures [9-10].

2.2.5.1 Intrinsic conditions

Intrinsic factors can be divided in three categories: aggregates, binder and asphalt mixtures. The main factor that affects rutting is the aggregates' surface texture which changing from smooth to rough determines an increased rutting resistance; the particle grading curve, changing from discontinuous to continuous leads to an increase in rutting resistance; shape and size of the aggregates, the transition from angular to rounded and an increase in grain size also leads to an increase in rutting resistance. The binder influences rutting resistance because of its stiffness, a stiffer binder increases the asphalt's resistance. Asphalt mixtures' characteristics as bitumen percentage, the air voids content and voids content in the mineral aggregate affects the pavement behavior. If these factors increase their presence, rutting resistance decreases.

Aggregate

The aggregate plays a major role in rutting resistance. In order to mitigate rutting effects it is important a proper compaction to obtain a certain density or a continuous distribution of aggregates with a low air voids content and many contact points between the particles for load distribution [10].

For a good rutting resistance, the surface texture of aggregates plays an extremely important role, especially for hot climates it is preferable using a rough texture than a smooth one.

Sousa, Craus and Monismith [10] show Brown and Pell results: a discontinuous aggregates distribution increases rutting susceptibility. Asphalt mixtures composed of different gradation but similar mineralogical composition exhibit significantly different permanent deformation behavior [1].

Aggregates with rough surface textures and angular rather than rounded shapes show improved rutting resistance. Crushed aggregates are, therefore, better than natural gravels. Chen, Chang and Lin [11] showed the results obtained from the wheel – tracking test for different aggregate shapes: blade, disk, dense, rod and cubical. Specimens had same physical properties and aggregate gradation, the only variable was the shape. The test was conducted at a temperature of 60°C under dry conditions. Mixtures with cubical aggregate clearly showed the best rutting resistance over the other shapes as it is shown in Figure 2.15. It is because of the fast answer of the internal resistance due to the contact among the cubical coarse aggregate. Flaky and elongated aggregate in a mixture resulted in a lower resistance to shear deformation. The skeleton of this aggregate remains relatively unstable and the rut depth continues to grow.

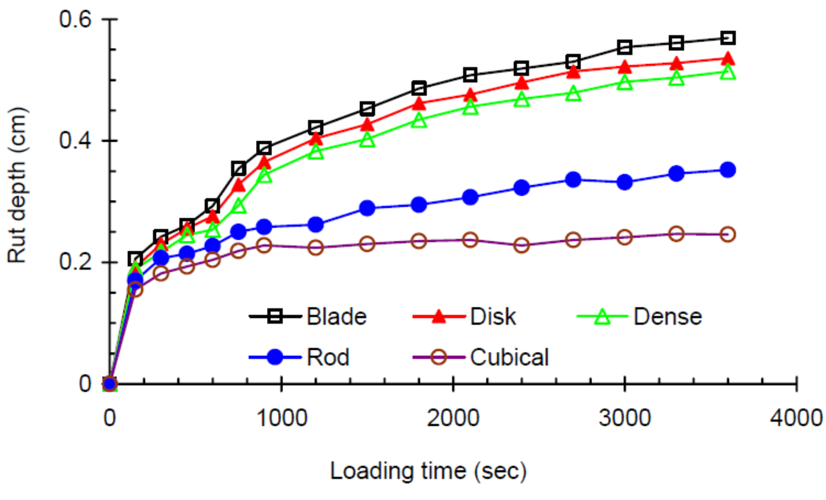


Figure 2.16 Wheel - track test results for different aggregates' shapes [11].

Binder

The term bituminous binder includes all materials used as binders in the field of civil construction and containing pure bitumen, first of all modified bitumen. The binder has an important role in all those typical damages affecting bound layers of flexible pavement, as rutting and fatigue cracking [10].

Long [12] reports that binder is a visco - elastic material and exhibits dependence on the rate of loading and temperature. Conventional binders are typically considered thermorheologically simple. However at higher strain levels binder behavior is nonlinear, indicating thermorheological complexity. The addition of material, such as asphalt rubber from recycled tires and polymers, to the conventional binder change the binder properties, thereby improving the resistance of the binder to distress. These modified binders show larger deviations from the thermorheological simplicity, which makes estimation of the mix properties complex. The more viscous and less temperature – susceptible the binder is, the better the mix performance at high temperatures.

Mixture

The proportion of the aggregate, asphalt, and air voids content in an asphalt concrete mix are critically determinants of the permanent deformation behavior. For conventional binders, the rut resistance of a mix is dependent on the mix stiffness; a stiffer mix provides more resistance. For well – proportioned mixes, the stiffness of the mix will improve with increased compaction effort.

As the binder content of a mix increase, the mix becomes increasingly prone to rutting. The coefficient of thermal expansion of the binder is approximately an order of magnitude higher than aggregate. In some hot temperature environments the binder may expand due to the heat, and if the binder content is high and the air void content is low, the binder can bleed through to the surface of the pavement, which is potentially very dangerous. Too low a binder content, however, results in a mix that has low workability, and as a result of the mix can be difficult to compact, resulting in a high air void content is preferable. In addition, a low binder content and high air void content compromise the durability and fatigue cracking resistance of a mix.

However a low air void content as a result of a high asphalt content will increase the propensity for rutting. It has been found that for asphalt concrete mixes below a threshold, an increase in density can result in a decrease of stability.

2.2.5.2 Extrinsic conditions

Extrinsic conditions influence rutting resistance through various factors as temperature, contact pressure and load repetition. If the factor increases it leads to a decrease in resistance

Temperature

Temperature has significant consequences on rutting resistance. Several authors have demonstrated, trough on field test, that rutting increases by a factor from 250 to 350 with an increase in temperature from 20° to 60°. Sousa, Craus and Monismith [10] determined the critical periods in which roads can accumulate permanent deformation:

- from April to October, permanent deformation occurs between 7.30 a.m. to 17.30 p.m.;
- when temperatures are below 10°, permanent deformation can be ignored.

Type of traffic and tire pressure

A change in the traffic distribution, especially if the percentage of heavy vehicles increases, may cause an increase of rutting.

3 PRESUMABLE EFFECTS OF CLIMATE CHANGE ON RUTTING

Environment conditions affect the pavement deterioration and performance influencing the construction phases and structural characteristics, traffic and maintenance (Figure 3.1). Flexible pavement performance revealed that climate is an important consideration in at least three deterioration processes: thermal cracking, frost heave and thaw weakening, and rutting [13]. The fundamental concern related to a changing climate in pavement management is the possibility that the frequency, duration or severity of permanent deformations may be altered leading to premature deterioration.

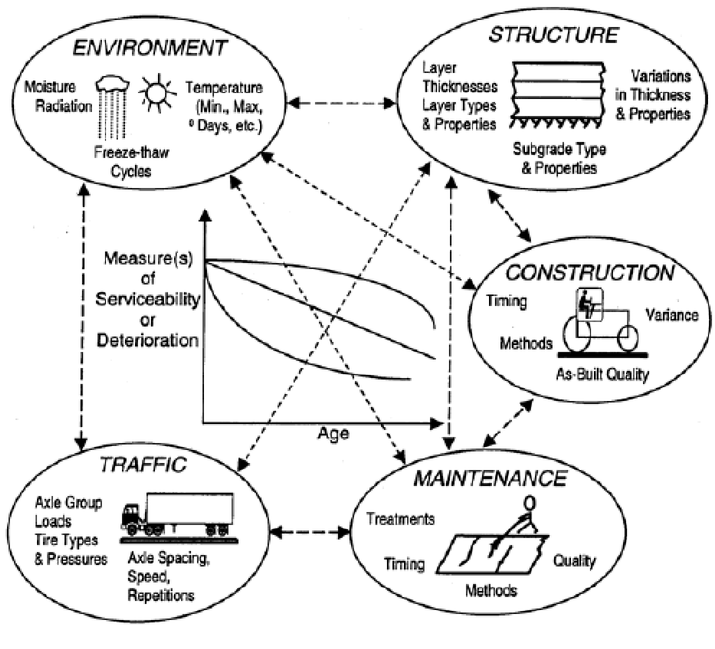


Figure 3.1 Factors affecting road performance [13].

In the coming decades is expected an increase in average temperatures in Europe as a result of the climate change in progress. Numerous efforts to model the impact of past and potential future global trends in emissions of carbon dioxide (CO_2) and other greenhouse gases (GHG) have all arrived at the same conclusion: global mean temperature has and will continue to increase over the next century, in the worst case up to 4°C compared to the last decade. Accompanying this warming will be a substantive rise in sea levels and a net increase in global precipitation.

3.1 Climate model projections

The Fourth Assessment Report (AR4) of the Intergovernmental Panel on Climate Change (IPCC), the fourth in a series of reports intended to assess scientific, technical and socio – economic information concerning climate change, its potential effects and option for adaption and mitigation, shows that the global average surface temperature has risen by 0.76°C in the past century, with accelerated warming during the past two decades. Most of the warming over the last 50 years is very likely to have been caused by emissions of carbon dioxide and other GHG from human activities.

Pachauri and Resinger, in their contribution to the AR4 [14], refer that during the XX century, the global average temperature rose 0.6°C. For the next two decades warming is projected of about 0.2°C, if nothing is done to reduce emissions, the average temperature could rise up by 1.8 - 4.0°C in this century, and by 6.4°C in the worst case. In the past a change of temperature of 5°C occurred in thousands of years. Even the lower end of this range would take the temperature increase since the beginning of the industrial revolution above 2°C, the threshold beyond which many scientists believe irreversible and possibly catastrophic changes would become more likely [14].

Impacts of climate change have been defined using SRES scenarios (Table 3.1). SRES scenarios were constructed to explore future developments in the global context with particular reference of harmful emissions. The SRES scenarios define four narrative storylines (A1, A2, B1 and B2) each storyline represents different demographic, social, economic, technological and environmental developments. Each scenario is associated with a different development prediction of forces driving GHG and aerosol emissions.

The four storylines combine two sets of divergent tendencies: one set varying between strong economic values and strong environmental ones, the other set between increasing globalization and increasing regionalization. They do not include additional climate policies above current ones. The emissions projections are widely used in the assessments of future climate change, and their underlying assumptions with respect to socio - economic, demographic and technological change serve as inputs to many recent climate change vulnerability and impact assessments.

- The A1 storyline assumes a world of very rapid economic growth, a global population that peaks in mid-century and rapid introduction of new and more efficient technologies. A1 is divided into three groups that describe alternative directions of technological change: fossil intensive (A1FI), non-fossil energy resources (A1T) and a balance across all sources (A1B).
- B1 describes a convergent world, with the same global population as A1, but with more rapid changes in economic structures toward a service and information economy.
- B2 describes a world with intermediate population and economic growth, emphasizing local solutions to economic, social, and environmental sustainability.
- A2 describes a very heterogeneous world with high population growth, slow economic development and slow technological change [14].

CASE	**Temperature change (°C at 2090-2099 relative to 1980-1999)** Best estimate	**(m at 2090-2099 relative to 1980-1999)** Likely range
Constant year 2000 concentrations[b]	0.6	0.3 – 0.9
B1 scenario	1.8	1.1 – 2.9
A1T scenario	2.4	1.4 – 3.8
B2 scenario	2.4	1.4 – 3.8
A1B scenario	2.8	1.7 – 4.4
A2 scenario	3.4	2.0 – 5.4
A1FI scenario	4.0	2.4 – 6.4

Table 3.1 Projected global average surface warming at the end of the 21st century [14].

Annual mean temperatures in Europe are likely to increase more than the global mean. The temperature increment in Europe in 2008, compared to pre – industrial values, was approximately 1.0°C for the costal system and 1.3°C on the mainland .

Figure 3.2 shows the evolution of European temperatures in the 20th century. The black line point out the temperature progress between 1900 and 2000, the red area represents the trend outcome of MMD simulations, a statistical simulation technique. Figure 3.2 and Figure 3.3 refer about the warming trend as it is projected for 2001 to 2100 for the A1B scenario. These projections estimate an increase of the average temperature between 2.3°C and 5.3°C in the northern Europe (NEU) and between 2.2°C and 5.1°C in southern Europe and Mediterranean area.

Obviously, using different emission scenarios, the estimation of temperature increment varies widely. In any case, in northern Europe the higher warming is expected during the winter season while, in the Mediterranean region especially in summer.

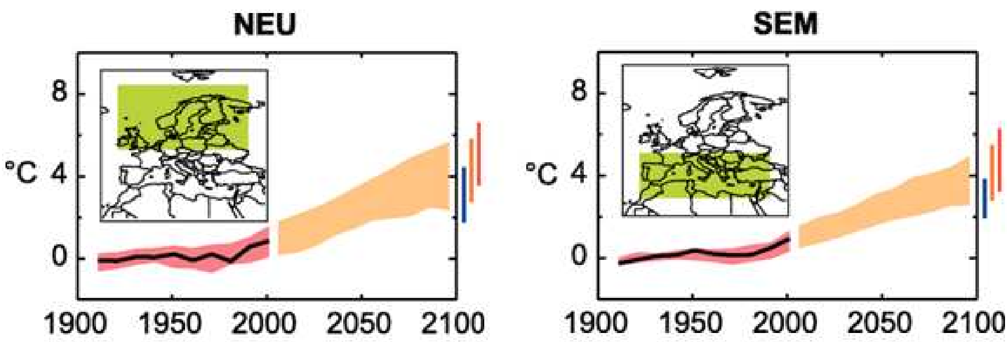


Figure 3.2 Temperature evolution from 1901 to 1950 for two Europe land regions (black line) and as simulated (red envelope) by MMD models; and as projected for 2001 to 2100 by MMD models for the A1B scenario.[15]

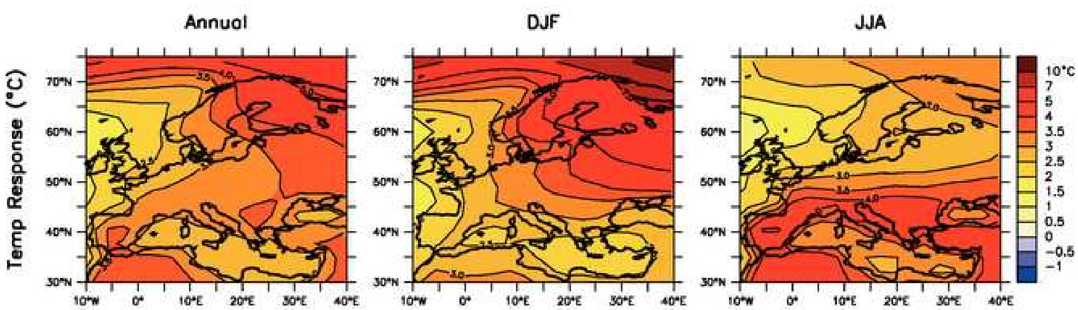


Figure 3.3 Temperature changes over Europe from the A1B scenario. Top row: Annual mean, December – January - February and June – July - August temperature change between 1980 to 1999 and 2080 to 2099 [16].

3.2 Impact of climate on pavement performance and deterioration

3.2.1 Heat absorption

The black surface of asphalt pavement absorbs heat from the sun affecting its performance and life span. The asphalt layer exhibits an higher surface temperature than other surfaces in summer days, the asphalt is softer and, during the strong sunshine, there is ah larger risk that heavy vehicles cause rutting, wave traction, sticking wheel and so on.

Rutting is a leading cause of pavement deterioration in regions with warm climates in particular at intersections in urban areas, where the asphalt pavement deforms not elastically under heavy and usually slow moving traffic [17]. Minimizing asphalt pavement deterioration and maximizing its durability requires high – quality asphalts, which are stiff enough to be resistant to permanent deformation at elevated temperatures and soft enough to respond elastically to large loads at low temperatures. The behavior of the asphalt binder at different conditions and its ability to preserve initial properties, strongly depends on its chemical composition. So, it is usual to use modified binders to improve the performance of asphalt concrete.

The materials' thermal balance is mainly determined by their thermal performance including optical and thermal characteristics.

3.2.1.1 Thermal balance

The asphalt pavement surface absorptivity for solar radiation may reach 0.90. According to Mei – Zhu, Wei and Shao – Peng [18], the surface temperature of pavement is 24°C higher than that of air, and it can reach above 60°C or 71-72°C when the air temperature is about 40°C. So, during solar irradiation in summer times, asphalt pavements can often be heated up to 70°C due to the excellent heat – absorbing property.

For a surface under the sun and insulated underneath, the equilibrium surface temperature T_s, can be obtained imposing the balance between the heat transfer rate coming from solar radiation, and the sum of dispersed heat because of solar radiation and convection, supposing that the asphalt surface is close to a black body.

$$\dot{Q}_{abs,s} = \dot{Q}_{rad} + \dot{Q}_{conv}$$

$$\alpha G A = \varepsilon \sigma T_s^4 A + h(T_s - T_a)A$$

$$\varepsilon \sigma T_s^4 + hT_s - hT_a - \alpha G = 0$$

Where:

α is coefficient of body's absorptivity, for asphalt it is 0.90 [19];

G is total solar radiation incident on the surface 1000 $[W/m^2]$ at the zenith [19];

A area of the emitting body [m^2];

ε is emissivity coefficient, for asphalt it is 0.90 [19];

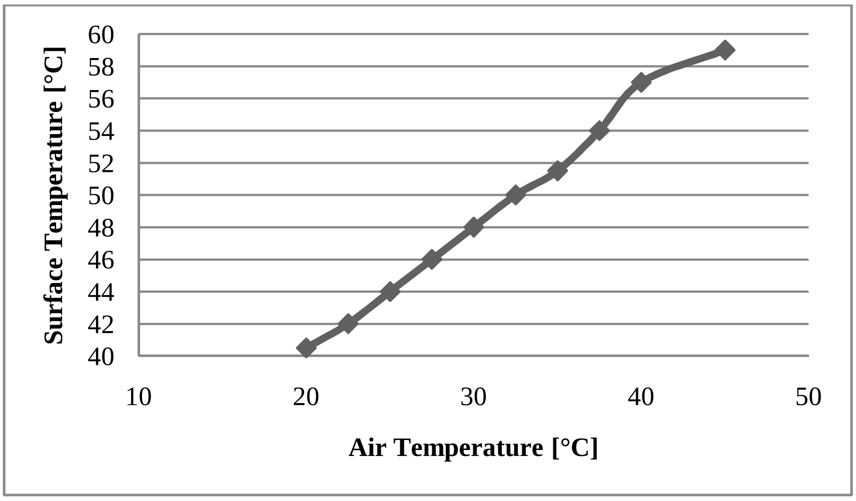
σ is Stefan-Boltzmann constant, $5.6703\ 10^{-8}\ [W/m^2K^4]$;

h is surface heat transfer coefficient, $20\ [W/(m^2K)]$ [19];

T_s is surface temperature $[K]$;

T_a is air temperature $[K]$.

Solving the equation in a temperature range between 20 and 40°C the results are in Graph 3.1.



Graph 3.1 Relation between air temperature and surface temperature of asphalt pavement.

In 1996 Dondi and Chinni presented an experimental observation of the variation in temperature with time of day in both summer and winter [20]. The cylindrical sample characteristics were: diameter $750\ mm$, thickness $200\ mm$, aggregate size between 0 and 18 mm and a bitumen 80/100 with a percentage of 5%.

The results showed a significant temperature gradient within the specimen during the hottest hours and a reversal of sign between night and day (Figure 3.4) with a maximum internal $\Delta t_{max,internal} = 11°\ C$ at 2,30 p.m. measured between the temperature of the first sensor at $-20\ mm$ depth and the last at $-180\ mm$. Figure 3.5

focuses on the difference between air conditions and internal mean temperature, it reveals a $\Delta t_{max} = 14° \, C$ at 1,00 p.m.. the maximum internal temperature of the specimen is $38° \, C$ at 5,30 p.m. with a delay of about 3 hours on the maximum external temperature.

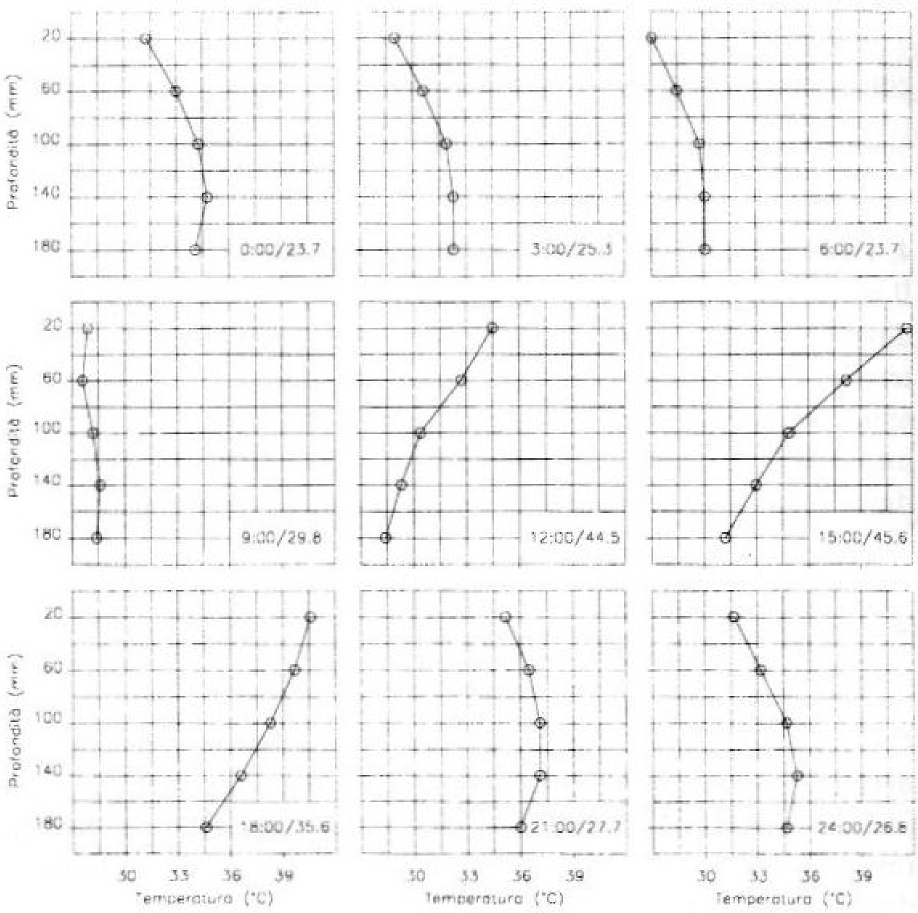


Figure 3.4 Temperature gradient within the sample during a summer day (07/27/1995) [20].

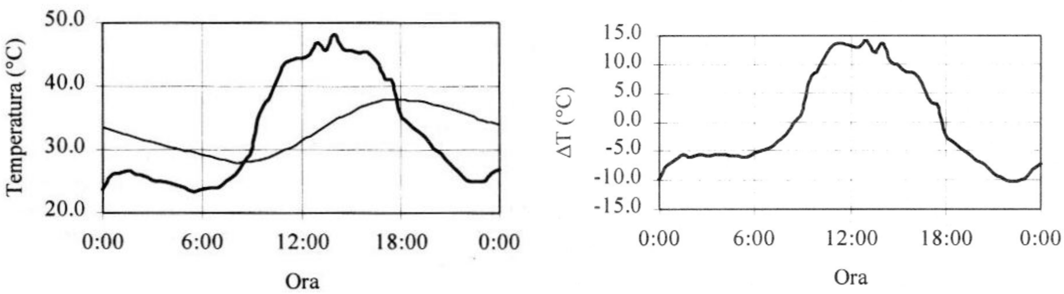


Figure 3.5 Difference between air conditions (bold line) and internal mean temperature (thin line) during a summer day (07/27/1995)[20].

Trough the test results Dondi and Chinni have led the Δt in the summer time via a multiple regression analysis

$$\Delta t(t) = -0.915 - 2.802 \cdot \sin \omega t - 9.130 \cdot \cos \omega t + 1.702 \cdot \sin 2\omega t + $$
$$+2.164 \cdot \cos 2\omega t.$$

Where:

$\Delta t(t)$ difference between air conditions and internal mean temperature;

ω $= 2\pi/24$

t time whereas $t = 0$ at 0.00 a.m. of the 01/01.

In Figure 3.6 in represented the capacity of the calculated regression law to approximate the measured data.

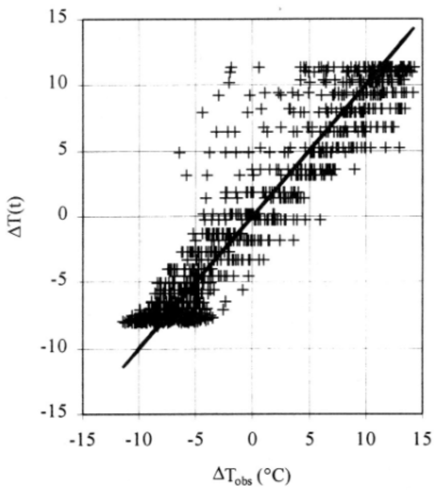


Figure 3.6 Difference between $\Delta t(t)$ calculated and Δt_{obs}observed. [20].

The observation have been made even in winter and spring time and the results showed a lower $\Delta t_{max,internal}$ and a $\Delta t_{max,external} = 5 \div 10° \, C$ anticipated in the middle of the day.

3.2.2 Global warming effects

Hoff and Lalagüe [21], through the prediction performance tool M-EPDG (Mechanistic-Empirical Pavement Design Guide), have observed a direct relationship between the temperature increment and the most of pavement distresses. The program predicts the performance of a given structure under a given traffic distribution over the day and the year. It is focused, especially, on temperature and moisture. The analysis, conducted on three different structures, showed a moderate decline in pavement lifetime for rutting and cracking due to increased temperature. Practically all the increase in total pavement deformations comes from the asphalt layers because of the little temperature dependency in unbound granular materials. The deformation is closely connected to the binder stiffness. For increase in precipitation the analysis did not show significant decrease in pavement lifetime.

The same tool has been used by Mills, Tighe, Andrey, Smith and Huen [22] to examine the impacts of future scenarios of climate change on flexible pavement infrastructure in southern Canada. The authors have considered the scenarios A2 and B2 and their development in 17 different Canadian sites. During the reporting period, the next 50 years, pavement performance simulations suggest that low temperature cracking will become less problematic, structures will freeze later and thaw earlier with corresponding shorter freeze season lengths, and higher extreme in – service pavement temperatures will raise the potential for rutting. In particular, rutting issues will be exacerbated by climate change and in general, maintenance, rehabilitation, or reconstruction will be required earlier in the design life.

4 LABORATORY TESTS

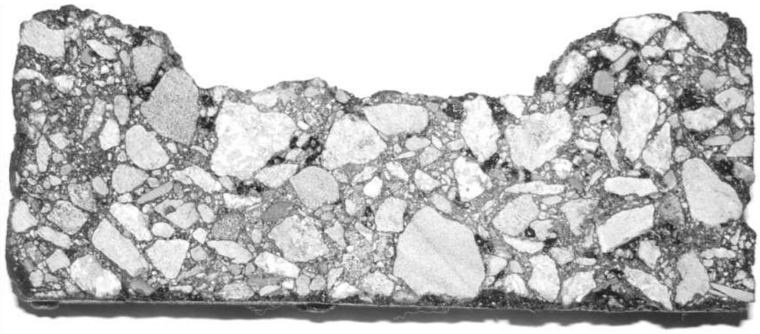
The aim of this study is to verify experimentally the behavior of a bituminous mixture towards the influence of temperature. It is necessary to determine the extent of permanent deformation of the asphalt surface layer subjected to repeated applications of stress such as that caused by the loads transmitted from vehicles.

A laboratory Wheeltracking test was used in this thesis to predict asphalt field performance. A series of samples were manufactured, thickened with a compactor device (Roller Compactor) and tested in the laboratory, according to the European Standard procedure EN 12697. Tests have been conducted in the laboratories of the Civil Engineering Department at NTNU in Trondheim. Each kind of mixture was tested in three different temperature in order to obtain the evolution of deformation with temperature variation. The Wheeltrack test were normally carried out in duplicate. The material used for this study consist of different kinds of asphalt concrete mixtures for the surface curse from Norwegian and Italian production facilities.

4.1 Wheeltrack test

The Wheeltrack test is a method that takes account of the role played by traffic in the process of rutting. The European Standard EN 12697 - 22 [23] describes test methods for determining the susceptibility of bituminous materials to deform under load.

In particular it is used to assess the resistance to rutting of asphaltic materials under conditions of load, speed and temperature while the development of the rut is monitored continuously during the test. The specimen can be either samples manufactured in laboratory or 200 ϕ cores cut from a pavement. Test specimens are held in a mould with their surface flush with the upper edge of the mould. It is subjected to repeated passes of a loaded wheel while the resultant rut depth is monitored (Figure 4.1).



G6_60° C

Figure 4.1 Final rut depth of sample G6 tested at 60°C.

The apparatus consist in two solid tired wheels which pass, in direct contact, over the specimens of compacted bituminous mixture to simulate the action of traffic. In the case of the equipment used, the test specimens on their cradle are enabled to move back and forwards under the loaded wheel. The test specifications are resumed in Table 4.1. Each wheel is loaded to give a total weight of $700\,kN$ bearing on the specimen and travel with at a frequency of $26.5\ cycles/min$ to achieve an amount of 10000 cycles (outward and return). The tests were performed in dry conditions at three different temperatures: 40°C - 50°C - 60°C in order to obtain a realistic relation between the temperature variability and the permanent deformation resistance. The high temperatures of the tests are due to the report air temperature – surface temperature defined in the previous Chapter (PRESUMABLE EFFECTS OF CLIMATE CHANGE ON RUTTING).

Wheel	Tired wheel in contact with the sample
Load	$700\ kN$
Number of cycles	10000 cycles ($26.5\ cycles/min$) or $17\ mm$ of rut depth
Test temperature	$40°\,C - 50°\,C - 60°\,C$
Test conditions	Dry
Samples	$30.50\ cm\ x\ 30.50\ cm\ x\ 4.00\ cm$
Strain’s measurement	Continuous on the specimen
Reference Standard	EN 12697 - 22 [23]

Table 4.1 Test specifications.

The rutting depth is measured at each pass every 4 mm, within $10{,}4\ cm$ of the centre point of the loaded area, with an automatic displacement transducer fixed on a steel arm connected to the test box and recorded to the elapsed loading times.

Testing procedure

According to EN 12697 - 22 [23], the testing procedure provides:

1. Pneumatic tire: ensure that the pneumatic tire is clean and that the material from the specimen does not adhere to the tire during the test to prevent any spurious heating. Maintain the tire pressure at $600 \pm 30\ kPa$ during the test.
2. Temperature conditioning. The specimens are to be conditioned at the specified test temperature $\pm 1°\ C$ for a period of minimum 4 hours.
3. Specimen fixing. Place the test specimen in the Wheeltracking device, fix it rigidly to the table of the machine and place a thermocouple in the sample approximately $20\ mm$ under the surface; set the dial gauge and take initial readings of the vertical displacement r_0.
4. Execution of the test. Set the machine in motion. The Wheeltrack machine will allow five cycles of the wheel before the test in commenced. Then the device will automatically measure the slab profile, and the temperature each cycle.

Results

At the end of the test the Wheeltrack test machine will provide the following data for each specimen with an interval of 100 cycles:

- rut depth within $10{,}4\ cm$ of the centre point of the loaded area;
- temperature within the specimen;
- wheel speed;
- Wheeltracking slope calculated as

$$WTS_{AIR} = \frac{(d_{10000} - d_{5000})}{5}$$

where:

WTS_{AIR} is the Wheeltracking slope, in $[mm/1000\ load\ cycles]$

d_{10000} is the rut depth after 10000 load cycles in $[mm]$;

d_{5000} is the rut depth after 5000 load cycles in $[mm]$.

4.2 Determination of bulk density and void characteristics

The samples, after being tested with the Wheeltrack machine, were cut in three pieces: the wheel path and the two edges. The two end pieces are used to determine the bulk density and the void characteristics of the bituminous sample.

According to the European Standard EN 12697 – 6 [24] the bulk density is determinated from the mass of the specimen and its volume. The mass of the specimen in obtained by weighing the dry specimen in air. In the SSD – procedure (saturated surface dry), the specimen is first saturated with water, after which its surface is plugged with a damp cloth.

The European Standard EN 12697 – 8 [25], describes the procedure for calculating the air voids content (V_m) and the voids content in the mineral aggregate filled with binder (VFB). These are two volumetric parameters for evaluating the mixture.

Testing procedure

According to EN 12697 – 6 [24], the testing procedure provides:

1. determine the mass of the dry specimen (m_1) with an accuracy of $\pm 1\ g$;
2. determine the water test temperature, and then its density (ρ_w);
3. immerse the specimen in the water – bath, at uniform temperature within $\pm 1°\ C$, and allow the water to saturate the specimen sufficiently long enough for the mass of the specimen not to change;
4. determine the mass of the saturated specimen when immersed (m_2) using a balance suitable for weighing the sample under water through a basket whose mass and water displacement are taken into account by tarring;
5. remove the specimen from the water, dry the surface from adhered drops by blotting and wiping the surface with a dump cloth;
6. determine the mass of the saturated, surface wiped specimen in air immediately after drying (m_3).

Results

The results of the test are:

– Bulk density of the specimen calculated as

$$\rho_{bssd} = \frac{m_1}{m_3 - m_2} \cdot \rho_w \quad [kg/m^3]$$

where:

ρ_{bssd} is the bulk density (SSD), in $[kg/m^3]$;

m_1 is the mass of the dry specimen, in $[g]$;

m_2 is the mass of the specimen in water, in $[g]$;

m_3 is the mass of the saturated surface – dried specimen, in $[g]$;

ρ_w is the density of the water at test temperature, in $[0.1\,kg/m^3]$.

The voids characteristics calculated from the bulk density are:

– the air voids content

$$V_m = \frac{\rho_m - \rho_b}{\rho_m} \cdot 100 \quad [\%\, v/v]$$

where:

V_m is the air voids content of the mixture, in $[\%\, \boldsymbol{v/v}]$;

ρ_m is the maximum density of the mixture, in $[kg/m^3]$;

ρ_b is the bulk density of the specimen, in $[kg/m^3]$;

– voids in mineral aggregate (the volume of compacted paving mix not occupied by the aggregates, Figure 4.2, when the volume of the aggregates is calculated based on their bulk specific gravity,)

$$VMA = V_m + B \cdot \rho_b/\rho_B \quad [\%\, v/v]$$

where:

VMA is the voids content in the mineral aggregate, in $[\%\, v/v]$.

V_m is the air voids content of the mixture, in $[\%\, v/v]$;

B is the percentage of binder in the specimen (in 100% mixture), in $[\%\, v/v]$;

ρ_b is the bulk density of the specimen, in $[kg/m^3]$;

ρ_B is the density of the binder, in $[kg/m^3]$;

– voids filled with asphalt (the percentage of voids in the mineral aggregate filled with binder, Figure 4.2)

$$VFB = ((B \cdot \rho_b/\rho_B)/VMA) \cdot 100 \quad [\%\, v/v]$$

where:

VFB is the percentage of the voids in the mineral

	aggregate filled with binder, in [% v/v];
B	is the percentage of binder in the specimen (in 100% mixture), in [% v/v];
$\boldsymbol{\rho_b}$	is the bulk density of the specimen, in [kg/m^3];
ρ_B	is the density of the binder, in [kg/m^3];
VMA	is the voids content in the mineral aggregate, in [% v/v].

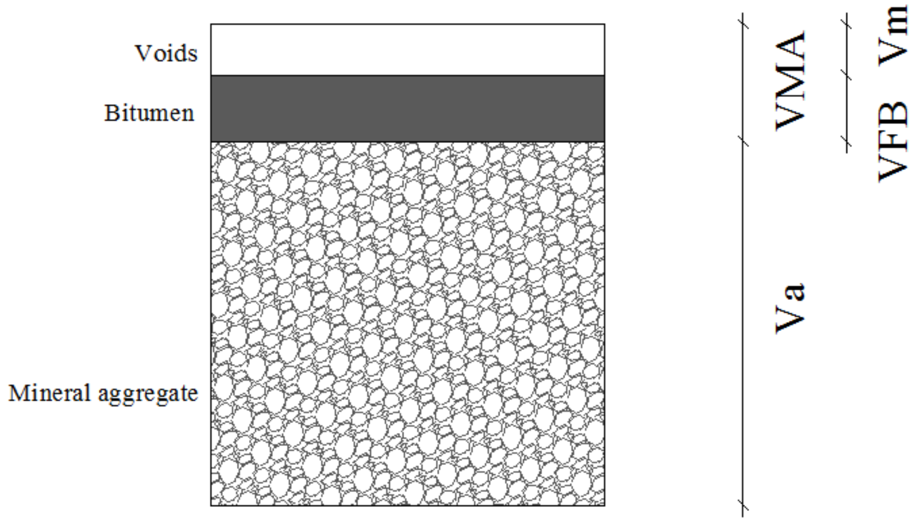


Figure 4.2 Voids in the mineral aggregate.

4.3 Determination of the maximum density

The maximum density has been measured for three bituminous mixtures according to EN 12697 – 5 [26]. The mixtures that have been tested are the Italian mix Drenoval HM and the sample 8A (Rec. n. 13143908) and 22A (Rec. n. 82212001014). The maximum density has been determined to verify the consistency between the properties of the sample and the directions of the receipt.

Testing procedure

According to EN 12697 – 5 [26], procedure B, the testing procedure provides:

1. loose and separate samples into coarse particles and agglomeration manually. If the ample is compacted mixture, it shall be placed in a ventilated cabinet at a temperature of $110 \pm 5\ °C$, dried to constant mass and then separated.
2. weight the empty pykonometer m_1;
3. weight the pykonometer submerged in water m_2;

4. place the sample in the dry pykonometer and weight it m_3;
5. fill the pykonometer with distilled water and a small amount of dispersion agent to facilitate air evacuation. Then evacuate entrapped air applying a partial vacuum of a residual pressure of $4\,kPA$ or less for $15\ \pm 1$ minutes. During the air evacuation it is possible to stir, rotate or vibrate the pykonometer;
6. place the pykonometer in a water – bath at known temperature, between 20 and 30°C, for at least 30 minutes, to keep the container and the content at the same test temperature;
7. determine the mass of the container plus the test sample when suspended in water m_4.

In this test have been used a residual pressure during the air evacuation was $3\,kPa$ and a water test temperature was $25°\,C$.

Results

The results of the test are:

– Maximum density of the specimen calculated as

$$\rho_{mh} = \frac{m_3 - m_1}{(m_3 - m_1) - (m_4 - m_2)} \cdot \rho_w \quad [kg/m^3]$$

where:

ρ_{mh}	is the maximum density of the bituminous mixture, in $[kg/m^3]$;
m_1	is the mass of the container in air, in $[g]$;
m_2	is the mass of the container suspended in water, in $[g]$;
m_3	is the mass of the container plus test sample in air, in $[g]$;
m_4	is the mass of the container plus test sample suspended in water, in $[g]$;
ρ_w	is the density of the water at test temperature, in $[0.1\,kg/m^3]$.

4.4 Materials

The materials tested are different Norwegian and Italian types of asphalt mixtures. Each mixture differs from the other because of the kind of aggregates used, the binder and the different proportions in the mixture.

In Table 4.2 are shown the main characteristics of the samples prepared. Data are taken from the receipt. Samples from n. 1 to 36 are made from Norwegian mixtures (dense graded mixtures Agb, Ab and stone mastic asphalt, Ska), initials following the name of the mixture are a suffix used to indentify bitumen modified; samples from G1 to G39 are equally made with Norwegian samples, but they have been produced during the Laboratory Course; samples from 37 to 54 are made from three different Italian mixtures characterized by the same grading curve and different bitumen, all modified with SBS.

Recepit Number	Sample n.	Mixture	Bitumen Content [%]	Air Voids Content [%]	Mixing Temp. [°C]	Theoretical Density [g/cm^3]	Volume [cm^3]	Mass [g]
13143908	1	Ab 16 Pmb	5,50	3,5	170	2,472	3721	9198
13143908	2	Ab 16 Pmb	5,50	3,5	170	2,472	3721	9198
13143908	3	Ab 16 Pmb	5,50	3,5	170	2,472	3721	9198
13143908	4	Ab 16 Pmb	5,50	3,5	170	2,472	3721	9198
13143908	5	Ab 16 Pmb	5,50	3,5	170	2,472	3721	9198
13143908	6	Ab 16 Pmb	5,50	3,5	170	2,472	3721	9198
13143908	7	Ab 16 Pmb	5,50	3,5	170	2,472	3721	9198
13143908	8	Ab 16 Pmb	5,50	3,5	170	2,472	3721	9198
82212001414	9	Ab 11 Pmb	5,70	3,5	140	2,454	3721	9131
82212001414	10	Ab 11 Pmb	5,70	3,5	140	2,454	3721	9131
82212001414	11	Ab 11 Pmb	5,70	3,5	140	2,454	3721	9131
82212001414	12	Ab 11 Pmb	5,70	3,5	140	2,454	3721	9131
82212000814	13	Ab 11	5,70	3,5	140	2,454	3721	9131
82212000814	14	Ab 11	5,70	3,5	140	2,454	3721	9131
82212000814	15	Ab 11	5,70	3,5	140	2,454	3721	9131
82212000814	16	Ab 11	5,70	3,5	140	2,454	3721	9131
82212000814	17	Ab 11	5,70	3,5	140	2,454	3721	9131
82212000814	18	Ab 11	5,70	3,5	140	2,454	3721	9131
82212001014	19	Ab 11 Pmb	5,70	3,5	140	2,454	3721	9131
82212001014	20	Ab 11 Pmb	5,70	3,5	140	2,454	3721	9131
82212001014	21	Ab 11 Pmb	5,70	3,5	140	2,454	3721	9131
82212001014	22	Ab 11 Pmb	5,70	3,5	140	2,454	3721	9131
82212001014	23	Ab 11 Pmb	5,70	3,5	140	2,454	3721	9131
82212001014	24	Ab 11 Pmb	5,70	3,5	140	2,454	3721	9131
82212001414	25	Ab 11 Pmb	5,70	3,5	140	2,454	3721	9131
82212001414	26	Ab 11 Pmb	5,70	3,5	140	2,454	3721	9131

06209407	27	Ska 11	6,40	3,5	180	2,376	3721	8841
06209407	28	Ska 11	6,40	3,5	180	2,376	3721	8841
06209407	29	Ska 11	6,40	3,5	180	2,376	3721	8841
06209407	30	Ska 11	6,40	3,5	180	2,376	3721	8841
06209407	31	Ska 11	6,40	3,5	180	2,376	3721	8841
06209407	32	Ska 11	6,40	3,5	180	2,376	3721	8841
06205205	33	Agb 11	5,60	4,5	155	2,453	3721	9128
06205205	34	Agb 11	5,60	4,5	155	2,453	3721	9128
06205205	35	Agb 11	5,60	4,5	155	2,453	3721	9128
06205205	36	Agb 11	5,60	4,5	155	2,453	3721	9128
10273302	G1	Ab 11	6,00	3,5	160	2,414	3721	8982
10279502	G2	Ska 16	6,10	3,5	160	2,41	3721	8968
10273302	G3	Ab 11	6,00	3,5	160	2,414	3721	8982
10279502	G4	Ska 16	6,10	3,5	160	2,41	3721	8968
10275202	G5	Agb 11	5,80	3,5	150	2,436	3721	9064
10275202	G6	Agb 11	5,80	3,5	150	2,436	3721	9064
10275201	G7	Agb 11	5,80	3,5	150	2,433	3721	9053
10275301	G8	Agb 16	5,6	3,5	150	2,453	3721	9128
10275301	G9	Agb 16	5,6	3,5	150	2,453	3721	9128
10275201	G10	Agb 11	5,80	3,5	150	2,433	3721	9053
6209409	G11	Ska 11	5,90	3,5	165	2,433	3721	9053
6209409	G12	Ska 11	5,90	3,5	165	2,433	3721	9053
6209407	G13	Ska 11	5,90	3,5	180	2,376	3721	8841
6209409	G14	Ska 11	5,90	3,5	165	2,433	3721	9053
6209409	G15	Ska 11	5,90	3,5	165	2,433	3721	9053
10263302	G16	Ab 11	6,00	3,5	160	2,382	3721	8863
10263302	G17	Ab 11	6,00	3,5	160	2,382	3721	8863
10321320	G18	Ab 11	6,00	3,5	160	2,382	3721	8863
10321320	G19	Agb 11	5,90	4,5	150	2,312	3721	8603
10321320	G20	Agb 11	5,90	4,5	150	2,312	3721	8603
10321320	G21	Agb 11	5,90	4,5	150	2,312	3721	8603
10321331	G22	Agb 16	5,70	4,5	150	2,333	3721	8681
10321331	G23	Agb 16	5,70	4,5	150	2,333	3721	8681
10321331	G24	Agb 16	5,70	4,5	150	2,333	3721	8681
8321125	G25	Ab 11 GIL	5,80	4,5	200	2,343	3721	8718
8321125	G26	Ab 11 GIL	5,80	4,5	200	2,343	3721	8718
8321125	G27	Ab 11 GIL	5,80	4,5	200	2,343	3721	8718
8321125	G28	Ab 11 GIL	5,80	4,5	200	2,343	3721	8718
8321125	G29	Ab 11 GIL	5,80	4,5	200	2,343	3721	8718
10321331	G30	Agb 16	5,70	4,5	150	2,443	3721	9090
10317127	G31	Ab 11 L	5,70	3,5	160	2,473	3721	9202
10317127	G32	Ab 11 L	5,70	3,5	160	2,473	3721	9202
10317127	G33	Ab 11 L	5,70	3,5	160	2,473	3721	9202
10317124	G34	Ab 11 Grà	5,70	3,5	160	2,475	3721	9209
10317124	G35	Ab 11 Grà	5,70	3,5	160	2,475	3721	9209
10317124	G36	Ab 11 Grà	5,70	3,5	160	2,475	3721	9209

10317119	G37	Ab 11 Lp	5,70	3,5	180	2,473	3721	9202
10317119	G38	Ab 11 Lp	5,70	3,5	180	2,473	3721	9202
10317119	G39	Ab 11 Lp	5,70	3,5	180	2,473	3721	9202
-	37	Drenoval HM	6,83	6	170	2,405	3721	8949
-	38	Drenoval HM	6,83	6	170	2,405	3721	8949
-	39	Drenoval HM	6,83	6	170	2,405	3721	8949
-	40	Drenoval HM	6,83	6	170	2,405	3721	8949
-	41	Drenoval HM	6,83	6	170	2,405	3721	8949
-	42	Drenoval HM	6,83	6	170	2,405	3721	8949
-	43	Drenoval Hard M	6,40	6	170	2,405	3721	8949
-	44	Drenoval Hard M	6,40	6	170	2,405	3721	8949
-	45	Drenoval Hard M	6,40	6	170	2,405	3721	8949
-	46	Drenoval Hard M	6,40	6	170	2,405	3721	8949
-	47	Drenoval Hard M	6,40	6	170	2,405	3721	8949
-	48	Drenoval Hard M	6,40	6	170	2,405	3721	8949
-	49	Lowval HM 40	6,40	6	170	2,405	3721	8949
-	50	Lowval HM 40	6,40	6	170	2,405	3721	8949
-	51	Lowval HM 40	6,40	6	170	2,405	3721	8949
-	52	Lowval HM 40	6,40	6	170	2,405	3721	8949
-	53	Lowval HM 40	6,40	6	170	2,405	3721	8949
-	54	Lowval HM 40	6,40	6	170	2,405	3721	8949

Table 4.2 Characteristics of the samples investigated.

4.4.1 Mixtures

The utilized mixtures can be divided in four main groups: Ab and Agb, Ska and mixture with polymeric modified bitumen.

Ab and Agb

Ab and Agb are different types of dense graded asphalt, they differ because of bitumen’s softness: the Ab mixture is characterized from a bitumen with a penetration grade of 50/100 and the Agb from a bitumen 160/220. Their grading curves are almost similar as it shown in Table 4.3 and Graph 4.1.

Ska

The Ska mixture is a typical Stone Mastic Asphalt, a hot mix asphalt consisting of a higher proportion of coarse aggregate than a conventional dense graded asphalt (Figure 4.3,

Table 4.3, Graph 4.1), that interlocks to form a stone on stone skeleton to resist permanent deformation. Improved asphalt durability is also a result of higher bitumen content (5.9 - 6.40% instead of 5.50 - 6.00% of an Ab mixture).

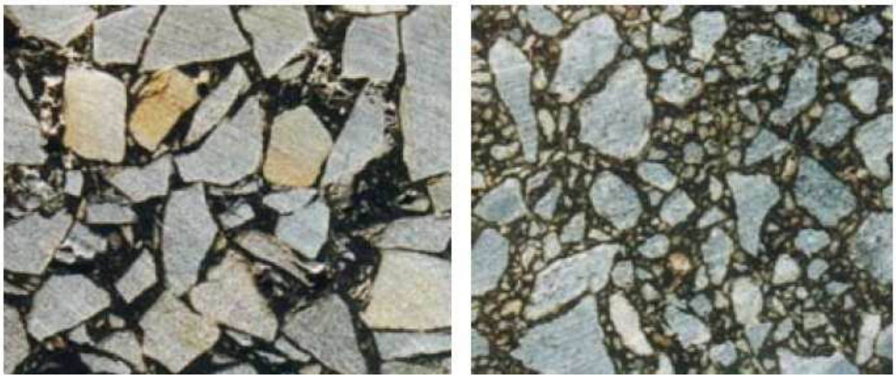


Figure 4.3 A Stone Mastic Asphalt, on the left, and a dense graded asphalt, on the right [27].

Polymer modified bitumen

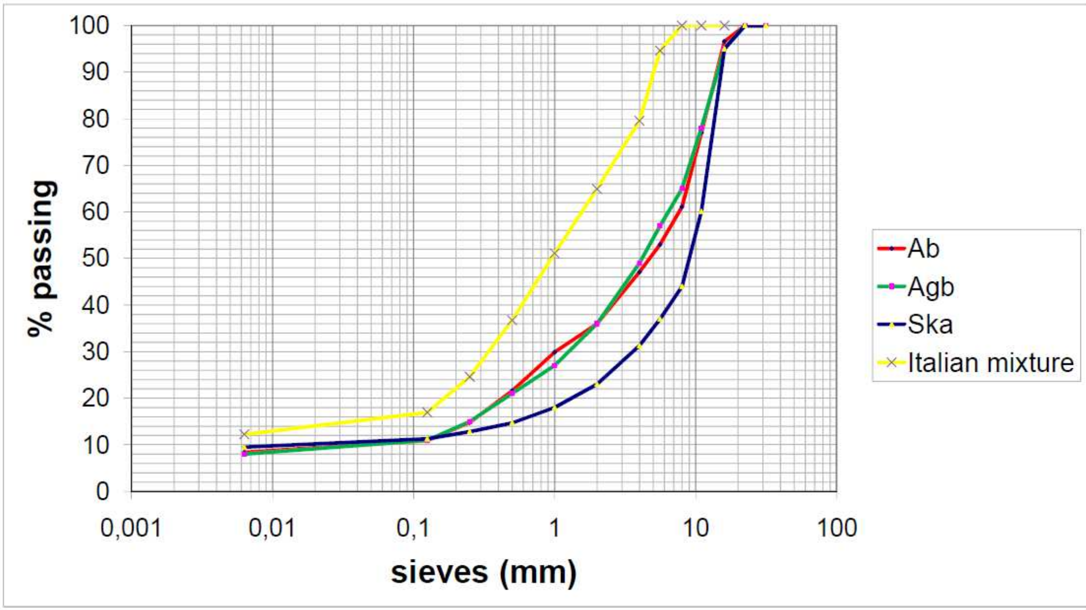
Modified binder derives from a mixture of bitumen with one or more polymers added in percentages ranging from 3% to 7% compared to the weight of the base bitumen. The binder obtained is a system in which coexist two phases, asphaltenic and polymeric. It is generally possible to assume that the presence of a polymeric phase within a binder will increase the performance characteristics reducing its susceptibility to heat and slowing the aging process in the short term.

Among modified binders, there are also the Italian bitumens Drenoval and Lowval.n Drenoval HM and Hard M are two kind of modified bitumen with elastomeric thermoploastic polymers SBS. These binders differs because of the hardness: HM has a penetration of 30-50 (average value 35dmm) and Hard M of 50-70 (average value 60 dmm). Lowval is a high workability bitumen modified with wax, an organic additive added with a percentage of 2-2.5% compared to the bitumen. Thanks to its capacity to improve bitumen viscosity through a phase transition at high working temperature, wax can lead to improved resistance to permanent deformation in asphalt mixtures.

Sieve Size	**Passing**			
	Ab	**Agb**	**Ska**	**Italian mixture**
31,5	100	100	100	100
22,4	100	100	100	100
16	96,6	95	95	100
11	77	78	60,1	95,44
8	61,1	65	44	80,47

5,6	53	57	37	65,30
4	47,1	49	31,3	52,78
2	36	36	23	37,86
1	29,9	27	18	25,14
0,5	21,6	21	14,7	17,38
0,25	14,8	15	12,8	12,72
0,125	10,9	11	11,3	8,91
0,0063	8,4	8	9,5	6,16

Table 4.3 Passing percentage of aggregates for: Ab16 (receipt n. 13143908), Agb 16 (receipt n. 10321331), Ska 16 (receipt n. 10279502) and the Italian mixtures.



Graph 4.1 Grading curve of Ab 16 in red (receipt n. 13143908), Agb 16 in green (receipt n. 10321331), Ska 16 in blue (receipt n. 10279502) and the Italian mixtures in yellow.

4.4.2 Specimen preparation

4.4.2.1 Receipts data

The needed information to produce the asphalt concrete mixture are given by the accompanying receipt. In the example receipt number 82212000814, Figure 4.4Figure 4.4 Receipt n. 82212000814. The information useful for the sample preparation are: a) type of binder, b) grading curve, c) mixture type, d) bitumen content, e) air voids content, f) mixing temperature, g) density, h) maximum density., related to samples number 13 – 14 – 15 – 16 – 17 – 18, are provided all data about the type of binder, of aggregates, the directions for preparing the mixture and the characteristics that should belong to the finite sample.

Binder:

a) type of binder (penetration test result).

Aggregates:

b) grading curve.

Mixture and finite sample:

c) mixture type;

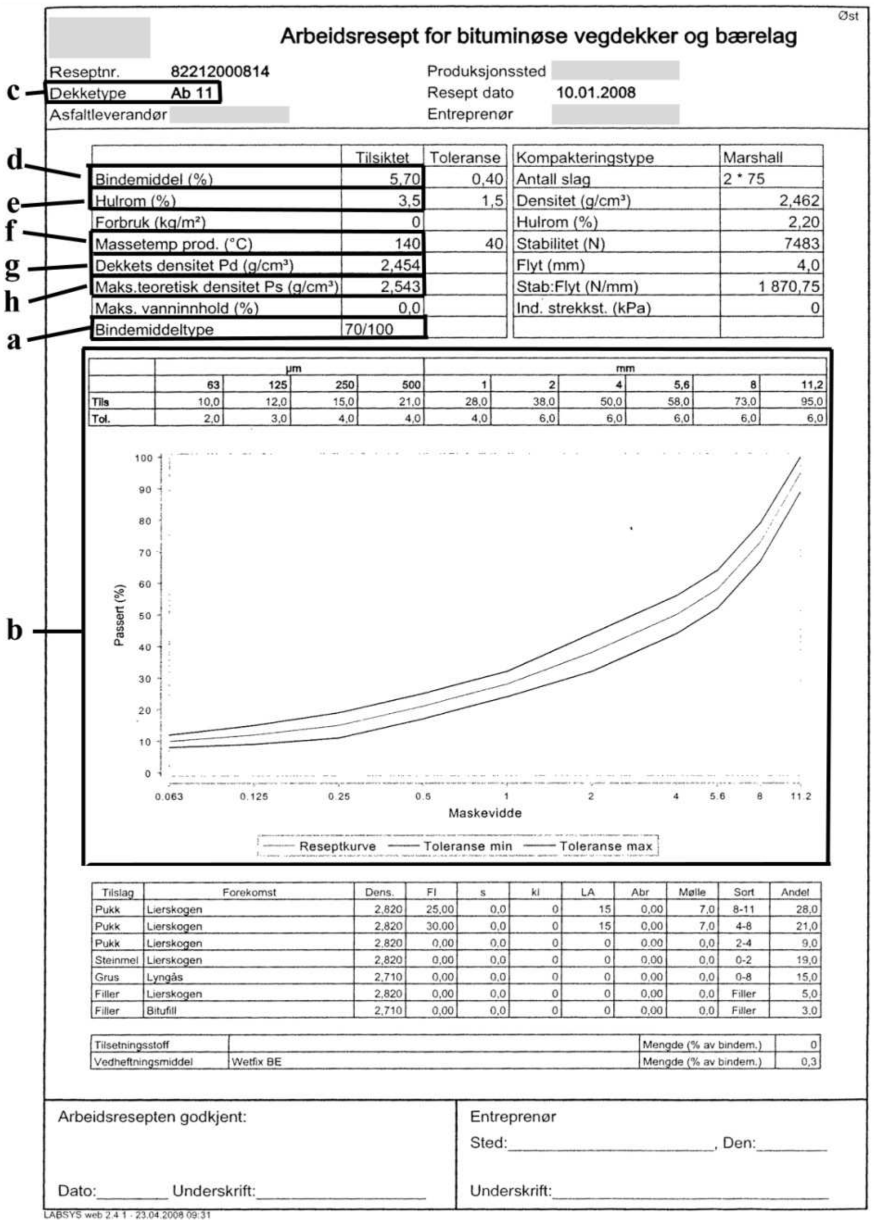
d) bitumen content [%];

e) air voids content [%];

f) mixing temperature [$° C$];

g) density [g/cm^3];

h) maximum density [g/cm^3].



Øst

Arbeidsresept for bituminøse vegdekker og bærelag

Reseptnr.	82212000814	Produksjonssted	
Dekketype	Ab 11	Resept dato	10.01.2008
Asfaltleverandør		Entreprenør	

	Tilsiktet	Toleranse	Kompakteringstype	Marshall
Bindemiddel (%)	5,70	0,40	Antall slag	2 * 75
Hulrom (%)	3,5	1,5	Densitet (g/cm³)	2,462
Forbruk (kg/m²)	0		Hulrom (%)	2,20
Massetemp prod. (°C)	140	40	Stabilitet (N)	7483
Dekkets densitet Pd (g/cm³)	2,454		Flyt (mm)	4,0
Maks.teoretisk densitet Ps (g/cm³)	2,543		Stab:Flyt (N/mm)	1 870,75
Maks. vanninnhold (%)	0,0		Ind. strekkst. (kPa)	0
Bindemiddeltype	70/100			

	µm				mm					
	63	125	250	500	1	2	4	5,6	8	11,2
Tils	10,0	12,0	15,0	21,0	28,0	38,0	50,0	58,0	73,0	95,0
Tol.	2,0	3,0	4,0	4,0	4,0	6,0	6,0	6,0	6,0	6,0

Tilslag	Forekomst	Dens.	FI	s	kl	LA	Abr	Mølle	Sort	Andel
Pukk	Lierskogen	2,820	25,00	0,0	0	15	0,00	7,0	8-11	28,0
Pukk	Lierskogen	2,820	30.00	0,0	0	15	0,00	7,0	4-8	21,0
Pukk	Lierskogen	2,820	0,00	0,0	0	0	0.00	0,0	2-4	9,0
Steinmel	Lierskogen	2,820	0,00	0,0	0	0	0,00	0,0	0-2	19,0
Grus	Lyngås	2,710	0,00	0,0	0	0	0,00	0,0	0-8	15,0
Filler	Lierskogen	2,820	0,00	0,0	0	0	0,00	0,0	Filler	5,0
Filler	Bitufill	2,710	0,00	0,0	0	0	0,00	0,0	Filler	3.0

Tilsetningsstoff		Mengde (% av bindem.)	0
Vedheftningsmiddel	Wetfix BE	Mengde (% av bindem.)	0,3

Arbeidsresepten godkjent:

Dato:________ Underskrift:____________________

Entreprenør

Sted:______________________, Den:________

Underskrift:______________________________

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Figure 4.4 Receipt n. 82212000814. The information useful for the sample preparation are: a) type of binder, b) grading curve, c) mixture type, d) bitumen content, e) air voids content, f) mixing temperature, g) density, h) maximum density.

Mixing

Note the grading curve and the percentage of bitumen and the final amount of material, it is possible to pack the mixture. In the following tables and graphs, there are shown the various steps as they have been for the packing of the Italian mixture (Drenoval HM, Drenoval Hard M and Lowval HM 40).

First of all it is necessary a sieve analysis of the different stone materials, characterized by a dominant size, that may be suitable to reach the grading curve given by the receipt (Table 4.4). In Table 4.5, are reported the sieve analysis for the three kind of aggregates used and the filler. The analysis was carried out according to EN 933 – 1 [28].

	0.0063	**0.125**	**0.25**	**0.5**	**1.0**	**2.0**	**4.0**	**5.6**	**8**	**16**
Reference curve	4.00	9.49	11.78	15.82	24.21	33.50	52.32	59.85	86.16	100

Table 4.4 Reference grading curve.

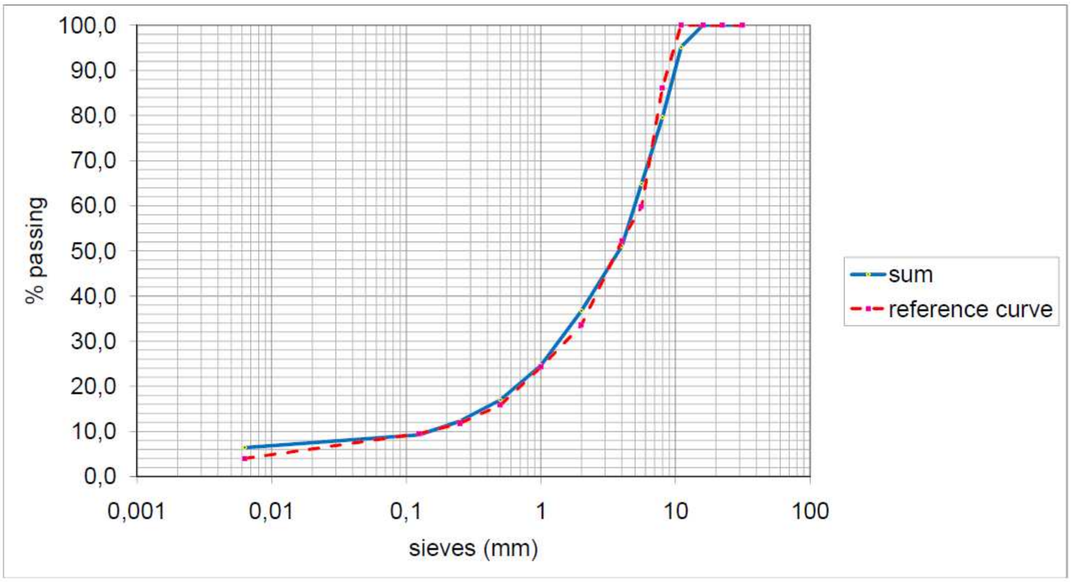
In Table 4.6 for each kind of aggregates have then been defined the percentage quantity that, combined with the others (sum column) allows to reach the particle size distribution of the reference curve (reference curve column). The reference grading curve (red dashed line) and the theoretical one (sum, blue line) are represented in Graph 4.2; in Graph 4.3 is added the yellow line that represents the results of the sieve analysis of the combination of aggregates defined theoretically in the previous step.

Sieve size	**Ottersbro 0-8 Fraction 1**	**Ottersbro 8-11 Fraction 2**	**Ottersbro 8-11 Fraction 3**	**Vassfjel 4-8 Fraction 4**	**Vassfjel 0-4 Fraction 5**	**filler Fraction 5**
16	100,0	100,0	100,0	100,0	100,00	100
11	100,00	75,5	80,6	100,0	100,00	100
8	96,25	14,9	15,3	98,0	100,00	100
5,6	79,54	2,6	2,0	60,7	100,00	100
4	63,00	0,9	0,6	16,7	97,50	100
2	41,60	0,5	0,5	2,2	79,50	100
1	26,00	0,4	0,4	1,3	52,00	100
0,5	16,37	0,4	0,4	1,2	34,00	100
0,25	10,74	0,4	0,4	1,1	23,00	95
0,125	6,05	0,2	0,2	0,9	18,25	90
0,0063	3,75	0,1	0,2	0,8	11	80

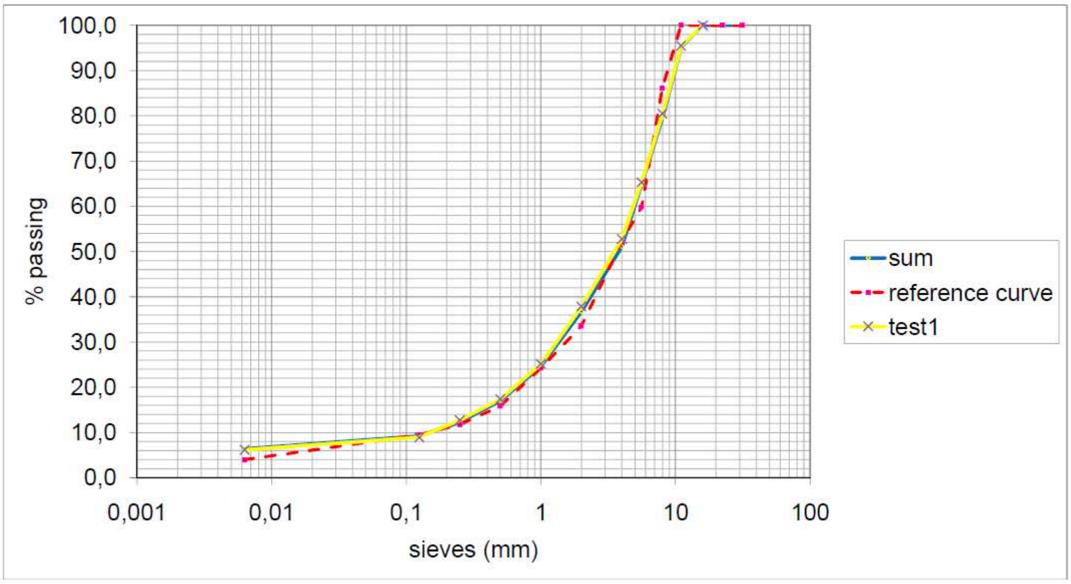
Table 4.5 Grading curve of the different type of aggregates used in the Italian mixtures.

Sieve size	Ottersbro 0-8 % grad. 1	Ottersbro 8-11 % grad. 2	Ottersbro 8-11 % grad. 3	Vassfjel 4-8 % grad. 4	Vassfjel 0-4 % grad. 5	Filler % grad.5	Sum	Reference curve
	38,0	**11,0**	**11,0**	**15,0**	**22,0**	**3,0**	**100,0**	
16	38,0	11,0	11,0	15,0	22,0	3,0	100,0	100
11	38,0	8,3	8,9	15,0	22,0	3,0	95,2	100
8	36,6	1,6	1,7	14,7	22,0	3,0	79,6	86,16
5,6	30,2	0,3	0,2	9,1	22,0	3,0	64,8	59,85
4	23,9	0,1	0,1	2,5	21,5	3,0	51,1	52,32
2	15,8	0,1	0,1	0,3	17,5	3,0	36,7	33,5
1	9,9	0,0	0,0	0,2	11,4	3,0	24,6	24,21
0,5	6,2	0,0	0,0	0,2	7,5	3,0	17,0	15,82
0,25	4,1	0,0	0,0	0,2	5,1	2,9	12,2	11,78
0,125	2,3	0,0	0,0	0,1	4,0	2,7	9,2	9,49
0,0063	1,4	0,0	0,0	0,1	2,4	2,4	6,4	4

Table 4.6 Theoretical grading curve for the mixture among the different types of aggregates(sum) and reference grading curve given by the receipt (reference curve).



Graph 4.2 Grading curve. In red the reference curve given by the receipt and in blue the curve given by the percentage sum of the various types of aggregates.



Graph 4.3 Grading curve. In red the reference curve given by the receipt, in blue the curve given by the percentage sum of the various types of aggregates and in yellow the effective grading curve.

Mass of bituminous mixture

The mass, *M*, of the bituminous mixture to be introduced in the mould is a function of the maximum density, ρ_m, of the bituminous mixture, of the interior dimensions of the mould, *L*, and, *l*, of the thickness of the specimen, *e*, and of the voids content, n, either prescribed, or anticipated (compaction under controlled energy)

$$M = 10^{-6} \times L \times l \times e \times \rho_m \times \left(\frac{100-v}{100}\right) \quad [29].$$

Where

M	is the mass of slab, in kilograms [kg];
L	is the interior length of mould, in [mm];
L	is the interior width of mould, [mm];
E	is the final thickness of slab, [mm];
ρ_m	is the maximum density of a bituminous mixture [kg/m^3];
ν	is the voids content in slab, in percent [%].

Parallelepiped metal moulds have been used for the test. Its internal dimension are 30.5 x 30.5 x 6 cm. The height of the formworks depend on the final thickness e (e = 4 cm) (Figure 4.5).

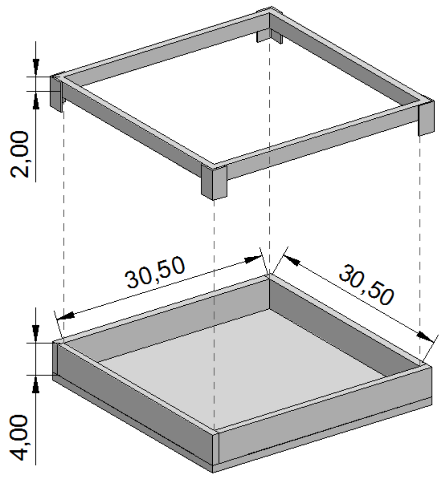


Figure 4.5 Mould internal dimensions.

For each sample were collected an amount of 12 kilos of stone material divided among the various types of aggregates as shown in Table 4.7. In addition it was determinated the required quantity of bitumen from the density on the total amount of aggregates (6.4%) given by producer.

Fraksjoner	%	Gram	Sum %	Sum Gram
Ottersbro 8-11	22	2640	22	**2640**
Vassfjell 4-8	15	1800	37	**4440**
Ottersbro 0-8	38	4560	75	**9000**
Vassfjell 0-4	22	2640	97	**11640**
Filler	3	360	100	**12000**
	(%)	**(g)**		
Bitumen	6,4	**768**		

Table 4.7 Determination of the amount of material for each type of aggregates and determination of the amount of bitumen.

Before proceeding with the preparation of the mixture, it is necessary heating the components at the mixing temperature (given by the producer, 170°C in this case), until the bitumen is completely melt. Afterwards the bitumen is added to the aggregates, in doses previously calculated, in a preheated pot; the pot full of the mixture is positioned in the kneading machine. When the mixture appears homogeneous, it is ready to be used to prepare the sample. Part of the material will be stored to be used for the determination of the maximum density.

4.4.2.2 Fixing the mould

The use of the roller compactor provides preheating of the mould to the specified compaction temperature for more than 2 h. Then the mould would be filled with the mass, ($M \pm 0{,}1\,\%$) of the bituminous mixture, taking care to spread the mixture evenly in the mould with a shovel and avoiding any segregation; the mixture, including the corners, should be tamped to achieve an even as possible surface before compaction commences.

4.4.2.3 Compaction

In the mix design/analysis process proper sample preparation prior to testing, in particular the compaction method used to prepare specimens, is a critical factor. The purpose of any laboratory compaction process is to simulate, as closely as it is possible, the actual compaction produced in the field. Factors such as particle orientation and aggregate interlock, void content and structure, and the number of interconnected voids should be closely reproduced [30]. According on researches about the relationship between compaction and expected performance, rolling wheel compaction is best suited for preparing laboratory specimens. Among the methods investigated, it appears to duplicate field compacted mixes quite well. Therefore it is strongly recommended that rolling compaction be used for the preparation of laboratory specimens of asphalt mixes.

Rolling wheel compaction is intuitively appealing for its obvious similarity to the rollers used in road construction. Moreover, extensive studies have demonstrated that it produces uniform specimens with engineering properties similar to those of cores extracted from recently constructed pavements [31]. Rolling compaction is the recommended form of samples preparation from the European Committee for Standardization (CEN) through the EN 12697 -33[29]. This European Standard describes the procedure for the construction of samples of bituminous mixtures with the characteristics of thickness and volume notes.

The roller compactor consists of an electro-pneumatic system that plays through linkage overhead imposed on a sector metal cylinders. A given mass of bituminous mixture is compacted in a rectangular mould under a load applied by a smooth steel roller (Figure 4.6). The roller may run directly on the bituminous mixture or apply a kneading action to the mixture through a vibrating plate. The compaction occurs at constant velocity in three different moments characterized by a different pressure. Each pressure in given in four cycles.

Before compaction commences, a film should be placed between the roller and the sample to avoid the material to attach on the roller.

Figure 4.6 Sample in the roller compactor.

5 TEST RESULTS

This chapter shows the results of the tests. Tested samples are divided in three categories: Norwegian mixture samples (from number 1 to number 36), samples produced during the laboratory course (from G1 to G39) and Italian mixture samples (from 37 to 54). For each category there are Wheeltrack test results, the determined bulk density, void characteristics and maximum density.

The values of bulk density, void characteristics and maximum density are in APPENDIX D: Determination of bulk density and void characteristics and APPENDIX E: Maximum density.

5.1 Wheeltrack Test results

The Wheeltrack test results are, for each specimen:

- the rut depth in each measured cross – section as a mean value of measured rut depth at least 30 points which are located within 60 mm in the centre of loaded area and the consequent longitudinal profile, measured at intervals of 100 cycles in $[mm]$;
- the temperature in $[°\,C]$ measured at intervals of cycle;
- the final rut depth in $[mm]$;
- the Mean Steady State Tracking Rate in $[mm/1000\ passes]$.

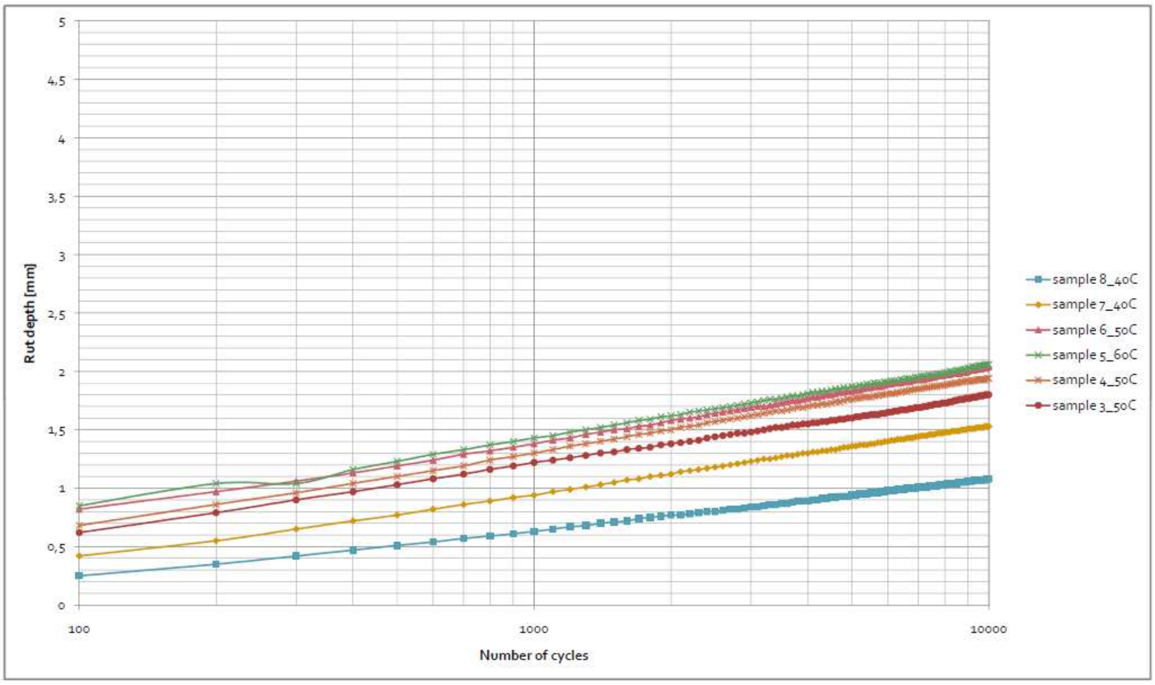
In the following pages, there are the final results of each test and a summary graph of the evolution of the deformation over the time. All the others data are included in APPENDIX C: Wheeltrack test results.

Samples 3 - 8

Mixture	Ab 16 Pmb
Receipt number	13143908

	Test Temperature [° C]	Sample Final Rut Depth [mm]	WTS_{AIR} [mm/1000 passes]
Sample 3	50	1.80	0.04
Sample 4	50	1.94	0.04
Sample 5	60	2.06	0.04
Sample 6	60	2.04	0.04
Sample 7	40	1.53	0.04
Sample 8	40	1.08	0.03

Graph 5.1 shows the evolution of deformation over the time for each sample.



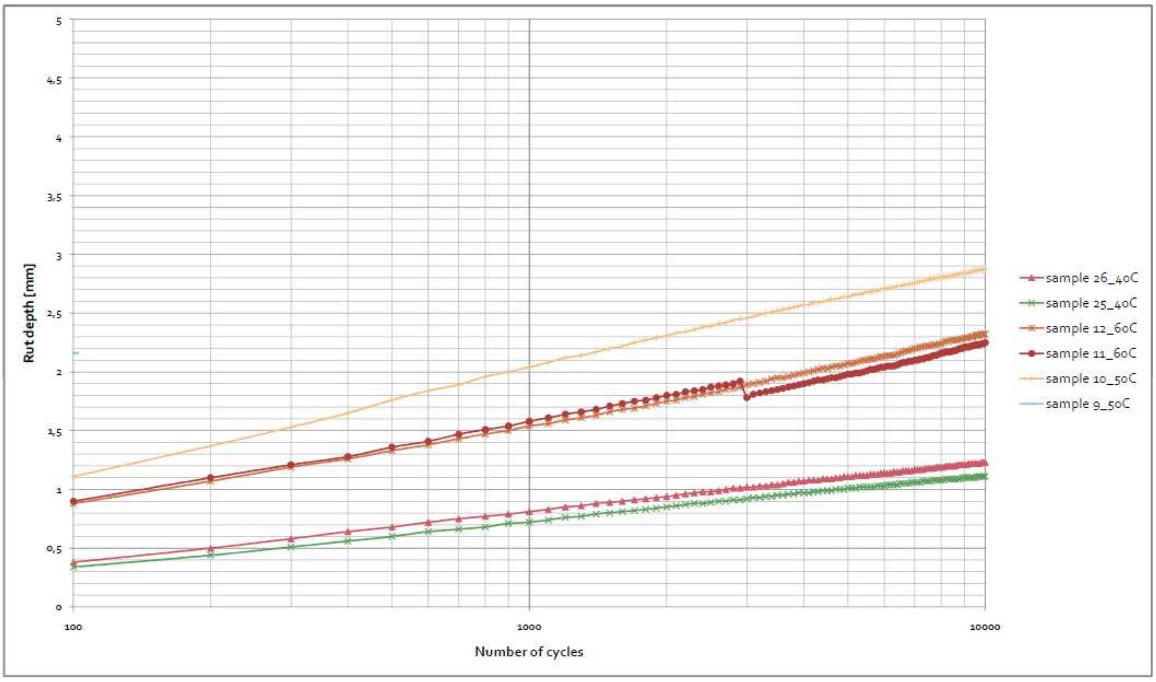
Graph 5.1 Wheeltrack Test results. Samples 3 - 8.

Samples 9 – 12, 25 - 26

Mixture	Ab 11 Pmb
Receipt number	82212001414

	Test Temperature $[° C]$	Sample Final Rut Depth $[mm]$	WTS_{AIR} $[mm/1000\ passes]$
Sample 9	50	2.16	0.04
Sample 10[1]	50	2.88	0.05
Sample 11	60	2.25	0.05
Sample 12	60	2.32	0.05
Sample 25	40	1.11	0.02
Sample 26	40	1.23	0.02

Graph 5.2 shows the evolution of deformation over the time for each sample.



Graph 5.2 Wheeltrack Test results. Samples 9 - 12, 25 -26.

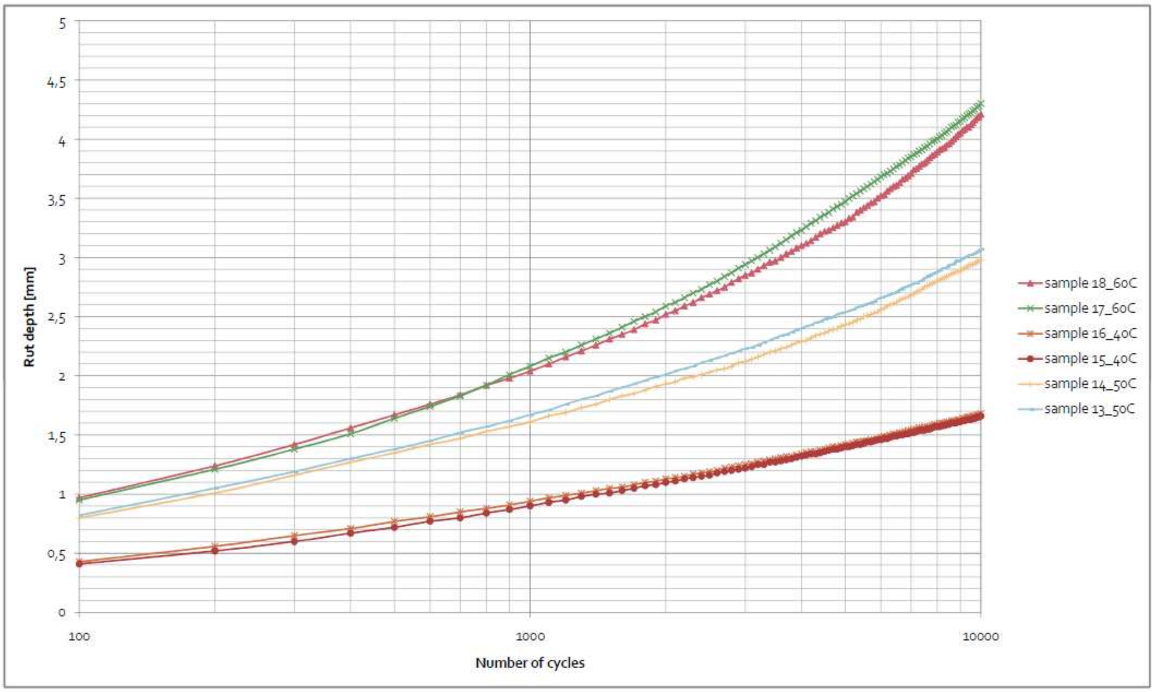
[1] *The sample does not contain the required quantity of material. Its behavior is indeed anomalous than the rest of the set. The sample will not be considered in future analysis.*

Samples 13 - 18

Mixture	Ab 11
Receipt number	82212000814

	Test Temperature $[°\,C]$	Sample Final Rut Depth $[mm]$	WTS_{AIR} $[mm/1000\,passes]$
Sample 13	50	3.07	0.11
Sample 14	50	2.98	0.11
Sample 15	40	1.66	0.05
Sample 16	40	1.68	0.05
Sample 17	60	4.30	0.17
Sample 18	60	4.21	0.18

Graph 5.3 shows the evolution of deformation over the time for each sample.



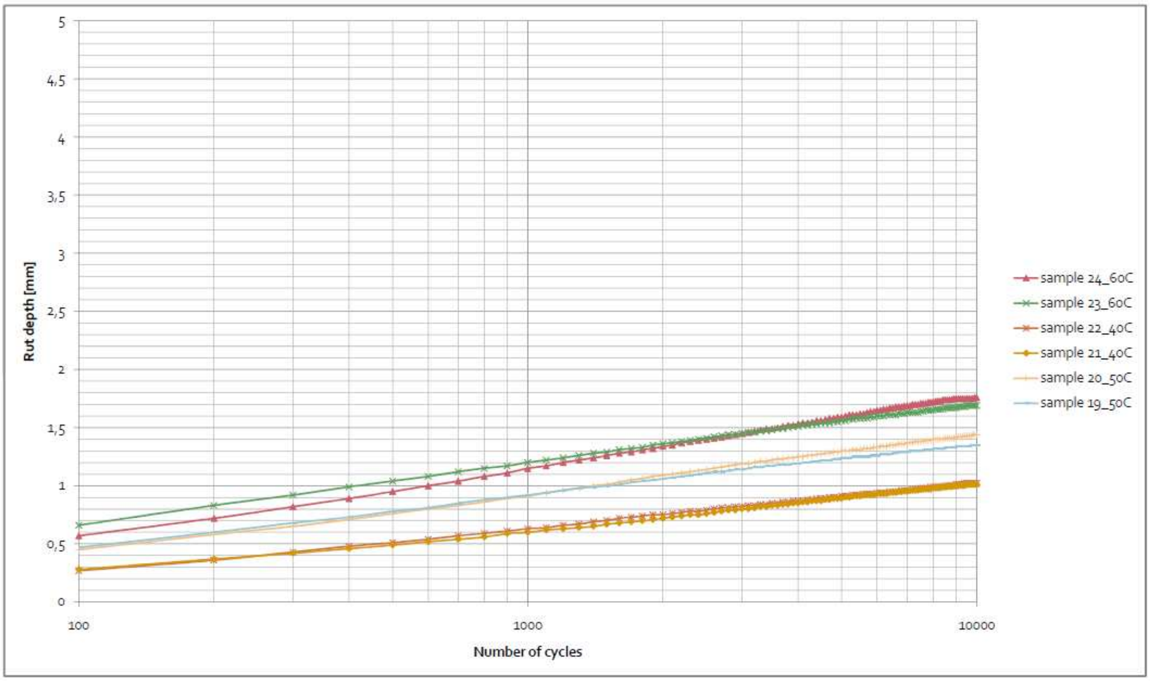
Graph 5.3 Wheeltrack Test results. Samples 13 - 18.

Samples 19 - 24

Mixture	Ab 11 Pmb
Receipt number	82212001014

	Test Temperature $[°\,C]$	Sample Final Rut Depth $[mm]$	WTS_{AIR} $[mm/1000\ passes]$
Sample 19	50	1.35	0.02
Sample 20	50	1.44	0.03
Sample 21	40	1.01	0.02
Sample 22	40	1.02	0.02
Sample 23	60	1.69	0.03
Sample 24	60	1.76	0.03

Graph 5.4 shows the evolution of deformation over the time for each sample.



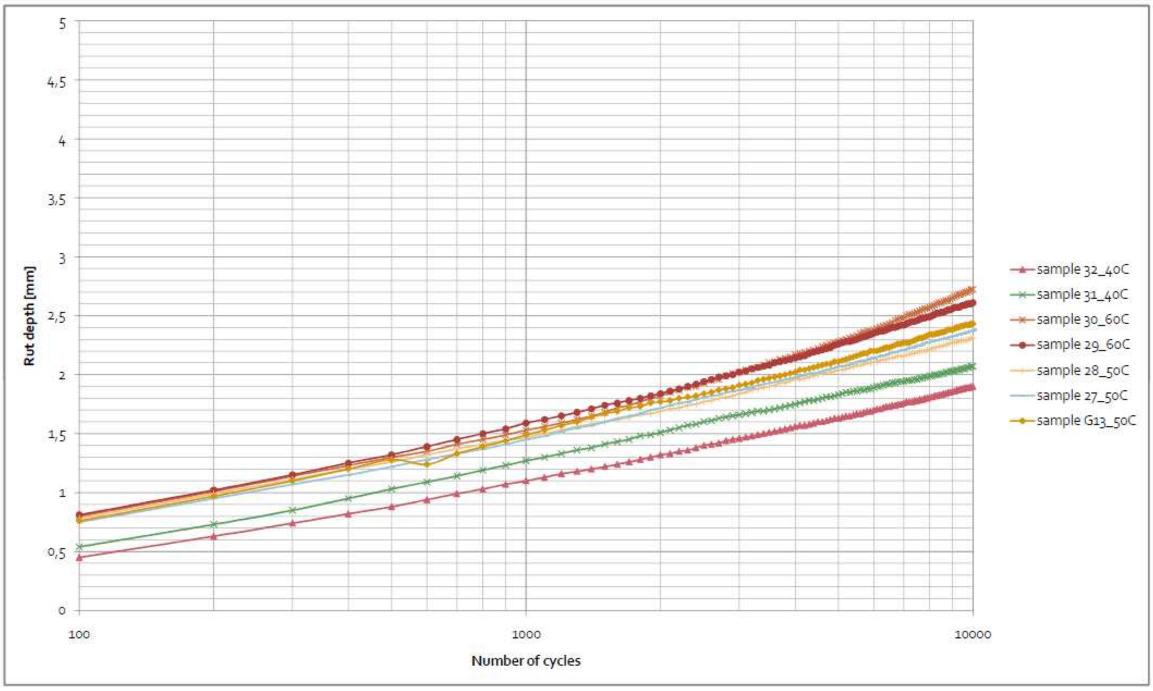
Graph 5.4 Wheeltrack Test results. Samples 19 - 24.

Samples 27 – 32, G13

Mixture	Ska 11
Receipt number	06209407

	Test Temperature $[°\,C]$	Sample Final Rut Depth $[mm]$	WTS_{AIR} $[mm/1000\,passes]$
Sample 27	50	2.38	0.06
Sample 28	50	2.31	0.05
Sample 29	60	2.61	0.07
Sample 30	60	2.72	0.09
Sample 31	40	2.07	0.05
Sample 32	40	1.90	0.05
Sample G13	50	2.43	0.06

Graph 5.5 shows the evolution of deformation over the time for each sample.



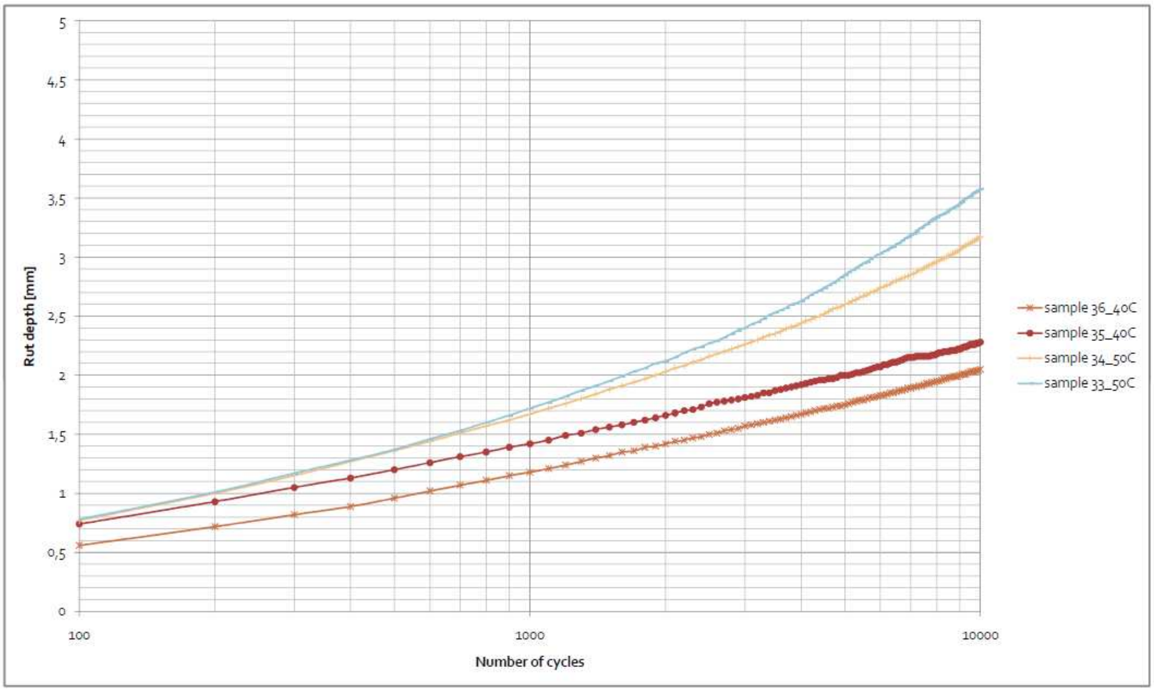
Graph 5.5 Wheeltrack Test results. Samples 27 - 32, G13.

Samples 33 - 36

Mixture	Agb 11
Receipt number	06205205

	Test Temperature	Sample Final Rut Depth	WTS_{AIR}
	$[° C]$	$[mm]$	$[mm/1000\ passes]$
Sample 33	50	3.58	0.15
Sample 34	50	3.17	0.11
Sample 35	40	2.28	0.06
Sample 36	40	2.05	0.06

Graph 5.6 shows the evolution of deformation over the time for each sample.



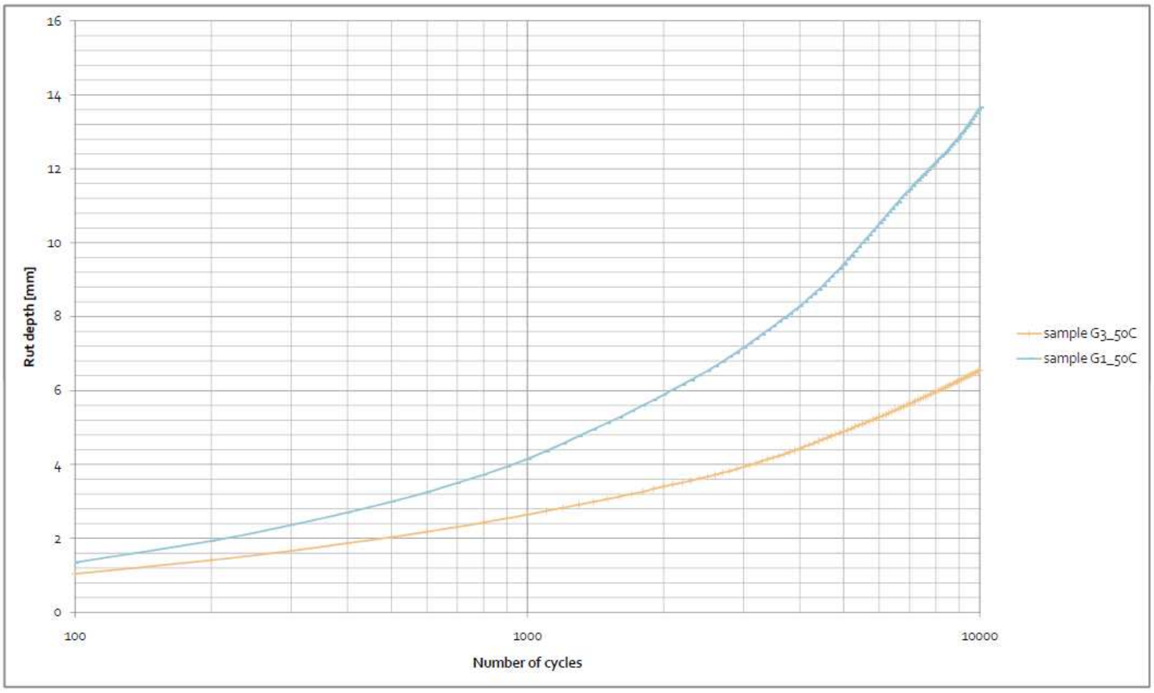
Graph 5.6 Wheeltrack Test results. Samples 33 - 36.

Samples G1, G3

Mixture	Ab 11
Receipt number	10273302

	Test Temperature $[°\,C]$	Sample Final Rut Depth $[mm]$	WTS_{AIR} $[mm/1000\,passes]$
Sample G1[2]	50	13.65	0.85
Sample G3	50	6.55	0.33

Graph 5.7[3] shows the evolution of deformation over the time for each sample.



Graph 5.7 Wheeltrack Test results. Samples G1,G3.

[2] The mould utilized was not comply with the others, the sample thickness is 4,20 cm. Its behavior is indeed anomalous than the rest of the set. The sample will not be considered in future analysis.

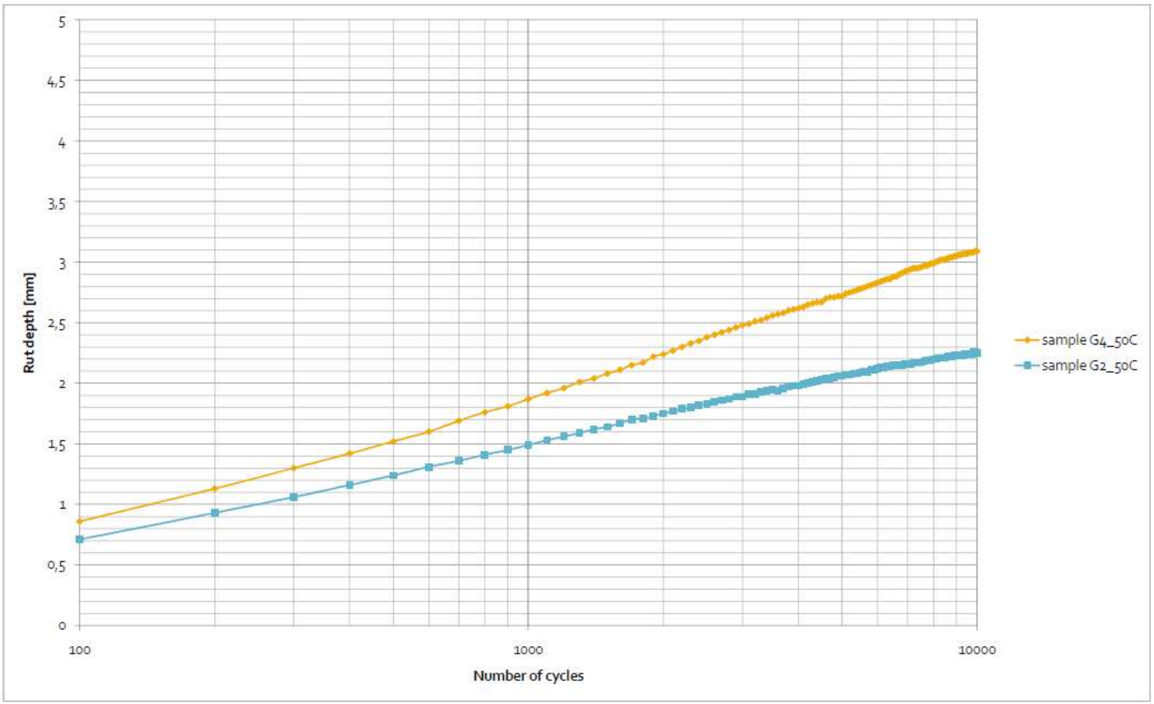
[3] The graph is represented in a different scale.

Samples G2,G4

Mixture	Ska 16
Receipt number	10279502

	Test Temperature $[°\,C]$	Sample Final Rut Depth $[mm]$	WTS_{AIR} $[mm/1000\,passes]$
Sample G2	50	2.25	0.04
Sample G4[4]	50	3.09	0.07

Graph 5.8 shows the evolution of deformation over the time for each sample.



Graph 5.8 Wheeltrack Test results. Samples G2,G4.

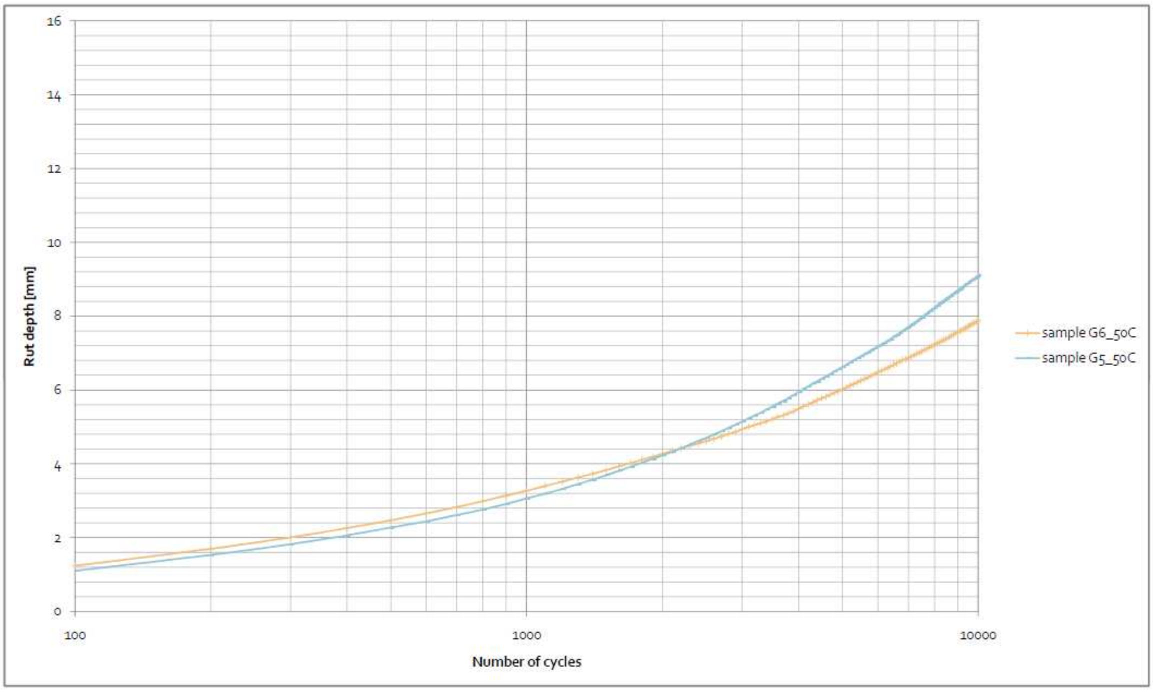
[4] The mould utilized was not comply with the others, the sample thickness is 4,20 cm. Its behavior is indeed anomalous than the rest of the set. The sample will not be considered in future analysis.

Samples G5,G6

Mixture	Agb 11
Receipt number	10275202

	Test Temperature $[°\ C]$	Sample Final Rut Depth $[mm]$	WTS_{AIR} $[mm/1000\ passes]$
Sample G5	60	9.10	0.49
Sample G6	60	7.87	0.37

Graph 5.9[5] shows the evolution of deformation over the time for each sample.



Graph 5.9 Wheeltrack Test results. Samples G5 - G6.

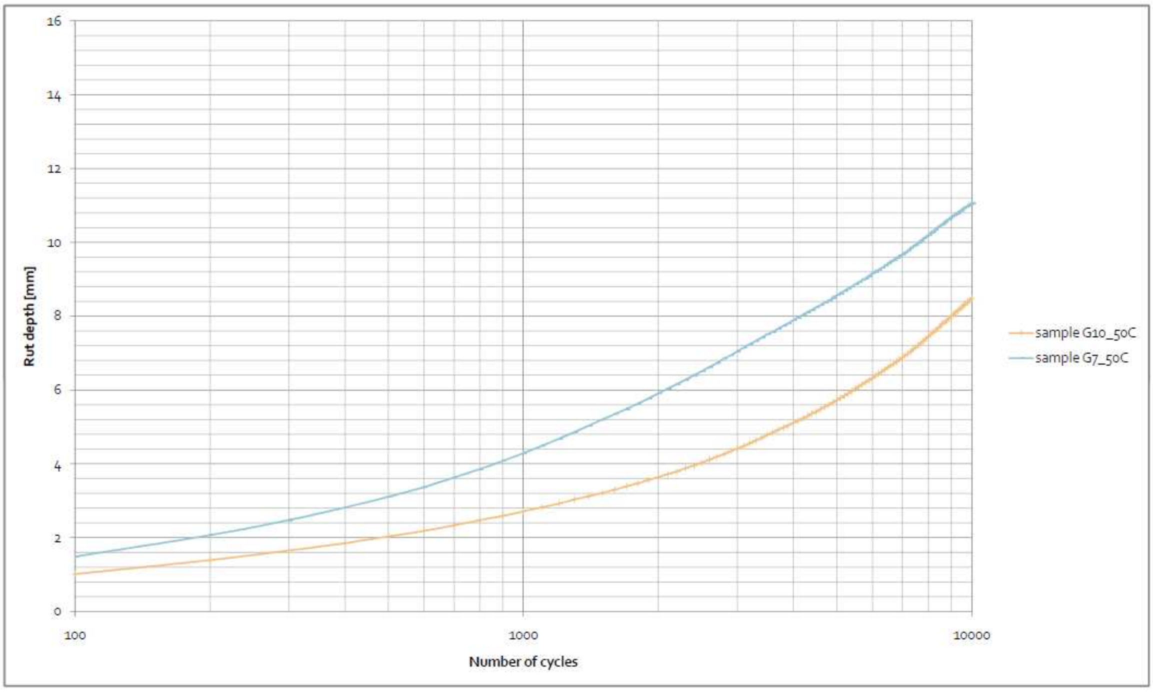
[5] The graph is represented in a different scale.

Samples G7,G10

Mixture	Agb 11
Receipt number	10275201

	Test Temperature $[°\,C]$	Sample Final Rut Depth $[mm]$	WTS_{AIR} $[mm/1000\,passes]$
Sample G7	50	11.07	0.50
Sample G10	50	8.48	0.55

Graph 5.10[6] shows the evolution of deformation over the time for each sample.



Graph 5.10 Wheeltrack Test results. Samples G7, G10.

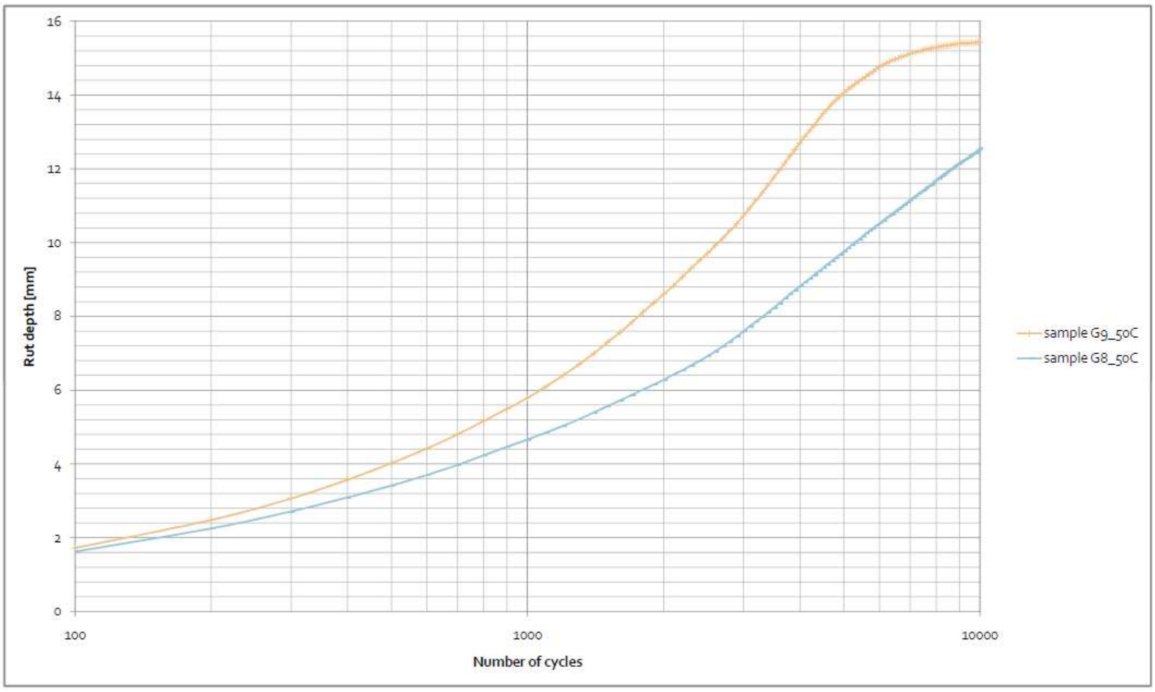
[6] The graph is represented in a different scale.

Samples G8 - G9

Mixture	Agb 16
Receipt number	10275301

	Test Temperature $[°\,C]$	Sample Final Rut Depth $[mm]$	WTS_{AIR} $[mm/1000\ passes]$
Sample G8	50	12.55	0.56
Sample G9	50	15.43	0.27

Graph 5.11[7]Graph 5.11Wheeltrack Test results. Samples G8 - G9. shows the evolution of deformation over the time for each sample.



Graph 5.11Wheeltrack Test results. Samples G8 - G9.

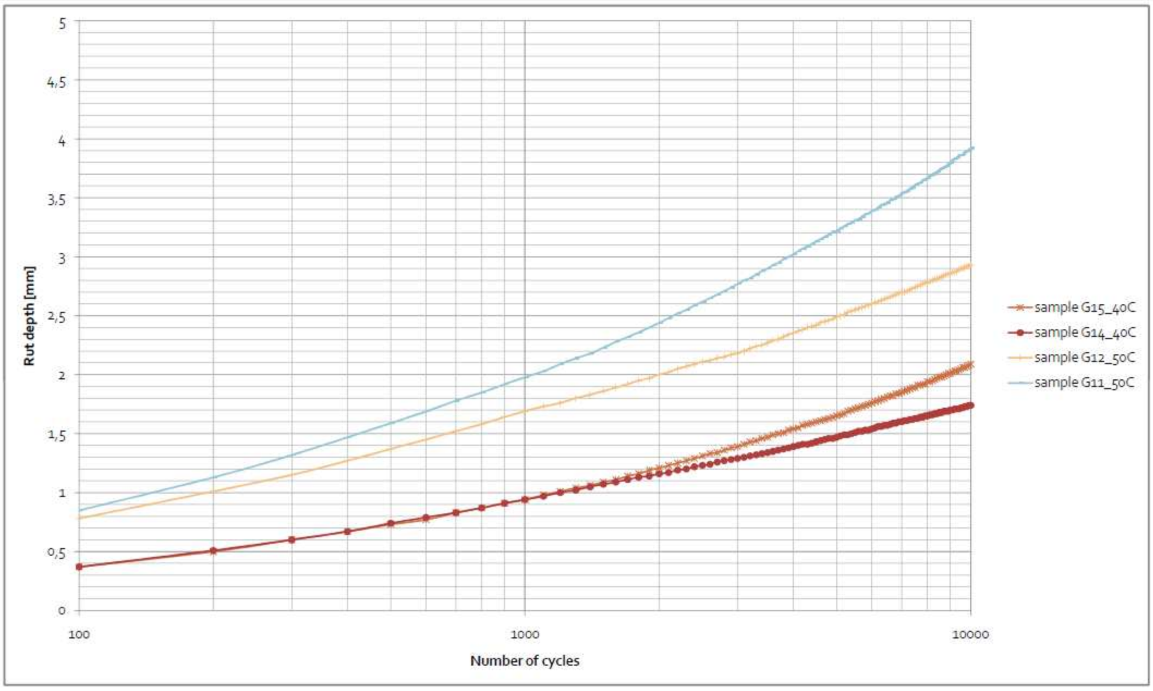
[7] The graph is represented in a different scale.

Samples G11 – G12, G14 – G15

Mixture	Ska 11
Receipt number	6209409

	Test Temperature [° C]	Sample Final Rut Depth [mm]	WTS_{AIR} [$mm/1000\ passes$]
Sample G11[8]	50	3.92	0.14
Sample G12	50	2.93	0.09
Sample G14	40	1.74	0.05
Sample G15[9]	40	2.09	0.09

Graph 5.12 shows the evolution of deformation over the time for each sample.



Graph 5.12 Wheeltrack Test results. Samples G11 - G12, G14 - G15.

[8] The mould utilized was not comply with the others, the sample thickness is 4,20 cm. Its behavior is indeed anomalous than the rest of the set. The sample will not be considered in future analysis.

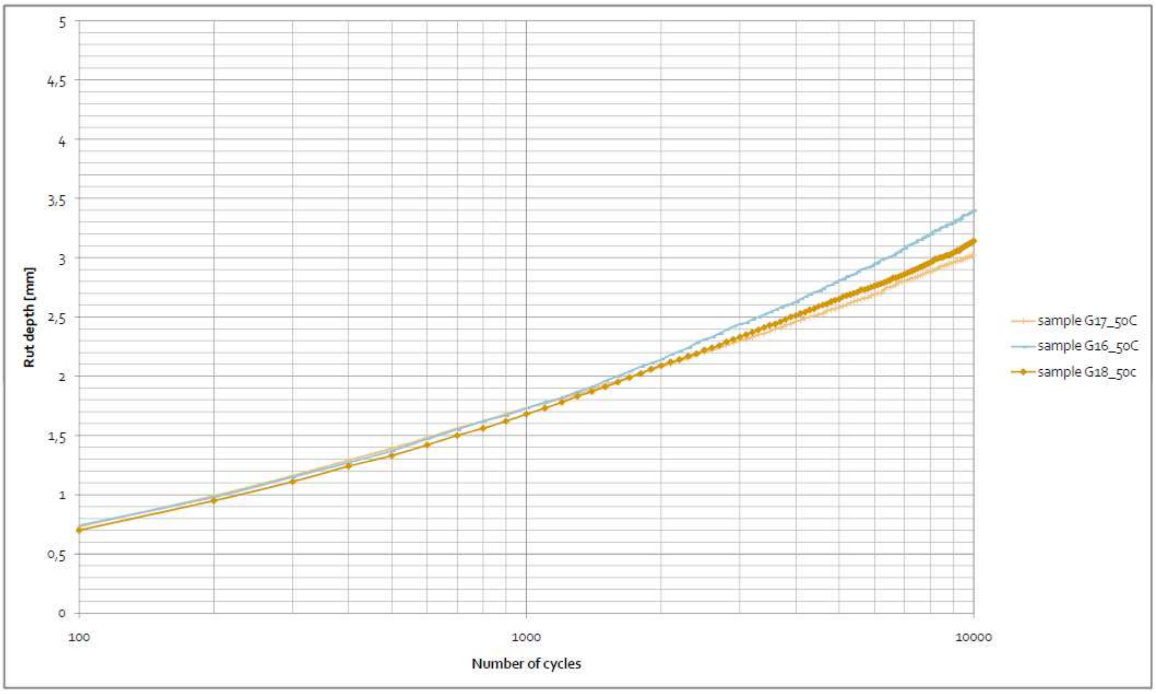
[9] The sample does not contain the required quantity of material. Its behavior is indeed anomalous than the rest of the set. The sample will not be considered in future analysis.

Samples G16 – G18

Mixture	Ab 11
Receipt number	10263302

	Test Temperature $[°\,C]$	Sample Final Rut Depth $[mm]$	WTS_{AIR} $[mm/1000\,passes]$
Sample G16	50	3.40	0.12
Sample G17	50	3.02	0.09
Sample G18	50	3.14	0.10

Graph 5.13 shows the evolution of deformation over the time for each sample.



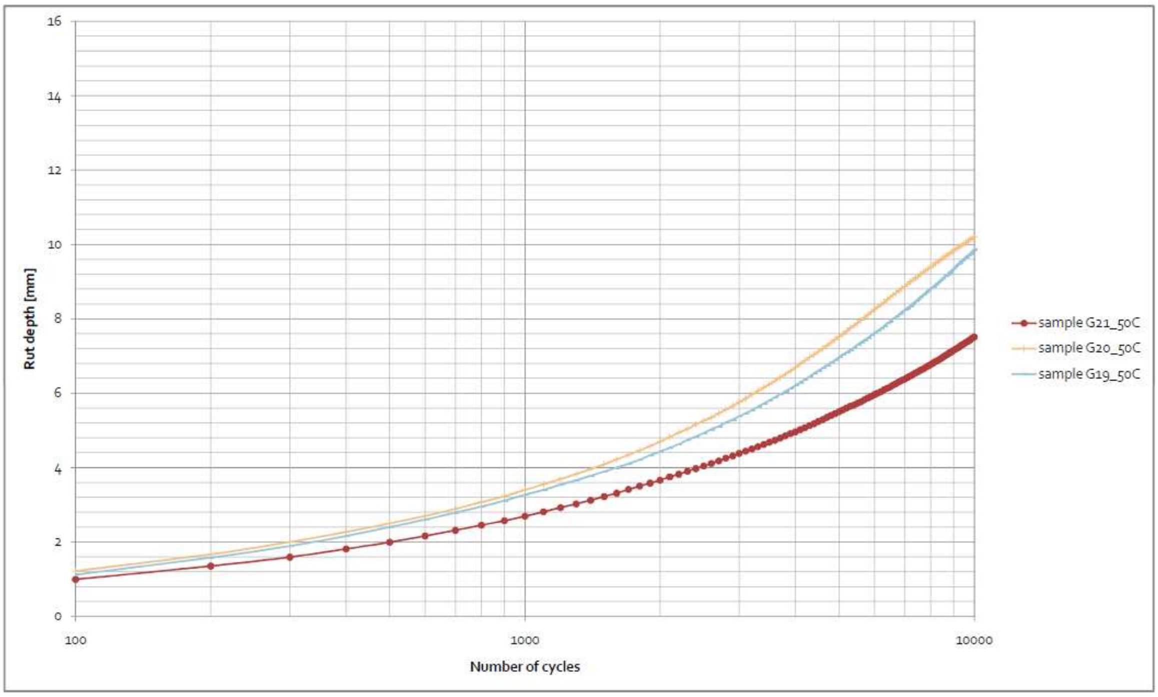
Graph 5.13 Wheeltrack Test results. Samples G16 - G18.

Samples G19 – G21

Mixture	**Agb11**
Receipt number	10321320

	Test Temperature $[°\,C]$	Sample Final Rut Depth $[mm]$	WTS_{AIR} $[mm/1000\,passes]$
Sample G19	50	9.87	0.58
Sample G20	50	10.20	0.54
Sample G21	50	7.51	0.40

Graph 5.14[10] shows the evolution of deformation over the time for each sample.



Graph 5.14 Wheeltrack Test results. Samples G19 - G21.

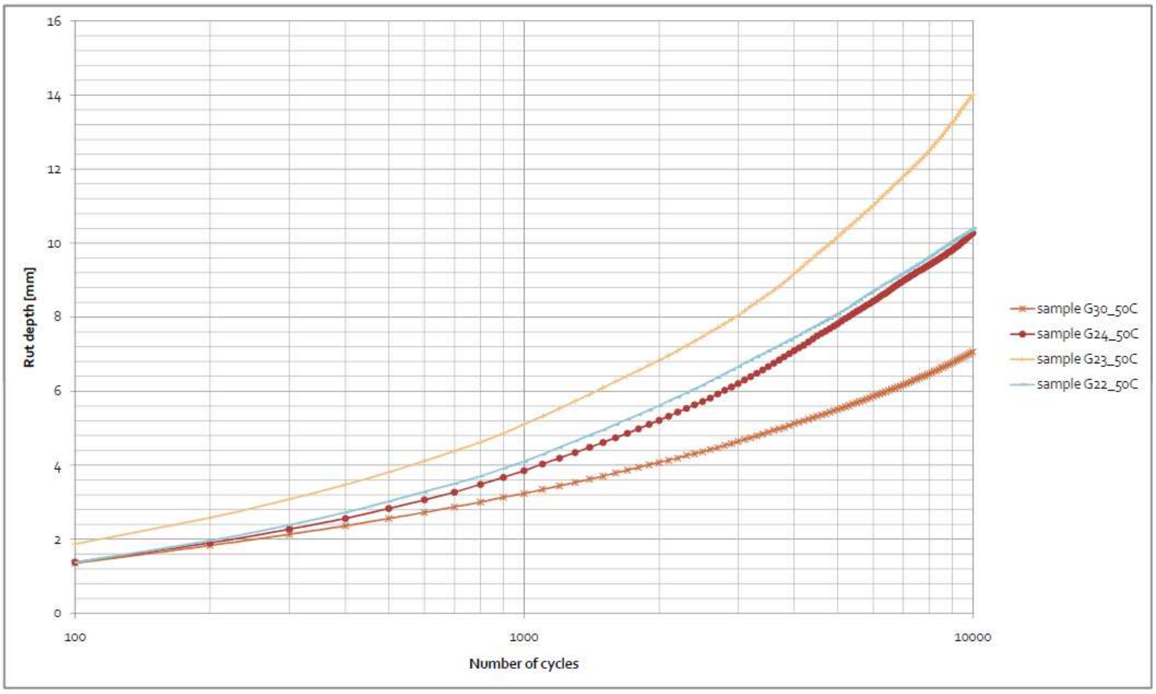
[10] The graph is represented in a different scale.

Samples G22 – G24, G30

Mixture	**Agb 16**
Receipt number	10321331

	Test Temperature $[° C]$	Sample Final Rut Depth $[mm]$	WTS_{AIR} $[mm/1000\ passes]$
Sample G22	50	10.40	0.46
Sample G23	50	14.00	0.77
Sample G24	50	10.27	0.49
Sample G30	50	7.06	0.31

Graph 5.15[11] shows the evolution of deformation over the time for each sample.



Graph 5.15 Wheeltrack Test results. Samples G22 - G24, G30.

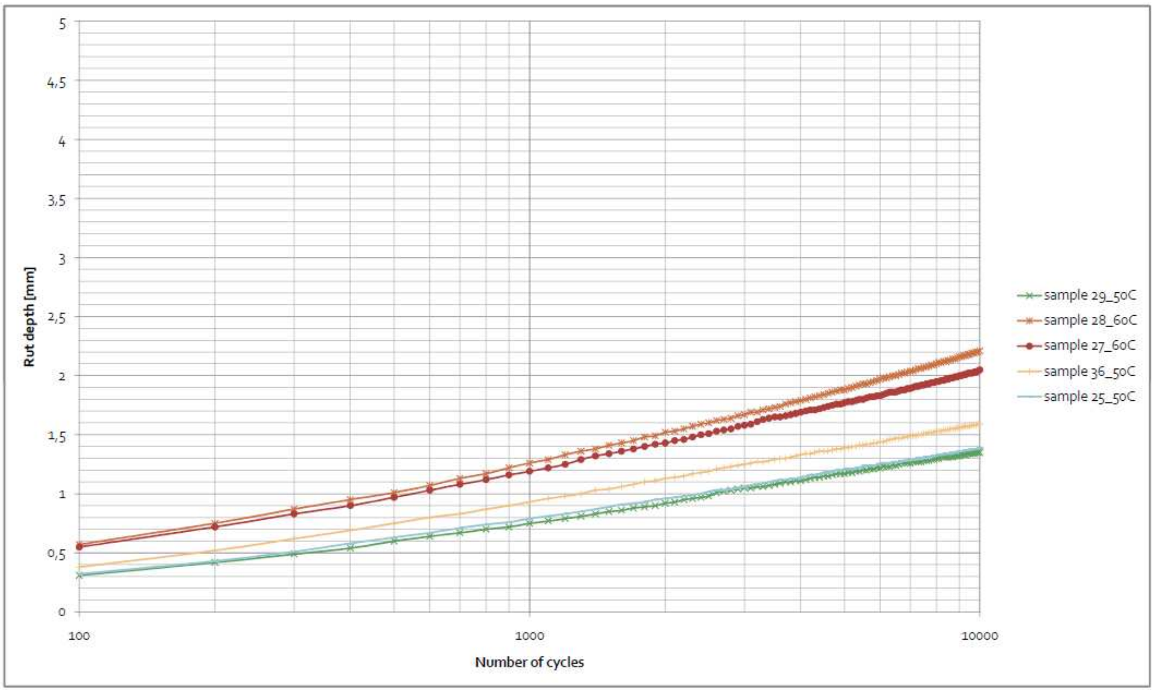
[11] The graph is represented in a different scale.

Samples G25 – G29

Mixture	**Ab 11 GIL**
Receipt number	8321125

	Test Temperature $[°C]$	Sample Final Rut Depth $[mm]$	WTS_{AIR} $[mm/1000\,passes]$
Sample G25	50	1.39	0.04
Sample G26	50	1.59	0.04
Sample G27	60	2.05	0.06
Sample G28	60	2.21	0.06
Sample G29	50	1.35	0.04

Graph 5.16 shows the evolution of deformation over the time for each sample.



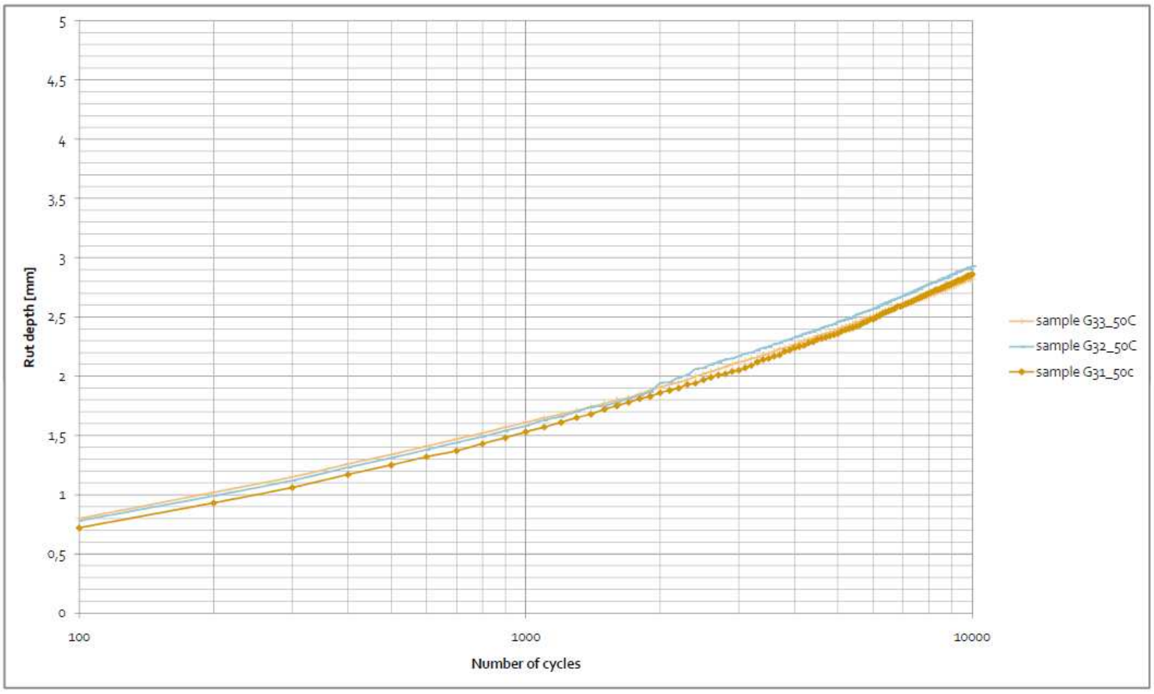
Graph 5.16 Wheeltrack Test results. Samples G25 - G29.

Samples G31 – G33

Mixture	**Ab 11 L**
Receipt number	10317127

	Test Temperature	Sample Final Rut Depth	WTS_{AIR}
	$[° C]$	$[mm]$	$[mm/1000\ passes]$
Sample G31	50	2.93	0.09
Sample G32	50	2.82	0.09
Sample G33	50	2.86	0.10

Graph 5.17 shows the evolution of deformation over the time for each sample.



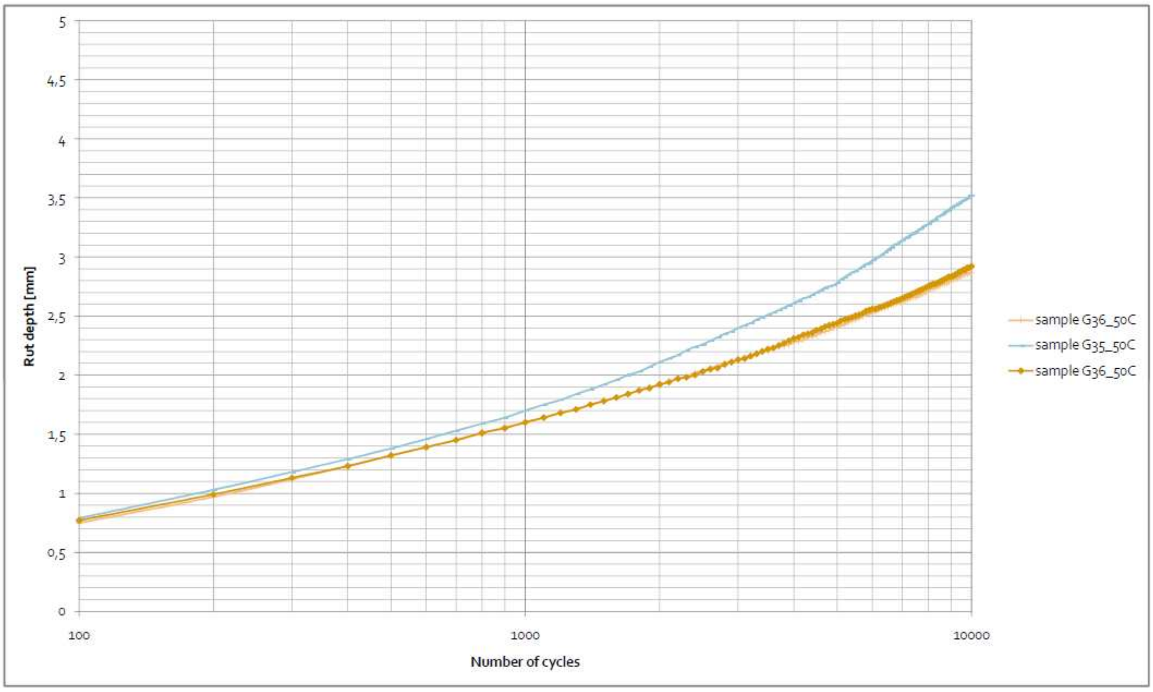
Graph 5.17 Wheeltrack Test results. Samples G31 - G33.

Samples G34 – G36

Mixture	**Ab 11 Grà**
Receipt number	10317124

	Test Temperature $[°C]$	Sample Final Rut Depth $[mm]$	WTS_{AIR} $[mm/1000\ passes]$
Sample G34	50	3.52	0.15
Sample G35	50	2.87	0.09
Sample G36	50	2.92	0.09

Graph 5.18 shows the evolution of deformation over the time for each sample.



Graph 5.18 Wheeltrack Test results. Samples G35 - G36.

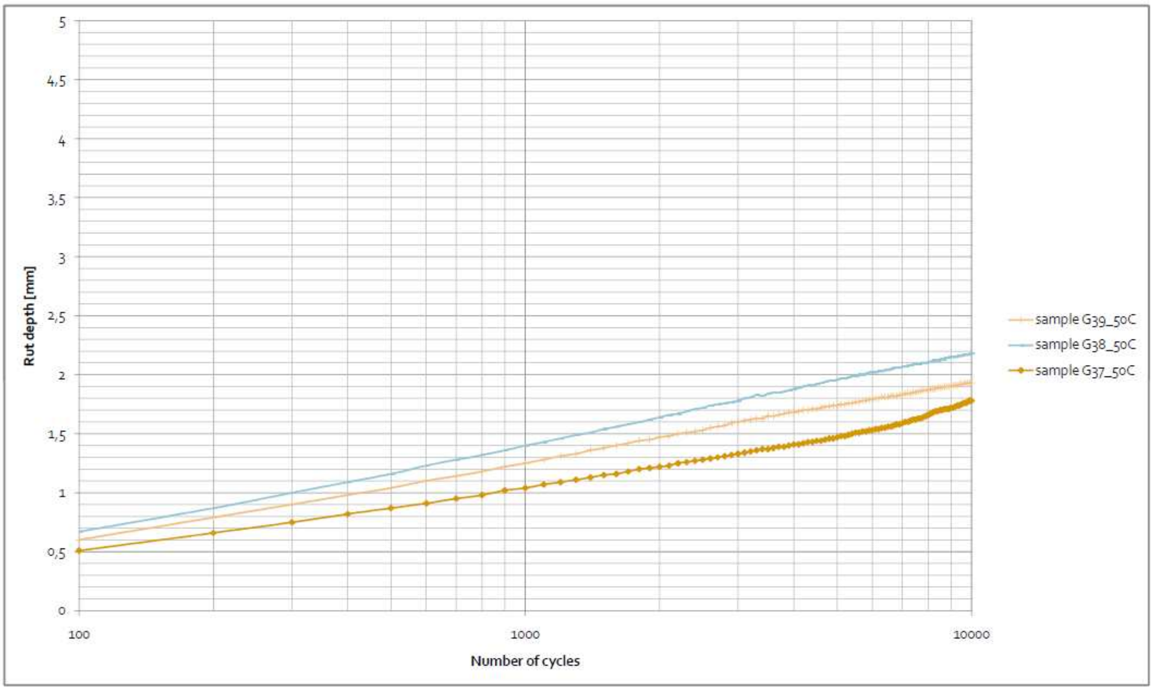
Samples G37 – G39

Mixture **Ab 11 Lp**

Receipt number 10317119

	Test Temperature $[°\,C]$	Sample Final Rut Depth $[mm]$	WTS_{AIR} $[mm/1000\,passes]$
Sample G37	50	2.18	0.04
Sample G38	50	1.93	0.04
Sample G39	50	1.78	0.06

Graph 5.19 shows the evolution of deformation over the time for each sample.



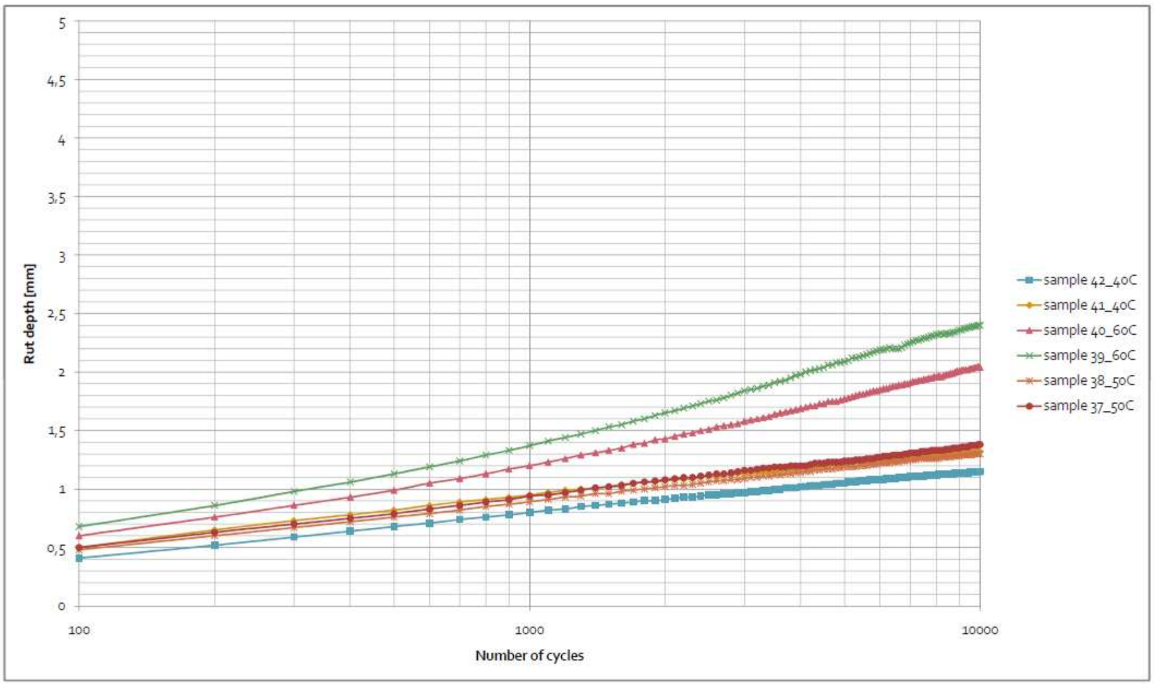
Graph 5.19 Wheeltrack Test results. Samples G37 - G39.

Samples 37 - 42

Mixture **Drenoval HM**

	Test Temperature $[° C]$	Sample Final Rut Depth $[mm]$	WTS_{AIR} $[mm/1000\ passes]$
Sample 37	50	1.38	0.03
Sample 38	50	1.30	0.02
Sample 39	60	2.40	0.06
Sample 40	60	2.04	0.05
Sample 41	40	1.32	0.02
Sample 42	40	1.15	0.02

Graph 5.20 shows the evolution of deformation over the time for each sample.



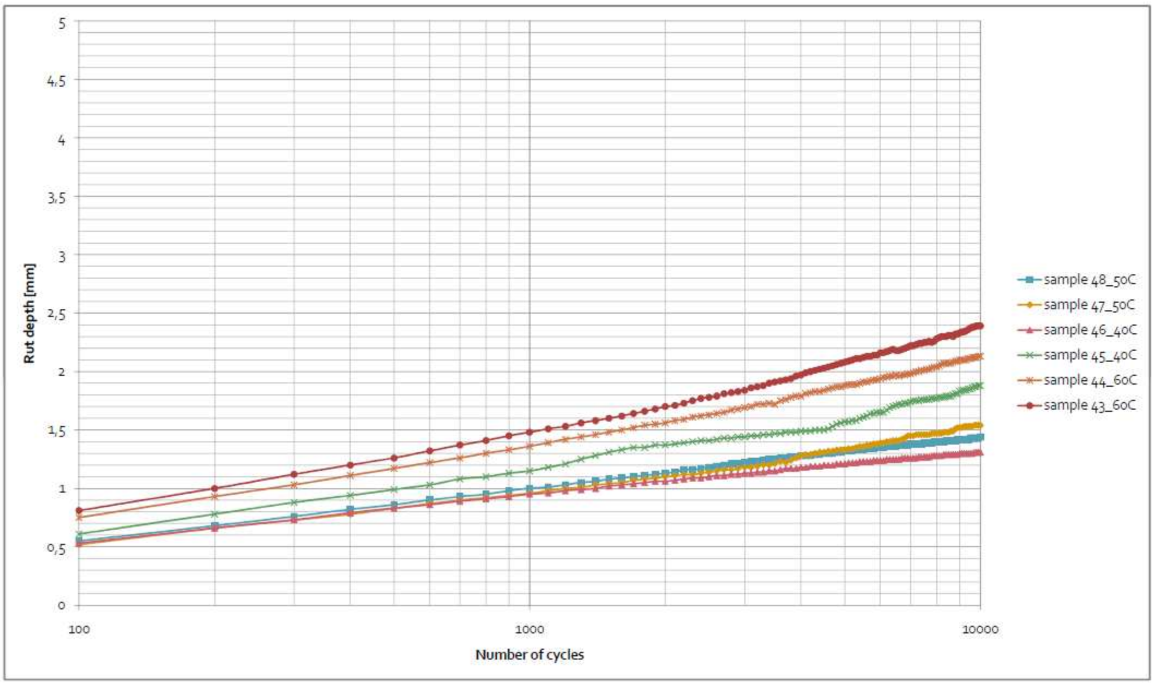
Graph 5.20 Wheeltrack Test results. Samples 37 - 42.

Samples 43 - 48

Mixture **Drenoval Hard M**

	Test Temperature $[°\,C]$	Sample Final Rut Depth $[mm]$	WTS_{AIR} $[mm/1000\,passes]$
Sample 43	60	2.39	0.06
Sample 44	60	2.13	0.05
Sample 45[12]	40	1.88	0.06
Sample 46	40	1.31	0.02
Sample 47	50	1.54	0.04
Sample 48	50	1.44	0.02

Graph 5.21 shows the evolution of deformation over the time for each sample.



Graph 5.21 Wheeltrack Test results. Samples 43 - 48.

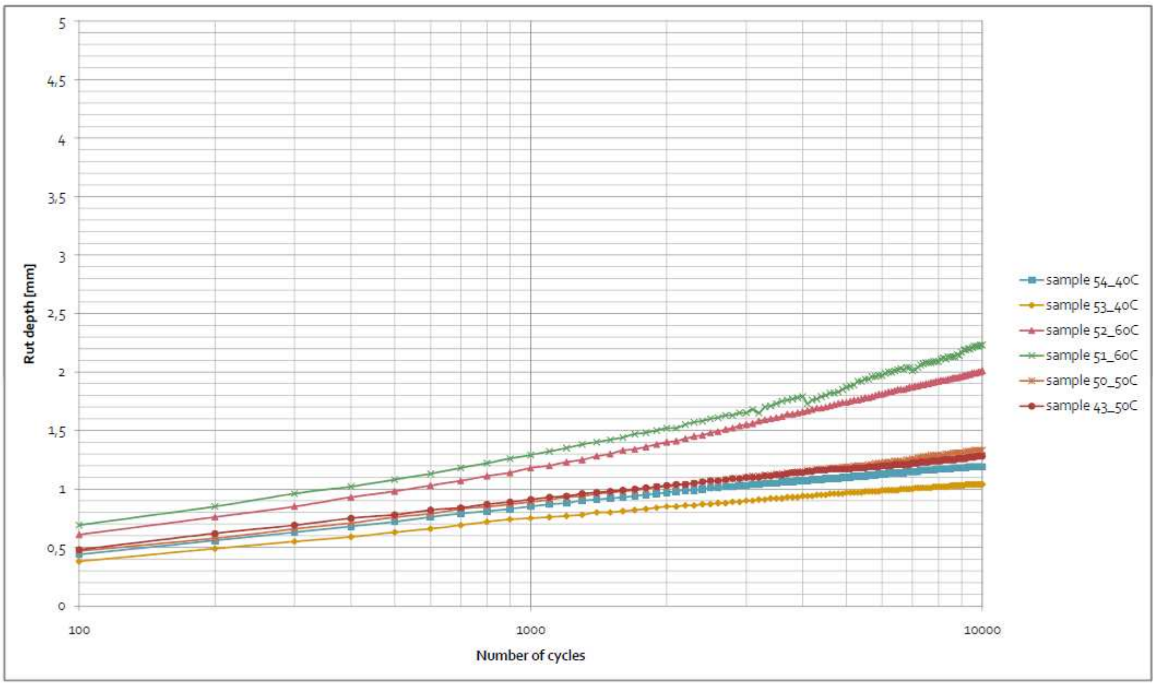
[12] *The mixture utilized was not homogeneous. Its behavior is indeed anomalous than the rest of the set. The sample will not be considered in future analysis.*

Samples 49 - 54

Mixture **Lowval HM 40**

	Test Temperature $[°\,C]$	Sample Final Rut Depth $[mm]$	WTS_{AIR} $[mm/1000\,passes]$
Sample 49	50	1.28	0.02
Sample 50	50	1.33	0.03
Sample 51	60	2.23	0.07
Sample 52	60	2.01	0.05
Sample 53	40	1.04	0.02
Sample 54	40	1.19	0.02

Graph 5.22 shows the evolution of deformation over the time for each sample.



Graph 5.22 Wheeltrack Test results. Samples 49 – 54.

In the following tables are resumed the test results grouping the results by the kind of mixture. then it have been calculated the average value.

The groups considered are:

- Ab 11 (Table 5.1);
- Ab 11 PmB (Table 5.2);
- Ab 11 other modifications (Table 5.3);
- Ab 16 PmB (Table 5.4);
- Agb 11 (Table 5.5);
- Agb 16 (Table 5.6);
- Ska 11 (Table 5.7);
- Ska 16 (Table 5.8);
- Drenoval HM (Table 5.9);
- Drenoval Hard M (Table 5.10);
- Lowval HM (Table 5.11).

The Agb groups have been distinguished from the Ab group even if they are both dense graded asphalt because of their high deformation values.

Ab 11

Recepit Number	Sample Number	Mixture	Testing Temperature [°C]	Final Rut Depth [mm]	Average Depth [mm]
82212000814	15	Ab 11	40	1,66	1,67
82212000814	16	Ab 11	40	1,68	
82212000814	13	Ab 11	50	3,07	5,12
82212000814	14	Ab 11	50	2,98	
10273302	G1	Ab 11	50	13,65	
10273302	G3	Ab 11	50	6,55	
10263302	G16	Ab 11	50	3,4	
10263302	G17	Ab 11	50	3,02	
10263302	G18	Ab 11	50	3,14	
82212000814	17	Ab 11	60	4,3	4,26
82212000814	18	Ab 11	60	4,21	

Table 5.1 Ab 11 mixtures: average rut depth value.

AB 11 Pmb

Recepit Number	Sample Number	Mixture	Testing Temperature [°C]	Final Rut Depth [mm]	Average Depth [mm]
82212001414	25	Ab 11 Pmb	40	1,11	1,09
82212001414	26	Ab 11 Pmb	40	1,23	
82212001014	21	Ab 11 Pmb	40	1,01	
82212001014	22	Ab 11 Pmb	40	1,02	
82212001414	9	Ab 11 Pmb	50	2,16	1,96
82212001414	10	Ab 11 Pmb	50	2,88	
82212001014	19	Ab 11 Pmb	50	1,35	
82212001014	20	Ab 11 Pmb	50	1,44	
82212001414	11	Ab 11 Pmb	60	2,25	2,01
82212001414	12	Ab 11 Pmb	60	2,32	
82212001014	23	Ab 11 Pmb	60	1,69	
82212001014	24	Ab 11 Pmb	60	1,76	

Table 5.2 Ab 11 Pmb mixtures: average rut depth value.

AB 11 others modifications

Recepit Number	Sample Number	Mixture	Testing Temperature [°C]	Final Rut Depth [mm]	Average Depth [mm]
8321125	G25	Ab 11 GIL	50	1,39	1,44
8321125	G26	Ab 11 GIL	50	1,59	
8321125	G29	Ab 11 GIL	50	1,35	
8321125	G27	Ab 11 GIL	60	2,05	2,13
8321125	G28	Ab 11 GIL	60	2,21	
10317127	G31	Ab 11 L	50	2,93	2,87
10317127	G32	Ab 11 L	50	2,82	
10317127	G33	Ab 11 L	50	2,86	
10317124	G34	Ab 11 Grà	50	3,52	3,10
10317124	G35	Ab 11 Grà	50	2,87	
10317124	G36	Ab 11 Grà	50	2,92	
10317119	G37	Ab 11 Lp	50	2,18	1,96
10317119	G38	Ab 11 Lp	50	1,93	
10317119	G39	Ab 11 Lp	50	1,78	

Table 5.3 Ab 11 mixtures with other modifications: average rut depth value.

AB 16 Pmb

Recepit Number	Sample Number	Mixture	Testing Temperature [°C]	Final Rut Depth [mm]	Average Depth [mm]
13143908	7	Ab 16 Pmb	40	1,53	1,31
13143908	8	Ab 16 Pmb	40	1,08	
13143908	3	Ab 16 Pmb	50	1,8	1,87
13143908	4	Ab 16 Pmb	50	1,94	
13143908	5	Ab 16 Pmb	60	2,06	2,05
13143908	6	Ab 16 Pmb	60	2,04	

Table 5.4 Ab 16 Pmb mixtures: average rut depth value.

AGB11

Recepit Number	Sample Number	Mixture	Testing Temperature [°C]	Final Rut Depth [mm]	Average Depth [mm]
06205205	35	Agb 11	40	2,28	2,17
06205205	36	Agb 11	40	2,05	
06205205	33	Agb 11	50	3,58	3,38
06205205	34	Agb 11	50	3,17	
10275202	G5	Agb 11	50	9,1	9,16
10275202	G6	Agb 11	50	7,87	
10275201	G7	Agb 11	50	11,07	
10275201	G10	Agb 11	50	8,48	
10321320	G19	Agb 11	50	9,87	
10321320	G20	Agb 11	50	10,2	
10321320	G21	Agb 11	50	7,51	

Table 5.5 Agb 11 mixtures: average rut depth value.

AGB16

Recepit Number	Sample Number	Mixture	Testing Temperature [°C]	Final Rut Depth [mm]	Average Depth [mm]
10275301	G8	Agb 16	50	12,55	11,62
10275301	G9	Agb 16	50	15,43	
10321331	G22	Agb 16	50	10,4	
10321331	G23	Agb 16	50	14	
10321331	G24	Agb 16	50	10,27	
10321331	G30	Agb 16	50	7,06	

Table 5.6 Agb 16 mixtures: average rut depth value.

Ska 11

Recepit Number	Sample Number	Mixture	Testing Temperature [°C]	Final Rut Depth [mm]	Average Depth [mm]
06209407	29	Ska 11	40	2,61	2,29
06209407	30	Ska 11	40	2,72	
6209409	G14	Ska 11	40	1,74	
6209409	G15	Ska 11	40	2,09	
6209409	G11	Ska 11	50	3,92	2,794
6209409	G12	Ska 11	50	2,93	
06209407	27	Ska 11	50	2,38	
06209407	28	Ska 11	50	2,31	
6209407	G13	Ska 11	50	2,43	
06209407	31	Ska 11	60	2,07	1,985
06209407	32	Ska 11	60	1,9	

Table 5.7 Ska 11 mixtures: average rut depth value.

Ska 16

Recepit Number	Sample Number	Mixture	Testing Temperature [°C]	Final Rut Depth [mm]	Average Depth [mm]
10279502	G2	Ska 16	50	2,25	2,67
10279502	G4	Ska 16	50	3,09	

Table 5.8 Ska 16 mixtures: average rut depth value.

Drenoval HM

Sample Number	Mixture	Testing Temperature [°C]	Final Rut Depth [mm]	Average Depth [mm]
41	Drenoval HM	40	1,32	1,235
42	Drenoval HM	40	1,15	
37	Drenoval HM	50	1,38	1,34
38	Drenoval HM	50	1,3	
39	Drenoval HM	60	2,4	2,22
40	Drenoval HM	60	2,04	

Table 5.9 Drenoval HM mixtures: average rut depth value.

Drenoval Hard M

Sample Number	Mixture	Testing Temperature [°C]	Final Rut Depth [mm]	Average Depth [mm]
45	Drenoval Hard HM	40	1,88	1,31
46	Drenoval Hard HM	40	1,31	
47	Drenoval Hard HM	50	1,54	1,49
48	Drenoval Hard HM	50	1,44	
43	Drenoval Hard HM	60	2,39	2,26
44	Drenoval Hard HM	60	2,13	

Table 5.10 Drenoval Hard HM mixtures: average rut depth value.

LOWVAL HM

Sample Number	Mixture	Testing Temperature [°C]	Final Rut Depth [mm]	Average Depth [mm]
53	Lowval HM 40	40	1,04	1,115
54	Lowval HM 40	40	1,19	
49	Lowval HM 40	50	1,28	1,305
50	Lowval HM 40	50	1,33	
51	Lowval HM 40	60	2,23	2,12
52	Lowval HM 40	60	2,01	

Table 5.11 Lowval HM mixtures: average rut depth value.

6 DISCUSSION OF TEST RESULTS

In this Chapter will be discussed the results of the tests carried out in the laboratory considering the effects of the parameters of the test, the components properties and the mixtures characteristics on their behavior. The results will be compared with each other to see how the variables interfere with the susceptibility of bituminous materials to deform if subjected to repeated passes of a loaded wheel at different temperature values.

6.1 Parameters of the test

6.1.1 Temperature

Test parameters have been adjusted before each test. Except the temperature of the test, the others as load, number of cycles, test conditions and samples dimensions were held constant for all samples as described in Table 4.1. Most of the samples were tested at three different temperature, 40°C, 50°C, 60°C, to better determine the increase in deformation due to an increase in ambient temperature while some only at the temperature of 50°C.

The different mixtures reacted differently to the increasing tests temperature, in particular, temperature affects the evolution of the deformation, in Graph 6.1, Graph 6.2 and Graph 6.3 are represented the three different behavior. The trend lines could have a linear (Graph 6.1), logarithmic (Graph 6.2) or exponential (Graph 6.3) trend.

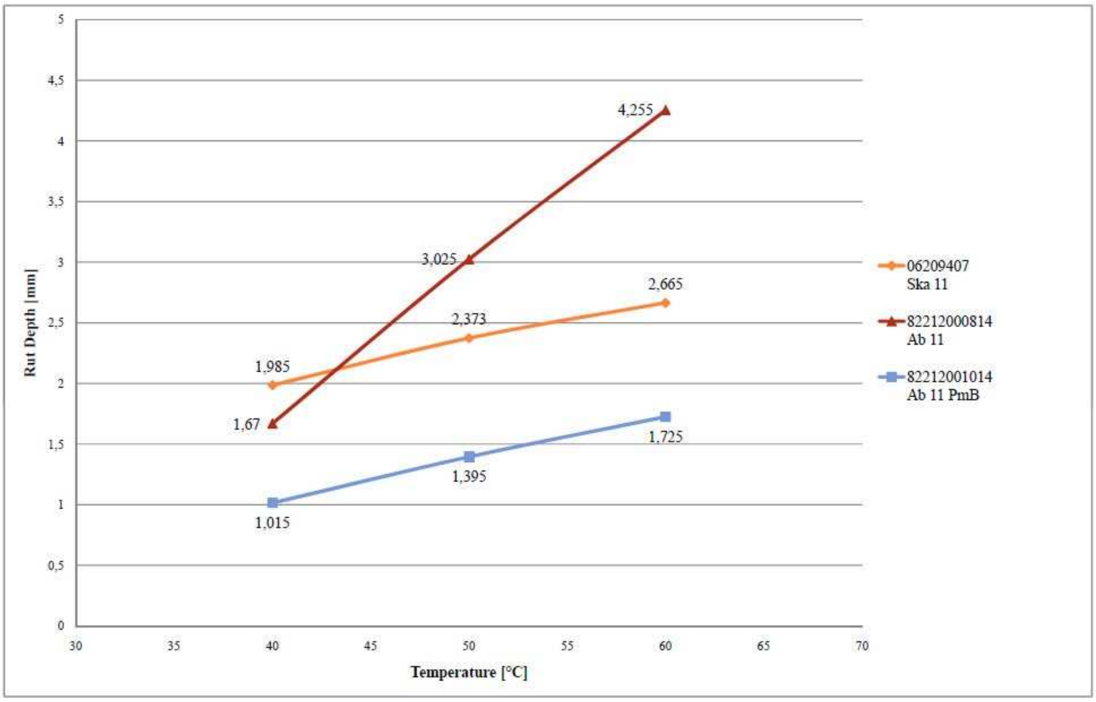
In the case of the linear trend, the relation between deformation and temperature is proportional and can be represented by the function

$$\varepsilon = a + bt\ .$$

Where

ε	is the deformation;
t	is the temperature;
a	is intercept;
b	is the slope.

The coefficient b, the slope, determines the steepness of the line, it is the ratio of change in y (rut depth) to change in x (temperature). This mixture behavior allows to easily estimate the value of deformation based on the value of temperature. In Table 6.1, there are the slopes values of the trend lines represented in Graph 6.1, belonging to three different mixtures: an Ab 11 Pmb (receipt n.82212001014) in blue, an Ab 11 (receipt n. 82212000814) in red and a Ska 11 (receipt n. 06209407) in orange. Therefore this behavior is not characteristic of a mixture.



Graph 6.1 Evolution of the rut depth depending on type of binder. Ab 11 PmB, receipt n.82212001014, in samples n. 19-24, Ab 11, receipt n. 82212000814, in samples n. 13-18 and Ska 11, receipt n. 06209407, in samples n. 27-32, G13.

Receipt n.	Mixture	Slope
82212001014	Ab 11 PmB	0.1293
82212000814	Ab 11	0.0355
06209407	Ska 11	0.034

Table 6.1 Slope of the trend lines represented in Graph 6.1

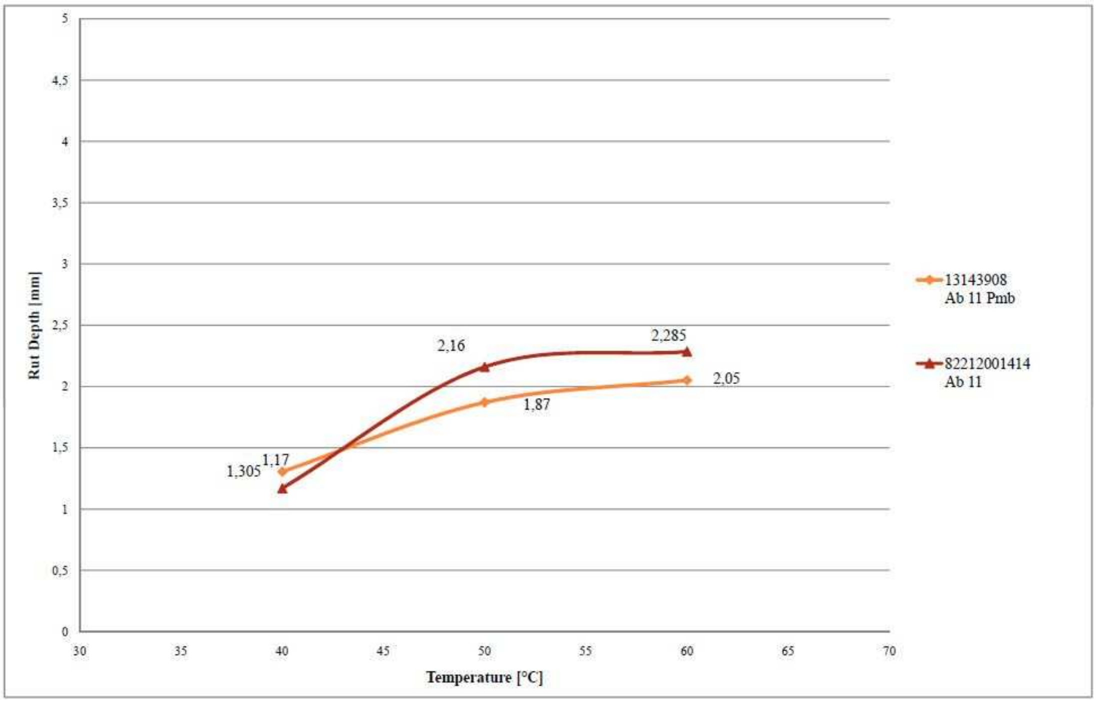
Graph 6.2 shows two examples of Ab 11 PmB (receipt n.13143908 in orange and receipt n. 82212001414 in red) with a logarithmic trend of the rut depth on temperature. This behavior reflects the function

$$\varepsilon = a + \log t.$$

Where

ε	is the deformation;
t	is the temperature;
a	is intercept.

The evolution of deformation on temperature is very steep for low temperature and, on the contrary, it is asymptotic when the pavement temperature increases. The rapid increase of deformation for low temperatures implies the inadequacy of the layer even for climates characterized by temperate summers.



Graph 6.2 Evolution of the rut depth depending on type of binder. Ab 16 PmB, receipt n.13143908 in samples n. 3-8 and Ab 11 PmB, receipt n. 82212001414 in samples n. 9-12,25-26.

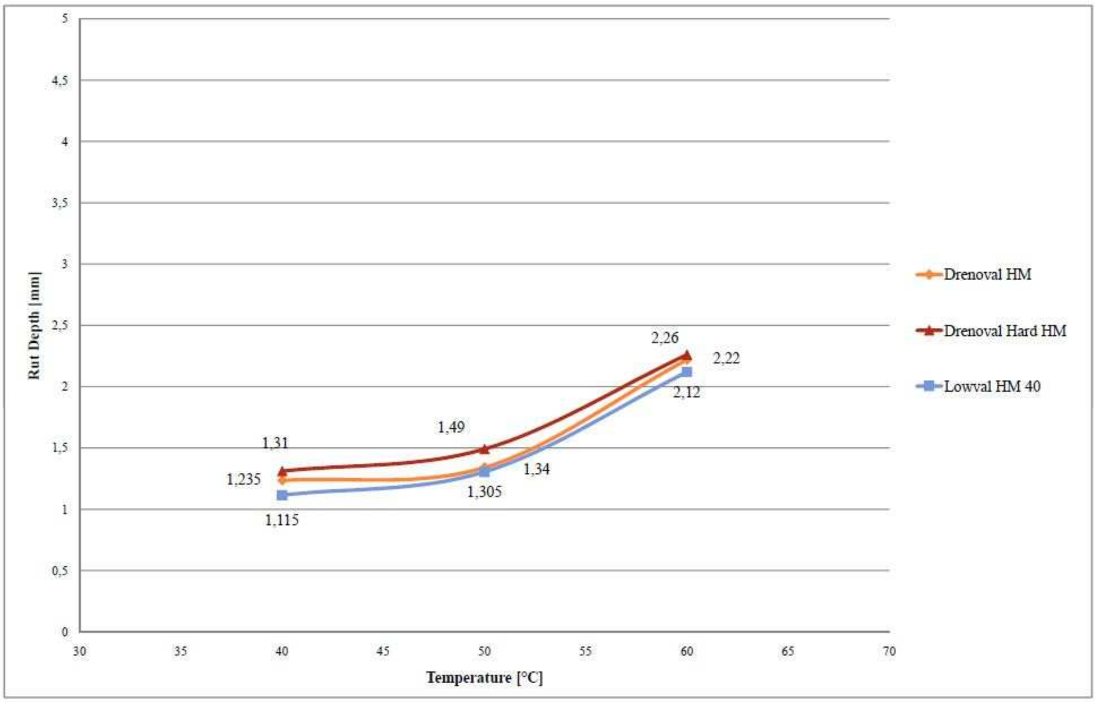
Exponential trends, as for the mixtures in Graph 6.3, instead, has an opposite behavior ruled by the function

$$\varepsilon = a + b^t$$

Where

ε	is the deformation;
t	is the temperature;
a	is intercept;
b	is the slope.

The deformation value is almost constant for temperature below 50°C and then increases rapidly with increasing heat, this implies a good resistance to medium - low temperatures. This behavior has been found in the Italian mixtures, Drenoval HM, Drenoval Hard M and Lowval HM 40. These mixtures are characterized by the same grading curve but different binders, even if all modified with the same polymer SBS.



Graph 6.3 Evolution of the rut depth depending on type of binder. Drenoval Hard M in samples n. 43-48, Drenoval HM in samples n. 37-42 and Lowval HM 40 in samples n. 49-54.

It is important to note that a certain behavior is not the typical result of a mixture in particular, only the exponential trends seems belonging just to the three Italian mixture. The behavior of the mixture subjected to an increase in temperature should influence the designer during the selection of the mixture taking into account the environmental condition of use.

6.2 Components properties

6.2.1 Aggregate

The asphalt behavior is highly influenced by the nature of the aggregate skeleton. Its characteristics determine most of the asphalt resistance to permanent deformation. During laboratory’s test it have been possible to analyze mixtures with same properties except the aggregate typology or grading curves characteristics. In the follow section will be compared the results of the Wheeltrack tests run on these samples to find how the mineral material has influenced the samples behavior.

The samples considered are an Ab 11, receipt n. 10263302, samples G16 – G18 and a Ska 16, receipt n. 10279502, samples G2,G4. Both the samples have been made using the same type of binder, a bitumen ViaFlex65, present with a content of 6.0 and 6.1%. The Ab 11 mixture is a dense grade asphalt, Table 6.2 describes its mineral components while in Table 6.3 are listed quantities of each fraction for the Ska 16 mixture, a stone mastic asphalt with an high coarse aggregate content.

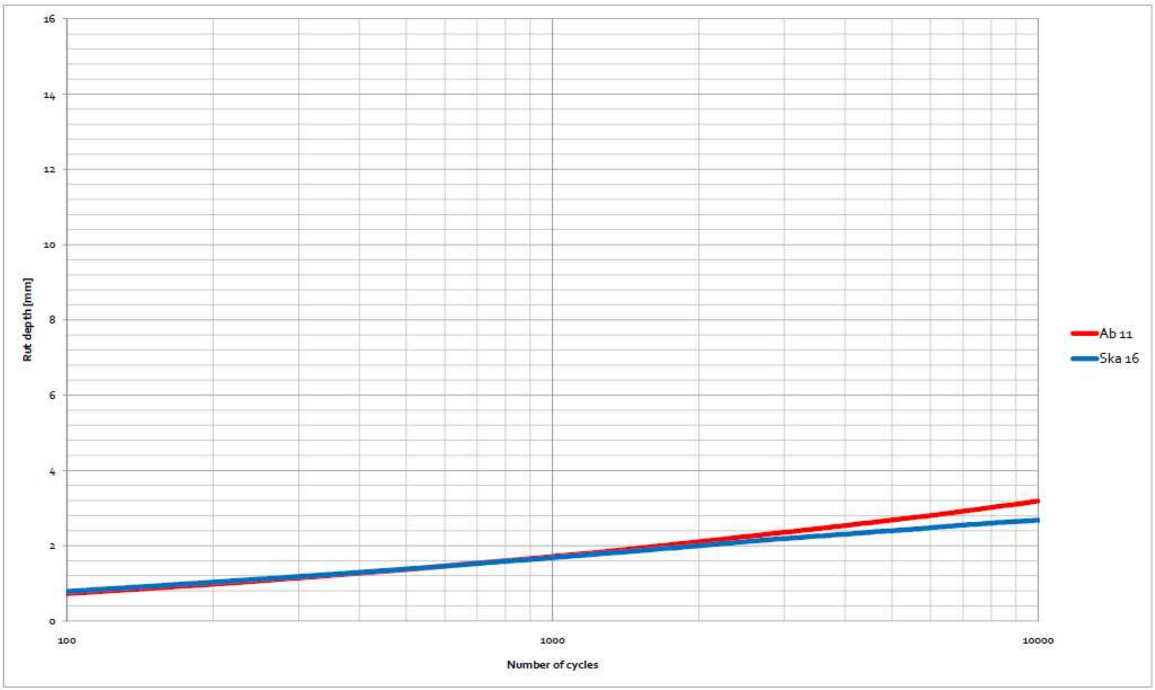
Mineral material	Fraction [mm]	Quantity in the mix [%]
Ottersbro	8 – 11	30.0
Ottersbro	4 – 8	20.0
Lauvåsen	0 – 4	15.0
Hembre	0 – 8	30.0
Hylla	filler	5.0

Table 6.2 Mineral material fractions in the Ab 11 mix, receipt n. 10263302.

Mineral material	Fraction [mm]	Quantity in the mix [%]
Ottersbro	11 – 16	50.0
Ottersbro	8 – 11	20.0
Vassfjell	0 – 4	16.0
Søberg	0 – 8	6.0
Hylla	filler	8.0

Table 6.3 Mineral material fractions in the Ska 16 mix, receipt n. 10279502.

Graph 6.4 represents the mean results for each set of samples subjected to the Wheeltrack test at 50°C. Although the mixtures are characterized by different grading curve, an dense graded mixture, Ab 11 in red (receipt n. 10263302), and a gap – graded asphalt, Ska 16 in blue (receipt n. 10279502), the behavior of their samples results almost similar and not distinguishable without a direct reference to the kind of mixture even if the Ska was supposed to have a better performance because of its stone skeleton that, providing an higher contact stone – on – stone than a dense graded asphalt, should have been more resistant against permanent deformation.



Graph 6.4 Rut depth according to the aggregates. Samples G16-G17-G18, Ab 11 receipt n. 10263302 and samples G2,G4, Ska 16 receipt n. 10279502.

The same rutting independence from the kind of aggregates fractions results from the comparison between the sets of tests G22 - G24,G30, Agb 16 receipt n. 10321331, and G19 – G21, Agb 11 receipt n. 10321320 both tested at a temperature of 50°C. The two mixtures have almost the same characteristics regarding the bitumen type and the mixture (Table 6.4). The difference between the two types of asphalt concrete consist in the grading curve (Table 6.5). The 1321331 mixture is characterized by the presence of aggregates of larger size (11 - 16) absent in the other where, instead, is higher the presence of aggregates of medium size.

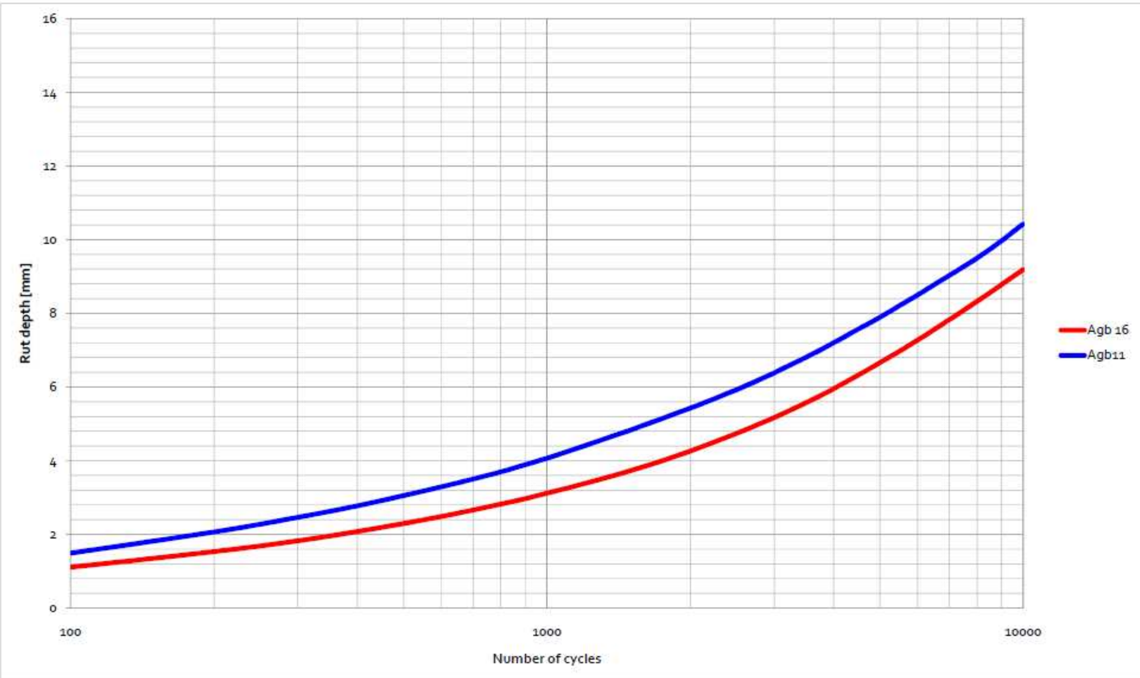
	10321331	**10321320**
Mixture	Agb 16	Agb 11
Bitumen type	160/220	160/220
Bitumen content	5.7	5.9
Air voids	4.5	4.5
Density	2.333	2.312

Table 6.4 Receipt n. 10321331 and receipt n. 10321320: mixtures characteristics.

	0.063	0.125	0.25	0.5	1.0	2.0	4.0	8.0	11.2	16.0	22.4	26.5
10321331 Agb 16	8	11	15	21	27	36	49	65	78	95	100	100
Δ	2.0	3.0	7.0	7.0	10.0	10.0	10.0	10.0	10.0	10.0	0.0	0.0
10321320 Agb 11	8	11	16	23	30	40	54	80	95	100	100	100
Δ	2.0	4.0	7.0	7.0	7.0	10.0	10.0	10.0	10.0	0.0	0.0	0.0

Table 6.5 Receipt n. 10321331 and receipt n. 10321320: grading curve.

Graph 6.5 represents the mean rut evolution of the different mixtures, in gray the evolution related to the mixture with a broader grading curve and in black the other. Table 6.6 shows the final mean results. The mean slope of the deformation curve can be considered equal, and the difference in deformation is less than 1 mm, much lower than the range of values where there are the results of samples belonging to the same set ($\pm 1.18\ mm$ and $\pm 3.47\ mm$).



Graph 6.5 Rut depth according to the aggregates. Samples G22 - G24,G30, receipt n. 10321331, and samples G19 – G21, receipt n. 10321320.

	Test Temperature $[°\,C]$	Mean Final Rut Depth $[mm]$	$WTS_{AIR,\ mean}$ $[mm/1000\,passes]$
10321331 Agb 16	50	10.43	0.507
10321320 Agb 11	50	9.19	0.508

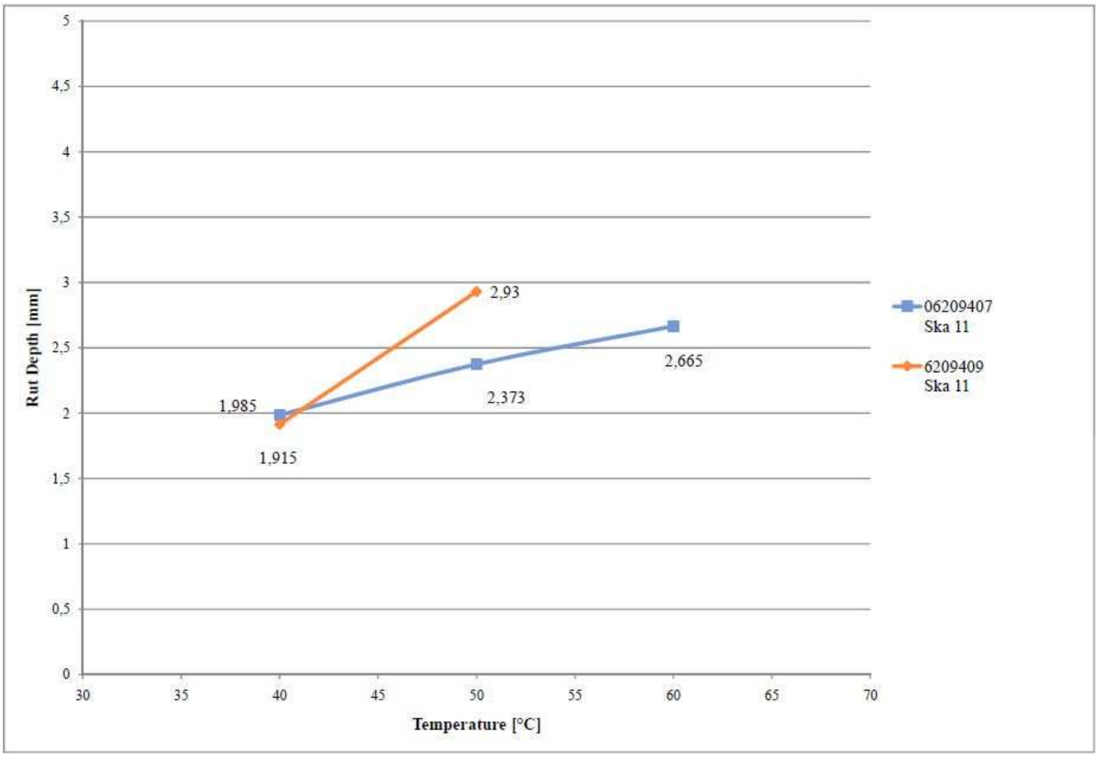
Table 6.6 Receipt n. 10321331 and receipt n. 10321320: mean Wheeltrack test results.

These two examples reported in the previous lines refer about a not direct influence of the aggregates grading curve on the behavior of samples subjected to the passage of a loaded wheel.

6.2.2 Bitumen

The performance of a bituminous mixtures depends from the type of bitumen utilized. There is a high difference between the use of not – modified and modified binders but also among the traditional (not - modified) because of their mechanical properties. In the following section will be discussed the results given by different traditional binders and by the difference between modified and not. In both the cases, the mixtures have aggregates with the same characteristics.

Graph 6.6 represents the evolution of the rut depth of samples made of two Ska 11 mixtures. The first set of samples, 27-32, G13, receipt n. 06209407 has as binder a bitumen with a penetration grade 50/70, tendentially hard present in the mixture with a percentage of 6.40%; the second set, samples n. G11-G15, receipt n. 06209409 is contains a typical bitumen 70/100 with a percentage of 5.90%. Even if the second set has been tested only at 40°C and 50°C, and the second also at 60°C, their behavior results very different. In the graph are reported the mean value between the samples tested simultanously. At low temperature, 40°C, the rut depth has almost the same value (1.985 mm in the first set and 1.915 mm in the second set). In the following results there is a large gap between the results: 2.373 mm against 3.425 mm. The hardness of the bitumen strongly influenced the results. In fact, the two mixtures differs only in the type of bitumen and in its content. It is possible to predict a future poor performance of mixtures containing softer binder.



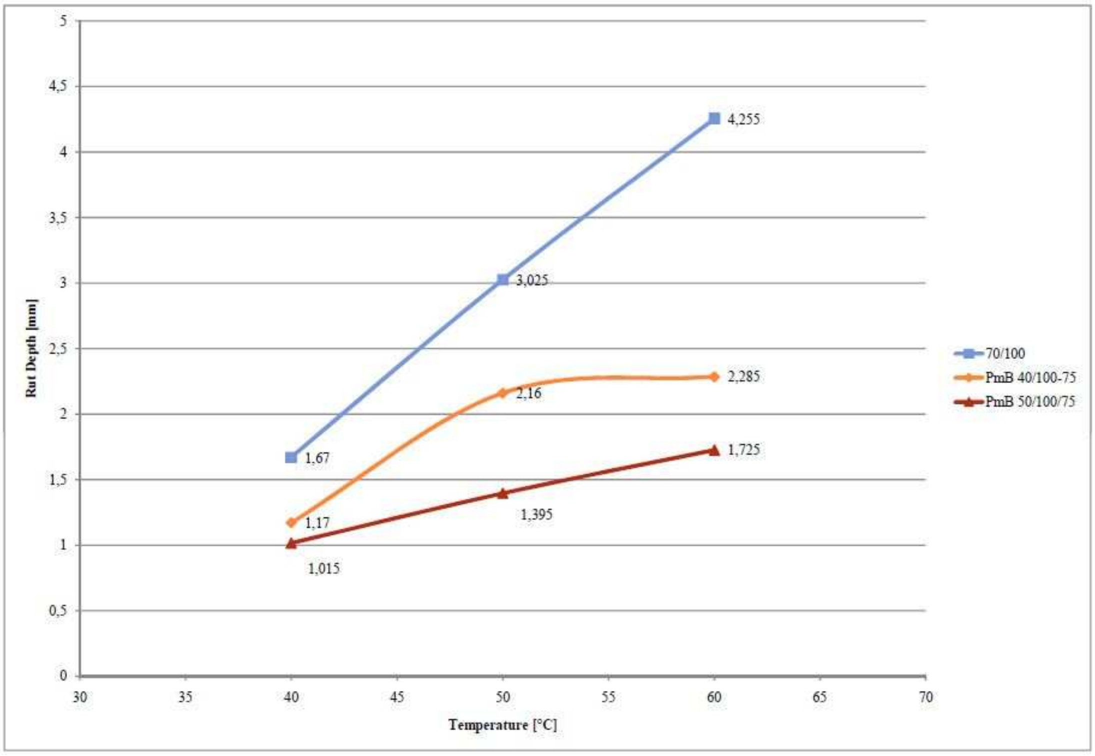
Graph 6.6 Evolution of the rut depth depending on type of binder. The Ska 11 mixtures (blue) contain a bitumen 50/70 in samples 27-32,G13, receipt n. 06209407 and a bitumen 70/100 (orange) in samples G11-G15, receipt n. 06209409.

The introduction of binders modified with polymers is due to the important role played by binders in the mixture behavior. It is possible to demonstrate it from the results of some Wheeltrack tests. Have been taken into account three mixtures produced from the same company (NCC Roads AS) with receipt n. 82212000814, 82212001414, 82212001014. These mixtures have the same characteristics (shown in the example receipt Figure 4.4) except the type of bitumen: it is a traditional Ab 11 in the mixture with receipt n. 82212000814, instead it is a polymer modified bitumen in the others. Table 6.7 shows, for each set of mixtures, the type of bitumen and the Wheeltrack test results at 40°C, 50°C and 60°C.

Receipt n.	Mixture	Bitumen	40°C	50°C	60°C
82212000814	Ab 11	70-100	1,67	3,025	4,255
82212001414	Ab 11 Pmb	PmB 40/100-75	1,17	2,52	2,285
82212001014	Ab 11 Pmb	PmB 50/100/75	1,015	1,395	1,725

Table 6.7 Wheeltrack test results depending on type of bitumen.

As it is possible to deduce form the table, the not – modified bitumen has determined a worse behavior than the others with an increase of the deformation from 155% at 40°C to 212% at 60°C, considering the mean value between the modified mixtures. In Graph 6.7 are represented trend lines of the Ab 11 mixtures, they show graphically the difference among the mixtures.



Graph 6.7 Evolution of the rut depth depending on type of binder. The Ab 11 mixtures contains traditional bitumen 70-100 (blue) utilized in samples n. 13-18 (Receipt n. 82212000814), modified Bitumen PmB 40/100-75 (orange) utilized in samples n. 9-12, 25-26 (Receipt n. 82212001414) and PmB 50/100/75(red) in samples n. 19-24 (Receipt n. 82212001014).

6.3 Mixtures characteristics

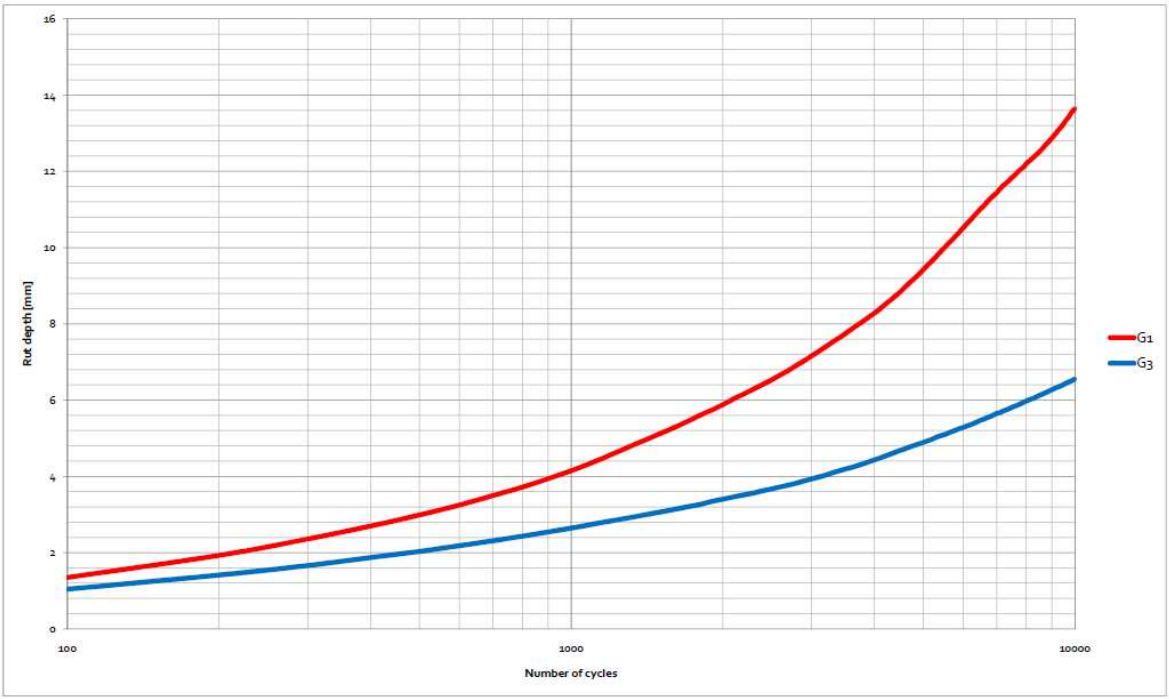
6.3.1 Air voids content

The air voids content plays an important role in the permanent deformation resistance. Samples G1 and G3 are made of the same mixture Ab 11 (receipt n. 10273302) and have almost the same mass:

		G1	G3
Weight of the mould	[g]	8922	9649
Weight of the mould + asphalt mass	[g]	17928	18646
Weight of the asphalt mass	[g]	**9006**	**8997**

The difference between the two samples consists in their volume, G1 has a thickness of 4,20 cm instead of 4,00 cm. This difference in volume of the 4.74% has repercussions on the mixtures behavior (Graph 6.8). Sample G1 tested with the Wheeltrack device at 50°C had a deformation of 13.65 mm on the other side, sample G3 tested at the same temperature had a deformation of 6.35 mm. A difference of the 47.9%.

The anomaly is also reflected by the results of the tests to determine the bulk density and voids characteristics (Table 6.8). Both the sides of the samples G1, have a lower bulk density, ρb, than G3A and G3B: a mean value of 2.380 kg/m^3 against 2.470 kg/m^3 this value implies a less percentage mass in the volume. From the voids characteristics of the mixture is shown an higher content of voids in the mineral aggregate (a mean value of 17.867 %v/v against 14.765 %v/v) and a lower value of voids filled with bitumen (a mean value of 72.776 %v/v against 91.235 %v/v).



Graph 6.8 Wheeltrack Test results. Samples G1,G3.

Ab 11_Receipt n. 10273302

Sample		G1A	G1B	G3A	G3B
m1	[g]	2698,7	2796,8	3564,3	3481,4
m2	[g]	1582,3	1628,0	2129,5	2081,3
m3	[g]	2705,3	2811,0	3569,7	3488,2
Tw	[°C]	19,00	19,00	21,00	21,00
γw		0,998	0,998	0,998	0,998

ρm	**[kg/m^3]**	2,502	2,502	2,502	2,502
ρb	**[kg/m^3]**	2,399	2,360	2,470	2,469
Vm	**[%v/v]**	4,109	5,664	1,287	1,301
B	**[%]**	6,00	6,00	6,00	6,00
ρB	**[kg/m^3]**	1,10	1,10	1,10	1,10
VMA	**[%v/v]**	17,196	18,538	14,759	14,771
VFB	**[%v/v]**	76,104	69,449	91,278	91,192

Table 6.8 Samples G1, G3: bulk density and air voids characteristics.

Considering the mean value of rutting deformation of all the others samples made of a similar mixture Ab 11 (Table 6.9), the sample G1 had, at the temperature of 50°C a much higher deformation than the samples 17-18, receipt n. 82212000814, tested at 60°C.

Receipt n.	40°C	50°C	60°C
82212000814	1,67	3,025	4,255
G1		13,65	
10263302		3,21	

Table 6.9 Mixtures Ab 11: mean rut depth.

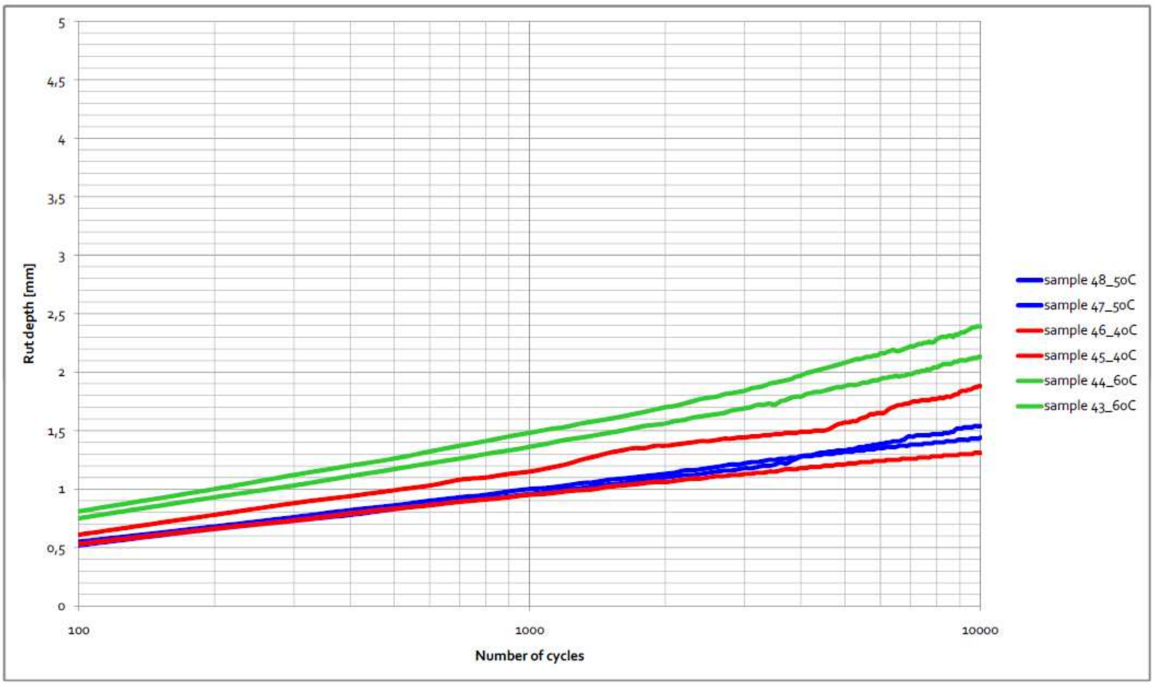
The air voids content proves to be a determining factor respect to the behavior of the mixture. An higher content of voids implies an higher susceptibility of the pavement to deformation is subjected to a moving load at high temperature.

6.3.2 Homogeneity

Some of the Wheeltrack test results could be affected from production errors. Besides the discordance due to the different internal dimensions of some moulds (samples G1, G4 and G15), probably there have been some errors in the preparation of few samples as in the case of sample n. 45. This mistake has negatively affected the results of the test (Table 6.10). Graph 6.9 shows its behavior, where the red lines represent the evolution of deformation of the samples tested simultaneously at 40°C. Samples 45th behavior differs from ordinary, its behavior is almost between that one of samples tested at 50°C (in blue) and that one of samples tested at 60°C (in green). This behavior is due to a not homogeneous mixing. During the preparation of the sample n. 45, the mixtures was not homogeneous, a certain amount of aggregates were not properly covered by the bitumen.

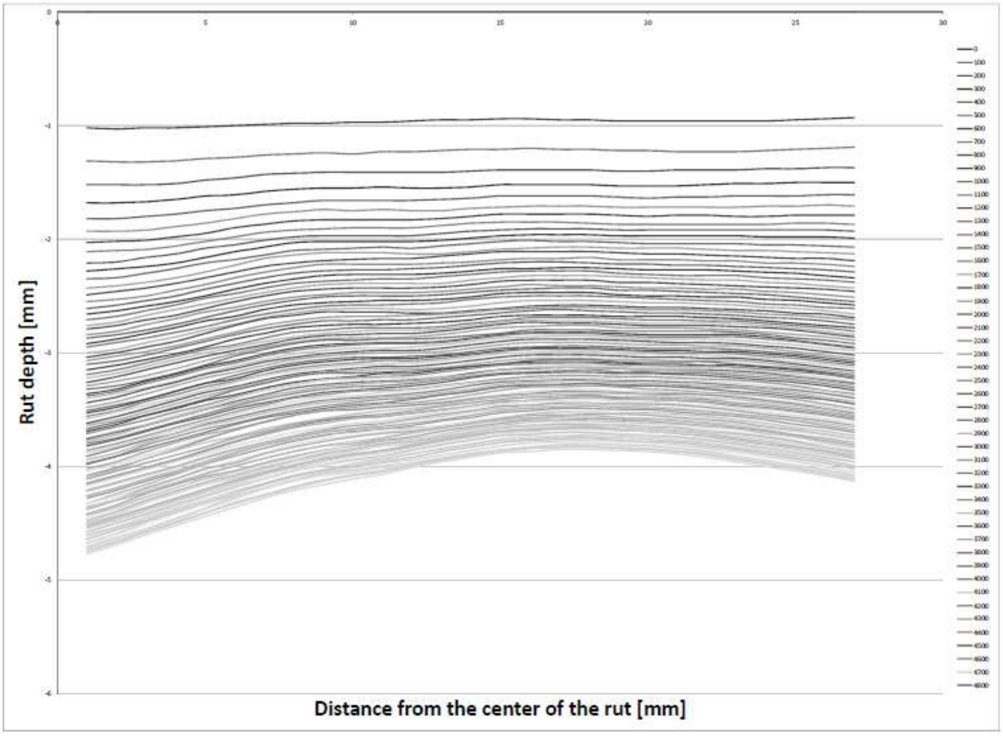
Drenoval Hard M	Test Temperature [$° C$]	Sample Final Rut Depth [mm]	WTS_{AIR} [$mm/1000\ passes$]
Sample 43	60	2.39	0.06
Sample 44	60	2.13	0.05
Sample 45	40	1.88	0.06
Sample 46	40	1.31	0.02
Sample 47	50	1.54	0.04
Sample 48	50	1.44	0.02

Table 6.10 Wheeltrack test results, samples 43-48 mixture Drenoval Hard M.

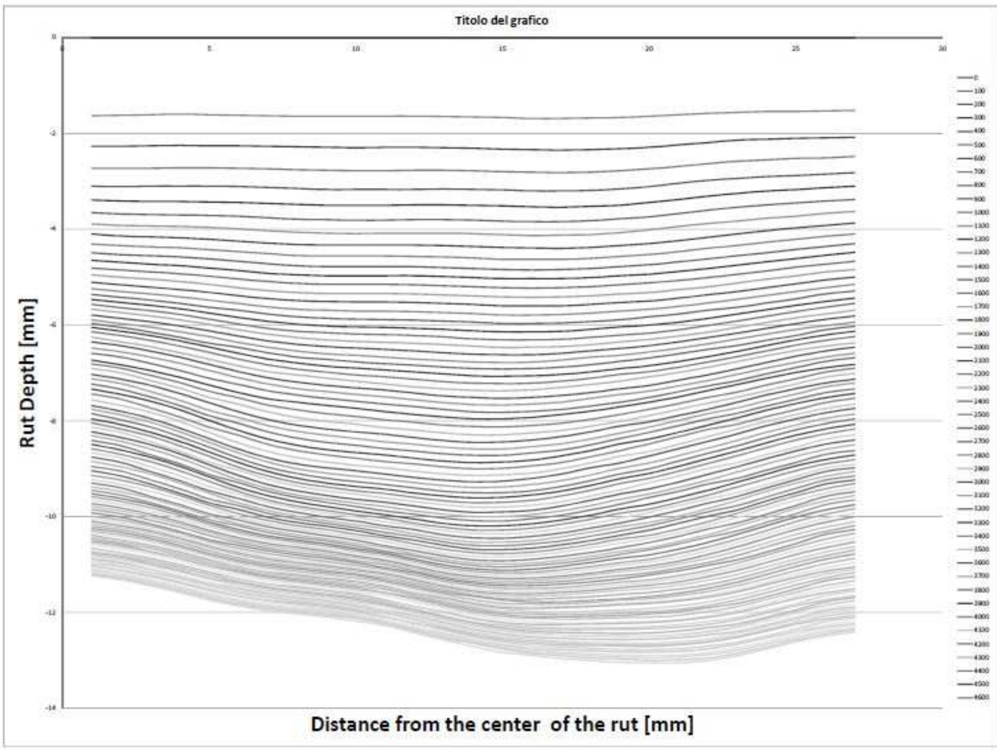


Graph 6.9 Wheeltrack Test results. Samples 43 - 48. Comparison between the evolution hot he deformation of the 45th sample (in green) and the 46th sample (in red) both tested at 40°C.

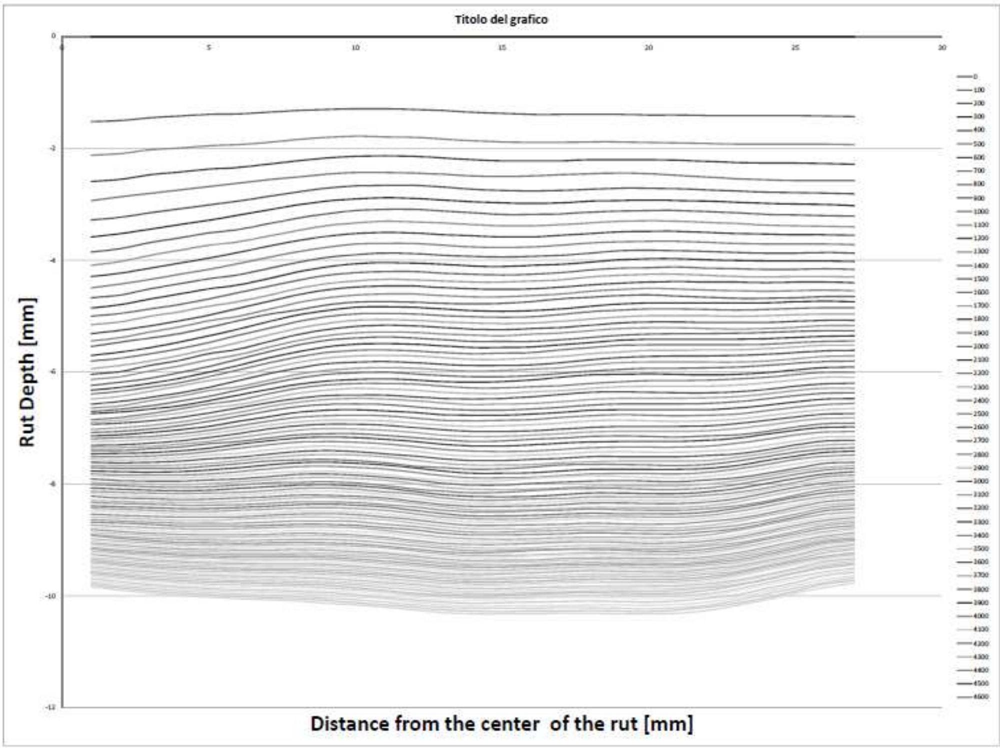
The mould fixing phase is also very important in fact, it is possible to influence the test performance even if the material was not correctly distributed in the mould. Among Graph 6.10, Graph 6.11 and Graph 6.12, belonging to sample 18, G8 and G24, it is possible to recognize a different trend of the sample longitudinal profile. Sample 18 probably has a segregation of aggregates in the central part because of the downward concavity. An aggregate segregation also occurred in sample n. G8 but, in this case, the stone material is mostly present on the edges of the mould. Instead, sample n G24 has an almost linear and correct profile. Hence, a not correct installation of a pavement layer can highly influence the structure behavior toward permanent deformation.



Graph 6.10 Sample18 tested at 60°C, longitudinal profile.



Graph 6.11 Sample G8 tested at 50°C, longitudinal profile.



Graph 6.12 Sample G24 tested at 50°C, longitudinal profile.

6.4 Data result analysis

After the analysis of the results, it was considered appropriate to recast the data in order to understand how the results are likely behavioral predictions of asphalt materials subject to Wheeltrack testing. In the following paragraphs will be first studied in deep the bitumen influence in relation to the ability to achieve a set deformation through a data regression analysis. Then will be considered the variation of volumetric characteristics of the samples after the test on the theoretical initial ones referring to minimum, maximum and average value. For these valuation samples will be grouped according to the kind of binder utilized whereas the above considerations have revealed a not direct influence between the grading curve and the rutting resistance.

6.4.1 Binder behavior as a function of temperature

In paragraph 6.2.2 has emerged a clear behavioral difference between samples containing a traditional binder and samples with a modified binder, in particular not modified mixtures had a worse performance than the others.

To simplify the comparison between the results obtained, it is necessary to assume that all samples have reached the same strain. If it was possible to continue testing for an unlimited time, as the mixture is enclosed within the mould, it would have not been possible to estimate the number of cycles of the live load necessary to reach a shear break. Therefore, considering the sample thickness of $40\ mm$ and the maximum size of the aggregates, is taken as the maximum strain value $5\ mm$ (12.5% on the thickness).

For samples in which the limit ($5\ mm$) has not been reached, the necessary number of cycles has been determined using logarithmic and potential models, calculated through a spreadsheet. Graph 6.13 and Graph 6.14 show respectively the logarithmic and potential model projections (in blue) for sample n.3 in a logarithmic graph (in red there are the experimental results). For each model have been determinated the characteristic regression equation. During the test the sample reached a rut depth of 1.8 mm, to determine the number of cycles needed to reach the limit strain, the logarithmic and potential equation have been solved as in Table 6.11, imposing $y = 5mm$.

The logarithmic model reflects the function:

$$y = a + \log x.$$

Where

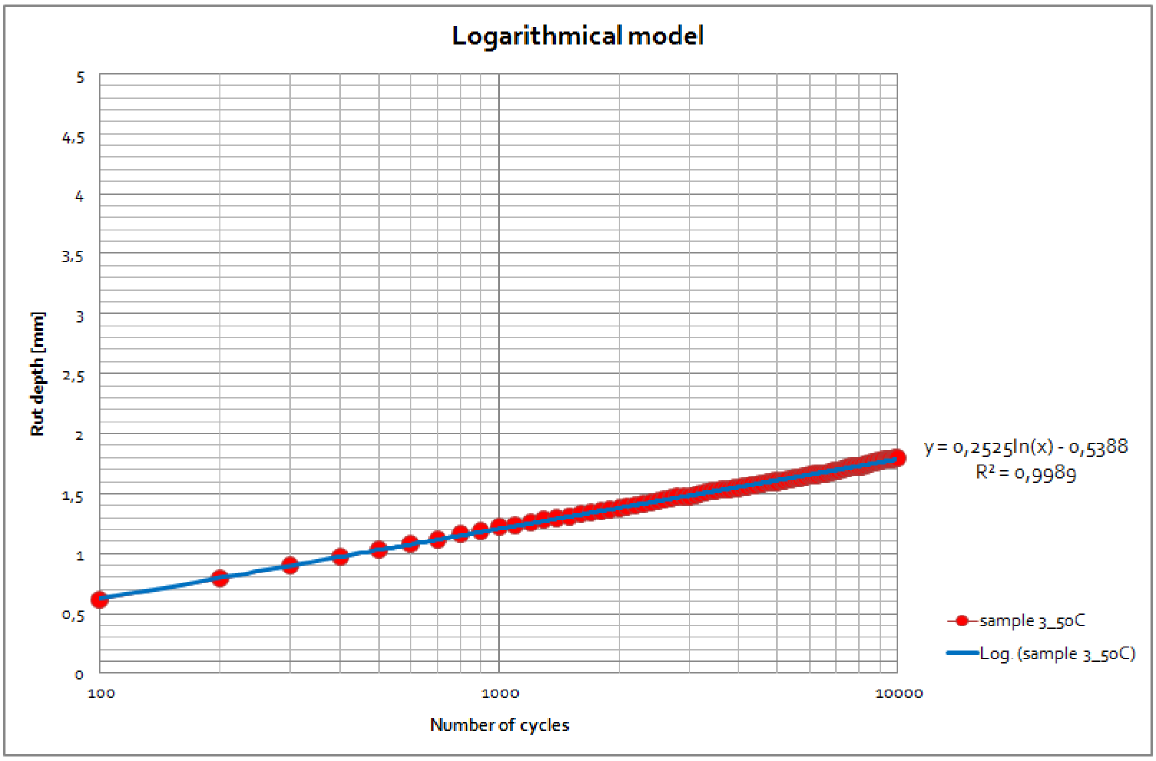
y	is the rut depth;
x	is the number of cycle;
a	is the regression constant.

Instead the exponential model is ruled by the function

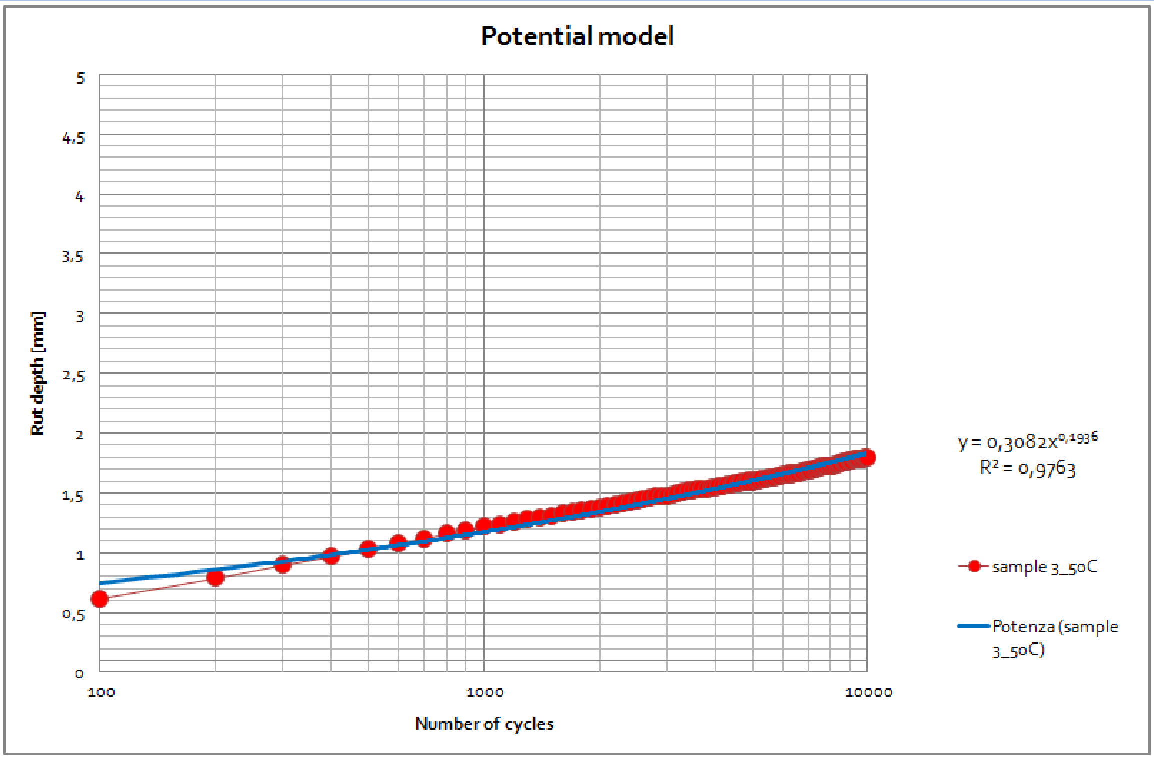
$$y = a + x^b$$

Where

y	is the rut depth;
x	is the number of cycle;
a	is intercept;
b	is a constant.



Graph 6.13 Sample 3: logarithmic model.



Graph 6.14 Sample 3: potential model.

	Logarithmic model		Potential model	
Equation	$y = 0{,}2525ln(x) - 0{,}5388$	$R^2 = 0{,}9989$	$y = 0{,}3082x^{0{,}1936}$	$R^2 = 0{,}9763$
Solving equation	$x = e^{(5+0{,}5388)/0{,}2525}$		$x = (y/0{,}3082)^{1/0{,}1936}$	
n. cycle ($y = 5mm$)	3362133515		1781187	

Table 6.11 Determination of the number of cycles necessary to reach the limit strain of 5 mm.

In the following tables, there are the analytical results. The mixtures have been dived because of the type of binder, whereas the above considerations have revealed a not direct influence between the grading curve and the rutting resistance. In particular the binders considered are:

- 50/70 (Table 6.12)
- 70/100 (Table 6.14)
- 160/220 (Table 6.15)
- Pmb 50/100 (Table 6.17)
- GIL 70/100 (Table 6.20)
- Drenoval HM 30/50 (Table 6.21)
- Drenoval Hard M 50/70 (Table 6.22)
- Lowval HM 40 30/50 (Table 6.23).

50/70

Sample Number	Mixture	Testing T [°C]	Logarithmic trend	R²	n. cycle x(y= 5mm)	Ptential trend	R²	n. cycle (y= 5mm)
29	Ska 11	40	y = 0,3429ln(x) - 1,0922	0,9994	51996961	$y = 0{,}2238x^{0{,}2457}$	0,9705	309658
30	Ska 11	40	y = 0,3316ln(x) - 1,1818	0,9962	124814622	$y = 0{,}168x^{0{,}2665}$	0,9812	338598
27	Ska 11	50	y = 0,3764ln(x) - 1,1246	0,9947	11658192	$y = 0{,}298x^{0{,}2272}$	0,9923	245834
28	Ska 11	50	y = 0,3854ln(x) - 1,1507	0,9939	8531392	$y = 0{,}3047x^{0{,}2275}$	0,9901	219325
G13	Ska 11	50	y = 0,3854ln(x) - 1,1507	0,9939	7778030	$y = 0{,}3047x^{0{,}2275}$	0,9901	88197
G2	Ska 16	50	y = 0,3395ln(x) - 0,8431	0,9973	29826218	$y = 0{,}3381x^{0{,}2109}$	0,964	352612
31	Ska 11	60	y = 0,4206ln(x) - 1,3104	0,991	198657	$y = 0{,}3106x^{0{,}2326}$	0,9948	154231
32	Ska 11	60	y = 0,4627ln(x) - 1,6279	0,979	1663443	$y = 0{,}2661x^{0{,}2526}$	0,9989	110472

Table 6.12 Bitumen 50/70: determination of the number of cycles necessary to reach the limit strain of 5 mm.

Sample n.G13 is highlighted in Table 6.12because of its anomalous expected n. cycle compared with the others results. Considering void characteristics of all the samples of the same mixture, determinated according to EN 12697-8 (APPENDIX D: Determination of bulk density and void characteristics), the values of the sample fall within a maximum range (maximum deviation) calculated on the whole set of samples as it is shown in Table 6.13.

The sample will not be considered in future considerations.

The deviation is calculated as:

$$\delta = \frac{(mean\ value - farther\ value)}{mean\ value}$$

Where

δ is the deviation.

Ska 11_Receipt n. 06209407

Sample		G13A	G13B	Mean Values	δ	Max δ
m1	**[g]**	2966,2	2933,3			
m2	**[g]**	1728,7	1707,3			
m3	**[g]**	2976,1	2943,4			
Tw	**[°C]**	19,0	19,0			
γw		0,998	0,998			
ρm	**[kg/m3]**	2,462	2,462	2,462		
ρb	**[kg/m3]**	2,374	2,369	2,375	0,003	-0,011
Vm	**[%v/v]**	3,573	3,771	3,528	-0,069	-0,200
B	**[%]**	6,40	6,40	6,400		
ρB	**[kg/m3]**	1,100	1,100	1,100		
VMA	**[%v/v]**	17,386	17,555	17,347	-0,012	-0,035
VFB	**[%v/v]**	79,446	78,518	79,720	0,003	-0,043

Table 6.13 Sample G13: void characteristics.

70/100

Sample Number	Mixture	Testing T [°C]	Logarithmic trend	R²	n. cycle x(y= 5mm)	Ptential trend	R²	n. cycle x(y= 5mm)
15	Ab 11	40	y = 0,3021ln(x) - 1,1657	0,988	730666043	$y = 0,125x^{0,2828}$	0,9939	462373
16	Ab 11	40	y = 0,2955ln(x) - 1,0865	0,9884	881638551	$y = 0,1434x^{0,2687}$	0,9936	549931
G14	Ska 11	40	y = 0,3257ln(x) - 1,2914	0,9923	244946156	$y = 0,1168x^{0,2969}$	0,9854	312757
13	Ab 11	50	y = 0,5398ln(x) - 2,0193	0,9791	443973	$y = 0,2575x^{0,269}$	0,9982	61492
14	Ab 11	50	y = 0,5246ln(x) - 1,9823	0,9706	603053	$y = 0,2472x^{0,2695}$	0,9979	70100
G12	Ska 11	50	y = 0,5068ln(x) - 1,8062	0,9889	679937	$y = 0,2694x^{0,2608}$	0,993	73141
17	Ab 11	60	y = 0,8484ln(x) - 3,7051	0,9696	28584	$y = 0,2217x^{0,3226}$	0,9996	15656
18	Ab 11	60	y = 0,8035ln(x) - 3,4378	0,96	36363	$y = 0,2391x^{0,3098}$	0,9992	18284

Table 6.14 Bitumen 70/100: determination of the number of cycles necessary to reach the limit strain of 5 mm.

160/220

Sample Number	Mixture	Testing T [°C]	Logarithmic trend	R^2	n. cycle x(y= 5mm)	Ptential trend	R^2	n. cycle x(y= 5mm)
35	Agb 11	40	y = 0,353ln(x) - 0,9983	0,9963	23970903	$y = 0,3062x^{0,22}$	0,9905	326194
36	Agb 11	40	y = 0,3507ln(x) - 1,2201	0,9929	50437313	$y = 0,1968x^{0,2565}$	0,9915	300171
33	Agb 11	50	y = 0,7055ln(x) - 3,0987	0,9613	96701	$y = 0,1832x^{0,3225}$	0,9994	28369
34	Agb 11	50	y = 0,5778ln(x) - 2,282	0,9783	297443	$y = 0,2277x^{0,2861}$	0,9975	48898
G8	Agb 16	50	y = 2,9816ln(x) - 15,527	0,9478	977	$y = 0,214x^{0,4459}$	0,9985	1173
G22	Agb 16	50	y = 2,3649ln(x) - 11,883	0,9639	1260	$y = 0,2239x^{0,4204}$	0,9964	1617
G23	Agb 16	50	y = 3,1644ln(x) - 16,411	0,933	868	$y = 0,2562x^{0,4325}$	0,9996	963
G24	Agb 16	50	y = 2,3673ln(x) - 12,184	0,9492	1421	$y = 0,1931x^{0,4332}$	0,9994	1829
G7	Agb 11	50	y = 2,5216ln(x) - 12,743	0,9618	1137	$y = 0,2294x^{0,424}$	0,997	1434
G10	Agb 11	50	y = 1,9845ln(x) - 10,81	0,898	2883	$y = 0,1031x^{0,4737}$	0,995	3619
G19	Agb 11	50	y = 2,3385ln(x) - 12,637	0,9185	1886	$y = 0,1224x^{0,4748}$	0,999	2474
G20	Agb 11	50	y = 2,4913ln(x) - 13,459	0,9271	1651	$y = 0,1271x^{0,478}$	0,9988	2170

Table 6.15 Bitumen 160/220: determination of the number of cycles necessary to reach the limit strain of 5 mm.

Samples n.33-34 are highlighted in Table 6.15 because of their anomalous expected n. cycle compared with the others results. Considering void characteristics of these two samples (Table 6.16), they have all a higher deviation from the mean value than the other samples of the same set (APPENDIX D: Determination of bulk density and void characteristics, Table 0.5). The least amount of air voids in the mixture has probably given its higher value of n. cycle at the limit rut. The samples will not be considered in future considerations.

Agb 11_Receipt n. 06205205

Sample		33A	33B	34A	34B	Mean Values	δ	Max δ
m1	**[g]**	3089,8	3705,3	3486,3	3470,7			
m2	**[g]**	1834,1	2195,3	2073,7	2063,3			
m3	**[g]**	3098,0	3714,8	3502,2	3482,3			
Tw	**[°C]**	20,3	20,3	20,3	20,3			
γw		0,998	0,998	0,998	0,998			
ρm	**[kg/m3]**	2,568	2,568	2,568	2,568	2,568		
ρb	**[kg/m3]**	2,440	2,434	2,436	2,441	2,420	-0,009	0,007
Vm	**[%v/v]**	4,984	5,224	5,145	4,937	5,749	0,141	-0,117
B	**[%]**	5,60	5,60	5,60	5,60	5,600		
ρB	**[kg/m3]**	1,100	1,100	1,100	1,100	1,100		
VMA	**[%v/v]**	17,406	17,614	17,546	17,365	18,071	0,039	-0,032
VFB	**[%v/v]**	71,364	70,344	70,678	71,570	68,216	-0,049	0,039

Table 6.16 Samples 33-34: void characteristics.

Pmb 50/100

Sample Number	Mixture	Testing T [°C]	Logarithmic trend	R^2	n. cycle x(y= 5mm)	Ptential trend	R^2	n. cycle x(y= 5mm)
7	Ab 16 Pmb	40	y = 0,251ln(x) - 0,7808	0,9993	10052384402	$y = 0{,}174x^{0{,}2402}$	0,9742	1179488
8	Ab 16 Pmb	40	y = 0,1878ln(x) - 0,6586	0,9983	12182119956655	$y = 0{,}0971x^{0{,}2656}$	0,973	2785126
25	Ab 11 Pmb	40	y = 0,1707ln(x) - 0,4514	0,9987	74035028929444	$y = 0{,}1563x^{0{,}2175}$	0,9675	8309807
26	Ab 11 Pmb	40	y = 0,1836ln(x) - 0,4565	0,9993	8072617626034	$y = 0{,}1836x^{0{,}2103}$	0,9667	6668807
21	Ab 11 Pmb	40	y = 0,1729ln(x) - 0,5808	0,9958	104229583919111	$y = 0{,}104x^{0{,}2512}$	0,9864	4961440
22	Ab 11 Pmb	40	y = 0,169ln(x) - 0,5322	0,9991	164661215986435	$y = 0{,}1129x^{0{,}2437}$	0,9697	5692969
3	Ab 16 Pmb	50	y = 0,2525ln(x) - 0,5388	0,9989	3362133515	$y = 0{,}3082x^{0{,}1936}$	0,9763	1781187
4	Ab 16 Pmb	50	y = 0,2786ln(x) - 0,6169	0,9994	570009142	$y = 0{,}3263x^{0{,}197}$	0,9772	1039968
9	Ab 11 Pmb	50	y = 0,2989ln(x) - 0,5819	0,9992	128933539	$y = 0{,}3961x^{0{,}1874}$	0,9754	751648
19	Ab 11 Pmb	50	y = 0,1911ln(x) - 0,3976	0,9981	1847580311490	$y = 0{,}2358x^{0{,}1934}$	0,9689	7218720
20	Ab 11 Pmb	50	y = 0,2244ln(x) - 0,6206	0,9984	72197683424	$y = 0{,}1948x^{0{,}2213}$	0,9762	2336924
5	Ab 16 Pmb	60	y = 0,2699ln(x) - 0,4332	0,9983	361917854	$y = 0{,}3892x^{0{,}1814}$	0,9907	1295517
6	Ab 16 Pmb	60	y = 0,2757ln(x) - 0,5143	0,9983	485693410	$y = 0{,}4217x^{0{,}1741}$	0,985	1474604
11	Ab 11 Pmb	60	y = 0,2799ln(x) - 0,374	0,9815	217936476	$y = 0{,}3961x^{0{,}1874}$	0,9754	751648
12	Ab 11 Pmb	60	y = 0,3298ln(x) - 0,7341	0,9978	35555234	$y = 0{,}4841x^{0{,}1666}$	0,969	1220799
23	Ab 11 Pmb	60	y = 0,2205ln(x) - 0,3245	0,9986	30695818905	$y = 0{,}3566x^{0{,}1723}$	0,973	4526547
24	Ab 11 Pmb	60	y = 0,2724ln(x) - 0,7295	0,9987	1363617259	$y = 0{,}2501x^{0{,}2164}$	0,9787	1026481

Table 6.17 Bitumen Pmb 50/100: determination of the number of cycles necessary to reach the limit strain of 5 mm.

Sample n.7 is highlighted in Table 6.17, because of their anomalous expected n. cycle compared with the others results. Considering void characteristics of sample n.7 (Table 6.18), results a non homogeneity of the two sides of the samples. The outlier can be attributed to this factor. The sample will not be considered in future considerations.

Ab 16 Pmb_Receipt n. 13143908

Sample		7A	7B	Mean Values
m1	**[g]**	3466,5	3530,8	
m2	**[g]**	2061,6	2039,2	
m3	**[g]**	3474,7	3440,5	
Tw	**[°C]**	20,2	20,2	
γw		0,998	0,998	
ρm	**[kg/m3]**	2,562	2,562	
ρb	**[kg/m3]**	2,448	2,515	2,450
Vm	**[%v/v]**	4,430	1,838	4,378
B	**[%]**	5,50	5,50	
ρB	**[kg/m3]**	1,100	1,100	
VMA	**[%v/v]**	16,673	14,412	16,627
VFB	**[%v/v]**	73,428	87,248	73,794

Table 6.18 Sample 7: void characteristics.

Considering void characteristics of sample n.19, 23 (Table 6.18), results a non homogeneity of the two sides of the samples. These two samples (Table 6.19), they have all a higher deviation from the mean value than the other samples of the same set (APPENDIX D: Determination of bulk density and void characteristics, Table 0.4) and quite different values between the two sides of the sample. These samples will not be considered in future considerations.

Ab 11 Pmb_Receipt n. 82212001014

Sample		19A	19B	23A	23B	Mean Values	δ 19	δ 23	Max δ
m1	**[g]**	3570,8	3268,8	3574,4	3348,0				
m2	**[g]**	2136,5	1958,1	2146,8	2012,8				
m3	**[g]**	3583,6	3278,8	3582,7	3353,1				
Tw	**[°C]**	18,5	19,5	20,6	20,6				
γw		0,998	0,998	0,998	0,998				
ρm	**[kg/m3]**	2,543	2,543	2,543	2,543				
ρb	**[kg/m3]**	2,464	2,471	2,484	2,493	2,473	0,004	-0,008	0,002
Vm	**[%v/v]**	3,115	2,841	2,304	1,965	2,734	-0,140	0,281	0,102
B	**[%]**	5,70	5,70	5,70	5,70				
ρB	**[kg/m3]**	1,100	1,100	1,100	1,100				
VMA	**[%v/v]**	15,882	15,644	15,178	14,883	15,551	-0,021	0,043	0,011
VFB	**[%v/v]**	80,385	81,839	84,821	86,799	82,430	0,025	-0,053	-0,019

Table 6.19 Samples 19,23: void characteristics.

GIL 70/100

Sample Number	Mixture	Testing T [°C]	Logarithmic trend	R^2	n. cycle x(y= 5mm)	Ptential trend	R^2	n. cycle x(y= 5mm)
G25	Ab 11 GIL	50	$y = 0,25\ln(x) - 0,9255$	0,9964	19662910846	$y = 0,1117x^{0,2779}$	0,9798	872342
G26	Ab 11 GIL	50	$y = 0,2773\ln(x) - 0,971$	0,9984	2246492918	$y = 0,1443x^{0,2649}$	0,975	649226
G29	Ab 11 GIL	50	$y = 0,2492\ln(x) - 0,9499$	0,9946	23400031613	$y = 0,1018x^{0,2855}$	0,9825	838920
G27	Ab 11 GIL	60	$y = 0,3476\ln(x) - 1,1857$	0,9957	53514037	$y = 0,2018x^{0,2542}$	0,9871	304834
G28	Ab 11 GIL	60	$y = 0,3855\ln(x) - 1,3848$	0,9924	15593840	$y = 0,1973x^{0,2646}$	0,9907	202083

Table 6.20 Bitumen GIL 70/100: determination of the number of cycles necessary to reach the limit strain of 5 mm.

Drenoval HM 30/50

Sample Numbe	Mixture	Testing T [°C]	Logarithmic trend	R^2	n. cycle x(y= 5mm)	Ptential trend	R^2	n. cycle x(y= 5mm)
41	Drenoval HM	40	y = 0,1681ln(x) - 0,2162	0,9942	29943670538400	$y = 0,2879x^{0,1687}$	0,959	22321106
42	Drenoval HM	40	y = 0,1589ln(x) - 0,3018	0,9982	309394651278977	$y = 0,2128x^{0,187}$	0,9673	21455673
37	Drenoval HM	50	y = 0,1897ln(x) - 0,3728	0,9984	1996895129012	$y = 0,2497x^{0,1879}$	0,9755	8449491
38	Drenoval HM	50	y = 0,1802ln(x) - 0,3531	0,9993	7967861801713	$y = 0,2387x^{0,1872}$	0,9785	11409118
39	Drenoval HM	60	y = 0,4215ln(x) - 1,5008	0,9892	4990332	$y = 0,2258x^{0,2599}$	0,9949	149973
40	Drenoval HM	60	y = 0,3456ln(x) - 1,1617	0,992	55339254	$y = 0,2141x^{0,2477}$	0,9942	334377

Table 6.21 Bitumen Drenoval HM 30/50: determination of the number of cycles necessary to reach the limit strain of 5 mm.

Drenoval Hard M 50/70

Sample Number	Mixture	Testing T [°C]	Logarithmic trend	R^2	n. cycle x(y= 5mm)	Ptential trend	R^2	n. cycle x(y= 5mm)
46	Drenoval Hard M	40	y = 0,164ln(x) - 0,1885	0,9973	54936282080839	$y = 0,2986x^{0,1637}$	0,9696	29947489
47	Drenoval Hard M	50	y = 0,237ln(x) - 0,6735	0,9823	91698526915	$y = 0,2117x^{0,2162}$	0,9949	2247779
48	Drenoval Hard M	50	y = 0,1932ln(x) - 0,3345	0,9987	980456036650	$y = 0,2823x^{0,1798}$	0,977	9493201
43	Drenoval Hard M	60	y = 0,3688ln(x) - 1,0579	0,988	13605384	$y = 0,3222x^{0,2182}$	0,9971	286802
44	Drenoval Hard M	60	y = 0,3164ln(x) - 0,8139	0,9936	95549790	$y = 0,3219x^{0,2064}$	0,9944	590956

Table 6.22 Bitumen Hard M 50/70: determination of the number of cycles necessary to reach the limit strain of 5 mm.

Lowval HM 40 30/50

Sample Number	Mixture	Testing T [°C]	Logarithmic trend	R^2	n. cycle x(y= 5mm)	Ptential trend	R^2	n. cycle (y= 5mm)
53	Lowval HM 40	40	y = 0,1379ln(x) - 0,2143	0,9939	2,64011E+16	$y = 0,2112x^{0,1774}$	0,955	55816794
54	Lowval HM 40	40	y = 0,1577ln(x) - 0,2439	0,994	276263968664577	$y = 0,2426x^{0,177}$	0,9564	26556835
49	Lowval HM 40	50	y = 0,1648ln(x) - 0,2334	0,9963	61870707530409	$y = 0,2694x^{0,172}$	0,963	23736736
50	Lowval HM 40	50	y = 0,1899ln(x) - 0,4209	0,9989	2496914492557	$y = 0,2239x^{0,1961}$	0,9804	7563355
51	Lowval HM 40	60	y = 0,368ln(x) - 1,2337	0,9781	22734682	$y = 0,2388x^{0,2423}$	0,9975	282913
52	Lowval HM 40	60	y = 0,3365ln(x) - 1,12	0,9907	79178978	$y = 0,2152x^{0,2447}$	0,9957	382708

Table 6.23 Bitumen Lowval HM40 30/50: determination of the number of cycles necessary to reach the limit strain of 5 mm.

The cycle number differs between the two models. To check which is the projection model with greater reliability, the limit cycle is calculated through the trend lines even for samples that had reached a greater deformation than 5 mm. Via a comparison between the experimental and the analytical results (Table 6.24), it was found a closer match between the potential trend line and the experimental results rather than the logarithmic one with a maximum deviation of 0.1% instead of 0.25% calculated as

$$\delta = \frac{(experimental\ value - analytical\ value)}{experimental\ value}$$

Where

δ is the deviation.

Sample Number	Mixture	Testing T [°C]	Experimental n. cycle	Log n. cycle	Log δ	Potential n. cycle	Potential δ
G8	Agb 16	50	1185	977	0,1754681	1173	0,0103502
G9	Agb 16	50	762	627	0,1773933	686	0,0999339
G22	Agb 16	50	1533	1260	0,1779802	1617	-0,0546456
G23	Agb 16	50	963	868	0,0986321	963	0,0001463
G24	Agb 16	50	1818	1421	0,2185388	1829	-0,0060332
G30	Agb 16	50	3742	3182	0,1497154	3727	0,0041391
G5	Agb 11	50	2834	2135	0,2467542	2780	0,0192124
G6	Agb 11	50	3100	2495	0,1950336	3089	0,0034926
G7	Agb 11	50	1386	1137	0,1794429	1434	-0,0346306
G10	Agb 11	50	3831	2883	0,2473379	3619	0,0553016
G19	Agb 11	50	2576	1886	0,2680031	2474	0,039585
G20	Agb 11	50	2261	1651	0,2696109	2170	0,0402629
G21	Agb 11	50	4068	3353	0,1756928	4031	0,0091385
G1	Ab 11	50	5266	4798	0,0888211	5222	0,0083742
G3	Ab 11	50	1437	1138	0,2083812	1417	0,0140575

Table 6.24 Comparison among the results proceeded from the logarithmic and potential trend line, and the experimental value.

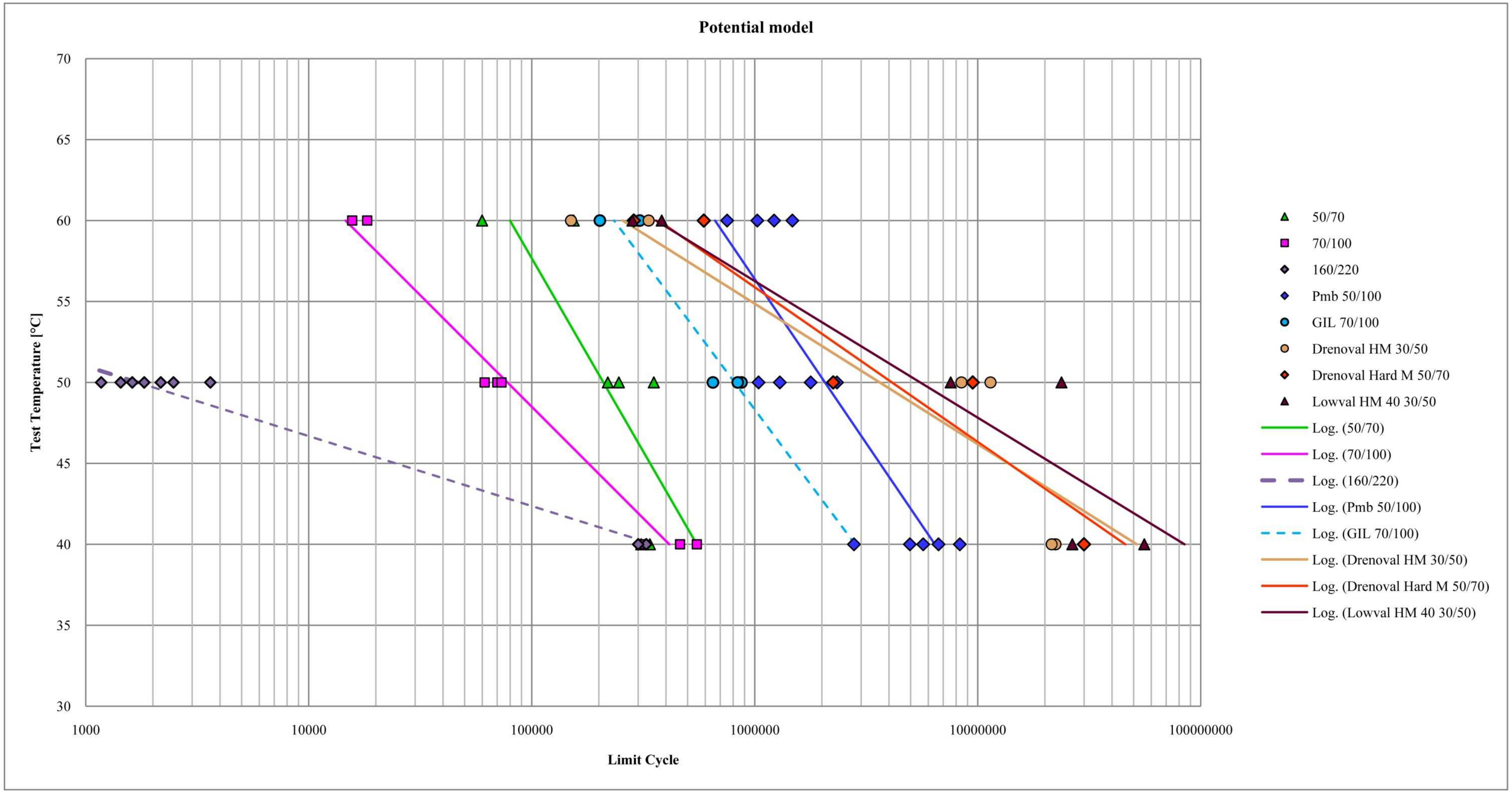
Even if data were compatible with the others, samples n.G5, G6, G9, G21 and G30 are not considered in this analysis because of their anomalous difference in air voids content between the two sides of the sample (APPENDIX D: Determination of bulk density and void characteristics, Table 0.9, Table 0.10, Table 0.13,Table 0.14). Probably the non homogeneity of the sample is due to the preparation of the samples happened during the laboratory course.

Known the number of cycles necessary to reach the limit deformation, it is possible to compare the behavior of bituminous mixture at constant strain. The function that best approximates the samples behavior is logarithmic. Graph 6.15 represents trend lines resulting from the potential projection of the limit amount of cycles depending on testing temperature. Dotted lines represent trend lines of material whose behavior is known only at two temperatures: 40-50°C for mixtures with 160/220 bitumen (in purple) and 50-60°C for mixtures with GIL 70/100 bitumen.

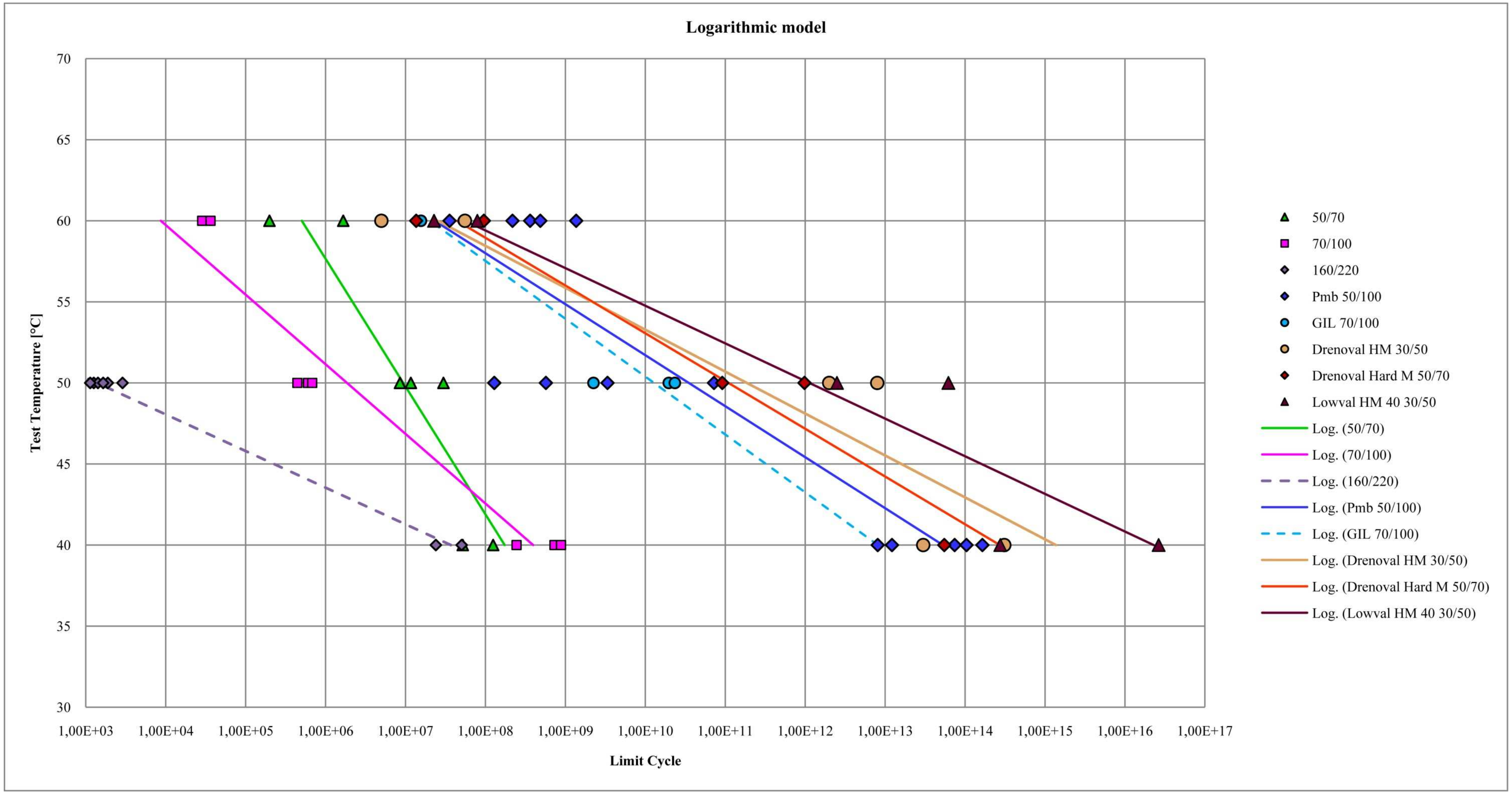
There is a great difference between modified and traditional binders, their trend lines cluster in two distinct areas of the graph showing a lower attitude of mixture with modified binders to reach the limit cycle. Lines characterizing traditional bitumens (50/70, 70/100, 160/220) assume a similar value of limit cycles at 40°C while, at superior temperatures the slope is greater the higher is the hardness of the binder. On the contrary, mixtures with modified bitumen, tend to behave the opposite, starting from a dispersed configuration, they converge at high temperature (60°C) involving a significant increase in the deformation capacity of the material. This result shows how the chemical characteristics of the binder and the mechanical properties of the aggregates interfere in two different phases. At low temperature, the difference between the behavior of the mixtures is primarily determined by the type of modification introduced in the bitumen rather than its mechanical properties. In fact while traditional mixtures converge to the limit cycle, modified ones have a various comportment due to different viscous characteristics resulting from the polymer added to the binder. At 60°C the effect of the polymer tends to vanish, because of the temperature sensitivity of the plastic material, bringing out the relevance of granulometric characteristics of the mixture. Indeed it is evident the worsening of the mixture modified with SBS (Drenoval, in orange and yellow, and Lowval, in pink) whose maximum aggregate size is 11 mm over others who reached first the limit cycle at low temperatures, whose maximum aggregate size is 16 mm (Table 4.3).

Considering even the air voids content of the mixture, 6.0% of the Italian mixtures (Drenoval and Lowal) against 3.5 - 4.5% of the others, which would adversely affect rutting resistence, and that usually a surface temperature next to 60°C is difficulty reached, or at least it is for few days per year, it is evident better behavior of samples with the Drenoval and Lowval modification. In particular it is noticed the great performance of the Lowval HM 40, that differs from the Drenoval HM because of a wax addition. Although the wax addition, at operating temperature, should produce a stiffening effect and lead to higher values of deformation, therefore to a lower value of the limit cycle, than the base bitumen (considering the Drenoval as the base bitumen), during the laboratory tests, the prediction has been refuted by the results.

The same behavior is deductible from Graph 6.16 where are shown the results given by the logarithmical model.



Graph 6.15 Trend lines at the limit deformation from a potential approximation.



Graph 6.16 Trend lines at the limit deformation from a logarithmical approximation.

6.4.2 Volumetric variation during the test

The following Table 6.25 reassumes the volumetric characteristics of the mixtures grouped, as in the previous paragraph, according to the type of bitumen. These characteristics were measured on the edge sides of the sample as explained in paragraph 4.2.

Mixture	Testin Temp. [°C]	V0	Vm,min	Vm,max	Vm,average
160/220	40	4,5	5,48	5,68	5,58
	50	4,5	2,90	3,57	3,34
160/220	50	3,5	3,11	3,29	3,19
50/70	40	3,5	3,76	3,88	3,82
	50	3,5	2,62	3,77	3,04
	60	3,5	3,08	3,39	3,23
70/100	40	3,5	2,575	3,587	3,232
	50	3,5	2,585	4,279	3,628
	60	3,5	3,617	4,060	3,838
Pmb 50/100	40	3,5	2,90	3,17	3,00
	50	3,5	2,06	3,12	2,37
	60	3,5	2,82	3,69	3,34
GIL 70/100	50	3,5	3,39	3,71	3,52
	60	3,5	3,29	3,47	3,38
Drenoval HM 30/50	40	6	5,29	5,40	5,35
	50	6	4,30	5,36	4,83
	60	6	5,09	5,38	5,23
Drenoval Hard M 50/70	40	6	6,06	6,06	6,06
	50	6	5,04	5,56	5,30
	60	6	5,84	6,29	6,06
Lowval HM 40 30/50	40	6	5,43	5,63	5,53
	50	6	5,14	5,25	5,19
	60	6	4,97	5,95	5,46

Table 6.25 Volumetric characteristics of the mixtures. Where V_0 is the initial predicted air void content and Vm,min, Vm,max, Vm,average are respectively the minimum, maximum and average air void content in the mixture set at the end of the test.

Where

V_0 is the initial predicted air void content;

$V_{m,min}$ is the minimum air void content in the mixture set at the end of the test;

$V_{m,max}$ is the maximum air void content in the mixture set at the end of the test.

Graph 6.17 represents the volumetric characteristics of the mixture set at the end of the test and their deviation considering the value V_0, the initial predicted air void content.

As the value V_0 is a design value non verified experimentally in the samples, it is highlighted a range of ± 0.5% of variability (bands) because, although during the sample packaging project data have been observed, it is likely that in the production process a portion of material was dispersed. Whereas all the samples have undergone the same process, it was chosen to introduce a fixed margin of error for all the mixtures rather than a percentage of the predicted air voids content.

From an analysis of this results, it derives a large variability of the average air voids content (crosses) at the end of the test than before it because of the effect of load on volumetric characteristics on the containment material. The variation of air void content can be considered temperature related. In particular, the average porosity tends to decrease especially at 50°C. This behavior reflects the rutting development as a sum of a deformation with decreasing volume (therefore in air voids content) and of a deformation at constant volume (paragraph 2.2.3 Rutting process). While at 50°C it tends to prevail the first phenomena, at higher temperature its effect is mitigate by the predominance of the second with a lower shear resistance of the material. In Figure 6.1 there is a picture taken from two samples tested at 50°C, sample G22, and at 60°C, sample G6. It is possible to see the difference in volumetric variation.

The variance of each set of samples is in general tolerable at low and high temperature while at 50°C has an higher variability, probably due to the different aggregate fractions present in the various mixtures.

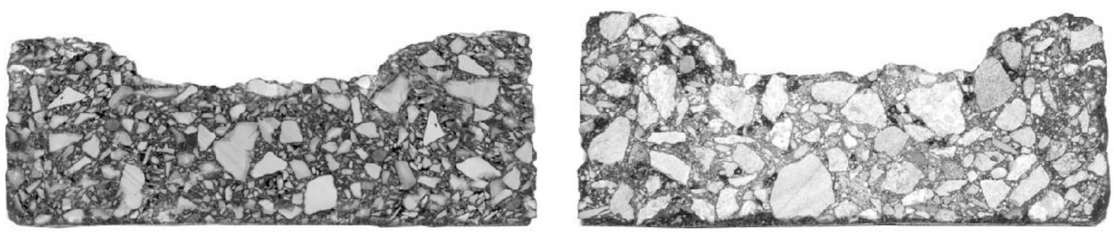


Figure 6.1 Final rut depth of sample G22 tested at 50°C and sample G6 tested at 60°C.

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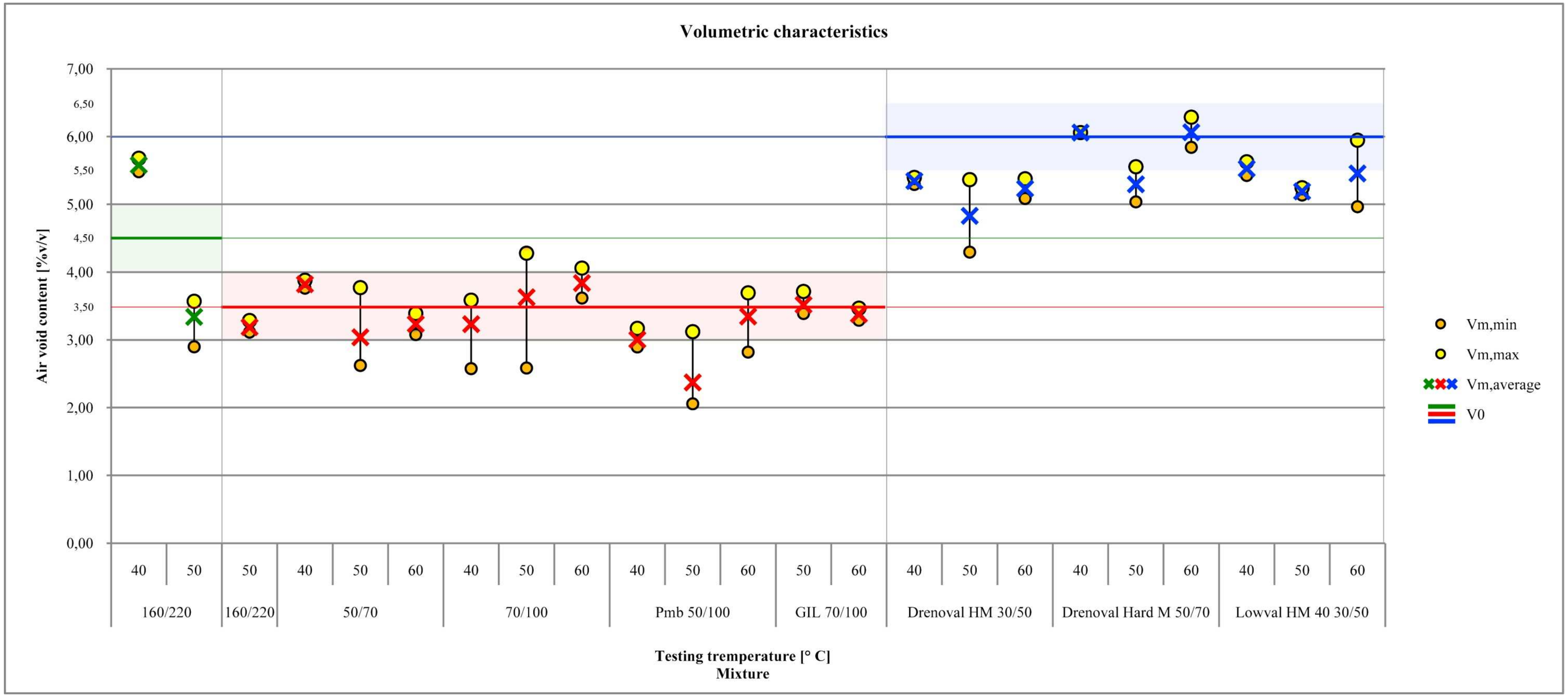

Graph 6.17 Volumetric characteristics of the mixture. In Vm,min in blue, Vm,max in red, Vm,average in green. In orange the band borders a range of variability of ±0.5% on V_0.

7 CONCLUSIONS

The purpose of this study was to analyze thoroughly the relationship between asphalt concrete mixtures and increasing environmental temperature, verifying the influence of the physical properties of the mixture and its components on the resistance to permanent deformation of the asphalt concrete mixture. To simulate the effect of traffic on the mixtures it was used Wheeltrack device. The results have shown the dependencies of the rutting resistance in relation to:

- parameters of the test;
- components properties;
- mixtures characteristics.

7.1 Benefits and detriments of the Wheeltrack test

The following are the benefits and detriments of the Wheeltrack test:

- the test is simple to conduct and non – destructive;
- the test can be carried out in duplicate on samples manufactured in the laboratory or on cores drilled from the pavement;
- the program connected with the Wheeltrack device automatically records all the data collected and shows the real – time behavior of the test;
- once the device is in action, it is not necessary the presence of an operator;
- test temperature cannot exceed 62°C to simulate the typical summer conditions of southern Europe regions;
- the time required for heating samples and test times do not allow to run more than two tests in parallel per day.

7.2 Conclusions

Through the Wheeltracking test, have been determinated the values of accumulated permanent deformation after 20000 passages of a loaded wheel. To represent the data were built strain curve depending on the number of cycles to describe concisely and comprehensively the results.

Based on tests performed and results obtained considering different parameters, the following conclusions were reached.

- All samples subjected to the rutting resistance test at different temperatures have shown a progressive linear, logarithmic or exponential increase of deformation. The first two types of behavior were detected in different mixtures without any relation to the parameters considered. The logarithmic behavior has characterized the mixtures containing the Italian binders, three kind of stiff bitumen modified with SBS polymer.
- No relevant correlation between the granulometric composition of stone aggregates of samples set with similar characteristics (binder and mixtures properties) and results was found in this study. The asphalt concrete behavior showed a substantial independence from the type fractions contained both considering the difference between a dense graded than a stone mastic asphalt and the difference between the same kind of mix with the addition of a coarser component among the aggregates.
- The most significant results were obtained comparing the behavior of asphalt concrete mixtures depending of the different types of binder. First of all have been compared binders with a different stiffness showing a large increase of rutting in samples with the softer bitumen. Then the study considered the difference between modified asphalt mixtures containing polymer and traditional ones. In particular has been found a sensible gap of size increasing with temperature between the high values of the traditional mixture and the modified.
- Air voids content has been found as an important parameter. It has been verified in two samples containing the same mass in a different volume. The increase of the rut depth in the less dense volume was of 47.9%. The different air voids content and density have been even observed through the value of VFB and bulk density determined according to European Standards.

– Negative effects on test results have been caused by the lack of homogeneity of some samples due to preparations mistakes in the phases of mixing and compaction.

Overall has emerged at working temperature, a decisive importance of bitumen composition, than the other characteristics of the mixture, that tends to disappear with heating in favor of increased dependence of rutting resistance from the granulometric composition of the sample considered. In particular it is essential, rather than the mechanical characteristics of the binder, its chemical properties given by the polymeric modification. These properties have resulted even more significant than the air voids content and the maximum size of the aggregates.

Specifically a better performance was found in materials whose components and characteristics according to the forecast would have a negative trend. These predictions have been refuted through the use of a high-performance modified binder.

It is therefore considered that the knowledge of the influence of characteristic parameters of materials and the forecasting model of the mixture subjected to a temperature increment can be used to determine the characteristic accumulation of strain of each type of asphalt concrete mixture, and evaluate its deformation behavior overtime.

There could have been more accurate conclusions if, the testing phase had started from a single mixture, known all its features, and had made change each time of a single parameter in order to observe its overall effect related to the temperature with the aim of optimizing the behavior of the wear layer.

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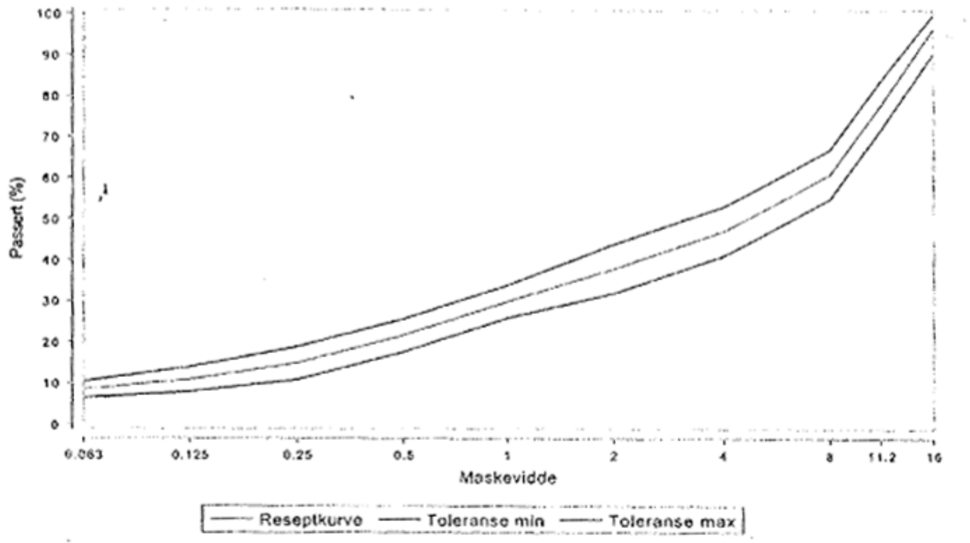
APPENDIX A: Receipts

Franzefoss PUKK OG GJENVINNING	Arbeidsresept for bituminøse vegdekker og bærelag	Bærum

Reseptnr.	13143908	Produksjonssted	Franzefoss -
Dekketype	Ab 16 Pmb	Resept dato	03.03.2008
Asfaltleverandør		Entreprenør	Franzefoss Pukk AS

	Tilsiktet	Toleranse	Kompakteringstype	
Bindemiddel (%)	5,50	0,40		
Hulrom (%)	3,5	1,5	Densitet (g/cm³)	0,000
Forbruk (kg/m²)	0		Hulrom (%)	0,00
Massetemp prod. (°C)	170	10	Stabilitet (N)	0
Dekkets densitet Pd (g/cm³)	2,472		Flyt (mm)	0,0
Maks.teoretisk densitet Ps (g/cm³)	2,562		Stab:Flyt (N/mm)	0
Maks. vanninnhold (%)	0,0		Ind. strekkst. (kPa)	0
Bindemiddeltype	NYPOL 50/100-75			

	µm				mm					
	63	125	250	500	1	2	4	8	11,2	16
Tils	8,4	10,9	14,8	21,6	29,9	38,0	47,1	61,1	77,6	96,6
Tol.	2,0	3,0	4,0	4,0	4,0	6,0	6,0	6,0	6,0	6,0



Tilslag	Forekomst	Dens.	FI	s	kl	LA	Abr	Mølle	Sort	Andel
Pukk	Brenne-Økri	2,830	15,00	0,0	0	15	0,00	7,0	11/16	24,0
Pukk	Brenne-Økri	2,830	20,00	0,0	0	0	0,00	0,0	8/11	20,0
Pukk	Brenne-Økri	2,830	25,00	0,0	0	0	0,00	0,0	4/8	12,0
Pukk	Steinskogen	2,920	0,00	0,0	0	0	0,00	0,0	0/4	19,0
Grus	Myrvang	2,660	0,00	0,0	0	0	0,00	0,0	0/8	18,0
Filler	Franzefoss	2,780	0,00	0,0	0	0	0,00	0,0	0/0,02	7,0

Tilsetningsstoff		Mengde (% av bindem.)	0
Vedheftningsmiddel	Amin	Mengde (% av bindem.)	0,3

Arbeidsresepten godkjent:	Entreprenør
	Sted:__________, Den:______
Dato:______ Underskrift:__________	Underskrift:__________

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Figure 0.1 Receipt n. 13143908.

Øst

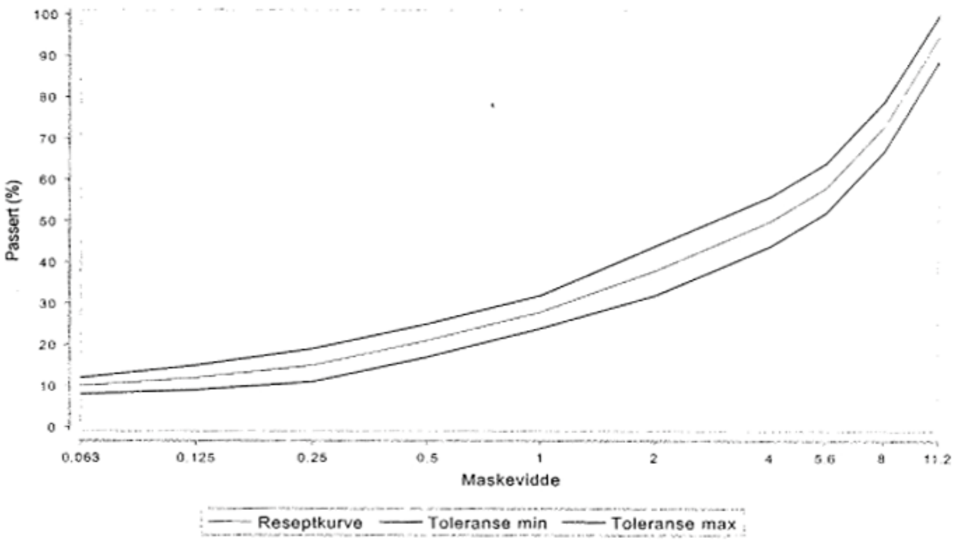
NCC

Arbeidsresept for bituminøse vegdekker og bærelag

Reseptnr. **82212001414** Produksjonssted **Lierskogen -**
Dekketype **Ab 11 Pmb** Resept dato **10.01.2008**
Asfaltleverandør **NCC Roads AS** Entreprenør **NCC Roads AS**

	Tilsiktet	Toleranse	Kompakteringstype	Marshall
Bindemiddel (%)	5,70	0,40	Antall slag	2 * 75
Hulrom (%)	3,5	1,5	Densitet (g/cm³)	2,479
Forbruk (kg/m²)	0		Hulrom (%)	1,90
Massetemp prod. (°C)	140	40	Stabilitet (N)	9394
Dekkets densitet Pd (g/cm³)	2,454		Flyt (mm)	2,5
Maks.teoretisk densitet Ps (g/cm³)	2,543		Stab:Flyt (N/mm)	3 757,6
Maks. vanninnhold (%)	0,0		Ind. strekkst. (kPa)	0
Bindemiddeltype	PmB 40/100-75			

	µm				mm					
	63	125	250	500	1	2	4	5,6	8	11,2
Tils	10,0	12,0	15,0	21,0	28,0	38,0	50,0	58,0	73,0	95,0
Tol.	2,0	3,0	4,0	4,0	4,0	6,0	6,0	6,0	6,0	6,0



Tilslag	Forekomst	Dens.	FI	s	kl	LA	Abr	Mølle	Sort	Andel
Pukk	Lierskogen	2,820	25,00	0,0	0	15	0,00	7,0	8-11	28,0
Pukk	Lierskogen	2,820	30,00	0,0	0	15	0,00	7,0	4-8	21,0
Pukk	Lierskogen	2,820	0,00	0,0	0	0	0,00	0,0	2-4	9,0
Steinmel	Lierskogen	2,820	0,00	0,0	0	0	0,00	0,0	0-2	19,0
Grus	Lyngås	2,710	0,00	0,0	0	0	0,00	0,0	0-8	15,0
Filler	Lierskogen	2,820	0,00	0,0	0	0	0,00	0,0	Filler	5,0
Filler	Bitufill	2,710	0,00	0,0	0	0	0,00	0,0	Filler	3,0

Tilsetningsstoff		Mengde (% av bindem.)	0
Vedheftningsmiddel	Wetfix BE	Mengde (% av bindem.)	0,3

Arbeidsresepten godkjent:	Entreprenør
	Sted:______________________, Den:________
Dato:________ Underskrift:____________________	Underskrift:______________________________

LABSYS web 2.4.1 - 23.04.2008 09:33

Figure 0.2 Receipt n. 82212001414.

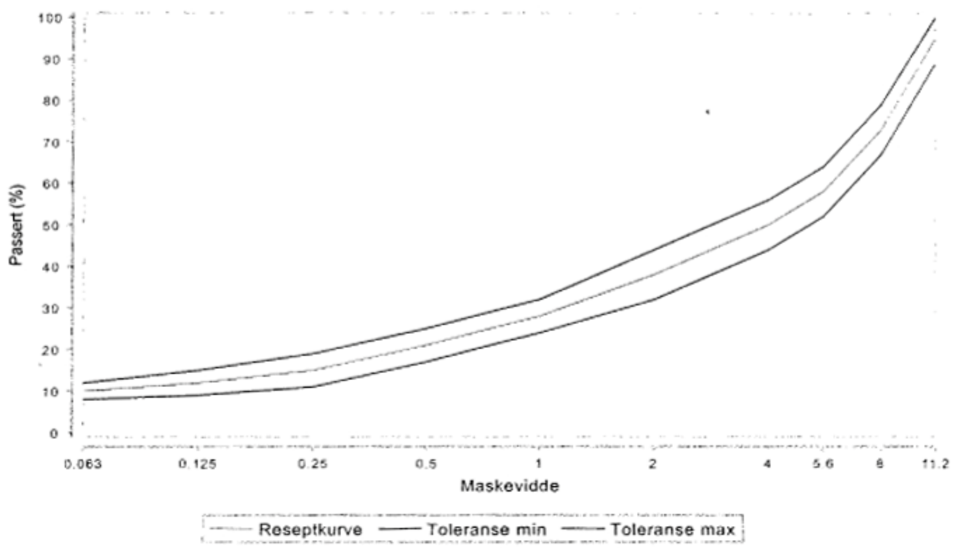
Øst

NCC **Arbeidsresept for bituminøse vegdekker og bærelag**

Reseptnr.	**82212000814**	Produksjonssted	**Lierskogen -**
Dekketype	**Ab 11**	Resept dato	**10.01.2008**
Asfaltleverandør	**NCC Roads AS**	Entreprenør	**NCC Roads AS**

	Tilsiktet	Toleranse	Kompakteringstype	Marshall
Bindemiddel (%)	5,70	0,40	Antall slag	2 * 75
Hulrom (%)	3,5	1,5	Densitet (g/cm³)	2,462
Forbruk (kg/m²)	0		Hulrom (%)	2,20
Massetemp prod. (°C)	140	40	Stabilitet (N)	7483
Dekkets densitet Pd (g/cm³)	2,454		Flyt (mm)	4,0
Maks.teoretisk densitet Ps (g/cm³)	2,543		Stab:Flyt (N/mm)	1 870,75
Maks. vanninnhold (%)	0,0		Ind. strekkst. (kPa)	0
Bindemiddeltype	70/100			

	µm				mm					
	63	125	250	500	1	2	4	5,6	8	11,2
Tils	10,0	12,0	15,0	21,0	28,0	38,0	50,0	58,0	73,0	95,0
Tol.	2,0	3,0	4,0	4,0	4,0	6,0	6,0	6,0	6,0	6,0



Tilslag	Forekomst	Dens.	FI	s	ki	LA	Abr	Mølle	Sort	Andel
Pukk	Lierskogen	2,820	25,00	0,0	0	15	0,00	7,0	8-11	28,0
Pukk	Lierskogen	2,820	30,00	0,0	0	15	0,00	7,0	4-8	21,0
Pukk	Lierskogen	2,820	0,00	0,0	0	0	0,00	0,0	2-4	9,0
Steinmel	Lierskogen	2,820	0,00	0,0	0	0	0,00	0,0	0-2	19,0
Grus	Lyngås	2,710	0,00	0,0	0	0	0,00	0,0	0-8	15,0
Filler	Lierskogen	2,820	0,00	0,0	0	0	0,00	0,0	Filler	5,0
Filler	Bitufill	2,710	0,00	0,0	0	0	0,00	0,0	Filler	3,0

Tilsetningsstoff		Mengde (% av bindem.)	0
Vedheftningsmiddel	Wetfix BE	Mengde (% av bindem.)	0,3

Arbeidsresepten godkjent:	Entreprenør Sted:______________________, Den:________
Dato:________ Underskrift:____________________	Underskrift:______________________________

LABSYS web 2.4.1 - 23.04.2008 09:31

Figure 0.3 Receipt n. 82212000814.

Øst

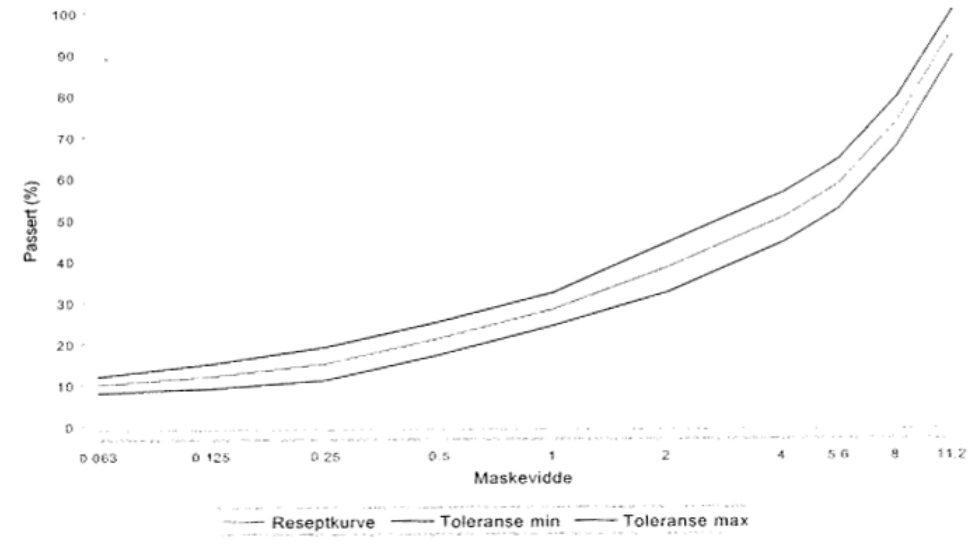
NCC **Arbeidsresept for bituminøse vegdekker og bærelag**

Reseptnr.	82212001014	Produksjonssted	Lierskogen 1111-08-0258
Dekketype	Ab 11 Pmb	Resept dato	06.05.2008
Asfaltleverandør	NCC Roads AS	Entreprenør	NCC Roads AS

	Tilsiktet	Toleranse
Bindemiddel (%)	5,70	0,40
Hulrom (%)	3,5	1,5
Forbruk (kg/m²)	0	
Massetemp prod. (°C)	140	40
Dekkets densitet Pd (g/cm³)	2,454	
Maks.teoretisk densitet Ps (g/cm³)	2,543	
Maks. vanninnhold (%)	0,0	
Bindemiddeltype	PmB 50/100/75	

Kompakteringstype	
Densitet (g/cm³)	0,000
Hulrom (%)	0,00
Stabilitet (N)	0
Flyt (mm)	0,0
Stab:Flyt (N/mm)	0
Ind. strekkst. (kPa)	0

	µm				mm					
	63	125	250	500	1	2	4	5,6	8	11,2
Tils	10,0	12,0	15,0	21,0	28,0	38,0	50,0	58,0	73,0	95,0
Tol.	2,0	3,0	4,0	4,0	4,0	6,0	6,0	6,0	6,0	6,0



Tilslag	Forekomst	Dens.	FI	s	kl	LA	Abr	Mølle	Sort	Andel
Pukk	Lierskogen	2.820	25,00	0.0	0	15	0,00	7,0	8-11	28.0
Pukk	Lierskogen	2.820	30,00	0,0	0	15	0.00	7.0	4-8	21.0
Pukk	Lierskogen	2.820	0.00	0.0	0	0	0,00	0,0	2-4	9.0
Steinmel	Lierskogen	2.820	0.00	0,0	0	0	0.00	0.0	0-2	19.0
Grus	Lyngas	2.710	0.00	0.0	0	0	0.00	0,0	0-8	15.0
Filler	Lierskogen	2,820	0.00	0.0	0	0	0.00	0.0	Filler	5.0
Filler	Bitufil	2.710	0.00	0.0	0	0	0.00	0.0	Filler	3.0

Tilsetningsstoff		Mengde (% av bindem.)	0
Vedheftningsmiddel	Wetfix BE	Mengde (% av bindem.)	0.3

Arbeidsresepten godkjent:	Entreprenør
	Sted:________________________, Den:________
Dato:________ Underskrift:____________________	Underskrift:__________________________________

LABSYS web 2.4.3 - 09.06.2009 11:53

Figure 0.4 Receipt n. 82212001014.

Arbeidsresept for bituminøse vegdekker og bærelag

Kontrakt	Oppdragsgiver	Vegnr	Dato	Arb.resept nr.
11-2006-03	SVV, Region Øst	EV 6	29.05.2006	06209407

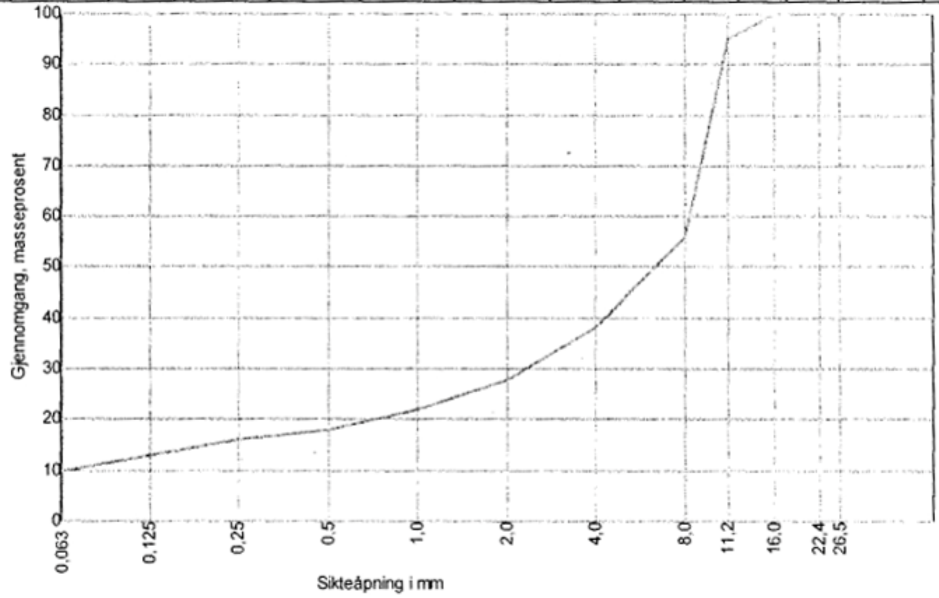
Entrepenør	Dekketype	Bruksområde	Blandeverk ved
KOLO VEIDEKKE a.s	Ska 11	Slitelag	Moss

	Tilsiktet	Toleranse
Bindemiddel	6,40	0,4
Hulrom	3,50	1,50
Forbruk		
Massetemp v/prod	180	
Dekkets densitet	2,376	
Maks vanninnh. %		
Andre		

Proporsjoneringsverdier

Deformasjon	40°C , mikrostrain		5390
E - modul	10°C, MPa		6234
E - modul	20°C, MPa		2103
Densitet ps	g/cm3		2,462
Densitet pd	g/cm3		2,398
Hulrom	%		2,6
Bitumenfylt hulrom	%		85,2
Gyrator	sykler		80,0

	0,063	0,125	0,25	0,5	1,0	2,0	4,0	8,0	11,2	16,0	22,4	26,5	
K4	10	13	16	18	22	28	38	56	95	100	100	100	A - Restprosent
K4T	2,0	3,0	4,0	4,0	4,0	6,0	6,0	6,0	6,0				B - Toleranse (T1)



Tilslag	Forekomst	Dens ps	Mølleverdi	FI	LA	KL	Sortering	Andel
Pukk	Hadeland Pukkve	2,600	3,4	9	12		8/11	54,0 %
Pukk	Hadeland Pukkve	2,600		18			4/8	5,0 %
Steinmel	Moss pukkverk	2,980					0/4	33,0 %
Filler	Steens Kalkverk	2,740					0/0,5	8,0 %
								%
								%
								%
								%

Bindemiddeltype: 50/70 | Cellulosefiber 4,00 % | Wetfix BE 0,50 % | %44

Arbeidsresepter godkjennes
Vegkontoret i ....
Dato .... Underskrift ....

Entrepenør ..KOLO VEIDEKKE a.s..........
Sted ..Ås.........., den ...29.05.2006..
Underskrift...Odd Christiansen..........

Figure 0.5 Receipt n. 06209407.

KOLO VEIDEKKE — **Arbeidsresept for bituminøse vegdekker og bærelag**

Kontrakt	Oppdragsgiver	Vegnr	Dato	Arb.resept nr.
12-2006-06 pkt.11	SVV, Region Øst	FV 56	11.05.2006	06205205

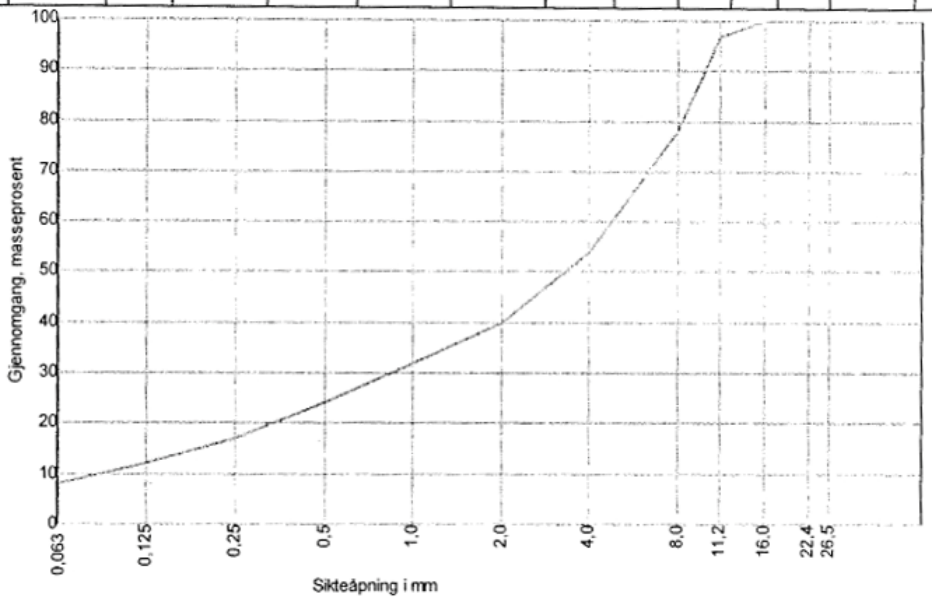
Entreprenør	Dekketype	Bruksområde	Blandeverk ved
KOLO VEIDEKKE a.s	Agb 11		Moss

	Tilsiktet	Toleranse
Bindemiddel	5,60	0,4
Hulrom	4,50	2,50
Forbruk		
Massetemp v/prod	155	
Dekkets densitet	2,453	
Maks vanninnh. %		
Andre		

Marshallverdier ved proporsjonering

Stabilitet N ved	°C	
Flyt	mm	
Stab/Flyt	N/mm	
Densitet ps	g/cm3	2,568
Densitet pd	g/cm3	
Hulrom	%	100,0
Bitumenfylt hulrom	%	
Slag		

	0,063	0,125	0,25	0,5	1,0	2,0	4,0	8,0	11,2	16,0	22,4	26,5	
K4	8	12	17	24	32	40	54	78	97	100	100	100	A - Restprosent
K4T	2,0	4,0	7,0	7,0	7,0	10,0	10,0	10,0	10,0				B - Toleranse (T1)



Tilslag	Forekomst	Dens ps	Mølleverdi	FI	LA	KL	Sortering	Andel
Pukk	Bjønndalen Bruk	2,720	6,6	9	15		8/11	25,0 %
Pukk	Bjønndalen Bruk	2,720		9			4/8	15,0 %
Steinmel	Moss pukkverk	2,980					0/4	44,0 %
Grus	Fossen	2,710					0/4	15,0 %
Filler	Steens Kalkverk	2,740					0/0,5	1,0 %
								%
								%
								%
Bindemiddeltype: 160/220	Wetfix BE		0,50%			%		%

Arbeidsresepter godkjennes Vegkontoret i .... Dato........ Underskrift........	Entreprenør ..KOLO VEIDEKKE a.s........ Sted ....Ås........ den ....11.09.2006.. Underskrift...Odd Christiansen........

Figure 0.6 Receipt n. 06205205.

[redacted] **Arbeidsresept for bituminøse vegdekker og bærelag**

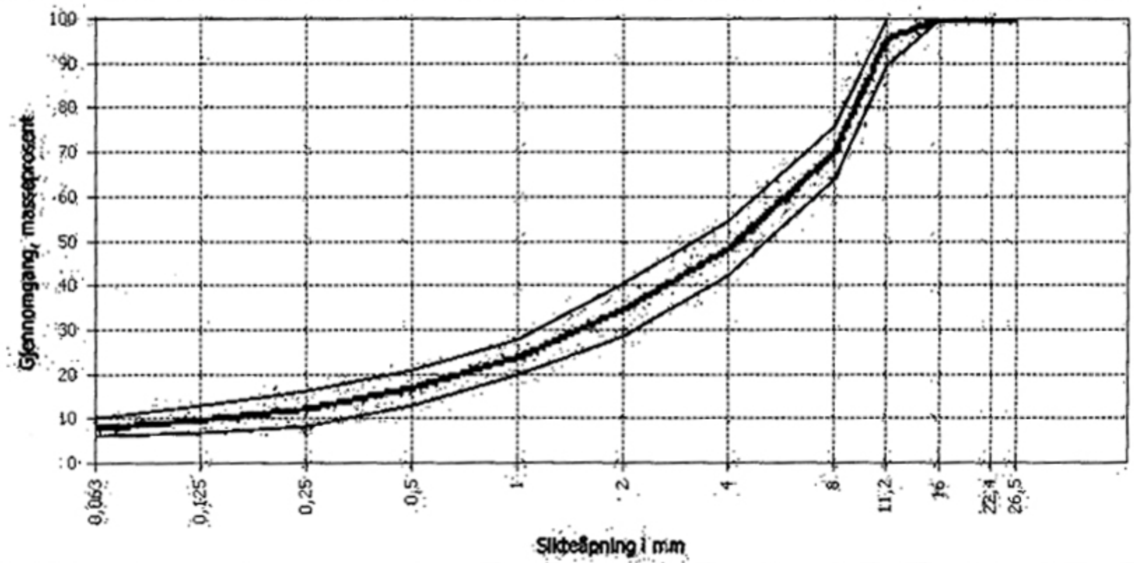
Kontrakt	Oppdragsgiver	Vegnr	Dato	Arb. resept nr.
			10.02.2010	10273302

Entrepenør	Dekketype	Bruksområde	Blandeverk ved
Kolo Veidekke a.s	AB 11	Slitelag	Sjøla

	Tilsiktet	Toleranse
Bindemiddel	6,00	0,4
Hulrom	3,50	1,50
Forbruk		
Massetemp v/prod	160	20
Dekkets densitet	2,414	
Maks vanninnh. %		
Andre		

Marshallverdier ved proporsjonering	
Stabilitet N ved	
Flyt	
Stab/Flyt	0
Densitet ps	2,502
Densitet pd	
Hulrom	100,0
Bitumenfylt hulrom	0,0
Slag	0,0

	0,063	0,125	0,25	0,5	1,0	2,0	4,0	8,0	11,2	16,0	22,4	26,5	
K4	8	9,9	12,4	16,9	23,7	34,5	48,4	69,9	95,5	100	100	100	A - Restprosent
K4T	2,0	3,0	4,0	4,0	4,0	6,0	6,0	6,0	6,0	0,0	0,0	0,0	B - Toleranse (T2)



Tilslag	Forekomst	Dens ps	Mølleverdi	FI	LA	KL	Sortering	Andel
Pukk	Ottersbo	2,740					8-11	38,0 %
Steinmel	Ottersbo	2,720					0-8	17,0 %
		2,700						%
Steinmel	Vassfjell	3,000					0-4	15,0 %
Grus	Søberg	2,700					0-8 N	25,0 %
Filler	Hylla	2,740					0-0,5	5,0 %
								%
								%

Bindemiddeltype 70/100	Amin	0,50 %		%		%

Arbeidsresepter godkjennes		Entrepenør	Kolo Veidekke a.s		
Vegkontoret i..		Sted	Sjøla	den	02.09.2010
Dato	Underskrift...	Underskrift	Olav Troan		

Figure 0.7 Receipt n. 10273302.

[redacted]

Arbeidsresept for bituminøse vegdekker og bærelag

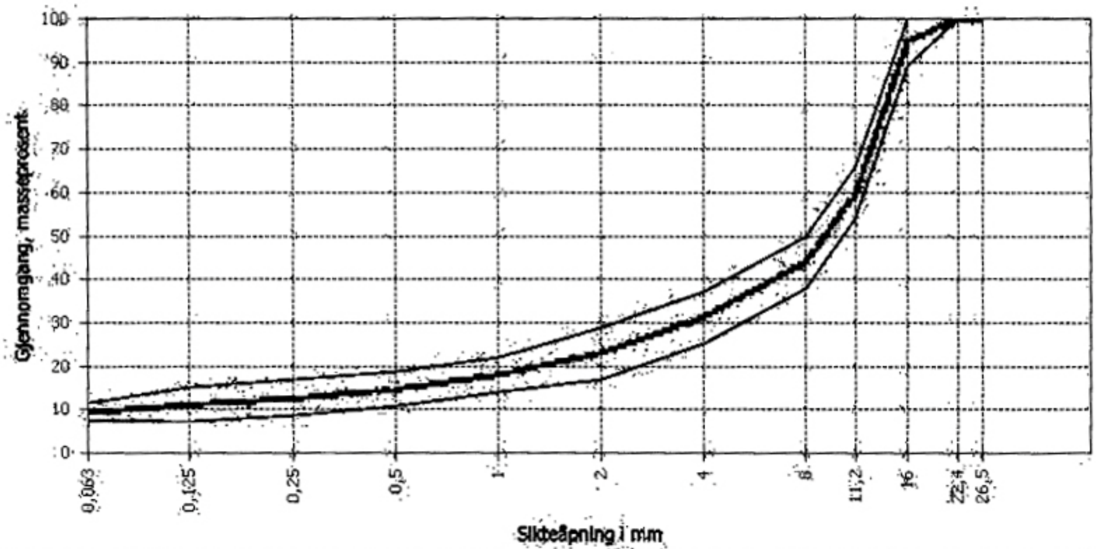
Kontrakt	Oppdragsgiver	Vegnr	Dato	Arb. resept nr.
			10.02.2010	10279502

Entrepenør	Dekketype	Bruksområde	Blandeverk ved
Kolo Veidekke a.s	SKA 16	Slitelag	Sjøla

	Tilsiktet	Toleranse
Bindemiddel	6,10	0,4
Hulrom	3,50	1,50
Forbruk		
Massetemp v/prod	160	20
Dekkets densitet	2,410	
Maks vanninnh. %		
Andre		

Marshallverdier ved proporsjonering	
Stabilitet N ved	
Flyt	
Stab/Flyt	0
Densitet ps	2,497
Densitet pd	
Hulrom	100,0
Bitumenfylt hulrom	0,0
Slag	0,0

	0,063	0,125	0,25	0,5	1,0	2,0	4,0	8,0	11,2	16,0	22,4	26,5	
K4	9,5	11,3	12,8	14,7	18	23	31,3	44	60,1	95	100	100	A - Restprosent
K4T	2,0	4,0	4,0	4,0	4,0	6,0	6,0	6,0	6,0	6,0	0,0	0,0	B - Toleranse (T2)



Tilslag	Forekomst	Dens ps	Mølleverdi	FI	LA	KL	Sortering	Andel
Pukk	Ottersbo	2,720					11-16	50,0 %
Steinmel	Ottersbo	2,720					0-8	20,0 %
Steinmel	Vassfjell	3,000					0-4	16,0 %
Grus	Søberg	2,700					0-8N	6,0 %
Filler	Hylla	2,740					0-0,5	8,0 %
								%
								%
								%

Bindemiddeltype	ViaFlex 65	Amin	0,50 %	Fiber	6,00 %	%

Arbeidsresepter godkjennes		Entrepenør	Kolo Veidekke a.s		
Vegkontoret i...		Sted	Sjøla	den	02.09.2010
Dato	Underskrift..	Underskrift	Olav Trøan		

Figure 0.8 Receipt n. 10279502.

[redacted] **Arbeidsresept for bituminøse vegdekker og bærelag**

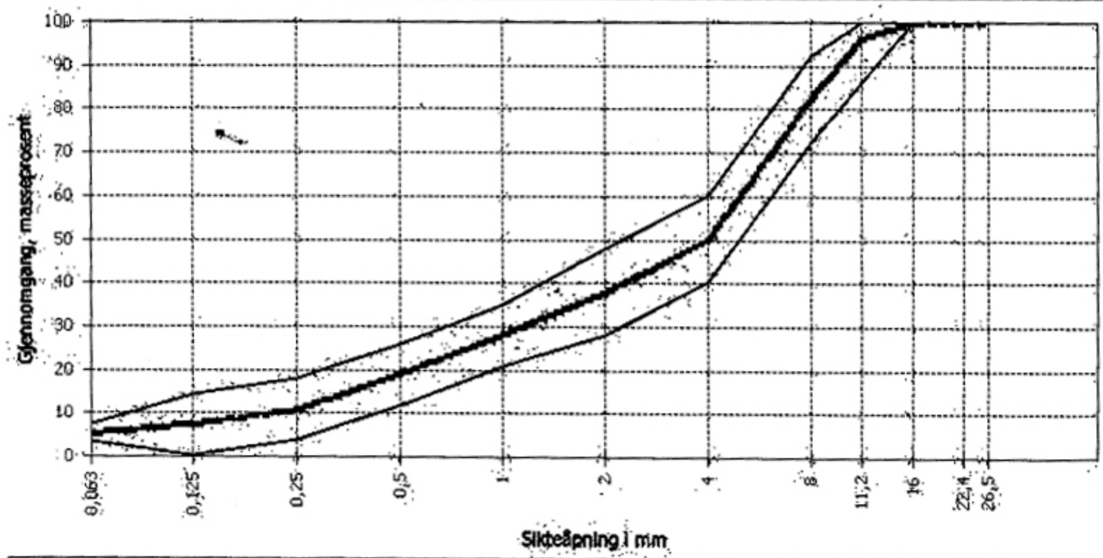
Kontrakt	Oppdragsgiver	Vegnr	Dato	Arb. resept nr.
			10.02.2010	10275202

Entrepenør	Dekketype	Bruksområde	Blandeverk ved
Kolo Veidekke a.s	AGB 11	Slitelag	Sjøla

	Tilsiktet	Toleranse
Bindemiddel	5,80	0,4
Hulrom	3,50	1,50
Forbruk		
Massetemp v/prod	150	20
Dekkets densitet	2,436	
Maks vanninnh. %		
Andre		

Marshallverdier ved proporsjonering	
Stabilitet N ved	
Flyt	
Stab/Flyt	0
Densitet ps	2,524
Densitet pd	
Hulrom	100,0
Bitumenfylt hulrom	0,0
Slag	0,0

	0,063	0,125	0,25	0,5	1,0	2,0	4,0	8,0	11,2	16,0	22,4	26,5	
K4	5,5	7,5	11	19	28	38	50,3	82,5	96,2	100	100	100	A - Restprosent
K4T	2,0	4,0	7,0	7,0	7,0	10,0	10,0	10,0	10,0	0,0	0,0	0,0	B - Toleranse (T2)



Tilslag	Forekomst	Dens ps	Mølleverdi	FI	LA	KL	Sortering	Andel
Pukk	Vassfjell pukkv	3,000	0,0			0	8-11	15,0 %
Pukk	Vassfjell pukkv	2,980	0,0			0	4-8	15,0 %
Grus	Søberg	2,700	100,0	100	100	100	0-8	70,0 %
								%
								0,0 %
								0,0 %
								0,0 %
								0,0 %

Bindemiddeltype 160/220	Amin	0,50 %		%		%

Arbeidsresepter godkjennes		Entrepenør	Kolo Veidekke a.s
Vegkontoret i...		Sted	Sjøla den 02.09.2010
Dato	Underskrift..	Underskrift	Olav Trøan

Figure 0.9 Receipt n. 10275202.

[redacted]

Arbeidsresept for bituminøse vegdekker og bærelag

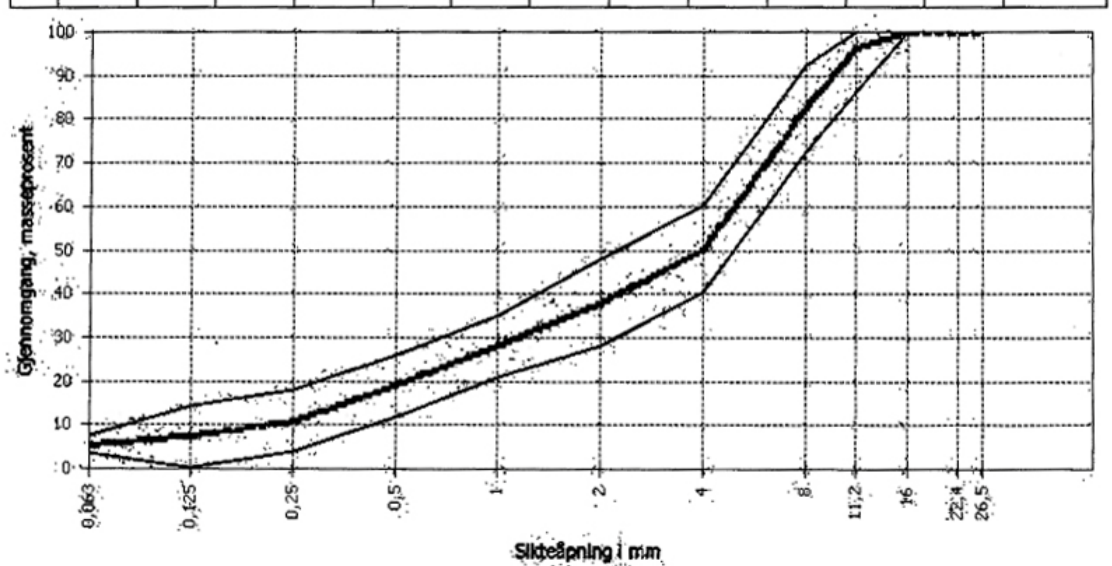
Kontrakt	Oppdragsgiver	Vegnr	Dato	Arb. resept nr.
			10.02.2010	10275201

Entrepenør	Dekketype	Bruksområde	Blandeverk ved
Kolo Veidekke a.s	AGB 11	Slitelag	Sjøla

	Tilsiktet	Toleranse
Bindemiddel	5,80	0,4
Hulrom	3,50	1,50
Forbruk		
Massetemp v/prod	150	20
Dekkets densitet	2,433	
Maks vanninnh. %		
Andre		

Marshallverdier ved proporsjonering	
Stabilitet N ved	
Flyt	
Stab/Flyt	0
Densitet ps	2,522
Densitet pd	
Hulrom	100,0
Bitumenfylt hulrom	0,0
Slag	0,0

	0,063	0,125	0,25	0,5	1,0	2,0	4,0	8,0	11,2	16,0	22,4	26,5	
K4	5,5	7,5	11	19	28	38	50,3	82,5	96,2	100	100	100	A - Restprosent
K4T	2,0	4,0	7,0	7,0	7,0	10,0	10,0	10,0	10,0	0,0	0,0	0,0	B - Toleranse (T2)



Tilslag	Forekomst	Dens ps	Mølleverdi	FI	LA	KL	Sortering	Andel
Pukk	Vassfjell pukkv	3,000	0,0			0	8-11	15,0 %
Pukk	Vassfjell pukkv	2,980	0,0			0	4-8	15,0 %
Grus	Søberg	2,700	100,0	100	100	100	0-8	60,0 %
Gjenbruk	Sjøla/gjenbruk	2,670	0,0				0-11	10,0 %
								0,0 %
								0,0 %
								0,0 %
								0,0 %

Bindemiddeltype 160/220	Amin	0,50 %		%	%

Arbeidsresepter godkjennes		Entrepenør	Kolo Veidekke a.s
Vegkontoret i...		Sted	Sjøla den 02.09.2010
Dato	Underskrift...	Underskrift	Olav Trøan

Figure 0.10 Receipt n. 10275201.

[redacted]

Arbeidsresept for bituminøse vegdekker og bærelag

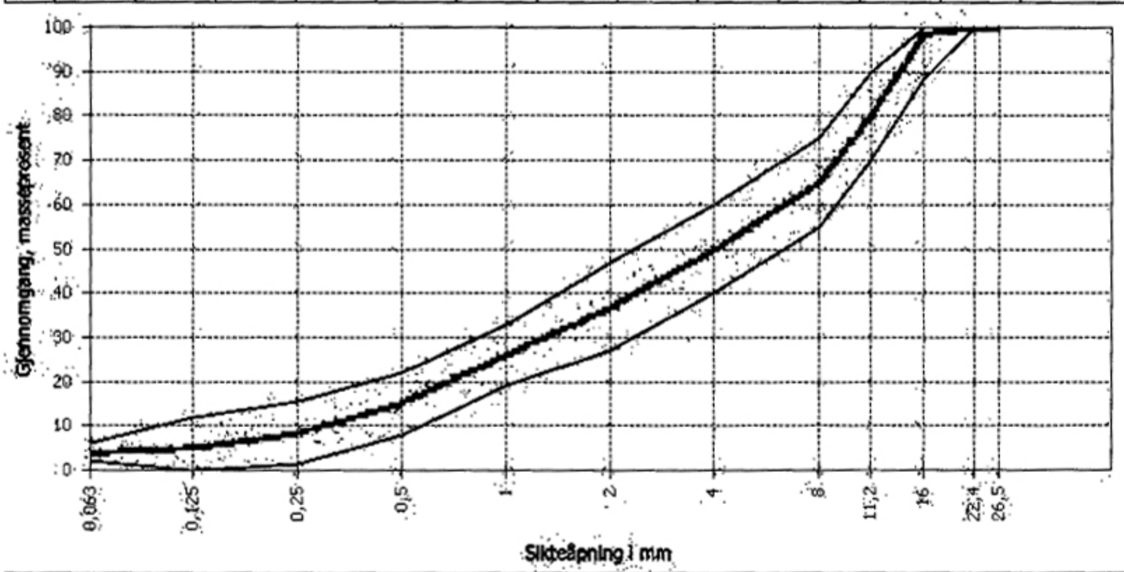
Kontrakt	Oppdragsgiver	Vegnr	Dato	Arb. resept nr.
			10.02.2010	10275301

Entreprenør	Dekketype	Bruksområde	Blandeverk ved
Kolo Veidekke a.s	AGB 16	Slitelag	Sjøla

	Tilsiktet	Toleranse
Bindemiddel	5,60	0,4
Hulrom	3,50	1,50
Forbruk		
Massetemp v/prod	150	20
Dekkets densitet	2,453	
Maks vanninnh. %		
Andre		

Marshallverdier ved proporsjonering	
Stabilitet N ved	
Flyt	
Stab/Flyt	0
Densitet ps	2,542
Densitet pd	
Hulrom	100,0
Bitumenfylt hulrom	0,0
Slag	0,0

	0,063	0,125	0,25	0,5	1,0	2,0	4,0	8,0	11,2	16,0	22,4	26,5	
K4	4	5	8,5	15	26	37	50	65	80	98,5	100	100	A - Restprosent
K4T	2,0	4,0	7,0	7,0	7,0	10,0	10,0	10,0	10,0	10,0	0,0	0,0	B - Toleranse (T2)



Tilslag	Forekomst	Dens ps	Mølleverdi	FI	LA	KL	Sortering	Andel
Pukk	Vassfjell pukkv	3,000	0,0			0	11-16	15,0 %
Pukk	Vassfjell pukkv	3,000	0,0			0	8-11	10,0 %
Pukk	Vassfjell pukkv	2,980	0,0			0	4-8	10,0 %
Grus	Søberg	2,700	100,0	100	100	100	0-8	55,0 %
Gjenbruk	Sjøla/gjenbruk	2,670	0,0			5	0-11	10,0 %
								0,0 %
								0,0 %
								0,0 %

Bindemiddeltype 160/220	Amin	0,50 %		%		%

Arbeidsresepter godkjennes		Entreprenør	Kolo Veidekke a.s		
Vegkontoret i..		Sted	Sjøla	den	02.09.2010
Dato	Underskrift..	Underskrift	Olav Trøan		

Figure 0.11 Receipt n. 10275301.

Arbeidsresept for bituminøse vegdekker og bærelag

Kontrakt	Oppdragsgiver	Vegnr	Dato	Arb.resept nr.
12-2006-06 pkt.05	SVV, Region Øst	RV 156	20.01.2006	06209409

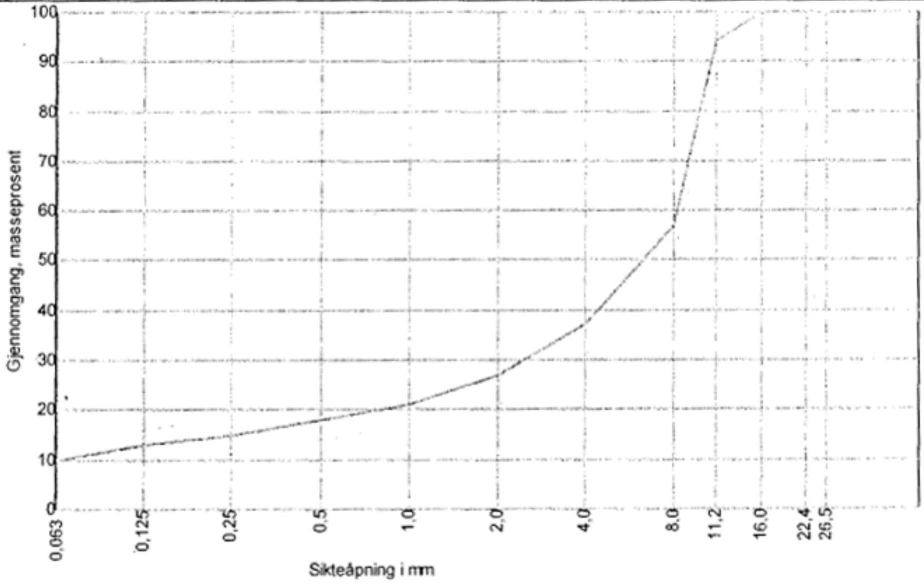
Entrepenør	Dekketype	Bruksområde	Blandeverk ved
KOLO VEIDEKKE a.s	Ska 11	Slitelag	Moss

	Tilsiktet	Toleranse
Bindemiddel	5,90	0,4
Hulrom	3,50	1,50
Forbruk		
Massetemp v/prod	165	
Dekkets densitet	2,433	
Maks vanninnh. %		
Andre		

Marshallverdier ved proporsjonering

Stabilitet N ved 60 °C		8324
Flyt	mm	3,5
Stab/Flyt	N/mm	2378
Densitet ps	g/cm3	2,521
Densitet pd	g/cm3	2,464
Hulrom	%	2,3
Bitumenfylt hulrom	%	86,3
Slag		75,0

	0,063	0,125	0,25	0,5	1,0	2,0	4,0	8,0	11,2	16,0	22,4	26,5	
K4	10	13	15	18	21	27	37	57	94	100	100	100	A - Restprosent
K4T	2,0	3,0	4,0	4,0	4,0	6,0	6,0	6,0	6,0				B - Toleranse (T1)



Tilslag	Forekomst	Dens ps	Mølleverdi	FI	LA	KL	Sortering	Andel
Pukk	Bjønndalen	2,680	6,6	9	15		8/11	48,0 %
Pukk	Bjønndalen	2,680		9			4/8	14,0 %
Steinmel	Moss pukkverk	2,980					0/4	36,0 %
Filler	Steens kalkverk	2,740					0/0,5	2,0 %
								%
								%
								%
								%

Bindemiddeltype: 70/100 | Cellulosefiber 4,00% | Wetfix BE 0,50 % | %

Arbeidsresepter godkjennes
Vegkontoret i ....
Dato.......... Underskrift........................

Entrepenør ..KOLO VEIDEKKE a.s..........
Sted ..Ås.........................., den ...11.09.2006.
Underskrift...Odd Christiansen...................

Figure 0.12 Receipt n. 06209409.

[redacted] **Arbeidsresept for bituminøse vegdekker og bærelag**

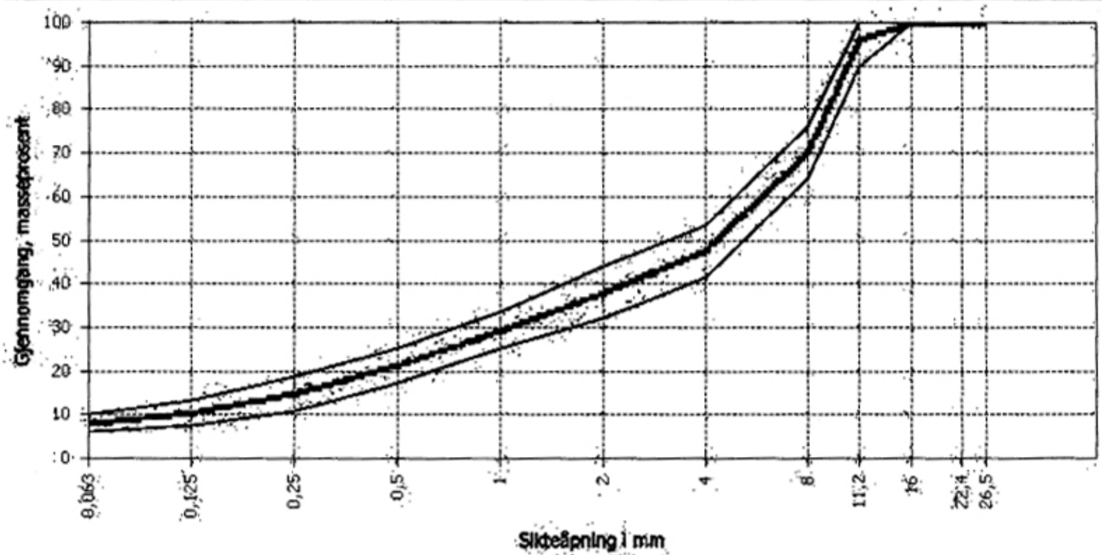
Kontrakt	Oppdragsgiver	Vegnr	Dato	Arb. resept nr.
			07.02.2010	10263302

Entrepenør	Dekketype	Bruksområde	Blandeverk ved
Kolo Veidekke a.s	AB 11	Slitelag	Stjørdal

	Tilsiktet	Toleranse
Bindemiddel	6,00	0,4
Hulrom	3,50	1,50
Forbruk		
Massetemp v/prod	160	20
Dekkets densitet	2,382	
Maks vanninnh. %		
Andre		

Marshallverdier ved proporsjonering	
Stabilitet N ved	
Flyt	
Stab/Flyt	0
Densitet ps	2,469
Densitet pd	
Hulrom	100,0
Bitumenfylt hulrom	0,0
Slag	0,0

	0,063	0,125	0,25	0,5	1,0	2,0	4,0	8,0	11,2	16,0	22,4	26,5	
K4	8,1	10,5	14,8	21,3	29,4	38	47,5	70,2	95,9	100	100	100	A - Restprosent
K4T	2,0	3,0	4,0	4,0	4,0	6,0	6,0	6,0	6,0	0,0	0,0	0,0	B - Toleranse (T2)



Tilslag	Forekomst	Dens ps	Mølleverdi	FI	LA	KL	Sortering	Andel
Pukk	Ottersbo	2,740					8-11	30,0 %
Pukk	Ottersbo	2,720					4-8	20,0 %
Steinmel	Lauvåsen	2,710					0-4	15,0 %
Grus	Hembre	2,700					0-8 N	30,0 %
Filler	Hylla	2,740					0-0,5	5,0 %
								%
								%
								%

Bindemiddeltype	ViaFlex 65	Amin	0,50 %		%		%

Arbeidsresepter godkjennes		Entrepenør	Kolo Veidekke a.s		
Vegkontoret i..		Sted	Sjøla	den	21.10.2010
Dato	Underskrift...	Underskrift	Olav Trøan		

Figure 0.13 Receipt n. 10263302.

Arbeidsresept for bituminøse vegdekker og bærelag

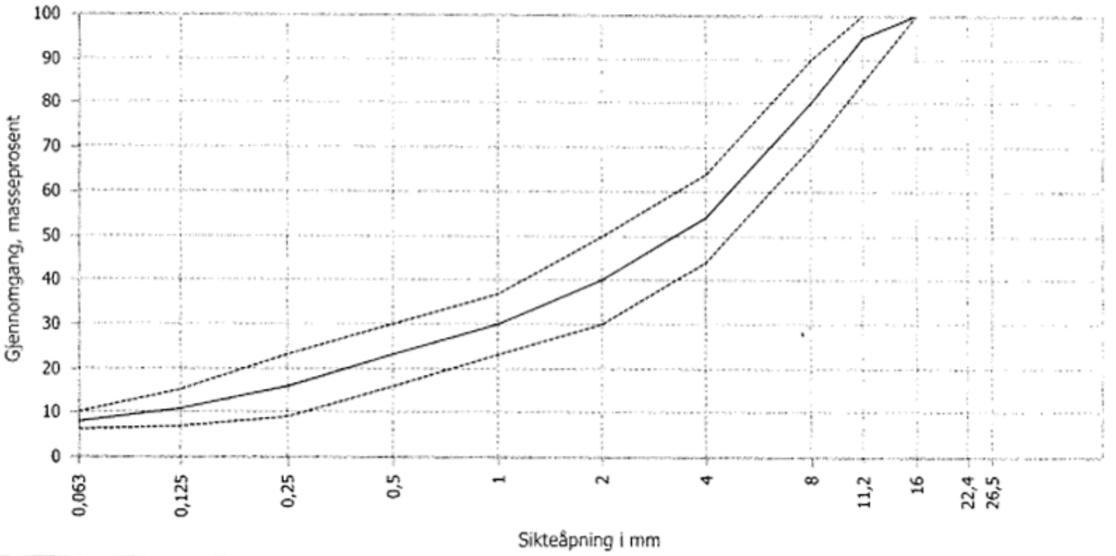
Kontrakt	Oppdragsgiver	Vegnr	Dato	Arb. resept nr.
			12.03.2010	10321320

Entreprenør	Dekketype	Bruksområde	Blandeverk ved
Lemminkäinen Norge AS	AGB 11		Elverum

	Tilsiktet	Toleranse
Bindemiddel	5,90	0,4
Hulrom	4,50	2,50
Forbruk	0	0
Massetemp v/prod	150	20
Dekkets densitet	2,312	0,000
Maks vanninnh. %	0,000	0,000

Marshallverdier ved proporsjonering	
Stabilitet N ved	0
Flyt	0,0
Stab/Flyt	0
Densitet ps	2,421
Densitet pd	0,000
Hulrom	100,0
Bitumenfylt hulrom	0,0
Slag	0,0

	0,063	0,125	0,25	0,5	1,0	2,0	4,0	8,0	11,2	16,0	22,4	26,5	
K4	8	11	16	23	30	40	54	80	95	100	100	100	A - Restprosent
K4T	2,0	4,0	7,0	7,0	7,0	10,0	10,0	10,0	10,0	0,0	0,0	0,0	



Tilslag	Forekomst	Dens ps	Mølleverdi	FI	LA	KL	Sortering	Andel
Kn.grus	Grundset	2,650	9,8	12	17	0	8-11	20,0 %
Kn.grus	Grundset	2,650	0,0	11		0	4-8	25,0 %
Kn.grus	Grundset	2,650	0,0			0	0-4	51,0 %
Filler	Kalkfiller	2,750	0,0			0		4,0 %
		0,000	0,0			0		0,0 %
		0,000	0,0			0		0,0 %
		0,000						0,0 %
		0,000						0,0 %

Bindemiddeltype 160/220		%		%		%

Arbeidsresepter godkjennes		Entreprenør	Lemminkäinen Norge AS		
Vegkontoret i..		Sted	Fjellhamar	den	25.10.2010
Dato	Underskrift..	Underskrift	Magne L. Enger		

Figure 0.14 Receipt n. 10321320.

Arbeidsresept for bituminøse vegdekker og bærelag

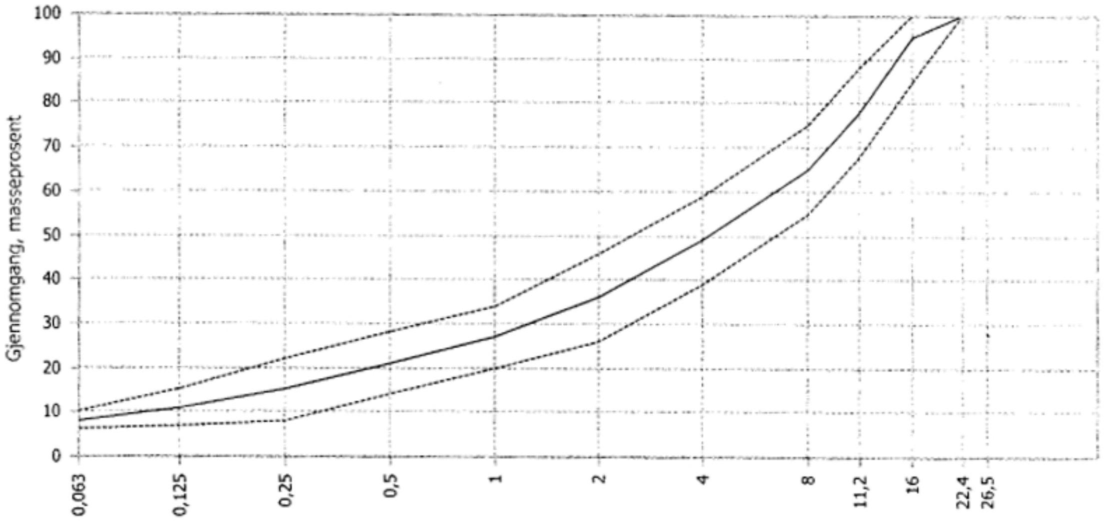
Kontrakt	Oppdragsgiver	Vegnr	Dato	Arb. resept nr.
			08.06.2010	10321331

Entreprenør	Dekketype	Bruksområde	Blandeverk ved
Lemminkäinen Norge AS	AGB 16	Slitelag	Elverum

	Tilsiktet	Toleranse
Bindemiddel	5,70	0,4
Hulrom	4,50	2,50
Forbruk		
Massetemp v/prod	150	20
Dekkets densitet	2,333	
Maks vanninnh. %		
Andre		

Marshallverdier ved proporsjonering	
Stabilitet N ved	
Flyt	
Stab/Flyt	0
Densitet ps	2,443
Densitet pd	
Hulrom	0,0
Bitumenfylt hulrom	0,0
Slag	0,0

	0,063	0,125	0,25	0,5	1,0	2,0	4,0	8,0	11,2	16,0	22,4	26,5	
K4	8	11	15	21	27	36	49	65	78	95	100	100	A - Restprosent
K4T	2,0	3,0	7,0	7,0	7,0	10,0	10,0	10,0	10,0	10,0	0,0	0,0	



Tilslag	Forekomst	Dens ps	Mølleverdi	FI	LA	KL	Sortering	Andel
Pukk	Grundset	2,650	0,0			0	11-16	25,0 %
Pukk	Grundset	2,650	0,0			0	8-11	12,0 %
Finpukk	Grundset	2,650	0,0			0	4-8	12,0 %
Knust grus	Grundset	2,650	0,0			0	0-4	48,0 %
Filler	Kalkstein	2,750	0,0			0		3,0 %
								0,0 %
								0,0 %
								0,0 %
Bindemiddeltype 160/220		Amin	0,30 %			%		%

Arbeidsresepter godkjennes		Entreprenør	Lemminkäinen Norge AS		
Vegkontoret i..		Sted	Fjellhamar	den	25.10.2010
Dato	Underskrift..	Underskrift	Magne L. Enger		

Figure 0.15 Receipt n. 10321331.

Arbeidsresept for bituminøse vegdekker og bærelag

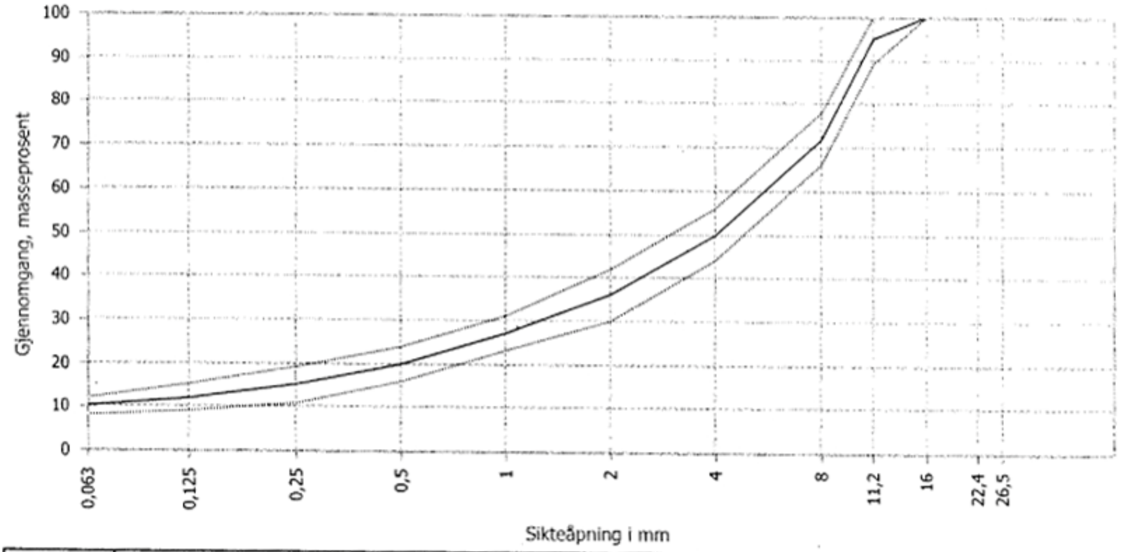
Kontrakt	Oppdragsgiver	Vegnr	Dato	Arb. resept nr.
			19.05.2010	10317127

Entreprenør	Dekketype	Bruksområde	Blandeverk ved
Lemminkäinen Norge AS	AB 11 L		Tønsberg

	Tilsiktet	Toleranse
Bindemiddel	5,70	0,4
Hulrom	3,50	1,50
Forbruk		
Massetemp v/prod	160	20
Dekkets densitet	2,387	
Maks vanninnh. %		
Andre		

Marshallverdier ved proporsjonering	
Stabilitet N ved	
Flyt	
Stab/Flyt	0
Densitet ps	2,473
Densitet pd	
Hulrom	0,0
Bitumenfylt hulrom	0,0
Slag	0,0

	0,063	0,125	0,25	0,5	1,0	2,0	4,0	8,0	11,2	16,0	22,4	26,5	
K4	10	12	15	20	27	36	50	72	95	100	100	100	A - Restprosent
K4T	2,0	3,0	4,0	4,0	4,0	6,0	6,0	6,0	6,0	0,0	0,0	0,0	



Tilslag	Forekomst	Dens ps	Mølleverdi	FI	LA	KL	Sortering	Andel
Pukk	Edelsplitt	2,740	9,2			0	8-11	10,0 %
Pukk	Haraldstad rød	2,700	0,0			0	8-11	22,0 %
Pukk	Haraldstad rød	2,700	0,0			0	4-8	14,0 %
Pukk	Haraldstad rød	2,700	0,0			0	0-4	19,0 %
Pukk	Haraldstad grå	2,710	0,0			0	0-4	29,0 %
Filler	Norcem filler	2,760	0,0			0	-	6,0 %
								0,0 %
								0,0 %
Bindemiddeltype 70/100	Amin	0,30 %			%			%

Arbeidsresepter godkjennes		Entreprenør	Lemminkäinen Norge AS	
Vegkontoret i..		Sted	Fjellhamar	den 25.10.2010
Dato	Underskrift..	Underskrift	Magne L. Enger	

Figure 0.16 Receipt n. 10317127.

Arbeidsresept for bituminøse vegdekker og bærelag

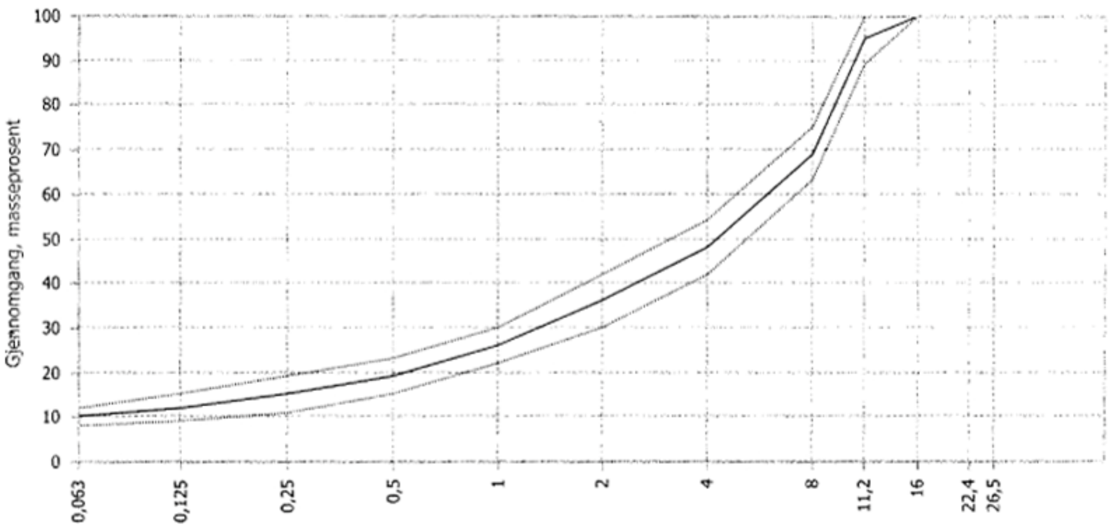
Kontrakt	Oppdragsgiver	Vegnr	Dato	Arb. resept nr.
			14.01.2010	10317124

Entreprenør	Dekketype	Bruksområde	Blandeverk ved
Lemminkäinen Norge AS	AB 11 grå		Tønsberg

	Tilsiktet	Toleranse
Bindemiddel	5,70	0,4
Hulrom	3,50	1,50
Forbruk		
Massetemp v/prod	160	20
Dekkets densitet	2,388	
Maks vanninnh. %		
Andre		

Marshallverdier ved proporsjonering	
Stabilitet N ved	
Flyt	
Stab/Flyt	0
Densitet ps	2,475
Densitet pd	
Hulrom	
Bitumenfylt hulrom	0,0
Slag	0,0

	0,063	0,125	0,25	0,5	1,0	2,0	4,0	8,0	11,2	16,0	22,4	26,5	
K4	10	12	15	19	26	36	48	69	95	100	100	100	A - Restprosent
K4T	2,0	3,0	4,0	4,0	4,0	6,0	6,0	6,0	6,0	0,0	0,0	0,0	



Tilslag	Forekomst	Dens ps	Mølleverdi	FI	LA	KL	Sortering	Andel
Pukk	Haraldstad grå	2,710	0,0			0	8-11	34,0 %
Pukk	Haraldstad grå	2,710	0,0			0	4-8	14,0 %
Pukk	Haraldstad grå	2,710	0,0			0	0-4	47,0 %
Filler	Norcem filler	2,760	0,0			0	-	5,0 %
								0,0 %
								0,0 %
								0,0 %
								0,0 %

Bindemiddeltype 70/100	Amin	0,30 %		%		%

Arbeidsresepter godkjennes		Entreprenør	Lemminkäinen Norge AS		
Vegkontoret i..		Sted	Fjellhamar	den	25.10.2010
Dato	Underskrift...	Underskrift	Magne L. Enger		

Figure 0.17 Receipt n. 10317124.

Arbeidsresept for bituminøse vegdekker og bærelag

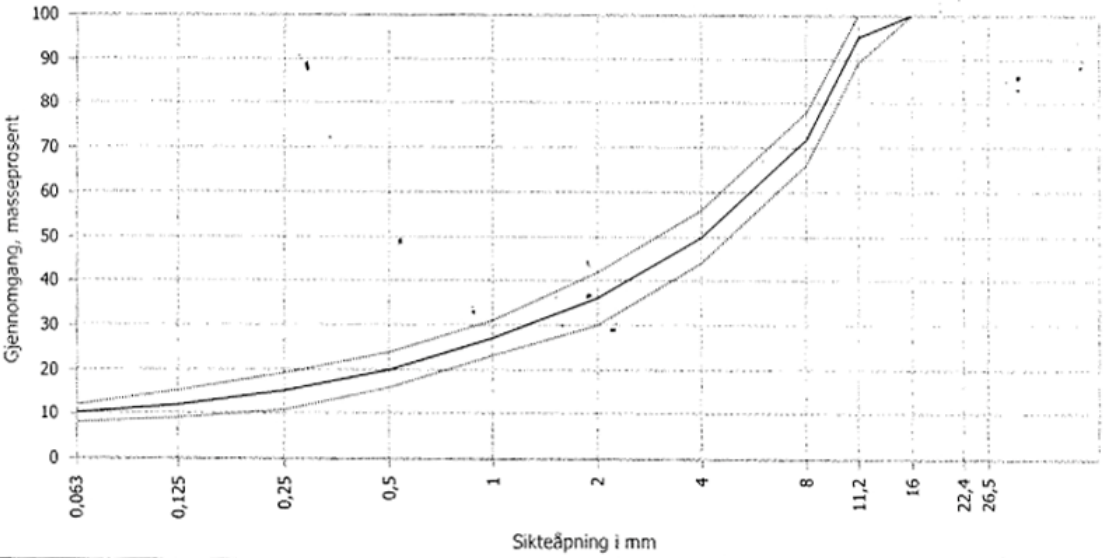
Kontrakt	Oppdragsgiver	Vegnr	Dato	Arb. resept nr.
			28.06.2010	10317119

Entrepenør	Dekketype	Bruksområde	Blandeverk ved
Lemminkäinen Norge AS	AB 11 LP	Slitelag	Tønsberg

	Tilsiktet	Toleranse
Bindemiddel	5,70	0,4
Hulrom	3,50	1,50
Forbruk		
Massetemp v/prod	180	20
Dekkets densitet	2,387	
Maks vanninnh. %		
Andre		

Marshallverdier ved proporsjonering	
Stabilitet N ved	
Flyt	
Stab/Flyt	0
Densitet ps	2,473
Densitet pd	
Hulrom	0,0
Bitumenfylt hulrom	0,0
Slag	0,0

	0,063	0,125	0,25	0,5	1,0	2,0	4,0	8,0	11,2	16,0	22,4	26,5	
K4	10	12	15	20	27	36	50	72	95	100	100	100	A - Restprosent
K4T	2,0	3,0	4,0	4,0	4,0	6,0	6,0	6,0	6,0	0,0	0,0	0,0	



Tilslag	Forekomst	Dens ps	Mølleverdi	FI	LA	KL	Sortering	Andel
Pukk	Edelsplitt	2,740	9,2			0	8-11	10,0 %
Pukk	Haraldstad rød	2,700	0,0			0	8-11	22,0 %
Pukk	Haraldstad rød	2,700	0,0			0	4-8	14,0 %
Pukk	Haraldstad rød	2,700	0,0			0	0-4	19,0 %
Pukk	Haraldstad grå	2,710	0,0			0	0-4	29,0 %
Filler	Norcem filler	2,760	0,0			0	-	6,0 %
								0,0 %
								0,0 %

Bindemiddeltype LemFlex A	Amin	0,30 %	%	%

Arbeidsresepter godkjennes		Entrepenør	Lemminkäinen Norge AS	
Vegkontoret i..		Sted	Fjellhamar	den 25.10.2010
Dato	Underskrift..	Underskrift	Magne L. Enger	

Figure 0.18 Receipt n. 10317119.

Arbeidsresept for bituminøse vegdekker og bærelag

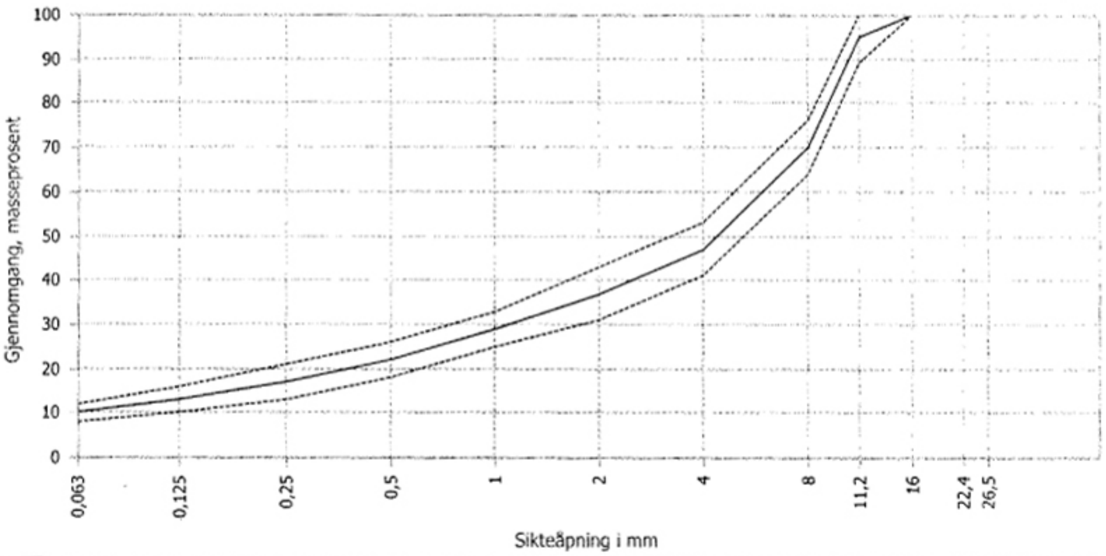
Kontrakt	Oppdragsgiver	Vegnr	Dato	Arb. resept nr.
			09.06.2008	08321125

Entrepenør	Dekketype	Bruksområde	Blandeverk ved
Lemminkäinen Norge AS	AB 11 GIL		Elverum

	Tilsiktet	Toleranse
Bindemiddel	5,80	0,4
Hulrom	4,50	2,50
Forbruk		
Massetemp v/prod	200	20
Dekkets densitet	2,343	
Maks vanninnh. %		
Andre		

Marshallverdier ved proporsjonering	
Stabilitet N ved	13793
Flyt	3,3
Stab/Flyt	4180
Densitet ps	2,454
Densitet pd	2,388
Hulrom	2,7
Bitumenfylt hulrom	82,5
Slag	0,0

	0,063	0,125	0,25	0,5	1,0	2,0	4,0	8,0	11,2	16,0	22,4	26,5	
K4	10	13	17	22	29	37	47	70	95	100	100	100	A - Restprosent
K4T	2,0	3,0	4,0	4,0	4,0	6,0	6,0	6,0	6,0				



Tilslag	Forekomst	Dens ps	Mølleverdi	FI	LA	KL	Sortering	Andel
Knust Grus	Grundset	2,650	9,8	11	17	0	8-11	32,0 %
Knust Grus	Grundset	2,650	0,0			0	4-8	20,0 %
Knust Grus	Grundset	2,650	0,0			0	0-4	43,0 %
Filler	Kalkfiller	2,750	0,0			0		5,0 %
								%
								0,0 %
								0,0 %
								0,0 %

Bindemiddeltype	70/100	Amin	0,30 %	Gilsonite	10,00 %		%

Arbeidsresepter godkjennes		Entrepenør	Lemminkäinen Norge AS		
Vegkontoret i..		Sted	Fjellhamar	den	25.10.2010
Dato	Underskrift...	Underskrift	Magne L. Enger		

Figure 0.19 Receipt n. 8321125.

APPENDIX B:
Mechanical characteristics of DRENOVAL HM, DRENOVAL HARD M and LOWVAM HM 40

DRENOVAL HM

Bitume modificato con polimeri termoplastici elastomerici SBS

- Bitume modificato con polimeri SBS (modifica HARD).
- Specifico per conglomerati bituminosi chiusi (vuoti < 6%) di base e collegamento ad elevate caratteristiche di modulo complesso dinamico.

CARATTERISTICHE	METODO DI PROVA	UNITÀ DI MISURA	RANGE VALORI	VALORI TIPICI
Penetrazione a 25°C, 100 g / 5"	EN 1426	dmm	30 ÷ 50	35
Punto di rammollimento (P.A.)	EN 1427	°C	> 70	78
Viscosità dinamica 160°C	EN 13702-1	Pas	> 0,4	0,75
Punto di rottura Fraaß	EN12593	°C	≤ - 10	- 16
Tuben Test 3 gg @ 180°C	EN 13399	°C	P.A. < 3	< 1
Ritorno elastico a 25°C	EN13398	%	> 50	70

CARATTERISTICHE DOPO RTFOT EN 12607-1	METODO DI PROVA	UNITÀ DI MISURA	RANGE VALORI	VALORI TIPICI
Penetrazione a 25°C, 100 g / 5"	% originale	%	min 60	70

CONDIZIONI OPERATIVE	UNITÀ DI MISURA	VALORI INDICATIVI
Temperatura di stoccaggio ottimale	°C	170
Temperatura di stoccaggio per max 3 gg	°C	180
Temperatura di stoccaggio prolungato oltre 5 gg	°C	140
Temperatura di impasto con inerti	°C	160 - 180
Temperatura di compattazione	°C	> 140

NB. Le caratteristiche dichiarate nella presente scheda sono garantite e sono rilevabili, su campioni omogenei di prodotto prelevati in contraddittorio alla consegna secondo le vigenti norme CEN, in particolare la EN 12594.
(Prelievo del campione omogeneo dal lotto - Preriscaldo campione, prima di ogni operazione di analisi a 190°C).

Rev. 2 – 04/10

VALLI ZABBAN

Ottanta anni avanti.

TONON GROUP

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Figure 0.1 DRENOVAL HM: mechanical characteristics.

DRENOVAL HARD M

Bitume modificato con polimeri termoplastici elastomerici SBS

- Bitume modificato con polimeri SBS (modifica HARD).
- Bitume modificato per conglomerati bituminosi di usura chiusi (vuoti < 10%) drenanti e microtappeti.

CARATTERISTICHE	METODO DI PROVA	UNITÀ DI MISURA	RANGE VALORI	VALORI TIPICI
Penetrazione a 25°C, 100 g / 5"	EN 1426	dmm	50 ÷ 70	60
Punto di rammollimento (P.A.)	EN 1427	°C	> 70	75
Viscosità dinamica 160°C	EN 13702-1	Pas	max 0,8	0,6
Punto di rottura Fraaß	EN12593	°C	≤ - 12	- 20
Tuben Test 3 gg @ 180°C	EN 13399	°C	P.A. < 3	< 1
Ritorno elastico a 25°C	EN13398	%	> 75	82

CARATTERISTICHE DOPO RTFOT EN 12607-1	METODO DI PROVA	UNITÀ DI MISURA	RANGE VALORI	VALORI TIPICI
Penetrazione a 25°C, 100 g / 5"	% originale	%	min 60	65

CONDIZIONI OPERATIVE	UNITÀ DI MISURA	VALORI INDICATIVI
Temperatura di stoccaggio ottimale	°C	170
Temperatura di stoccaggio per max 3 gg	°C	180
Temperatura di stoccaggio prolungato oltre 5 gg	°C	140
Temperatura minima di stoccaggio	°C	140
Temperatura di impasto con inerti	°C	160 - 180
Temperatura di compattazione	°C	> 140
Temperatura massima di riscaldamento	°C	180
Temperatura minima di pompaggio	°C	140

NB. Le caratteristiche dichiarate nella presente scheda sono garantite e sono rilevabili, su campioni omogenei di prodotto prelevati in contraddittorio alla consegna secondo le vigenti norme CEN, in particolare la EN 12594.
(Prelievo del campione omogeneo dal lotto - Preriscaldo campione, prima di ogni operazione di analisi a 190°C).

Rev. 3 – 04/10

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Figure 0.2 DRENOVAL HARD M: mechanical characteristics.

LOWVAL HM 40

Bitume modificato SBS ad alta lavorabilità

- Bitume modificato con polimeri SBS (modifica HARD) a viscosità controllata.
- Specifico per conglomerati bituminosi chiusi (vuoti < 6%) di base e collegamento ad elevate caratteristiche di modulo complesso dinamico.
- I conglomerati prodotti con questo legante manifestano caratteristiche di addensabilità semplificata sotto l'azione dei rulli a tutte le temperature superiori ai 90°C.

CARATTERISTICHE	METODO DI PROVA	UNITÀ DI MISURA	RANGE VALORI	VALORI TIPICI
Penetrazione a 25°C, 100 g / 5"	EN 1426	dmm	30 ÷ 50	32
Punto di rammollimento (P.A.)	EN 1427	°C	> 70	80
Viscosità dinamica 160°C	EN 13702-1	Pas	> 0,4	0,45
Punto di rottura Fraaß	EN12593	°C	≤ - 10	- 15
Tuben Test 3 gg @ 180°C	EN 13399	°C	P.A. < 3	< 1
Ritorno elastico a 25°C	EN 13398	%	> 50	75

CARATTERISTICHE DOPO RTFOT EN 12607-1	METODO DI PROVA	UNITÀ DI MISURA	RANGE VALORI	VALORI TIPICI
Penetrazione a 25°C, 100 g / 5"	% originale	%	min 60	70

CONDIZIONI OPERATIVE	UNITÀ DI MISURA	VALORI INDICATIVI
Temperatura di stoccaggio ottimale	°C	170
Temperatura di stoccaggio per max 3 gg	°C	180
Temperatura di stoccaggio prolungato oltre 5 gg	°C	140
Temperatura di impasto con inerti	°C	140 – 180
Temperatura di compattazione	°C	> 100

NB. Le caratteristiche dichiarate nella presente scheda sono garantite e sono rilevabili, su campioni omogenei di prodotto prelevati in contraddittorio alla consegna secondo le vigenti norme CEN, in particolare la EN 12594.
(Prelievo del campione omogeneo dal lotto - Preriscaldo campione, prima di ogni operazione di analisi a 190°C).

Rev. 2 – 04-10

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Figure 0.3 LOWVAL HM 40: mechanical characteristics.

APPENDIX C:
Wheeltrack test results

Wheeltracking Test Summary
Specimen Name: Ab 16 samples 3 and 4 50C
Date: 15.09.2010
Test Temperature: 50
Sample 1 Thickness: 40
Sample 2 Thickness: 40

Pass No.	Rut Depth(mm) 1	Rut Depth(mm) 2	Speed (RPM)	RTD 1 Deg.C.	RTD 2 Deg.C.
0	0	0	26,5	48,29	49,31
100	0,62	0,68	26,53	48,23	49,21
200	0,79	0,86	26,52	48,36	49,31
300	0,9	0,96	26,48	48,3	49,24
400	0,97	1,04	26,47	48,3	49,31
500	1,03	1,1	26,47	48,27	49,16
600	1,08	1,15	26,52	48,31	49,34
700	1,12	1,19	26,52	48,31	49,21
800	1,16	1,24	26,42	48,36	49,44
900	1,19	1,27	26,49	48,29	49,3
1000	1,22	1,3	26,5	48,28	49,29
1100	1,24	1,33	26,51	48,3	49,31
1200	1,26	1,36	26,49	48,37	49,38
1300	1,28	1,38	26,49	48,42	49,34
1400	1,3	1,4	26,48	48,36	49,35
1500	1,31	1,42	26,51	48,38	49,42
1600	1,33	1,44	26,5	48,43	49,39
1700	1,34	1,46	26,5	48,5	49,39
1800	1,35	1,47	26,4	48,44	49,39
1900	1,37	1,49	26,52	48,45	49,45
2000	1,38	1,5	26,5	48,49	49,38
2100	1,39	1,52	26,5	48,49	49,5
2200	1,4	1,53	26,5	48,57	49,51
2300	1,41	1,54	26,48	48,51	49,51
2400	1,43	1,56	26,48	48,58	49,52
2500	1,44	1,57	26,52	48,5	49,4
2600	1,45	1,58	26,51	48,54	49,53
2700	1,46	1,59	26,46	48,51	49,38
2800	1,47	1,6	26,52	48,52	49,38
2900	1,47	1,61	26,46	48,57	49,41
3000	1,48	1,62	26,5	48,61	49,47
3100	1,49	1,63	26,53	48,54	49,33
3200	1,5	1,64	26,48	48,63	49,49
3300	1,51	1,65	26,51	48,55	49,43
3400	1,52	1,66	26,49	48,64	49,58
3500	1,52	1,66	26,49	48,62	49,49
3600	1,53	1,67	26,48	48,63	49,49
3700	1,54	1,68	26,47	48,58	49,47
3800	1,54	1,69	26,52	48,59	49,44
3900	1,55	1,69	26,5	48,66	49,54
4000	1,55	1,7	26,54	48,59	49,38
4100	1,56	1,71	26,49	48,6	49,46
4200	1,56	1,71	26,48	48,56	49,43
4300	1,57	1,72	26,5	48,61	49,53
4400	1,57	1,72	26,56	48,61	49,41
4500	1,58	1,73	26,51	48,71	49,6
4600	1,58	1,74	26,51	48,63	49,5
4700	1,59	1,74	26,51	48,66	49,5
4800	1,59	1,75	26,33	48,63	49,52
4900	1,6	1,76	26,5	48,71	49,6
5000	1,6	1,76	26,46	48,64	49,4
5100	1,61	1,77	26,5	48,69	49,62
5200	1,61	1,77	26,52	48,67	49,48
5300	1,62	1,78	26,59	48,67	49,59
5400	1,62	1,78	26,49	48,7	49,48
5500	1,63	1,78	26,49	48,66	49,49
5600	1,63	1,79	26,49	48,75	49,53

5700	1,63	1,79	26,48	48,69	49,42
5800	1,64	1,8	26,5	48,74	49,5
5900	1,64	1,8	26,48	48,72	49,46
6000	1,65	1,81	26,49	48,72	49,47
6100	1,65	1,81	26,48	48,66	49,49
6200	1,66	1,81	26,5	48,68	49,33
6300	1,66	1,82	26,48	48,64	49,46
6400	1,67	1,82	26,53	48,6	49,43
6500	1,67	1,83	26,5	48,66	49,46
6600	1,67	1,83	26,47	48,66	49,38
6700	1,68	1,84	26,52	48,7	49,47
6800	1,68	1,84	26,52	48,61	49,4
6900	1,69	1,85	26,51	48,66	49,4
7000	1,69	1,85	26,51	48,7	49,4
7100	1,69	1,85	26,48	48,61	49,39
7200	1,7	1,86	26,49	48,61	49,44
7300	1,7	1,86	26,48	48,54	49,3
7400	1,71	1,86	26,5	48,66	49,4
7500	1,71	1,87	26,49	48,6	49,49
7600	1,72	1,87	26,46	48,7	49,41
7700	1,72	1,87	26,49	48,65	49,42
7800	1,72	1,88	26,48	48,61	49,38
7900	1,73	1,88	26,54	48,59	49,37
8000	1,73	1,88	26,51	48,75	49,51
8100	1,73	1,89	26,48	48,61	49,4
8200	1,74	1,89	26,48	48,77	49,56
8300	1,74	1,89	26,49	48,66	49,37
8400	1,75	1,9	26,48	48,74	49,65
8500	1,75	1,9	26,49	48,66	49,46
8600	1,76	1,9	26,51	48,75	49,57
8700	1,76	1,91	26,48	48,67	49,47
8800	1,76	1,91	26,49	48,69	49,5
8900	1,77	1,92	26,51	48,72	49,46
9000	1,77	1,92	26,5	48,66	49,48
9100	1,77	1,91	26,49	48,65	49,35
9200	1,78	1,92	26,55	48,66	49,35
9300	1,78	1,92	26,47	48,66	49,35
9400	1,78	1,93	26,5	48,72	49,49
9500	1,79	1,93	26,53	48,63	49,4
9600	1,79	1,93	26,5	48,72	49,54
9700	1,79	1,93	26,46	48,61	49,38
9800	1,8	1,93	26,51	48,68	49,52
9900	1,8	1,94	26,51	48,64	49,41
10000	1,8	1,94	26,47	48,67	49,35

Test Ended at 10000 Passes
Sample 1 Final rut depth = 1,80 mm
Sample 2 Final rut depth = 1,94 mm
Sample 1 Mean Steady State Tracking Rate = 0,04 mm/1000 Passes

Table 0.1 Samples 3-4: Wheeltrack test results.

Wheeltracking Test Summary
Specimen Name: Ab16 pmb 5 and 6 60C
Date: 17.09.2010
Test Temperature: 60
Sample 1 Thickness: 40
Sample 2 Thickness: 40

Pass No.	Rut Depth(mm) 1	Rut Depth(mm) 2	Speed (RPM)	RTD 1 Deg.C.	RTD 2 Deg.C.
0	0	0	26,5	56,12	56,97
100	0,85	0,82	26,42	58	58,65
200	1,04	0,97	26,48	58,04	58,88
300	1,04	1,06	26,5	58,02	58,66
400	1,16	1,13	26,5	58,02	58,82
500	1,23	1,19	26,49	57,98	58,7
600	1,29	1,24	26,51	58,02	58,78
700	1,33	1,29	26,46	58,07	58,67
800	1,37	1,32	26,47	58,07	58,73
900	1,4	1,35	26,55	58,05	58,69
1000	1,43	1,38	26,5	58,03	58,65
1100	1,45	1,41	26,46	58,02	58,71
1200	1,48	1,43	26,56	58,06	58,71
1300	1,5	1,46	26,52	57,98	58,7
1400	1,52	1,48	26,46	58,06	58,67
1500	1,54	1,5	26,52	58,01	58,74
1600	1,56	1,51	26,5	58,06	58,7
1700	1,58	1,53	26,49	57,99	58,74
1800	1,59	1,54	26,52	57,98	58,72
1900	1,61	1,56	26,54	57,98	58,78
2000	1,62	1,58	26,45	57,96	58,65
2100	1,63	1,59	26,54	58,06	58,77
2200	1,65	1,6	26,48	58	58,63
2300	1,66	1,61	26,49	58,04	58,78

2400	1,67	1,63	26,5	57,97	58,55
2500	1,68	1,64	26,48	58,09	58,83
2600	1,69	1,65	26,47	57,94	58,62
2700	1,7	1,66	26,49	58,06	58,67
2800	1,71	1,67	26,54	57,94	58,53
2900	1,72	1,68	26,51	58,05	58,72
3000	1,73	1,69	26,47	57,99	58,6
3100	1,74	1,7	26,5	58,09	58,85
3200	1,75	1,7	26,48	57,99	58,59
3300	1,76	1,71	26,51	58,1	58,77
3400	1,76	1,72	26,47	57,93	58,6
3500	1,77	1,73	26,47	57,99	58,76
3600	1,78	1,74	26,5	57,98	58,58
3700	1,79	1,75	26,52	57,99	58,71
3800	1,79	1,75	26,5	57,95	58,54
3900	1,8	1,76	26,51	57,98	58,75
4000	1,81	1,77	26,49	57,9	58,56
4100	1,82	1,78	26,49	57,97	58,65
4200	1,82	1,78	26,53	57,95	58,54
4300	1,83	1,79	26,53	58	58,66
4400	1,83	1,8	26,53	58,01	58,63
4500	1,84	1,8	26,49	57,95	58,66
4600	1,85	1,81	26,5	57,99	58,58
4700	1,85	1,82	26,49	57,93	58,66
4800	1,86	1,82	26,5	57,98	58,65
4900	1,86	1,83	26,5	57,93	58,64
5000	1,87	1,83	26,48	57,98	58,7
5100	1,87	1,84	26,47	57,99	58,63
5200	1,88	1,84	26,51	57,99	58,59
5300	1,88	1,85	26,48	58,02	58,62
5400	1,89	1,86	26,52	57,94	58,55
5500	1,89	1,86	26,51	57,97	58,67
5600	1,9	1,87	26,53	57,98	58,66
5700	1,9	1,87	26,52	57,96	58,63
5800	1,9	1,87	26,51	57,96	58,57
5900	1,91	1,88	26,48	57,96	58,54
6000	1,91	1,89	26,5	57,96	58,63
6100	1,92	1,89	26,5	57,95	58,56
6200	1,92	1,9	26,49	57,91	58,6
6300	1,92	1,9	26,47	57,93	58,55
6400	1,93	1,9	26,49	57,91	58,65
6500	1,93	1,91	26,48	57,99	58,64
6600	1,94	1,91	26,56	57,96	58,65
6700	1,94	1,91	26,53	57,94	58,68
6800	1,94	1,92	26,45	57,93	58,58
6900	1,95	1,93	26,47	57,94	58,62
7000	1,95	1,93	26,52	57,9	58,58
7100	1,96	1,93	26,48	57,93	58,58
7200	1,96	1,93	26,5	57,94	58,69
7300	1,96	1,94	26,51	57,95	58,55
7400	1,97	1,94	26,52	58	58,71
7500	1,97	1,95	26,56	57,95	58,59
7600	1,97	1,95	26,48	58	58,65
7700	1,98	1,96	26,48	57,92	58,64
7800	1,98	1,97	26,64	57,92	58,66
7900	1,98	1,96	26,5	57,98	58,59
8000	1,99	1,97	26,47	57,96	58,64
8100	1,99	1,97	26,49	57,92	58,55
8200	2	1,97	26,46	57,98	58,65
8300	2	1,98	26,34	57,97	58,66
8400	2	1,98	26,49	57,95	58,7
8500	2,01	1,98	26,54	57,95	58,61
8600	2,01	1,98	26,5	57,98	58,66
8700	2,01	1,99	26,35	57,96	58,58
8800	2,02	1,99	26,61	57,99	58,66
8900	2,02	1,99	26,51	57,93	58,5
9000	2,03	2	26,52	57,94	58,76
9100	2,03	2,01	26,52	57,95	58,76
9200	2,04	2,01	26,5	58,02	58,81
9300	2,04	2,01	26,52	58,02	58,73
9400	2,04	2,02	26,5	58,08	58,87
9500	2,05	2,02	26,48	58,05	58,87
9600	2,05	2,02	26,52	58,2	59,03
9700	2,05	2,03	26,53	58,08	58,81
9800	2,06	2,03	26,5	58,21	59,02
9900	2,06	2,03	26,51	58,1	59,01
10000	2,06	2,04	26,5	58,2	59,1

Test Ended at 10000 Passes
Sample 1 Final rut depth = 2,06 mm
Sample 2 Final rut depth = 2,04 mm
Sample 1 Mean Steady State Tracking Rate = 0,04 mm/1000 Passes
Sample 2 Mean Steady State Tracking Rate = 0,04 mm/1000 Passes

Table 0.2 Samples 5-6: Wheeltrack test results.

Wheeltracking Test Summary
Specimen Name: Ab16 pmb samples 7 and 8 40C
Date: 21.09.2010
Test Temperature: 40
Sample 1 Thickness: 40
Sample 2 Thickness: 40

Pass No.	Rut Depth(mm) 1	Rut Depth(mm) 2	Speed (RPM)	RTD 1 Deg.C.	RTD 2 Deg.C.
0	0	0	26,5	39,48	40,05
100	0,42	0,25	26,53	39,5	40
200	0,55	0,35	26,49	39,58	40,07
300	0,65	0,42	26,49	39,55	39,91
400	0,72	0,47	26,52	39,64	40,03
500	0,77	0,51	26,51	39,62	39,96
600	0,82	0,54	26,51	39,61	39,93
700	0,86	0,57	26,49	39,61	39,97
800	0,89	0,59	26,45	39,58	39,91
900	0,92	0,61	26,47	39,55	39,98
1000	0,94	0,63	26,5	39,58	39,91
1100	0,97	0,65	26,51	39,63	39,96
1200	0,99	0,67	26,51	39,58	39,99
1300	1,01	0,68	26,49	39,61	39,93
1400	1,03	0,7	26,51	39,59	39,99
1500	1,05	0,71	26,47	39,52	39,89
1600	1,07	0,72	26,52	39,6	39,9
1700	1,08	0,74	26,48	39,6	39,86
1800	1,1	0,75	26,51	39,62	39,92
1900	1,11	0,76	26,5	39,61	39,89
2000	1,12	0,77	26,49	39,58	39,97
2100	1,14	0,77	26,5	39,6	39,91
2200	1,15	0,78	26,52	39,63	39,95
2300	1,16	0,79	26,54	39,63	39,99
2400	1,17	0,8	26,54	39,59	39,92
2500	1,18	0,8	26,5	39,62	39,88
2600	1,19	0,81	26,48	39,58	39,9
2700	1,2	0,82	26,49	39,65	39,88
2800	1,21	0,82	26,5	39,67	39,95
2900	1,22	0,83	26,46	39,65	39,87
3000	1,23	0,84	26,52	39,67	39,94
3100	1,24	0,84	26,48	39,63	39,97
3200	1,25	0,85	26,5	39,66	39,94
3300	1,25	0,86	26,5	39,57	39,88
3400	1,26	0,86	26,51	39,62	39,96
3500	1,27	0,87	26,5	39,63	39,86
3600	1,28	0,87	26,51	39,7	39,95
3700	1,28	0,88	26,53	39,66	39,89
3800	1,29	0,89	26,49	39,66	39,88
3900	1,3	0,89	26,48	39,64	39,98
4000	1,3	0,89	26,5	39,68	39,96
4100	1,31	0,9	26,52	39,7	39,91
4200	1,31	0,9	26,48	39,61	39,94
4300	1,32	0,91	26,48	39,71	39,98
4400	1,32	0,91	26,49	39,63	39,98
4500	1,33	0,92	26,51	39,67	39,93
4600	1,33	0,92	26,5	39,65	39,98
4700	1,34	0,93	26,47	39,68	39,95
4800	1,35	0,93	26,51	39,68	39,91
4900	1,35	0,93	26,51	39,67	39,88
5000	1,36	0,94	26,48	39,66	40
5100	1,36	0,94	26,52	39,62	39,94
5200	1,37	0,95	26,49	39,71	39,98
5300	1,37	0,95	26,52	39,64	39,97
5400	1,37	0,95	26,49	39,68	39,99
5500	1,38	0,96	26,5	39,67	39,97
5600	1,38	0,96	26,51	39,7	39,94
5700	1,39	0,96	26,51	39,7	39,96
5800	1,39	0,97	26,56	39,68	39,94
5900	1,4	0,97	26,47	39,71	39,98
6000	1,4	0,98	26,5	39,59	39,89
6100	1,41	0,98	26,59	39,71	39,96
6200	1,41	0,98	26,26	39,65	39,87
6300	1,42	0,99	26,49	39,63	39,88
6400	1,42	0,99	26,5	39,68	39,91
6500	1,42	0,99	26,52	39,61	39,9
6600	1,43	1	26,5	39,67	39,9
6700	1,43	1	26,5	39,69	39,99
6800	1,43	1	26,48	39,64	39,94
6900	1,44	1	26,51	39,67	39,98
7000	1,44	1,01	26,52	39,7	39,93
7100	1,45	1,01	26,52	39,65	40,01
7200	1,45	1,01	26,5	39,69	39,9
7300	1,45	1,01	26,49	39,7	39,92
7400	1,46	1,02	26,53	39,7	40
7500	1,46	1,02	26,47	39,63	39,94
7600	1,46	1,02	26,47	39,67	39,91

7700	1,47	1,02	26,54	39,71	39,97
7800	1,47	1,03	26,48	39,64	39,94
7900	1,47	1,03	26,49	39,65	39,97
8000	1,48	1,03	26,48	39,67	39,98
8100	1,48	1,04	26,49	39,65	39,93
8200	1,48	1,04	26,51	39,67	39,96
8300	1,49	1,04	26,51	39,66	39,99
8400	1,49	1,04	26,46	39,69	39,89
8500	1,49	1,04	26,53	39,66	40,04
8600	1,49	1,05	26,51	39,7	39,92
8700	1,5	1,05	26,5	39,65	39,95
8800	1,5	1,05	26,51	39,7	39,93
8900	1,5	1,05	26,51	39,72	39,95
9000	1,51	1,06	26,51	39,65	39,91
9100	1,51	1,06	26,54	39,66	39,93
9200	1,51	1,06	26,47	39,69	40,01
9300	1,51	1,07	26,5	39,67	39,96
9400	1,52	1,07	26,53	39,7	39,94
9500	1,52	1,07	26,49	39,64	39,94
9600	1,52	1,07	26,48	39,71	40,01
9700	1,52	1,07	26,48	39,69	39,97
9800	1,53	1,07	26,46	39,73	39,98
9900	1,53	1,08	26,47	39,67	39,89
10000	1,53	1,08	26,51	39,71	40,03

Test Ended at 10000 Passes
Sample 1 Final rut depth = 1,53 mm
Sample 2 Final rut depth = 1,08 mm
Sample 1 Mean Steady State Tracking Rate = 0,04 mm/1000 Passes
Sample 2 Mean Steady State Tracking Rate = 0,03 mm/1000 Passes

Table 0.3 Samples 7-8: Wheeltrack test results.

Wheeltracking Test Summary
Specimen Name: Ab11 pmb samples 9 and 10 50C
Date: 22.09.2010
Test Temperature: 50
Sample 1 Thickness: 40
Sample 2 Thickness: 40

Pass No.	Rut Depth(mm) 1	Rut Depth(mm) 2	Speed (RPM)	RTD 1 Deg.C.	RTD 2 Deg.C.
0	0	0	26,5	48,75	49,37
100	0,79	1,11	26,51	48,59	49,52
200	0,99	1,37	26,52	48,76	51,06
300	1,1	1,53	26,46	48,63	51,1
400	1,19	1,65	26,5	48,77	51,27
500	1,27	1,76	26,51	48,51	48,86
600	1,32	1,84	26,5	48,81	49,51
700	1,37	1,89	26,53	48,72	49,42
800	1,42	1,96	26,55	48,74	49,38
900	1,45	2	26,49	48,73	49,44
1000	1,48	2,04	26,5	48,73	49,44
1100	1,51	2,08	26,46	48,79	49,49
1200	1,54	2,12	26,46	48,78	49,59
1300	1,56	2,14	26,49	48,75	49,68
1400	1,58	2,17	26,51	48,8	49,55
1500	1,61	2,2	26,52	48,87	49,61
1600	1,63	2,22	26,49	48,79	49,53
1700	1,64	2,25	26,49	48,89	49,65
1800	1,66	2,27	26,5	48,79	49,6
1900	1,67	2,29	26,52	48,93	49,65
2000	1,69	2,31	26,5	48,8	49,55
2100	1,71	2,33	26,45	48,81	49,55
2200	1,72	2,34	26,47	48,82	49,51
2300	1,73	2,36	26,49	48,87	49,64
2400	1,75	2,38	26,47	48,89	49,55
2500	1,76	2,39	26,51	48,85	49,55
2600	1,78	2,41	26,53	48,88	49,56
2700	1,79	2,42	26,47	48,82	49,48
2800	1,8	2,44	26,49	48,88	49,62
2900	1,81	2,45	26,52	48,82	49,5
3000	1,82	2,46	26,5	48,87	49,52
3100	1,83	2,47	26,49	48,86	49,54
3200	1,84	2,49	26,5	48,81	49,44
3300	1,85	2,5	26,49	48,84	49,64
3400	1,86	2,51	26,5	48,81	49,41
3500	1,87	2,52	26,5	48,84	49,45
3600	1,88	2,53	26,46	48,84	49,53
3700	1,88	2,54	26,54	48,76	49,36
3800	1,89	2,55	26,5	48,92	49,72
3900	1,9	2,56	26,47	48,87	49,5
4000	1,91	2,57	26,48	48,91	47,12
4100	1,91	2,57	26,51	48,87	46,7
4200	1,92	2,59	26,48	48,83	46,72

4300	1,93	2,59	26,51	48,9	46,85
4400	1,93	2,6	26,53	48,88	46,59
4500	1,94	2,61	26,52	48,89	46,79
4600	1,95	2,62	26,51	48,88	46,78
4700	1,95	2,62	26,51	48,91	46,77
4800	1,96	2,63	26,48	48,85	46,71
4900	1,97	2,64	26,48	48,95	46,87
5000	1,97	2,64	26,52	48,95	46,79
5100	1,98	2,65	26,5	48,87	46,8
5200	1,98	2,66	26,54	48,86	46,73
5300	1,99	2,66	26,5	48,89	46,76
5400	1,99	2,67	26,48	48,87	46,66
5500	2	2,68	26,5	48,93	46,68
5600	2	2,68	26,49	48,86	46,6
5700	2,01	2,69	26,46	48,88	46,55
5800	2,01	2,69	26,48	49,01	46,77
5900	2,01	2,7	26,52	48,87	46,6
6000	2,02	2,71	26,48	48,99	46,82
6100	2,02	2,71	26,43	48,93	46,68
6200	2,03	2,72	26,51	48,99	46,83
6300	2,03	2,72	26,46	48,85	46,64
6400	2,04	2,73	26,51	49,01	46,76
6500	2,04	2,73	26,48	48,93	46,75
6600	2,05	2,74	26,49	48,96	46,72
6700	2,05	2,74	26,5	48,86	46,66
6800	2,05	2,75	26,5	48,9	46,69
6900	2,06	2,75	26,49	48,96	46,68
7000	2,06	2,76	26,49	48,88	46,63
7100	2,07	2,76	26,51	49,02	46,98
7200	2,07	2,77	26,53	48,97	46,92
7300	2,08	2,77	26,49	49,02	46,93
7400	2,08	2,78	26,48	49,08	46,92
7500	2,08	2,78	26,47	49	46,79
7600	2,08	2,79	26,5	48,98	46,86
7700	2,09	2,79	26,52	48,95	46,84
7800	2,09	2,8	26,49	49,09	46,83
7900	2,1	2,8	26,56	49,07	46,92
8000	2,1	2,8	26,52	49	46,9
8100	2,1	2,81	26,47	49,05	46,84
8200	2,11	2,81	26,48	49,01	46,9
8300	2,11	2,81	26,5	48,95	46,81
8400	2,11	2,82	26,46	49,01	46,86
8500	2,12	2,82	26,47	48,95	46,72
8600	2,12	2,83	26,57	49,07	46,8
8700	2,12	2,83	26,5	49,06	46,71
8800	2,13	2,84	26,47	48,99	46,75
8900	2,13	2,84	26,5	49,01	46,75
9000	2,13	2,84	26,47	48,99	46,75
9100	2,13	2,84	26,49	49,01	46,73
9200	2,13	2,84	26,52	48,92	46,56
9300	2,14	2,85	26,53	49,03	46,65
9400	2,14	2,86	26,62	48,94	46,62
9500	2,14	2,86	26,52	48,99	46,7
9600	2,15	2,86	26,49	49,04	46,75
9700	2,15	2,87	26,49	48,94	46,64
9800	2,15	2,87	26,52	49	46,73
9900	2,16	2,87	26,49	48,97	46,72
10000	2,16	2,88	26,46	49,02	46,84

Test Ended at 10000 Passes
Sample 1 Final rut depth = 2,16 mm
Sample 2 Final rut depth = 2,88 mm
Sample 1 Mean Steady State Tracking Rate = 0,04 mm/1000 Passes
Sample 2 Mean Steady State Tracking Rate = 0,05 mm/1000 Passes

Table 0.4 Samples 9-10: Wheeltrack test results.

Wheeltracking Test Summary
Specimen Name: Ab11 pmb samples 11 and 12 60C
Date: 23.09.2010
Test Temperature: 60
Sample 1 Thickness: 40
Sample 2 Thickness: 40

Pass No.	Rut Depth(mm) 1	Rut Depth(mm) 2	Speed (RPM)	RTD 1 Deg.C.	RTD 2 Deg.C.
0	0	0	26,5	58,95	59,48
100	0,9	0,88	26,51	58,79	59,17
200	1,1	1,07	26,5	58,95	59,42
300	1,21	1,19	26,53	58,74	59,24
400	1,28	1,26	26,49	58,88	59,4
500	1,36	1,33	26,53	58,71	59,18
600	1,41	1,38	26,5	58,9	59,41
700	1,47	1,43	26,5	58,88	59,27
800	1,51	1,47	26,5	58,98	59,4

900	1,54	1,5	26,66	58,89	59,38
1000	1,58	1,54	26,5	59,03	59,48
1100	1,61	1,56	26,51	59	59,5
1200	1,64	1,59	26,5	59,05	59,4
1300	1,66	1,61	26,49	59,04	59,54
1400	1,68	1,63	26,46	59,04	59,4
1500	1,71	1,66	26,6	59,12	59,53
1600	1,73	1,68	26,5	58,98	59,39
1700	1,75	1,69	26,5	59,14	59,53
1800	1,76	1,71	26,49	59,08	59,45
1900	1,78	1,73	26,5	59,11	59,57
2000	1,8	1,75	26,48	59,16	59,42
2100	1,81	1,76	26,48	59,16	59,57
2200	1,83	1,78	26,49	59,09	59,41
2300	1,84	1,79	26,49	59,22	59,58
2400	1,85	1,81	26,51	59,07	59,36
2500	1,87	1,82	26,47	59,25	59,53
2600	1,88	1,83	26,48	59,08	59,38
2700	1,89	1,85	26,48	59,25	59,64
2800	1,9	1,86	26,49	59,09	59,47
2900	1,92	1,87	26,51	59,36	59,61
3000	1,78	1,89	26,61	61,02	59,38
3100	1,81	1,9	26,5	61,08	59,69
3200	1,82	1,91	26,49	60,93	59,4
3300	1,83	1,92	26,51	61	59,61
3400	1,84	1,94	26,49	60,93	59,48
3500	1,85	1,95	26,49	61,01	59,61
3600	1,86	1,95	26,52	60,88	59,41
3700	1,87	1,96	26,49	60,95	59,68
3800	1,88	1,97	26,49	60,92	59,55
3900	1,89	1,98	26,46	60,9	59,57
4000	1,9	1,99	26,52	60,94	59,51
4100	1,91	2	26,47	60,92	59,48
4200	1,92	2,01	26,52	60,94	59,59
4300	1,93	2,02	26,53	60,89	59,43
4400	1,93	2,03	26,44	60,93	59,61
4500	1,94	2,03	26,49	60,87	59,48
4600	1,95	2,04	26,49	60,95	59,64
4700	1,95	2,05	26,46	60,87	59,45
4800	1,96	2,05	26,53	60,91	59,54
4900	1,97	2,06	26,51	60,86	59,43
5000	1,98	2,07	26,5	60,85	59,57
5100	1,98	2,07	26,52	60,76	59,36
5200	1,99	2,08	26,51	60,92	59,62
5300	1,99	2,09	26,47	60,77	59,41
5400	2	2,1	26,48	60,89	59,69
5500	2,01	2,1	26,5	60,8	59,45
5600	2,02	2,11	26,5	60,92	59,63
5700	2,02	2,11	26,51	60,86	59,42
5800	2,03	2,12	26,51	60,88	59,63
5900	2,04	2,13	26,48	60,83	59,38
6000	2,04	2,13	26,47	60,87	59,52
6100	2,05	2,14	26,48	60,78	59,46
6200	2,05	2,14	26,49	60,84	59,54
6300	2,05	2,14	26,54	60,83	59,43
6400	2,06	2,15	26,53	60,81	59,48
6500	2,07	2,16	26,47	60,78	59,45
6600	2,08	2,17	26,48	60,79	59,42
6700	2,08	2,18	26,51	60,77	59,49
6800	2,09	2,18	26,48	60,77	59,37
6900	2,09	2,19	26,5	60,84	59,56
7000	2,1	2,2	26,51	60,78	59,32
7100	2,1	2,2	26,5	60,74	59,51
7200	2,11	2,21	26,51	60,76	59,28
7300	2,11	2,21	26,49	60,76	59,61
7400	2,12	2,22	26,49	60,72	59,4
7500	2,12	2,22	26,51	60,78	59,68
7600	2,13	2,22	26,49	60,75	59,36
7700	2,14	2,23	26,5	60,77	59,67
7800	2,14	2,23	26,52	60,79	59,35
7900	2,15	2,24	26,48	60,75	57,26
8000	2,16	2,24	26,49	60,79	55,64
8100	2,16	2,25	26,49	60,84	55,73
8200	2,17	2,26	26,51	60,84	55,74
8300	2,17	2,26	26,56	60,82	55,63
8400	2,17	2,27	26,52	60,81	55,7
8500	2,18	2,27	26,54	60,79	55,59
8600	2,18	2,27	26,51	60,87	55,72
8700	2,19	2,27	26,51	60,72	55,31
8800	2,2	2,28	26,49	60,85	55,72
8900	2,2	2,28	26,47	60,75	55,36
9000	2,21	2,29	26,51	60,84	55,63
9100	2,21	2,29	26,52	60,78	55,23
9200	2,21	2,29	26,51	60,85	55,49
9300	2,22	2,3	26,53	60,82	55,37
9400	2,22	2,3	26,49	60,84	55,47
9500	2,23	2,31	26,48	60,86	55,45

9600	2,23	2,31	26,5	60,84	55,6
9700	2,23	2,31	26,52	60,79	55,36
9800	2,24	2,32	26,5	60,84	55,4
9900	2,24	2,32	26,48	60,84	55,41
10000	2,25	2,32	26,5	60,82	55,43

Test Ended at 10000 Passes
Sample 1 Final rut depth = 2,25 mm
Sample 2 Final rut depth = 2,32 mm
Sample 1 Mean Steady State Tracking Rate = 0,05 mm/1000 Passes
Sample 2 Mean Steady State Tracking Rate = 0,05 mm/1000 Passes

Table 0.5 Samples 11-12: Wheeltrack test results.

Wheeltracking Test Summary
Specimen Name: Ab11 samples 13 and 14 50C
Date: 28.09.2010
Test Temperature: 50
Sample 1 Thickness: 40
Sample 2 Thickness: 40

Pass No.	Rut Depth(mm) 1	Rut Depth(mm) 2	Speed (RPM)	RTD 1 Deg.C.	RTD 2 Deg.C.
0	0	0	26,5	48,32	48,66
100	0,82	0,8	26,52	48,19	48,51
200	1,05	1,01	26,56	48,27	48,5
300	1,19	1,16	26,49	48,24	48,46
400	1,3	1,27	26,49	48,27	48,48
500	1,38	1,35	26,51	48,27	48,44
600	1,45	1,42	26,49	48,37	48,66
700	1,52	1,47	26,51	48,34	48,58
800	1,57	1,53	26,51	48,32	48,56
900	1,62	1,57	26,49	48,31	48,58
1000	1,67	1,61	26,5	48,32	48,53
1100	1,71	1,66	26,5	48,29	48,59
1200	1,76	1,69	26,5	48,32	48,54
1300	1,8	1,73	26,49	48,34	48,54
1400	1,83	1,76	26,49	48,29	48,53
1500	1,87	1,8	26,49	48,34	48,53
1600	1,9	1,83	26,44	48,35	48,68
1700	1,93	1,85	26,47	48,44	48,66
1800	1,96	1,88	26,49	48,42	48,67
1900	1,99	1,91	26,49	48,34	48,69
2000	2,01	1,93	26,51	48,33	48,64
2100	2,04	1,95	26,49	48,31	48,61
2200	2,06	1,98	26,48	48,3	48,65
2300	2,08	1,99	26,51	48,32	48,58
2400	2,11	2,01	26,49	48,32	48,57
2500	2,13	2,03	26,5	48,35	48,66
2600	2,15	2,05	26,51	48,29	48,62
2700	2,17	2,06	26,51	48,33	48,63
2800	2,19	2,08	26,51	48,28	48,61
2900	2,21	2,11	26,51	48,49	48,74
3000	2,23	2,12	26,46	48,34	48,64
3100	2,24	2,14	26,5	48,45	48,69
3200	2,26	2,16	26,52	48,36	48,56
3300	2,28	2,18	26,49	48,38	48,6
3400	2,3	2,2	26,52	48,35	48,65
3500	2,32	2,21	26,52	48,39	48,62
3600	2,34	2,23	26,5	48,39	48,59
3700	2,35	2,24	26,48	48,34	48,53
3800	2,37	2,26	26,49	48,41	48,63
3900	2,39	2,28	26,49	48,3	48,54
4000	2,4	2,29	26,52	48,4	48,63
4100	2,42	2,3	26,53	48,26	48,53
4200	2,43	2,32	26,57	48,46	48,74
4300	2,45	2,34	26,51	48,36	48,69
4400	2,46	2,35	26,45	48,45	48,66
4500	2,48	2,36	26,55	48,34	48,63
4600	2,49	2,38	26,48	48,36	48,62
4700	2,5	2,39	26,55	48,38	48,63
4800	2,52	2,4	26,48	48,4	48,65
4900	2,53	2,42	26,5	48,38	48,66
5000	2,54	2,43	26,5	48,33	48,63
5100	2,55	2,44	26,5	48,48	48,68
5200	2,56	2,45	26,57	48,34	48,65
5300	2,58	2,47	26,5	48,39	48,71
5400	2,59	2,48	26,46	48,38	48,64
5500	2,6	2,5	26,5	48,36	48,63
5600	2,61	2,51	26,51	48,27	48,6
5700	2,62	2,52	26,51	48,38	48,65
5800	2,63	2,53	26,49	48,4	48,6
5900	2,65	2,54	26,52	48,33	48,55
6000	2,66	2,56	26,48	48,37	48,62
6100	2,67	2,57	26,48	48,3	48,59

6200	2,68	2,59	26,49	48,43	48,79
6300	2,69	2,6	26,49	48,42	48,59
6400	2,7	2,61	26,5	48,46	48,67
6500	2,71	2,62	26,47	48,35	48,65
6600	2,73	2,64	26,47	48,43	48,63
6700	2,74	2,65	26,48	48,38	48,67
6800	2,75	2,66	26,43	48,45	48,67
6900	2,76	2,67	26,49	48,38	48,59
7000	2,77	2,68	26,51	48,45	48,65
7100	2,78	2,69	26,51	48,3	48,6
7200	2,78	2,71	26,5	48,47	48,78
7300	2,8	2,72	26,45	48,43	48,75
7400	2,81	2,73	26,49	48,48	48,67
7500	2,83	2,75	26,5	48,33	48,57
7600	2,84	2,76	26,49	48,39	48,6
7700	2,85	2,77	26,52	48,31	48,63
7800	2,86	2,78	26,5	48,48	48,74
7900	2,87	2,79	26,47	48,37	48,59
8000	2,88	2,8	26,46	48,41	48,64
8100	2,89	2,81	26,51	48,33	48,57
8200	2,91	2,82	26,49	48,43	48,73
8300	2,91	2,83	26,49	48,38	48,6
8400	2,92	2,84	26,55	48,38	48,69
8500	2,94	2,85	26,51	48,36	48,62
8600	2,94	2,86	26,5	48,37	48,57
8700	2,95	2,87	26,5	48,32	48,55
8800	2,97	2,88	26,46	48,33	48,62
8900	2,97	2,88	26,51	48,38	48,61
9000	2,98	2,89	26,51	48,37	48,69
9100	2,99	2,9	26,46	48,36	48,54
9200	3	2,91	26,51	48,34	48,66
9300	3,01	2,92	26,51	48,31	48,56
9400	3,02	2,93	26,53	48,38	48,67
9500	3,02	2,94	26,43	48,38	48,6
9600	3,03	2,94	26,51	48,34	48,59
9700	3,04	2,95	26,57	48,35	48,56
9800	3,05	2,96	26,49	48,33	48,64
9900	3,06	2,97	26,47	48,39	48,57
10000	3,07	2,98	26,49	48,45	48,64

Test Ended at 10000 Passes
Sample 1 Final rut depth = 3,07 mm
Sample 2 Final rut depth = 2,98 mm
Sample 1 Mean Steady State Tracking Rate = 0,11 mm/1000 Passes
Sample 2 Mean Steady State Tracking Rate = 0,11 mm/1000 Passes

Table 0.6 Samples 13-14: Wheeltrack test results.

Wheeltracking Test Summary
Specimen Name: Ab11 samples 15 and 16 40C
Date: 30.09.2010
Test Temperature: 40
Sample 1 Thickness: 40
Sample 2 Thickness: 40

Pass No.	Rut Depth(mm) 1	Rut Depth(mm) 2	Speed (RPM)	RTD 1 Deg.C.	RTD 2 Deg.C.
0	0	0	26,5	38,48	38,95
100	0,41	0,43	26,53	38,46	38,88
200	0,52	0,56	26,6	38,48	38,9
300	0,6	0,65	26,49	38,53	38,93
400	0,67	0,71	26,5	38,53	38,92
500	0,72	0,77	26,5	38,48	38,95
600	0,77	0,81	26,5	38,57	38,95
700	0,8	0,85	26,5	38,48	38,9
800	0,84	0,88	26,51	38,56	39,02
900	0,87	0,91	26,5	38,59	38,96
1000	0,9	0,94	26,52	38,61	38,98
1100	0,93	0,97	26,49	38,64	39
1200	0,95	0,99	26,5	38,64	38,96
1300	0,98	1,01	26,34	38,68	39,07
1400	1	1,03	26,46	38,6	38,99
1500	1,01	1,05	26,48	38,63	39,07
1600	1,03	1,06	26,49	38,68	39,1
1700	1,05	1,08	26,52	38,62	39
1800	1,07	1,1	26,5	38,69	39,03
1900	1,08	1,11	26,51	38,72	39,12
2000	1,1	1,13	26,5	38,74	39,07
2100	1,11	1,14	26,48	38,73	39,05
2200	1,13	1,15	26,48	38,73	39,11
2300	1,14	1,17	26,51	38,74	39,13
2400	1,15	1,18	26,48	38,74	39,15
2500	1,16	1,19	26,51	38,74	39,06
2600	1,18	1,2	26,49	38,83	39,15
2700	1,19	1,22	26,49	38,76	39,13

2800	1,2	1,23	26,52	38,79	39,17
2900	1,21	1,24	26,51	38,82	39,1
3000	1,22	1,25	26,5	38,81	39,13
3100	1,23	1,26	26,49	38,78	39,16
3200	1,25	1,27	26,49	38,85	39,24
3300	1,25	1,28	26,48	38,85	39,13
3400	1,27	1,29	26,53	38,81	39,13
3500	1,27	1,3	26,49	38,91	39,17
3600	1,28	1,31	26,5	38,88	39,22
3700	1,29	1,32	26,5	38,89	39,15
3800	1,3	1,32	26,49	38,86	39,19
3900	1,31	1,33	26,46	38,86	39,26
4000	1,32	1,34	26,5	38,86	39,21
4100	1,33	1,35	26,51	38,85	39,2
4200	1,34	1,36	26,49	38,95	39,28
4300	1,34	1,36	26,5	38,9	39,16
4400	1,35	1,37	26,5	38,93	39,21
4500	1,36	1,38	26,48	38,91	39,19
4600	1,37	1,39	26,52	38,95	39,28
4700	1,38	1,4	26,51	38,9	39,2
4800	1,38	1,4	26,51	38,99	39,28
4900	1,39	1,41	26,51	38,98	39,29
5000	1,4	1,42	26,49	38,92	39,25
5100	1,4	1,42	26,47	38,99	39,23
5200	1,41	1,43	26,5	38,99	39,29
5300	1,42	1,44	26,51	38,97	39,27
5400	1,42	1,44	26,49	39,01	39,23
5500	1,43	1,45	26,52	39,02	39,32
5600	1,44	1,45	26,53	38,97	39,26
5700	1,44	1,46	26,49	38,98	39,25
5800	1,45	1,46	26,49	38,95	39,26
5900	1,46	1,47	26,49	39,01	39,33
6000	1,46	1,48	26,49	39,02	39,34
6100	1,47	1,49	26,5	38,97	39,32
6200	1,47	1,49	26,5	39	39,28
6300	1,48	1,5	26,49	39,01	39,22
6400	1,49	1,51	26,49	39,06	39,29
6500	1,49	1,51	26,54	39,06	39,3
6600	1,5	1,52	26,49	39,05	39,31
6700	1,5	1,52	26,52	39,05	39,37
6800	1,51	1,53	26,49	39,06	39,3
6900	1,51	1,54	26,48	39,09	39,35
7000	1,52	1,54	26,49	39,06	39,37
7100	1,52	1,55	26,5	39,1	39,3
7200	1,53	1,55	26,48	39,08	39,36
7300	1,54	1,56	26,5	39,08	39,35
7400	1,54	1,56	26,93	39,04	39,35
7500	1,54	1,57	26,5	39,05	39,36
7600	1,55	1,57	26,49	39,08	39,31
7700	1,55	1,57	26,45	39,09	39,35
7800	1,56	1,58	26,47	39,03	39,33
7900	1,57	1,59	26,49	39,04	39,32
8000	1,57	1,59	26,52	39,08	39,26
8100	1,57	1,6	26,44	39,13	39,38
8200	1,58	1,6	26,52	39,09	39,38
8300	1,58	1,6	26,5	39,07	39,38
8400	1,59	1,61	26,48	39,13	39,33
8500	1,59	1,61	26,5	39,08	39,36
8600	1,6	1,62	26,46	39,13	39,4
8700	1,6	1,62	26,48	39,09	39,3
8800	1,6	1,62	26,5	39,07	39,3
8900	1,61	1,63	26,49	39,11	39,38
9000	1,61	1,63	26,5	39,07	39,36
9100	1,62	1,64	26,49	39,14	39,4
9200	1,62	1,64	26,51	39,1	39,37
9300	1,63	1,65	26,5	39,08	39,33
9400	1,63	1,65	26,5	39,12	39,32
9500	1,63	1,65	26,51	39,05	39,31
9600	1,64	1,66	26,5	39,05	39,33
9700	1,64	1,66	26,5	39,08	39,39
9800	1,65	1,67	26,47	39,14	39,33
9900	1,65	1,67	26,52	39,16	39,37
10000	1,66	1,68	26,5	39,05	39,3

Test Ended at 10000 Passes
Sample 1 Final rut depth = 1,66 mm
Sample 2 Final rut depth = 1,68 mm
Sample 1 Mean Steady State Tracking Rate = 0,05 mm/1000 Passes
Sample 2 Mean Steady State Tracking Rate = 0,05 mm/1000 Passes

Table 0.7 Samples 15-16: Wheeltrack test results.

Wheeltracking Test Summary

Specimen Name: Ab11 samples 17 and 18 60C
Date: 01.10.2010
Test Temperature: 60
Sample 1 Thickness: 40
Sample 2 Thickness: 40

Pass No.	Rut Depth(mm) 1	Rut Depth(mm) 2	Speed (RPM)	RTD 1 Deg.C.	RTD 2 Deg.C.
0	0	0	26,5	57,48	58,02
100	0,95	0,97	26,5	56,41	58,01
200	1,21	1,24	26,53	56,27	57,87
300	1,38	1,42	26,49	56,42	58,01
400	1,51	1,56	26,46	56,38	57,93
500	1,64	1,67	26,52	56,51	57,99
600	1,74	1,76	26,52	56,38	57,98
700	1,83	1,84	26,48	56,38	57,97
800	1,92	1,92	26,52	56,4	58,09
900	2,01	1,98	26,49	56,39	57,92
1000	2,08	2,04	26,46	56,4	58,08
1100	2,15	2,1	26,5	56,33	57,92
1200	2,2	2,16	26,52	56,37	58,03
1300	2,26	2,21	26,5	56,28	57,99
1400	2,31	2,26	26,49	56,34	55,5
1500	2,36	2,31	26,49	56,32	54,37
1600	2,41	2,35	26,5	56,37	54,04
1700	2,46	2,39	26,51	56,16	53,98
1800	2,5	2,44	26,47	56,39	54,19
1900	2,54	2,47	26,49	56,15	53,86
2000	2,59	2,52	26,48	56,39	54,04
2100	2,62	2,55	26,47	56,2	53,76
2200	2,66	2,59	26,49	56,44	54,02
2300	2,7	2,62	26,54	56,19	53,68
2400	2,73	2,66	26,49	56,44	53,9
2500	2,77	2,69	26,46	56,15	53,82
2600	2,8	2,72	26,51	56,33	53,82
2700	2,84	2,75	26,51	56,08	53,66
2800	2,87	2,79	26,49	56,36	53,83
2900	2,91	2,82	26,5	56,21	53,61
3000	2,94	2,85	26,5	56,39	53,89
3100	2,97	2,87	26,5	56,14	53,77
3200	3	2,9	26,5	56,34	53,74
3300	3,03	2,93	26,52	56,21	53,69
3400	3,06	2,96	26,46	56,23	53,6
3500	3,09	2,97	26,47	56,24	53,66
3600	3,12	3	26,51	56,35	53,88
3700	3,15	3,03	26,5	56,42	53,72
3800	3,18	3,05	26,47	56,25	53,57
3900	3,21	3,08	26,51	56,4	53,9
4000	3,23	3,1	26,46	56,25	53,6
4100	3,26	3,12	26,5	56,39	53,81
4200	3,29	3,14	26,52	56,19	53,61
4300	3,31	3,17	26,5	56,24	53,82
4400	3,34	3,2	26,49	56,18	53,49
4500	3,36	3,22	26,53	56,24	53,73
4600	3,38	3,23	26,48	56,11	53,61
4700	3,41	3,25	26,51	56,22	53,68
4800	3,43	3,27	26,53	56,08	53,43
4900	3,45	3,29	26,49	56,24	53,68
5000	3,47	3,3	26,51	55,97	53,53
5100	3,5	3,33	26,51	56,21	53,67
5200	3,52	3,34	26,51	55,97	53,5
5300	3,54	3,38	26,5	56,22	53,74
5400	3,56	3,4	26,55	56	53,61
5500	3,58	3,42	26,51	56,27	53,74
5600	3,6	3,44	26,5	56,05	53,59
5700	3,62	3,46	26,5	56,24	53,67
5800	3,64	3,47	26,49	56,06	53,61
5900	3,66	3,5	26,48	56,18	53,74
6000	3,68	3,52	26,52	56,11	53,54
6100	3,7	3,53	26,54	56,29	53,62
6200	3,71	3,56	26,5	56,07	53,63
6300	3,73	3,58	26,52	56,28	53,66
6400	3,75	3,6	26,49	56,05	53,63
6500	3,77	3,61	26,49	56,13	53,63
6600	3,78	3,63	26,52	56,07	53,54
6700	3,8	3,66	26,53	56,15	53,58
6800	3,82	3,67	26,53	56,05	53,63
6900	3,84	3,69	26,49	56,2	53,49
7000	3,85	3,71	26,52	56,19	53,64
7100	3,87	3,74	26,45	56,17	53,57
7200	3,88	3,75	26,52	56,23	53,68
7300	3,9	3,77	26,46	56,12	53,58
7400	3,91	3,79	26,49	56,18	53,64
7500	3,93	3,8	26,52	56	53,5
7600	3,94	3,82	26,49	56,21	53,76
7700	3,96	3,84	26,5	55,97	53,42
7800	3,98	3,86	26,52	56,31	53,65
7900	3,99	3,87	26,48	56,01	53,5
8000	4	3,89	26,47	56,23	53,73

8100	4,02	3,91	26,52	56,03	53,53
8200	4,03	3,92	26,5	56,22	53,6
8300	4,05	3,93	26,49	56,15	53,57
8400	4,06	3,95	26,51	56,23	53,72
8500	4,08	3,96	26,5	56,04	53,65
8600	4,1	3,98	26,5	56,25	53,78
8700	4,11	4	26,52	56,08	53,64
8800	4,12	4,02	26,51	56,16	53,71
8900	4,14	4,04	26,45	56,1	53,85
9000	4,15	4,05	26,5	56,08	53,77
9100	4,17	4,07	26,53	56,16	53,76
9200	4,18	4,08	26,5	56,18	53,79
9300	4,2	4,1	26,52	56,22	53,82
9400	4,21	4,1	26,51	56,2	53,73
9500	4,22	4,12	26,49	56,12	53,88
9600	4,24	4,14	26,52	56,16	53,77
9700	4,25	4,16	26,52	56,19	53,86
9800	4,27	4,18	26,57	56,15	53,81
9900	4,28	4,19	26,51	56,21	53,98
10000	4,3	4,21	26,52	56,06	53,96

Test Ended at 10000 Passes
Sample 1 Final rut depth = 4,30 mm
Sample 2 Final rut depth = 4,21 mm
Sample 1 Mean Steady State Tracking Rate = 0,17 mm/1000 Passes
Sample 2 Mean Steady State Tracking Rate = 0,18 mm/1000 Passes

Table 0.8 Samples 17-18. Wheeltrack test results.

Wheeltracking Test Summary
Specimen Name: Ab 11 pmb samples 19 and 20 50C
Date: 04.10.2010
Test Temperature: 50
Sample 1 Thickness: 40
Sample 2 Thickness: 40

Pass No.	Rut Depth(mm) 1	Rut Depth(mm) 2	Speed (RPM)	RTD 1 Deg.C.	RTD 2 Deg.C.
0	0	0	26,5	48,77	49,3
100	0,47	0,45	26,53	48,72	49,25
200	0,6	0,58	26,48	48,8	49,2
300	0,68	0,65	26,5	48,71	49,18
400	0,73	0,71	26,5	48,8	49,2
500	0,78	0,76	26,5	48,77	49,24
600	0,81	0,8	26,51	48,79	49,19
700	0,85	0,83	26,5	48,77	49,2
800	0,88	0,86	26,45	48,75	49,22
900	0,9	0,89	26,49	48,77	49,26
1000	0,92	0,91	26,52	48,8	49,18
1100	0,94	0,94	26,46	48,84	49,27
1200	0,96	0,96	26,51	48,87	49,3
1300	0,98	0,98	26,53	48,84	49,22
1400	0,99	1	26,5	48,86	49,34
1500	1	1,01	26,5	48,77	49,16
1600	1,01	1,03	26,48	48,89	49,28
1700	1,03	1,05	26,42	48,84	49,3
1800	1,04	1,06	26,47	48,95	49,35
1900	1,05	1,08	26,49	48,88	49,24
2000	1,06	1,09	26,47	48,89	49,37
2100	1,07	1,1	26,47	48,9	49,31
2200	1,08	1,11	26,52	48,95	49,31
2300	1,09	1,12	26,51	48,88	49,38
2400	1,1	1,13	26,52	48,94	49,34
2500	1,11	1,14	26,48	48,91	49,27
2600	1,12	1,15	26,47	48,84	49,28
2700	1,12	1,16	26,51	48,93	49,38
2800	1,13	1,17	26,55	48,93	49,34
2900	1,14	1,18	26,5	48,92	49,38
3000	1,14	1,19	26,51	48,83	49,23
3100	1,15	1,19	26,5	48,96	49,43
3200	1,16	1,2	26,48	48,85	49,26
3300	1,16	1,21	26,52	48,95	49,38
3400	1,17	1,21	26,55	48,93	49,28
3500	1,17	1,22	26,52	48,97	49,44
3600	1,18	1,23	26,5	48,89	49,27
3700	1,18	1,23	26,49	48,94	49,4
3800	1,18	1,24	26,49	48,95	49,3
3900	1,19	1,24	26,5	48,95	49,43
4000	1,19	1,25	26,51	48,92	49,32
4100	1,2	1,25	26,49	48,95	49,41
4200	1,2	1,26	26,49	48,99	49,35
4300	1,21	1,26	26,5	48,94	49,35
4400	1,21	1,27	26,49	48,97	49,43
4500	1,22	1,27	26,48	48,98	49,34
4600	1,22	1,28	26,49	48,95	49,38

4700	1,22	1,28	26,47	48,97	49,32
4800	1,23	1,29	26,47	48,97	49,43
4900	1,23	1,29	26,52	49	49,43
5000	1,24	1,3	26,47	48,97	49,35
5100	1,24	1,3	26,51	49,05	49,45
5200	1,24	1,3	26,5	48,95	49,36
5300	1,25	1,31	26,53	49	49,49
5400	1,25	1,31	26,5	49,01	49,35
5500	1,25	1,31	26,52	49	49,4
5600	1,25	1,32	26,47	48,94	49,36
5700	1,25	1,32	26,48	49	49,48
5800	1,26	1,32	26,52	48,99	49,38
5900	1,26	1,33	26,52	48,98	49,4
6000	1,26	1,33	26,49	48,98	49,33
6100	1,27	1,34	26,51	49,03	49,38
6200	1,27	1,34	26,47	49	49,33
6300	1,27	1,34	26,48	49	49,44
6400	1,27	1,35	26,53	49	49,35
6500	1,28	1,35	26,49	48,99	49,38
6600	1,28	1,35	26,49	49	49,35
6700	1,29	1,36	26,48	49	49,43
6800	1,29	1,36	26,5	48,96	49,39
6900	1,29	1,36	26,46	49,04	49,41
7000	1,29	1,37	26,52	48,99	49,37
7100	1,3	1,37	26,53	48,98	49,43
7200	1,3	1,37	26,49	49,05	49,38
7300	1,3	1,38	26,51	48,95	49,34
7400	1,3	1,38	26,52	49,04	49,38
7500	1,3	1,38	26,47	49	49,43
7600	1,31	1,38	26,5	49,07	49,41
7700	1,31	1,39	26,49	48,99	49,33
7800	1,31	1,39	26,52	49,05	49,48
7900	1,31	1,39	26,5	48,96	49,32
8000	1,32	1,4	26,53	49,09	49,45
8100	1,32	1,4	26,47	49,03	49,44
8200	1,32	1,4	26,48	49,01	49,37
8300	1,32	1,4	26,51	49,06	49,36
8400	1,32	1,4	26,53	49,05	49,48
8500	1,33	1,41	26,52	49,03	49,47
8600	1,33	1,41	26,51	49,06	49,35
8700	1,33	1,41	26,49	49,02	49,35
8800	1,33	1,41	26,46	49,1	49,43
8900	1,33	1,41	26,43	49,01	49,39
9000	1,34	1,42	26,55	49,08	49,44
9100	1,34	1,42	26,49	49,05	49,37
9200	1,34	1,42	26,5	49,02	49,44
9300	1,34	1,42	26,43	49,05	49,4
9400	1,34	1,43	26,58	49,01	49,44
9500	1,34	1,43	26,51	49	49,42
9600	1,34	1,43	26,53	49,05	49,49
9700	1,35	1,43	26,46	48,97	49,38
9800	1,35	1,44	26,49	49,1	49,48
9900	1,35	1,44	26,49	49,06	49,35
10000	1,35	1,44	26,49	49,01	49,37

Test Ended at 10000 Passes
Sample 1 Final rut depth = 1,35 mm
Sample 2 Final rut depth = 1,44 mm
Sample 1 Mean Steady State Tracking Rate = 0,02 mm/1000 Passes
Sample 2 Mean Steady State Tracking Rate = 0,03 mm/1000 Passes

Table 0.9 Samples 19-20: Wheeltrack test results.

Wheeltracking Test Summary
Specimen Name: Ab11 pmb samples 21 and 22 40C
Date: 06.10.2010
Test Temperature: 40
Sample 1 Thickness: 40
Sample 2 Thickness: 40

Pass No.	Rut Depth(mm) 1	Rut Depth(mm) 2	Speed (RPM)	RTD 1 Deg.C.	RTD 2 Deg.C.
0	0	0	26,5	39,08	39,71
100	0,28	0,27	26,52	39,14	39,71
200	0,37	0,36	26,51	39,14	39,7
300	0,42	0,43	26,49	39,16	39,7
400	0,46	0,48	26,53	39,16	39,69
500	0,49	0,51	26,5	39,14	39,76
600	0,52	0,54	26,5	39,12	39,75
700	0,54	0,57	26,51	39,15	39,69
800	0,56	0,59	26,49	39,23	39,78
900	0,59	0,61	26,52	39,14	39,66
1000	0,6	0,63	26,61	39,27	39,79
1100	0,62	0,64	26,5	39,24	39,7
1200	0,63	0,66	26,52	39,2	39,74

1300	0,64	0,67	26,47	39,21	39,75
1400	0,65	0,69	26,42	39,22	39,73
1500	0,67	0,7	26,5	39,29	39,82
1600	0,68	0,72	26,5	39,27	39,79
1700	0,69	0,73	26,49	39,29	39,75
1800	0,7	0,74	26,49	39,24	39,75
1900	0,71	0,75	26,48	39,33	39,8
2000	0,72	0,75	26,5	39,33	39,76
2100	0,73	0,76	26,51	39,36	39,87
2200	0,74	0,77	26,51	39,31	39,83
2300	0,75	0,78	26,49	39,44	39,85
2400	0,75	0,78	26,46	39,32	39,75
2500	0,76	0,79	26,5	39,41	39,89
2600	0,77	0,8	26,48	39,38	39,78
2700	0,78	0,81	26,48	39,46	39,89
2800	0,79	0,81	26,5	39,45	39,86
2900	0,79	0,82	26,47	39,42	39,81
3000	0,8	0,82	26,44	39,38	39,77
3100	0,8	0,83	26,52	39,42	39,83
3200	0,81	0,83	26,56	39,43	39,78
3300	0,82	0,84	26,51	39,47	39,9
3400	0,82	0,84	26,5	39,43	39,79
3500	0,83	0,85	26,51	39,43	39,86
3600	0,83	0,85	26,49	39,43	39,78
3700	0,84	0,86	26,49	39,53	39,91
3800	0,84	0,86	26,47	39,42	39,84
3900	0,85	0,87	26,49	39,47	39,9
4000	0,85	0,87	26,46	39,46	39,87
4100	0,86	0,87	26,51	39,52	39,85
4200	0,86	0,88	26,48	39,51	39,84
4300	0,87	0,88	26,5	39,49	39,9
4400	0,87	0,89	26,48	39,52	39,93
4500	0,87	0,89	26,48	39,42	39,83
4600	0,88	0,89	26,51	39,51	39,87
4700	0,88	0,9	26,51	39,56	39,86
4800	0,89	0,9	26,47	39,59	39,9
4900	0,89	0,9	26,5	39,54	39,83
5000	0,89	0,91	26,48	39,55	39,83
5100	0,9	0,91	26,52	39,51	39,86
5200	0,9	0,91	26,53	39,56	39,91
5300	0,91	0,92	26,48	39,57	39,96
5400	0,91	0,92	26,52	39,54	39,88
5500	0,91	0,92	26,5	39,55	39,86
5600	0,92	0,93	26,52	39,56	39,92
5700	0,92	0,93	26,47	39,6	39,9
5800	0,92	0,93	26,52	39,57	39,96
5900	0,92	0,93	26,48	39,52	39,88
6000	0,93	0,94	26,5	39,63	39,92
6100	0,93	0,94	26,59	39,62	39,94
6200	0,93	0,94	26,5	39,59	39,96
6300	0,93	0,94	26,49	39,63	39,95
6400	0,94	0,95	26,53	39,58	39,87
6500	0,94	0,95	26,48	39,59	39,89
6600	0,94	0,95	26,5	39,55	39,94
6700	0,95	0,95	26,5	39,54	39,91
6800	0,95	0,96	26,5	39,57	39,96
6900	0,95	0,96	26,52	39,59	39,96
7000	0,95	0,96	26,5	39,52	39,86
7100	0,96	0,96	26,48	39,64	39,97
7200	0,96	0,97	26,48	39,6	39,94
7300	0,96	0,97	26,51	39,63	39,94
7400	0,96	0,97	26,51	39,56	39,94
7500	0,97	0,98	26,47	39,61	39,89
7600	0,97	0,98	26,49	39,58	39,95
7700	0,97	0,98	26,48	39,58	39,87
7800	0,97	0,98	26,5	39,63	39,92
7900	0,97	0,99	26,52	39,59	39,87
8000	0,98	0,99	26,5	39,62	39,97
8100	0,98	0,99	26,49	39,64	39,94
8200	0,98	0,99	26,49	39,61	39,89
8300	0,98	0,99	26,47	39,62	39,89
8400	0,99	0,99	26,5	39,65	39,97
8500	0,99	1	26,46	39,59	39,89
8600	0,99	1	26,52	39,57	39,89
8700	0,99	1	26,48	39,6	39,94
8800	0,99	1	26,52	39,6	39,92
8900	1	1	26,51	39,61	39,94
9000	1	1,01	26,44	39,64	39,91
9100	1	1,01	26,53	39,68	39,94
9200	1	1,01	26,51	39,66	39,99
9300	1	1,01	26,48	39,7	40,01
9400	1	1,02	26,61	39,61	39,96
9500	1,01	1,02	26,51	39,67	39,93
9600	1,01	1,02	26,48	39,68	39,93
9700	1,01	1,02	26,49	39,63	39,93
9800	1,01	1,02	26,54	39,57	39,94
9900	1,01	1,02	26,51	39,7	39,96

10000	1,01	1,02	26,48	39,59	39,94

Test Ended at 10000 Passes
Sample 1 Final rut depth = 1,01 mm
Sample 2 Final rut depth = 1,02 mm
Sample 1 Mean Steady State Tracking Rate = 0,02 mm/1000 Passes
Sample 2 Mean Steady State Tracking Rate = 0,02 mm/1000 Passes

Table 0.10 Samples 21-22: Wheeltrack test results.

Wheeltracking Test Summary
Specimen Name: Ab11 pmb samples 23 and 24 60C
Date: 07.10.2010
Test Temperature: 60
Sample 1 Thickness: 40
Sample 2 Thickness: 40

Pass No.	Rut Depth(mm) 1	Rut Depth(mm) 2	Speed (RPM)	RTD 1 Deg.C.	RTD 2 Deg.C.
0	0	0	26,5	58,32	58,85
100	0,66	0,57	26,49	58,11	58,57
200	0,83	0,72	26,51	58,3	58,76
300	0,92	0,82	26,49	58,15	58,62
400	0,99	0,89	26,5	58,32	58,75
500	1,04	0,95	26,53	58,19	58,6
600	1,08	1	26,52	58,26	58,72
700	1,12	1,04	26,5	58,12	58,56
800	1,15	1,08	26,5	58,25	58,62
900	1,17	1,11	26,51	58,17	58,52
1000	1,2	1,15	26,48	58,28	58,64
1100	1,22	1,17	26,53	58,24	58,61
1200	1,24	1,2	26,52	58,3	58,75
1300	1,26	1,22	26,49	58,24	58,65
1400	1,28	1,24	26,5	58,3	58,78
1500	1,29	1,26	26,53	58,28	58,66
1600	1,31	1,28	26,5	58,33	58,78
1700	1,32	1,29	26,54	58,2	58,66
1800	1,33	1,31	26,48	58,32	58,69
1900	1,35	1,32	26,49	58,24	58,67
2000	1,36	1,34	26,48	58,28	58,68
2100	1,37	1,35	26,51	58,27	58,73
2200	1,38	1,37	26,48	58,32	58,8
2300	1,39	1,38	26,51	58,34	58,72
2400	1,4	1,39	26,53	58,35	58,71
2500	1,41	1,4	26,51	58,3	58,64
2600	1,42	1,41	26,47	58,34	58,72
2700	1,43	1,42	26,51	58,32	58,77
2800	1,44	1,43	26,51	58,33	58,76
2900	1,44	1,44	26,51	58,3	58,72
3000	1,45	1,45	26,49	58,39	58,72
3100	1,46	1,46	26,49	58,27	58,71
3200	1,46	1,47	26,47	58,25	58,67
3300	1,47	1,48	26,5	58,37	58,77
3400	1,47	1,49	26,47	58,24	58,68
3500	1,48	1,49	26,5	58,39	58,76
3600	1,49	1,5	26,49	58,29	58,65
3700	1,49	1,51	26,48	58,36	58,83
3800	1,5	1,52	26,51	58,35	58,71
3900	1,51	1,52	26,5	58,41	58,78
4000	1,51	1,53	26,5	58,34	58,74
4100	1,52	1,54	26,51	58,36	58,77
4200	1,52	1,54	26,51	58,3	58,64
4300	1,53	1,55	26,49	58,45	58,84
4400	1,53	1,56	26,49	58,33	58,74
4500	1,54	1,56	26,51	58,43	58,78
4600	1,54	1,57	26,48	58,3	58,74
4700	1,54	1,58	26,49	58,36	58,79
4800	1,55	1,58	26,54	58,27	58,72
4900	1,55	1,59	26,51	58,37	58,77
5000	1,56	1,59	26,48	58,34	58,77
5100	1,56	1,6	26,53	58,41	58,86
5200	1,57	1,61	26,49	58,4	58,8
5300	1,57	1,61	26,51	58,32	58,77
5400	1,58	1,61	26,52	58,36	58,78
5500	1,58	1,62	26,49	58,4	58,75
5600	1,58	1,62	26,51	58,48	58,83
5700	1,58	1,63	26,53	58,42	58,77
5800	1,59	1,64	26,51	58,46	58,89
5900	1,59	1,64	26,5	58,42	58,89
6000	1,6	1,65	26,51	58,32	58,75
6100	1,6	1,65	26,51	58,47	58,93
6200	1,6	1,66	26,5	58,34	58,8
6300	1,61	1,66	26,47	58,52	58,97
6400	1,61	1,67	26,49	58,36	58,8
6500	1,61	1,67	26,46	58,5	58,95

6600	1,61	1,68	26,54	58,36	58,8
6700	1,62	1,68	26,58	58,47	58,92
6800	1,62	1,68	26,5	58,37	58,78
6900	1,62	1,69	26,47	58,51	58,91
7000	1,63	1,69	26,54	58,37	58,79
7100	1,63	1,69	26,51	58,52	58,97
7200	1,63	1,7	26,54	58,35	58,69
7300	1,63	1,7	26,51	58,44	58,9
7400	1,63	1,7	26,45	58,28	58,69
7500	1,64	1,71	26,51	58,45	58,82
7600	1,64	1,71	26,4	58,27	58,66
7700	1,65	1,71	26,49	58,47	58,87
7800	1,65	1,72	26,5	58,35	58,77
7900	1,65	1,72	26,5	58,55	58,87
8000	1,65	1,72	26,48	58,38	58,72
8100	1,66	1,73	26,47	58,49	58,86
8200	1,66	1,73	26,51	58,41	58,76
8300	1,66	1,73	26,49	58,52	58,87
8400	1,66	1,74	26,51	58,37	58,72
8500	1,67	1,74	26,5	58,51	58,88
8600	1,67	1,74	26,5	58,43	58,77
8700	1,67	1,74	26,49	58,35	58,77
8800	1,67	1,74	26,54	58,43	58,76
8900	1,67	1,75	26,49	58,45	58,82
9000	1,67	1,75	26,51	58,38	58,7
9100	1,68	1,75	26,51	58,45	58,77
9200	1,68	1,75	26,47	58,45	58,84
9300	1,68	1,75	26,49	58,5	58,9
9400	1,68	1,75	26,51	58,44	58,87
9500	1,69	1,75	26,49	58,45	58,85
9600	1,69	1,75	26,5	58,52	58,98
9700	1,69	1,75	26,53	58,52	58,84
9800	1,69	1,75	26,48	58,48	58,85
9900	1,69	1,76	26,5	58,32	58,77
10000	1,69	1,76	26,52	58,49	58,97

Test Ended at 10000 Passes
Sample 1 Final rut depth = 1,69 mm
Sample 2 Final rut depth = 1,76 mm
Sample 1 Mean Steady State Tracking Rate = 0,03 mm/1000 Passes
Sample 2 Mean Steady State Tracking Rate = 0,03 mm/1000 Passes

Table 0.11 Samples 23-24: Wheeltrack test results.

Wheeltracking Test Summary
Specimen Name: Ab11 pmb samples 25 and 26 40C
Date: 08.10.2010
Test Temperature: 40
Sample 1 Thickness: 40
Sample 2 Thickness: 40

Pass No.	Rut Depth(mm) 1	Rut Depth(mm) 2	Speed (RPM)	RTD 1 Deg.C.	RTD 2 Deg.C.
0	0	0	26,5	40,67	40,8
100	0,34	0,38	26,5	40,69	40,84
200	0,44	0,5	26,5	40,65	40,73
300	0,51	0,58	26,51	40,62	40,77
400	0,56	0,64	26,44	40,66	40,76
500	0,6	0,68	26,48	40,58	40,64
600	0,64	0,72	26,51	40,54	40,64
700	0,66	0,75	26,48	40,52	40,59
800	0,68	0,77	26,51	40,47	40,6
900	0,71	0,79	26,5	40,52	40,6
1000	0,72	0,81	26,45	40,45	40,57
1100	0,74	0,83	26,6	40,41	40,51
1200	0,76	0,85	26,48	40,42	40,44
1300	0,77	0,86	26,54	40,43	40,44
1400	0,79	0,88	26,49	40,37	40,49
1500	0,8	0,89	26,52	40,38	40,41
1600	0,81	0,9	26,48	40,37	40,44
1700	0,82	0,91	26,51	40,3	40,36
1800	0,83	0,92	26,54	40,33	40,38
1900	0,84	0,93	26,52	40,35	40,39
2000	0,85	0,94	26,57	40,28	40,39
2100	0,86	0,95	26,5	40,31	40,38
2200	0,87	0,96	26,46	40,28	40,3
2300	0,88	0,97	26,48	40,25	40,26
2400	0,88	0,98	26,52	40,26	40,3
2500	0,89	0,98	26,48	40,18	40,28
2600	0,9	0,99	26,5	40,16	40,28
2700	0,9	1	26,5	40,16	40,28
2800	0,91	1,01	26,5	40,11	40,24
2900	0,91	1,01	26,51	40,19	40,22
3000	0,92	1,02	26,53	40,07	40,14
3100	0,93	1,02	26,53	40,11	40,14

3200	0,93	1,03	26,51	40,09	40,14
3300	0,94	1,03	26,5	40,04	40,15
3400	0,94	1,04	26,55	40,04	40,16
3500	0,95	1,04	26,5	39,99	40,12
3600	0,95	1,05	26,51	40,01	40,14
3700	0,96	1,06	26,5	40,01	40,19
3800	0,96	1,06	26,48	40,02	40,15
3900	0,97	1,07	26,59	40,02	40,09
4000	0,97	1,07	26,5	40,01	40,09
4100	0,97	1,08	26,49	39,92	40,05
4200	0,98	1,08	26,51	39,96	40,02
4300	0,98	1,08	26,5	39,89	40,03
4400	0,99	1,09	26,5	39,92	39,99
4500	0,99	1,09	26,53	39,89	39,94
4600	0,99	1,09	26,53	39,89	40,04
4700	1	1,1	26,5	39,88	40,03
4800	1	1,1	26,5	39,82	39,97
4900	1	1,11	26,52	39,84	39,99
5000	1,01	1,11	26,51	39,88	39,93
5100	1,01	1,11	26,48	39,78	39,92
5200	1,01	1,12	26,48	39,85	39,95
5300	1,02	1,12	26,5	39,84	39,88
5400	1,02	1,12	26,49	39,81	39,94
5500	1,02	1,12	26,5	39,78	39,93
5600	1,02	1,13	26,5	39,8	39,87
5700	1,02	1,13	26,49	39,73	39,89
5800	1,03	1,13	26,5	39,78	39,85
5900	1,03	1,14	26,52	39,69	39,8
6000	1,03	1,14	26,51	39,73	39,89
6100	1,04	1,14	26,49	39,66	39,82
6200	1,04	1,14	26,48	39,68	39,78
6300	1,04	1,15	26,51	39,69	39,86
6400	1,04	1,15	26,5	39,65	39,84
6500	1,05	1,15	26,51	39,65	39,78
6600	1,05	1,16	26,51	39,63	39,77
6700	1,05	1,16	26,47	39,69	39,79
6800	1,05	1,16	26,59	39,61	39,78
6900	1,06	1,16	26,5	39,61	39,7
7000	1,06	1,17	26,49	39,59	39,75
7100	1,06	1,17	26,51	39,62	39,8
7200	1,06	1,17	26,5	39,65	39,74
7300	1,07	1,17	26,48	39,59	39,79
7400	1,07	1,18	26,48	39,57	39,74
7500	1,07	1,18	26,51	39,64	39,75
7600	1,07	1,18	26,52	39,61	39,71
7700	1,08	1,18	26,5	39,59	39,7
7800	1,08	1,19	26,5	39,57	39,77
7900	1,08	1,19	26,53	39,57	39,76
8000	1,08	1,19	26,51	39,57	39,68
8100	1,08	1,19	26,53	39,54	39,75
8200	1,09	1,2	26,51	39,51	39,71
8300	1,09	1,2	26,52	39,57	39,67
8400	1,09	1,2	26,52	39,5	39,7
8500	1,09	1,2	26,52	39,56	39,65
8600	1,09	1,2	26,49	39,52	39,74
8700	1,09	1,21	26,49	39,53	39,74
8800	1,09	1,21	26,51	39,56	39,71
8900	1,1	1,21	26,51	39,49	39,71
9000	1,1	1,21	26,5	39,47	39,64
9100	1,1	1,21	26,49	39,52	39,73
9200	1,1	1,22	26,54	39,54	39,66
9300	1,1	1,22	26,46	39,46	39,69
9400	1,1	1,22	26,5	39,53	39,67
9500	1,1	1,22	26,52	39,47	39,71
9600	1,11	1,22	26,48	39,53	39,65
9700	1,11	1,22	26,5	39,43	39,64
9800	1,11	1,23	26,51	39,51	39,66
9900	1,11	1,23	26,49	39,5	39,67
10000	1,11	1,23	26,49	39,43	39,65

Test Ended at 10000 Passes
Sample 1 Final rut depth = 1,11 mm
Sample 2 Final rut depth = 1,23 mm
Sample 1 Mean Steady State Tracking Rate = 0,02 mm/1000 Passes
Sample 2 Mean Steady State Tracking Rate = 0,02 mm/1000 Passes

Table 0.12 SAmples 25-26: Wheeltrack test results.

Wheeltracking Test Summary
Specimen Name: Ska11 samples 27 and 28 50C
Date: 11.10.2010
Test Temperature: 50
Sample 1 Thickness: 40

Sample 2 Thickness: 40

Pass No.	Rut Depth(mm) 1	Rut Depth(mm) 2	Speed (RPM)	RTD 1 Deg.C.	RTD 2 Deg.C.
0	0	0	26,5	48,92	49,94
100	0,75	0,78	26,5	48,79	49,6
200	0,95	0,99	26,52	48,75	49,63
300	1,07	1,11	26,51	48,71	49,54
400	1,15	1,2	26,46	48,75	49,54
500	1,22	1,26	26,5	48,7	49,39
600	1,28	1,32	26,52	48,72	49,41
700	1,33	1,37	26,48	48,7	49,43
800	1,37	1,41	26,49	48,79	49,44
900	1,41	1,44	26,48	48,82	49,46
1000	1,45	1,47	26,47	48,76	49,34
1100	1,48	1,5	26,43	48,79	49,42
1200	1,52	1,53	26,51	48,73	49,37
1300	1,55	1,56	26,43	48,8	49,44
1400	1,57	1,58	26,47	48,77	49,28
1500	1,6	1,6	26,51	48,83	49,37
1600	1,63	1,62	26,47	48,76	49,3
1700	1,65	1,64	26,49	48,83	49,33
1800	1,67	1,66	26,53	48,83	49,33
1900	1,7	1,67	26,46	48,78	49,28
2000	1,72	1,69	26,51	48,81	49,41
2100	1,74	1,71	26,53	48,76	49,29
2200	1,76	1,72	26,47	48,85	49,37
2300	1,77	1,74	26,51	48,82	49,28
2400	1,79	1,75	26,48	48,88	49,35
2500	1,81	1,77	26,47	48,83	49,31
2600	1,82	1,78	26,51	48,92	49,38
2700	1,83	1,8	26,55	48,77	49,25
2800	1,85	1,81	26,5	48,86	49,38
2900	1,86	1,82	26,49	48,76	49,3
3000	1,87	1,84	26,51	48,86	49,31
3100	1,88	1,85	26,47	48,83	49,24
3200	1,89	1,87	26,49	48,91	49,31
3300	1,91	1,88	26,54	48,82	49,26
3400	1,92	1,89	26,48	48,91	49,3
3500	1,93	1,9	26,5	48,92	49,35
3600	1,94	1,91	26,55	48,87	49,27
3700	1,95	1,93	26,44	48,88	49,3
3800	1,96	1,93	26,5	48,82	49,29
3900	1,97	1,95	26,49	48,95	49,34
4000	1,98	1,96	26,44	48,89	49,27
4100	1,99	1,96	26,47	48,87	49,36
4200	2	1,97	26,55	48,79	49,24
4300	2,01	1,98	26,45	48,92	49,38
4400	2,01	1,99	26,5	48,9	49,27
4500	2,02	2	26,53	48,9	49,28
4600	2,03	2,01	26,48	48,82	49,28
4700	2,04	2,02	26,48	48,89	49,28
4800	2,05	2,02	26,53	48,81	49,22
4900	2,06	2,03	26,51	48,88	49,32
5000	2,07	2,04	26,51	48,86	49,28
5100	2,07	2,04	26,51	48,85	49,29
5200	2,08	2,05	26,5	48,94	49,31
5300	2,09	2,06	26,46	48,8	49,22
5400	2,1	2,07	26,54	48,91	49,28
5500	2,11	2,08	26,52	48,91	49,27
5600	2,12	2,08	26,5	48,88	49,35
5700	2,12	2,09	26,52	48,82	49,23
5800	2,13	2,1	26,49	48,95	49,32
5900	2,14	2,1	26,54	48,93	49,28
6000	2,14	2,11	26,49	48,9	49,24
6100	2,15	2,11	26,47	48,89	49,37
6200	2,16	2,12	26,46	48,93	49,38
6300	2,16	2,13	26,52	48,95	49,33
6400	2,17	2,13	26,48	48,89	49,31
6500	2,18	2,14	26,51	48,9	49,36
6600	2,19	2,14	26,5	48,9	49,28
6700	2,19	2,15	26,49	48,96	49,42
6800	2,2	2,16	26,47	48,88	49,32
6900	2,21	2,16	26,86	48,95	49,33
7000	2,21	2,16	26,51	48,95	49,34
7100	2,22	2,17	26,47	48,95	49,37
7200	2,23	2,17	26,52	48,93	49,28
7300	2,23	2,18	26,5	48,95	49,37
7400	2,24	2,18	26,49	48,91	49,35
7500	2,25	2,19	26,51	48,95	49,38
7600	2,25	2,2	26,49	48,95	49,4
7700	2,26	2,2	26,45	48,98	49,33
7800	2,27	2,2	26,49	48,95	49,45
7900	2,27	2,21	26,51	48,93	49,27
8000	2,28	2,21	26,51	48,92	49,35
8100	2,28	2,22	26,5	48,89	49,28
8200	2,29	2,23	26,53	48,97	49,39
8300	2,29	2,23	26,49	48,93	49,38
8400	2,3	2,24	26,5	48,91	49,34

8500	2,3	2,24	26,49	48,99	49,33
8600	2,31	2,25	26,49	48,97	49,3
8700	2,31	2,25	26,49	48,98	49,4
8800	2,32	2,26	26,5	48,93	49,28
8900	2,32	2,27	26,48	48,9	49,37
9000	2,33	2,27	26,54	48,91	49,37
9100	2,33	2,27	26,51	48,91	49,36
9200	2,34	2,28	26,48	48,97	49,35
9300	2,34	2,28	26,5	48,84	49,28
9400	2,35	2,29	26,52	48,92	49,32
9500	2,35	2,29	26,46	48,94	49,33
9600	2,36	2,29	26,51	48,94	49,43
9700	2,36	2,29	26,53	48,87	49,3
9800	2,37	2,3	26,47	48,97	49,43
9900	2,37	2,31	26,42	48,91	49,3
10000	2,38	2,31	26,51	48,95	49,41

Test Ended at 10000 Passes
Sample 1 Final rut depth = 2,38 mm
Sample 2 Final rut depth = 2,31 mm
Sample 1 Mean Steady State Tracking Rate = 0,06 mm/1000 Passes
Sample 2 Mean Steady State Tracking Rate = 0,05 mm/1000 Passes

Table 0.13 Samples 27-28: Wheeltrack test results.

Wheeltracking Test Summary
Specimen Name: Ska11 samples 29 and 30 60C
Date: 12.10.2010
Test Temperature: 60
Sample 1 Thickness: 40
Sample 2 Thickness: 40

Pass No.	Rut Depth(mm) 1	Rut Depth(mm) 2	Speed (RPM)	RTD 1 Deg.C.	RTD 2 Deg.C.
0	0	0	26,5	58,04	58,58
100	0,81	0,8	26,45	58,1	58,65
200	1,02	1,01	26,55	58,11	58,62
300	1,15	1,14	26,56	58,07	58,57
400	1,25	1,23	26,5	58,17	58,64
500	1,32	1,3	26,5	58,03	58,56
600	1,39	1,35	26,51	58,09	58,66
700	1,45	1,41	26,48	58,05	58,52
800	1,5	1,45	26,47	58,06	58,58
900	1,54	1,49	26,52	58,11	58,56
1000	1,59	1,53	26,51	58,11	58,72
1100	1,62	1,56	26,5	58,07	58,6
1200	1,65	1,59	26,5	58,12	58,69
1300	1,68	1,62	26,5	58,08	58,62
1400	1,71	1,65	26,5	58,09	58,65
1500	1,74	1,68	26,52	58,15	58,7
1600	1,76	1,72	26,48	58,06	58,61
1700	1,78	1,74	26,52	58,09	58,69
1800	1,8	1,77	26,49	58,06	58,67
1900	1,82	1,8	26,53	58,14	58,76
2000	1,84	1,82	26,44	58,13	58,57
2100	1,86	1,85	26,49	58,18	58,72
2200	1,88	1,87	26,48	58,11	58,69
2300	1,9	1,89	26,45	58,09	58,64
2400	1,92	1,9	26,53	58,2	58,7
2500	1,94	1,93	26,49	58,14	58,74
2600	1,96	1,95	26,5	58,18	58,74
2700	1,98	1,96	26,5	58,16	58,64
2800	1,99	1,99	26,49	58,11	58,67
2900	2	2,01	26,48	58,08	58,55
3000	2,02	2,02	26,49	58,16	58,68
3100	2,03	2,04	26,49	58,13	58,59
3200	2,05	2,05	26,49	58,17	58,73
3300	2,06	2,06	26,5	58,16	58,64
3400	2,07	2,08	26,5	58,13	58,65
3500	2,08	2,1	26,47	58,22	58,64
3600	2,1	2,11	26,51	58,16	58,62
3700	2,11	2,13	26,56	58,16	58,61
3800	2,12	2,14	26,51	58,09	58,63
3900	2,13	2,15	26,5	58,14	58,63
4000	2,14	2,17	26,52	58,17	58,64
4100	2,15	2,18	26,44	58,11	58,6
4200	2,16	2,19	26,52	58,21	58,75
4300	2,18	2,2	26,46	58,16	58,59
4400	2,19	2,21	26,5	58,29	58,8
4500	2,2	2,22	26,5	58,17	58,63
4600	2,21	2,24	26,5	58,22	58,71
4700	2,22	2,25	26,49	58,1	58,58
4800	2,23	2,26	26,48	58,23	58,81
4900	2,25	2,27	26,51	58,23	58,75
5000	2,26	2,28	26,51	58,29	58,81

5100	2,27	2,29	26,51	58,19	58,74
5200	2,28	2,3	26,49	58,3	58,81
5300	2,28	2,31	26,5	58,2	58,75
5400	2,29	2,32	26,5	58,31	58,81
5500	2,3	2,33	26,48	58,19	58,74
5600	2,31	2,35	26,53	58,25	58,86
5700	2,32	2,36	26,47	58,21	58,79
5800	2,33	2,37	26,48	58,24	58,84
5900	2,34	2,37	26,52	58,27	58,75
6000	2,35	2,38	26,47	58,26	58,82
6100	2,36	2,39	26,51	58,3	58,8
6200	2,37	2,4	26,48	58,26	58,82
6300	2,37	2,41	26,55	58,27	58,88
6400	2,38	2,42	26,5	58,25	58,81
6500	2,39	2,43	26,47	58,28	58,88
6600	2,4	2,44	26,5	58,32	58,82
6700	2,4	2,46	26,51	58,31	58,77
6800	2,41	2,47	26,49	58,31	58,8
6900	2,42	2,48	26,5	58,27	58,87
7000	2,42	2,48	26,51	58,31	58,72
7100	2,43	2,5	26,55	58,3	58,87
7200	2,44	2,51	26,46	58,28	58,82
7300	2,45	2,51	26,5	58,37	58,88
7400	2,45	2,52	26,42	58,24	58,77
7500	2,46	2,53	26,49	58,29	58,83
7600	2,47	2,54	26,49	58,28	58,78
7700	2,48	2,55	26,5	58,3	58,84
7800	2,48	2,56	26,52	58,22	58,74
7900	2,49	2,56	26,5	58,26	58,82
8000	2,49	2,57	26,47	58,26	58,72
8100	2,5	2,58	26,52	58,38	58,84
8200	2,51	2,59	26,5	58,24	58,75
8300	2,52	2,6	26,5	58,37	58,88
8400	2,52	2,61	26,5	58,22	58,67
8500	2,53	2,61	26,51	58,38	58,82
8600	2,53	2,62	26,47	58,28	58,71
8700	2,54	2,63	26,46	58,3	58,88
8800	2,55	2,63	26,49	58,26	58,69
8900	2,55	2,64	26,5	58,37	58,93
9000	2,56	2,65	26,49	58,31	58,75
9100	2,57	2,66	26,5	58,37	58,93
9200	2,57	2,67	26,49	58,36	58,78
9300	2,57	2,68	26,48	58,34	58,86
9400	2,58	2,68	26,52	58,31	58,8
9500	2,59	2,69	26,45	58,29	58,74
9600	2,59	2,7	26,48	58,35	58,9
9700	2,6	2,7	26,54	58,29	58,78
9800	2,6	2,71	26,51	58,36	58,84
9900	2,6	2,72	26,55	58,25	58,76
10000	2,61	2,72	26,45	58,36	58,92

Test Ended at 10000 Passes
Sample 1 Final rut depth = 2,61 mm
Sample 2 Final rut depth = 2,72 mm
Sample 1 Mean Steady State Tracking Rate = 0,07 mm/1000 Passes
Sample 2 Mean Steady State Tracking Rate = 0,09 mm/1000 Passes

Table 0.14 Samples 29-30: Wheeltrack test results.

Wheeltracking Test Summary
Specimen Name: Ska11 samples 31 and 32 40C
Date: 14.10.2010
Test Temperature: 40
Sample 1 Thickness: 40
Sample 2 Thickness: 40

Pass No.	Rut Depth(mm) 1	Rut Depth(mm) 2	Speed (RPM)	RTD 1 Deg.C.	RTD 2 Deg.C.
0	0	0	26,5	39,35	40,04
100	0,54	0,45	26,54	39,79	40,31
200	0,73	0,63	26,5	39,84	40,27
300	0,85	0,74	26,52	39,78	40,19
400	0,95	0,82	26,51	39,89	40,31
500	1,03	0,88	26,49	39,89	40,29
600	1,09	0,94	26,49	39,91	40,33
700	1,14	0,99	26,5	39,85	40,25
800	1,19	1,03	26,85	39,86	40,33
900	1,23	1,07	26,48	39,84	40,29
1000	1,27	1,1	26,5	39,84	40,26
1100	1,3	1,13	26,5	39,86	40,25
1200	1,33	1,16	26,48	39,95	40,35
1300	1,36	1,18	26,52	39,95	40,31
1400	1,38	1,2	26,5	39,85	40,3
1500	1,41	1,22	26,51	39,83	40,26
1600	1,43	1,24	26,5	39,94	40,34

1700	1,45	1,26	26,51	39,9	40,27
1800	1,48	1,28	26,51	39,93	40,3
1900	1,49	1,3	26,46	39,93	40,32
2000	1,51	1,32	26,51	39,98	40,36
2100	1,53	1,33	26,52	39,93	40,42
2200	1,55	1,35	26,49	39,89	40,32
2300	1,57	1,36	26,49	39,91	40,38
2400	1,58	1,38	26,5	39,94	40,33
2500	1,6	1,4	26,53	39,97	40,34
2600	1,61	1,41	26,51	39,96	40,41
2700	1,63	1,42	26,51	40	40,34
2800	1,64	1,44	26,53	39,98	40,3
2900	1,65	1,45	26,49	39,99	40,33
3000	1,66	1,46	26,48	39,95	40,39
3100	1,67	1,47	26,52	40,04	40,38
3200	1,68	1,48	26,47	39,99	40,39
3300	1,69	1,49	26,54	39,97	40,39
3400	1,69	1,5	26,55	39,95	40,3
3500	1,7	1,51	26,48	39,98	40,37
3600	1,71	1,52	26,5	40,02	40,4
3700	1,72	1,53	26,52	39,95	40,3
3800	1,73	1,54	26,5	40,04	40,34
3900	1,74	1,55	26,5	39,96	40,37
4000	1,75	1,56	26,47	40,04	40,38
4100	1,76	1,57	26,49	39,96	40,34
4200	1,77	1,57	26,49	40,01	40,39
4300	1,78	1,58	26,53	39,97	40,35
4400	1,78	1,59	26,53	40,03	40,3
4500	1,79	1,6	26,46	40,05	40,36
4600	1,8	1,6	26,49	39,98	40,36
4700	1,81	1,61	26,52	40,04	40,38
4800	1,81	1,62	26,51	39,99	40,3
4900	1,82	1,63	26,5	40,02	40,31
5000	1,83	1,63	26,51	40,03	40,39
5100	1,84	1,64	26,47	40,01	40,37
5200	1,85	1,65	26,53	39,98	40,34
5300	1,85	1,65	26,51	40,01	40,39
5400	1,86	1,66	26,49	40,05	40,31
5500	1,86	1,67	26,49	40,02	40,29
5600	1,87	1,67	26,51	40,06	40,34
5700	1,87	1,68	26,48	40,02	40,37
5800	1,88	1,69	26,48	40	40,36
5900	1,88	1,69	26,52	40,01	40,38
6000	1,89	1,7	26,48	40,01	40,28
6100	1,9	1,71	26,52	40,02	40,29
6200	1,9	1,71	26,51	40	40,35
6300	1,91	1,72	26,47	40	40,38
6400	1,92	1,73	26,5	39,98	40,34
6500	1,92	1,73	26,52	40,04	40,3
6600	1,93	1,74	26,47	40,07	40,34
6700	1,93	1,74	26,48	39,99	40,26
6800	1,94	1,75	26,5	40,07	40,3
6900	1,94	1,75	26,49	40,05	40,3
7000	1,94	1,76	26,51	40,05	40,35
7100	1,95	1,77	26,5	40,05	40,37
7200	1,95	1,77	26,49	40	40,36
7300	1,95	1,77	26,52	40,03	40,28
7400	1,96	1,78	26,52	40,04	40,35
7500	1,96	1,78	26,49	40	40,36
7600	1,97	1,79	26,52	40,05	40,28
7700	1,97	1,79	26,5	40,01	40,33
7800	1,98	1,8	26,52	40,1	40,35
7900	1,98	1,8	26,5	40,01	40,33
8000	1,99	1,81	26,38	40,02	40,35
8100	1,99	1,81	26,49	40,01	40,37
8200	2	1,82	26,53	40,02	40,34
8300	2	1,82	26,51	40,02	40,37
8400	2	1,83	26,49	40,07	40,31
8500	2,01	1,83	26,52	40,07	40,36
8600	2,01	1,84	26,5	40,02	40,37
8700	2,02	1,84	26,47	39,97	40,27
8800	2,02	1,85	26,5	40,04	40,26
8900	2,03	1,85	26,5	40,02	40,36
9000	2,03	1,86	26,49	40,03	40,26
9100	2,03	1,86	26,49	40,05	40,32
9200	2,04	1,87	26,51	40,02	40,35
9300	2,04	1,87	26,52	40,04	40,35
9400	2,05	1,88	26,53	40	40,35
9500	2,05	1,88	26,5	39,99	40,29
9600	2,05	1,89	26,51	39,98	40,27
9700	2,06	1,89	26,48	40,04	40,29
9800	2,06	1,89	26,52	40,06	40,34
9900	2,07	1,9	26,51	40,08	40,35
10000	2,07	1,9	26,5	39,99	40,31

Test Ended at 10000 Passes
Sample 1 Final rut depth = 2,07 mm

Sample 2 Final rut depth = 1,90 mm
Sample 1 Mean Steady State Tracking Rate = 0,05 mm/1000 Passes
Sample 2 Mean Steady State Tracking Rate = 0,05 mm/1000 Passes

Table 0.15 Samples 31-32: Wheeltrack test results.

Wheeltracking Test Summary
Specimen Name: Agb11 samples 33 and 34 50C
Date: 15.10.2010
Test Temperature: 50
Sample 1 Thickness: 40
Sample 2 Thickness: 40

Pass No.	Rut Depth(mm) 1	Rut Depth(mm) 2	Speed (RPM)	RTD 1 Deg.C.	RTD 2 Deg.C.
0	0	0	26,5	48,89	49,49
100	0,78	0,77	26,6	48,79	49,38
200	1,01	1	26,5	48,94	49,49
300	1,17	1,15	26,48	48,88	49,39
400	1,28	1,27	26,49	48,99	49,47
500	1,37	1,36	26,52	48,95	49,43
600	1,46	1,44	26,5	49,01	49,49
700	1,53	1,51	26,54	48,99	49,57
800	1,6	1,57	26,51	48,93	49,48
900	1,66	1,62	26,49	49	49,51
1000	1,72	1,67	26,5	49	49,52
1100	1,77	1,72	26,5	49,04	49,57
1200	1,82	1,76	26,49	48,94	49,5
1300	1,87	1,8	26,5	49,08	49,57
1400	1,91	1,84	26,51	48,96	49,48
1500	1,95	1,88	26,48	49,03	49,49
1600	1,99	1,91	26,49	49,07	49,47
1700	2,03	1,94	26,52	49,06	49,5
1800	2,06	1,97	26,51	49,13	49,58
1900	2,1	2	26,5	49,04	49,47
2000	2,12	2,03	26,5	49,09	49,49
2100	2,15	2,06	26,52	49,07	49,54
2200	2,19	2,08	26,54	49,09	49,49
2300	2,22	2,11	26,49	49,15	49,54
2400	2,24	2,13	26,47	49,07	49,59
2500	2,27	2,16	26,52	49,14	49,55
2600	2,29	2,18	26,54	49,06	49,52
2700	2,32	2,2	26,49	49,18	49,56
2800	2,35	2,22	26,51	49,13	49,61
2900	2,38	2,24	26,52	49,21	49,62
3000	2,4	2,26	26,52	49,19	49,58
3100	2,43	2,28	26,49	49,15	49,61
3200	2,45	2,3	26,51	49,27	49,67
3300	2,48	2,32	26,48	49,21	49,61
3400	2,51	2,34	26,52	49,26	49,62
3500	2,53	2,35	26,56	49,15	49,55
3600	2,55	2,37	26,49	49,26	49,71
3700	2,57	2,39	26,56	49,17	49,53
3800	2,6	2,41	26,48	49,35	49,68
3900	2,61	2,42	26,46	49,26	49,65
4000	2,63	2,44	26,51	49,28	49,63
4100	2,65	2,46	26,53	49,21	49,58
4200	2,68	2,47	26,5	49,3	49,61
4300	2,7	2,49	26,48	49,25	49,6
4400	2,72	2,5	26,49	49,33	49,69
4500	2,74	2,52	26,48	49,23	49,66
4600	2,76	2,54	26,47	49,3	49,63
4700	2,78	2,56	26,53	49,3	49,69
4800	2,8	2,57	26,49	49,35	49,62
4900	2,83	2,58	26,5	49,25	49,62
5000	2,85	2,6	26,39	49,27	49,63
5100	2,87	2,61	26,48	49,3	49,61
5200	2,89	2,63	26,45	49,27	49,68
5300	2,91	2,64	26,52	49,34	49,66
5400	2,93	2,66	26,49	49,24	49,69
5500	2,95	2,67	26,5	49,31	49,63
5600	2,96	2,68	26,59	49,22	49,62
5700	2,98	2,7	26,49	49,33	49,73
5800	3	2,71	26,47	49,23	49,64
5900	3,02	2,72	26,49	49,26	49,62
6000	3,03	2,74	26,5	49,3	49,63
6100	3,05	2,75	26,52	49,29	49,67
6200	3,06	2,76	26,49	49,34	49,66
6300	3,08	2,77	26,52	49,27	49,68
6400	3,09	2,79	26,49	49,36	49,66
6500	3,11	2,8	26,48	49,24	49,63
6600	3,12	2,81	26,47	49,33	49,68
6700	3,14	2,82	26,48	49,36	49,68
6800	3,16	2,83	26,5	49,3	49,68

6900	3,17	2,84	26,5	49,35	49,62
7000	3,19	2,85	26,47	49,28	49,6
7100	3,2	2,86	26,46	49,4	49,67
7200	3,22	2,87	26,47	49,34	49,64
7300	3,24	2,89	26,48	49,35	49,65
7400	3,25	2,89	26,56	49,24	49,58
7500	3,27	2,91	26,52	49,3	49,64
7600	3,28	2,92	26,47	49,36	49,73
7700	3,3	2,93	26,45	49,24	49,62
7800	3,32	2,94	26,52	49,41	49,65
7900	3,33	2,95	26,48	49,26	49,6
8000	3,34	2,96	26,51	49,36	49,75
8100	3,35	2,97	26,49	49,3	49,7
8200	3,36	2,98	26,51	49,32	49,62
8300	3,37	2,99	26,5	49,41	49,65
8400	3,38	3	26,51	49,35	49,63
8500	3,4	3,01	26,52	49,36	49,66
8600	3,41	3,02	26,51	49,38	49,68
8700	3,42	3,03	26,5	49,36	49,71
8800	3,43	3,04	26,47	49,31	49,67
8900	3,44	3,05	26,49	49,53	49,75
9000	3,46	3,06	26,47	49,39	49,71
9100	3,47	3,08	26,47	49,51	49,79
9200	3,49	3,09	26,5	49,49	49,85
9300	3,5	3,1	26,52	49,48	49,77
9400	3,51	3,11	26,49	49,52	49,92
9500	3,52	3,12	26,52	49,49	49,8
9600	3,54	3,13	26,54	49,48	49,88
9700	3,55	3,14	26,43	49,44	49,78
9800	3,56	3,15	26,46	49,5	49,85
9900	3,57	3,16	26,49	49,44	49,84
10000	3,58	3,17	26,49	49,42	49,77

Test Ended at 10000 Passes
Sample 1 Final rut depth = 3,58 mm
Sample 2 Final rut depth = 3,17 mm
Sample 1 Mean Steady State Tracking Rate = 0,15 mm/1000 Passes
Sample 2 Mean Steady State Tracking Rate = 0,11 mm/1000 Passes

Table 0.16 Samples 33-34: Wheeltrack test results.

Wheeltracking Test Summary
Specimen Name: Agb11 35 og 36 40C
Date: 18.10.2010
Test Temperature: 40
Sample 1 Thickness: 40
Sample 2 Thickness: 40

Pass No.	Rut Depth(mm) 1	Rut Depth(mm) 2	Speed (RPM)	RTD 1 Deg.C.	RTD 2 Deg.C.
0	0	0	26,5	39,74	40,16
100	0,74	0,56	26,55	40,33	40,57
200	0,93	0,72	26,51	40,29	40,48
300	1,05	0,82	26,5	40,25	40,54
400	1,13	0,89	26,5	40,29	40,49
500	1,2	0,96	26,55	40,23	40,54
600	1,26	1,02	26,5	40,27	40,46
700	1,31	1,07	26,52	40,25	40,53
800	1,35	1,11	26,51	40,29	40,5
900	1,39	1,15	26,48	40,24	40,51
1000	1,42	1,18	26,51	40,22	40,4
1100	1,45	1,21	26,53	40,16	40,45
1200	1,49	1,24	26,49	40,24	40,43
1300	1,51	1,27	26,51	40,13	40,41
1400	1,54	1,3	26,5	40,17	40,46
1500	1,56	1,32	26,48	40,13	40,38
1600	1,58	1,35	26,52	40,16	40,35
1700	1,6	1,36	26,5	40,2	40,41
1800	1,62	1,39	26,5	40,2	40,4
1900	1,64	1,4	26,5	40,11	40,42
2000	1,66	1,42	26,48	40,19	40,39
2100	1,68	1,44	26,49	40,11	40,35
2200	1,7	1,45	26,5	40,19	40,41
2300	1,71	1,47	26,4	40,13	40,41
2400	1,73	1,48	26,5	40,15	40,36
2500	1,76	1,5	26,51	40,14	40,4
2600	1,77	1,51	26,49	40,16	40,39
2700	1,78	1,53	26,47	40,13	40,34
2800	1,79	1,54	26,5	40,09	40,39
2900	1,8	1,55	26,49	40,1	40,3
3000	1,81	1,57	26,57	40,11	40,3
3100	1,82	1,58	26,57	40,09	40,39
3200	1,83	1,59	26,53	40,1	40,31
3300	1,85	1,6	26,32	40,14	40,35
3400	1,85	1,61	26,49	40,1	40,29

3500	1,87	1,62	26,5	40,11	40,32
3600	1,88	1,63	26,49	40,08	40,28
3700	1,89	1,64	26,52	40,08	40,35
3800	1,9	1,65	26,49	40,1	40,31
3900	1,91	1,66	26,48	40,1	40,37
4000	1,92	1,67	26,5	40,1	40,37
4100	1,93	1,68	26,5	40,04	40,34
4200	1,94	1,69	26,53	40,06	40,29
4300	1,95	1,7	26,51	40,07	40,35
4400	1,96	1,71	26,47	40,14	40,34
4500	1,96	1,72	26,5	40,03	40,24
4600	1,97	1,72	26,5	40,11	40,29
4700	1,97	1,73	26,5	40,08	40,27
4800	1,98	1,74	26,49	40,08	40,25
4900	2	1,74	26,48	40,07	40,26
5000	2	1,75	26,52	40,02	40,29
5100	2	1,76	26,49	40,1	40,34
5200	2,01	1,77	26,5	39,99	40,28
5300	2,02	1,78	26,49	40,05	40,25
5400	2,02	1,79	26,49	40,04	40,24
5500	2,03	1,79	26,5	40,08	40,29
5600	2,04	1,8	26,5	40,08	40,3
5700	2,05	1,81	26,49	40,04	40,33
5800	2,06	1,81	26,51	40,03	40,24
5900	2,07	1,82	26,5	40,01	40,25
6000	2,07	1,83	26,48	40,04	40,24
6100	2,09	1,83	26,5	40,05	40,25
6200	2,09	1,84	26,51	40	40,28
6300	2,1	1,85	26,49	40,04	40,23
6400	2,11	1,85	26,49	40	40,26
6500	2,11	1,86	26,47	40,03	40,32
6600	2,12	1,87	26,48	40,01	40,31
6700	2,13	1,87	26,49	40,04	40,32
6800	2,14	1,88	26,5	40	40,31
6900	2,15	1,89	26,49	39,99	40,27
7000	2,15	1,89	26,52	39,99	40,22
7100	2,15	1,9	26,5	40	40,31
7200	2,16	1,9	26,48	40,03	40,27
7300	2,16	1,91	26,52	39,96	40,27
7400	2,16	1,91	26,52	40,04	40,28
7500	2,16	1,92	26,48	40,04	40,28
7600	2,16	1,93	26,49	40,05	40,23
7700	2,16	1,93	26,53	40,05	40,29
7800	2,17	1,94	26,48	39,96	40,24
7900	2,17	1,94	26,49	40	40,23
8000	2,18	1,95	26,54	39,96	40,28
8100	2,19	1,95	26,48	39,99	40,31
8200	2,19	1,96	26,51	39,94	40,23
8300	2,2	1,97	26,54	40,01	40,21
8400	2,2	1,97	26,49	40,04	40,25
8500	2,2	1,98	26,52	39,99	40,22
8600	2,21	1,98	26,5	40,04	40,28
8700	2,21	1,99	26,51	40,04	40,23
8800	2,21	1,99	26,51	39,99	40,25
8900	2,22	1,99	26,51	40	40,32
9000	2,22	2	26,49	39,97	40,3
9100	2,23	2,01	26,49	40,01	40,23
9200	2,24	2,01	26,49	40,01	40,34
9300	2,24	2,01	26,48	40,01	40,31
9400	2,25	2,02	26,5	40,04	40,35
9500	2,26	2,03	26,52	39,97	40,27
9600	2,26	2,03	26,49	40,05	40,28
9700	2,26	2,03	26,5	40,05	40,32
9800	2,27	2,04	26,51	39,97	40,24
9900	2,27	2,04	26,46	40,04	40,33
10000	2,28	2,05	26,5	40,04	40,31

Test Ended at 10000 Passes
Sample 1 Final rut depth = 2,28 mm
Sample 2 Final rut depth = 2,05 mm
Sample 1 Mean Steady State Tracking Rate = 0,06 mm/1000 Passes
Sample 2 Mean Steady State Tracking Rate = 0,06 mm/1000 Passes

Table 0.17 Samples 35-36:Wheeltrack test results.

Wheeltracking Test Summary
Specimen Name: It 37 and 38
Date: 30.11.2010
Test Temperature: 50
Sample 1 Thickness: 40
Sample 2 Thickness: 40

Pass No.	Rut Depth(mm) 1	Rut Depth(mm) 2	Speed (RPM)	RTD 1 Deg.C.	RTD 2 Deg.C.
0	0	0	26,5	49,1	49,46

100	0,5	0,48	26,6	49	49,3
200	0,63	0,6	26,46	49,11	49,49
300	0,7	0,67	26,52	49,02	49,42
400	0,75	0,72	26,48	49,09	49,4
500	0,79	0,76	26,53	49,11	49,44
600	0,83	0,79	26,5	49,05	49,53
700	0,86	0,82	26,49	49,1	49,58
800	0,89	0,85	26,52	49,02	49,53
900	0,91	0,87	26,52	49,06	49,54
1000	0,94	0,89	26,48	49,06	49,45
1100	0,95	0,91	26,5	49,1	49,55
1200	0,97	0,93	26,48	49,09	49,49
1300	0,99	0,94	26,62	49,17	49,66
1400	1,01	0,96	26,52	49,11	49,55
1500	1,02	0,96	26,53	49,18	49,65
1600	1,03	0,98	26,52	49,13	49,65
1700	1,05	0,99	26,82	49,11	49,62
1800	1,06	1	26,52	49,16	49,6
1900	1,07	1,01	26,43	49,13	49,58
2000	1,08	1,02	26,51	49,14	49,68
2100	1,09	1,03	26,51	49,1	49,6
2200	1,1	1,03	26,56	49,11	49,63
2300	1,1	1,04	26,53	49,09	49,64
2400	1,11	1,05	26,49	49,2	49,68
2500	1,12	1,06	26,4	49,13	49,56
2600	1,13	1,07	26,48	49,18	49,66
2700	1,13	1,07	26,47	49,14	49,6
2800	1,14	1,08	26,49	49,17	49,62
2900	1,15	1,08	26,5	49,15	49,63
3000	1,16	1,09	26,52	49,19	49,64
3100	1,16	1,1	26,47	49,23	49,67
3200	1,17	1,1	26,53	49,1	49,65
3300	1,18	1,11	26,51	49,23	49,77
3400	1,18	1,11	26,48	49,09	49,65
3500	1,19	1,12	26,5	49,2	49,72
3600	1,19	1,12	26,51	49,12	49,64
3700	1,19	1,13	26,47	49,1	49,69
3800	1,2	1,13	26,49	49,18	49,79
3900	1,2	1,14	26,47	49,13	49,71
4000	1,2	1,14	26,48	49,24	49,77
4100	1,2	1,15	26,5	49,17	49,68
4200	1,21	1,15	26,48	49,21	49,7
4300	1,22	1,16	26,47	49,12	49,72
4400	1,22	1,16	26,5	49,21	49,77
4500	1,22	1,17	26,47	49,18	49,64
4600	1,23	1,17	26,48	49,22	49,69
4700	1,23	1,17	26,56	49,11	49,65
4800	1,23	1,18	26,5	49,16	49,74
4900	1,23	1,18	26,48	49,11	49,65
5000	1,24	1,19	26,5	49,16	49,75
5100	1,24	1,19	26,5	49,16	49,7
5200	1,24	1,19	26,49	49,23	49,73
5300	1,25	1,19	26,5	49,19	49,72
5400	1,25	1,2	26,51	49,17	49,75
5500	1,25	1,2	26,47	49,18	49,74
5600	1,26	1,2	26,52	49,12	49,65
5700	1,26	1,21	26,52	49,21	49,7
5800	1,26	1,21	26,5	49,23	49,67
5900	1,27	1,21	26,52	49,21	49,65
6000	1,27	1,22	26,5	49,27	49,76
6100	1,28	1,22	26,47	49,18	49,7
6200	1,28	1,22	26,49	49,25	49,76
6300	1,28	1,22	26,51	49,19	49,67
6400	1,29	1,23	26,47	49,19	49,71
6500	1,29	1,23	26,5	49,19	49,72
6600	1,29	1,23	26,5	49,25	49,67
6700	1,29	1,24	26,51	49,2	49,72
6800	1,3	1,24	26,49	49,13	49,69
6900	1,3	1,24	26,51	49,19	49,7
7000	1,31	1,25	26,44	49,16	49,7
7100	1,31	1,25	26,46	49,24	49,82
7200	1,31	1,25	26,59	49,18	49,73
7300	1,31	1,26	26,51	49,27	49,79
7400	1,32	1,26	26,51	49,21	49,75
7500	1,32	1,26	26,48	49,22	49,8
7600	1,32	1,26	26,51	49,17	49,68
7700	1,32	1,26	26,49	49,2	49,78
7800	1,33	1,26	26,59	49,17	49,74
7900	1,33	1,26	26,25	49,19	49,77
8000	1,33	1,26	26,47	49,18	49,71
8100	1,33	1,26	26,52	49,17	49,77
8200	1,33	1,27	26,52	49,23	49,68
8300	1,33	1,27	26,53	49,19	49,75
8400	1,34	1,27	26,53	49,2	49,77
8500	1,34	1,27	26,39	49,23	49,69
8600	1,34	1,27	26,55	49,22	49,69
8700	1,35	1,28	26,49	49,28	49,76

8800	1,35	1,28	26,43	49,22	49,69
8900	1,35	1,28	26,51	49,27	49,75
9000	1,35	1,28	26,54	49,13	49,69
9100	1,36	1,29	26,49	49,24	49,81
9200	1,36	1,29	26,49	49,2	49,76
9300	1,36	1,29	26,55	49,2	49,77
9400	1,36	1,29	26,49	49,23	49,72
9500	1,37	1,29	26,53	49,2	49,69
9600	1,37	1,29	26,51	49,14	49,7
9700	1,37	1,3	26,5	49,22	49,8
9800	1,37	1,3	26,48	49,16	49,69
9900	1,38	1,3	26,53	49,19	49,77
10000	1,38	1,3	26,54	49,16	49,71

Test Ended at 10000 Passes
Sample 1 Final rut depth = 1,38 mm
Sample 2 Final rut depth = 1,30 mm
Sample 1 Mean Steady State Tracking Rate = 0,03 mm/1000 Passes
Sample 2 Mean Steady State Tracking Rate = 0,02 mm/1000 Passes

Table 0.18 Samples 37-38: Wheeltrack test results.

Wheeltracking Test Summary
Specimen Name: It samples 39 and 40 60C
Date: 01.12.2010
Test Temperature: 60
Sample 1 Thickness: 40
Sample 2 Thickness: 40

Pass No.	Rut Depth(mm) 1	Rut Depth(mm) 2	Speed (RPM)	RTD 1 Deg.C.	RTD 2 Deg.C.
0	0	0	26,5	58,21	59,02
100	0,68	0,6	26,52	58,13	59,02
200	0,86	0,76	26,48	58,02	58,86
300	0,98	0,86	26,5	58,18	59,06
400	1,06	0,93	26,53	58,01	58,84
500	1,13	0,99	26,48	58,22	59,14
600	1,19	1,05	26,48	58,04	58,97
700	1,24	1,09	26,49	58,17	59,14
800	1,29	1,13	26,5	58,01	58,97
900	1,33	1,17	26,49	58,17	59,07
1000	1,37	1,2	26,52	58,04	58,93
1100	1,41	1,23	26,51	58,18	59,08
1200	1,44	1,26	26,49	58,05	59,02
1300	1,47	1,29	26,49	58,13	59,02
1400	1,5	1,31	26,5	58,07	59,02
1500	1,53	1,33	26,48	58,12	59,18
1600	1,55	1,35	26,49	58,04	59,06
1700	1,58	1,38	26,51	58,14	59,15
1800	1,6	1,39	26,49	58,03	59,05
1900	1,63	1,42	26,49	58,09	59,12
2000	1,65	1,43	26,51	58,01	59,05
2100	1,67	1,45	26,49	58,14	59,19
2200	1,69	1,47	26,54	58,02	59,06
2300	1,71	1,48	26,5	58,12	59,14
2400	1,73	1,5	26,48	58,05	59,11
2500	1,75	1,51	26,37	58,1	59,19
2600	1,76	1,53	26,52	58,1	59,19
2700	1,78	1,54	26,5	58,13	59,15
2800	1,8	1,55	26,52	58,15	59,16
2900	1,82	1,56	26,52	58,06	59,13
3000	1,84	1,58	26,51	58,13	59,26
3100	1,85	1,59	26,46	58,08	59,23
3200	1,86	1,6	26,52	58,09	59,17
3300	1,88	1,61	26,47	58,19	59,21
3400	1,89	1,62	26,48	58,18	59,2
3500	1,91	1,64	26,5	58,18	59,21
3600	1,92	1,65	26,51	58,18	59,29
3700	1,93	1,66	26,51	58,07	59,16
3800	1,95	1,67	26,5	58,2	59,25
3900	1,97	1,68	26,49	58,08	59,15
4000	1,98	1,69	26,48	58,25	59,32
4100	2	1,7	26,54	58,03	59,16
4200	2,01	1,71	26,51	58,2	59,34
4300	2,02	1,71	26,51	58,01	59,13
4400	2,03	1,73	26,5	58,18	59,25
4500	2,04	1,73	26,55	58,09	59,21
4600	2,06	1,75	26,51	58,22	59,32
4700	2,06	1,75	26,5	58,13	59,19
4800	2,08	1,75	26,49	58,17	59,28
4900	2,08	1,76	26,49	58,11	59,1
5000	2,09	1,77	26,48	58,25	59,27
5100	2,1	1,78	26,48	58,16	59,2
5200	2,12	1,79	26,52	58,2	59,29
5300	2,12	1,8	26,51	58,13	59,19

5400	2,13	1,81	26,52	58,25	59,26
5500	2,14	1,81	26,51	58,18	59,17
5600	2,15	1,82	26,49	58,19	59,21
5700	2,16	1,83	26,48	58,18	59,24
5800	2,17	1,84	26,5	58,14	59,2
5900	2,18	1,84	26,52	58,07	59,15
6000	2,19	1,85	26,49	58,15	59,21
6100	2,19	1,86	26,51	58,12	59,19
6200	2,2	1,86	26,52	58,22	59,25
6300	2,21	1,87	26,52	58,2	59,18
6400	2,2	1,88	26,47	58,16	59,17
6500	2,2	1,88	26,5	58,17	59,28
6600	2,2	1,89	26,48	58,1	59,07
6700	2,21	1,89	26,5	58,2	59,32
6800	2,23	1,9	26,53	58,11	59,1
6900	2,24	1,9	26,48	58,25	59,28
7000	2,25	1,91	26,48	58,11	59,15
7100	2,26	1,92	26,5	58,16	59,32
7200	2,27	1,92	26,49	58,13	59,19
7300	2,27	1,93	26,5	58,23	59,26
7400	2,28	1,93	26,53	58,06	59,1
7500	2,29	1,94	26,51	58,17	59,3
7600	2,29	1,94	26,4	58,04	59,07
7700	2,3	1,95	26,49	58,22	59,32
7800	2,31	1,95	26,51	58,15	59,12
7900	2,31	1,96	26,5	58,15	59,18
8000	2,32	1,96	26,53	58,04	59,07
8100	2,32	1,97	26,53	58,19	59,21
8200	2,33	1,96	26,46	58,2	59,14
8300	2,32	1,97	26,52	58,17	59,3
8400	2,33	1,98	26,54	58,17	59,13
8500	2,33	1,98	26,48	58,18	59,27
8600	2,33	1,99	26,53	58,07	59,03
8700	2,34	1,99	26,51	58,2	59,21
8800	2,34	2	26,46	58,15	59,16
8900	2,35	2,01	26,5	58,14	59,21
9000	2,36	2,01	26,45	58,11	59,09
9100	2,36	2,02	26,5	58,18	59,29
9200	2,37	2,02	26,53	58,04	59,05
9300	2,37	2,02	26,51	58,2	59,18
9400	2,38	2,02	26,47	58,1	59,03
9500	2,38	2,03	26,5	58,22	59,2
9600	2,39	2,03	26,49	58,12	59,1
9700	2,39	2,04	26,49	58,16	59,25
9800	2,39	2,04	26,5	58,04	59,07
9900	2,4	2,05	26,49	58,16	59,22
10000	2,4	2,04	26,46	58,02	58,99

Test Ended at 10000 Passes
Sample 1 Final rut depth = 2,40 mm
Sample 2 Final rut depth = 2,04 mm
Sample 1 Mean Steady State Tracking Rate = 0,06 mm/1000 Passes
Sample 2 Mean Steady State Tracking Rate = 0,05 mm/1000 Passes

Table 0.19 Samples 39-40: Wheeltrack test results.

Wheeltracking Test Summary
Specimen Name: It samples 41r and 42r 40C
Date: 02.12.2010
Test Temperature: 40
Sample 1 Thickness: 40
Sample 2 Thickness: 40

Pass No.	Rut Depth(mm) 1	Rut Depth(mm) 2	Speed (RPM)	RTD 1 Deg.C.	RTD 2 Deg.C.
0	0	0	26,5	40,14	40,42
100	0,5	0,41	26,49	40,13	40,34
200	0,65	0,52	26,51	40,14	40,4
300	0,73	0,59	26,53	40,09	40,38
400	0,78	0,64	26,5	40,17	40,49
500	0,82	0,68	26,51	40,05	40,4
600	0,86	0,71	26,49	40,05	40,47
700	0,89	0,74	26,5	40,03	40,4
800	0,91	0,76	26,49	40,03	40,38
900	0,93	0,78	26,48	40,01	40,5
1000	0,95	0,8	26,49	40,08	40,44
1100	0,97	0,82	26,49	40,05	40,53
1200	0,99	0,83	26,48	40,06	40,55
1300	1	0,85	26,48	39,99	40,44
1400	1,01	0,86	26,49	40,08	40,56
1500	1,02	0,87	26,5	40,08	40,46
1600	1,04	0,88	26,49	40,07	40,54
1700	1,05	0,89	26,48	40,07	40,43
1800	1,06	0,9	26,5	40,08	40,47
1900	1,06	0,9	26,54	40,1	40,48

2000	1,07	0,91	26,5	40,06	40,45
2100	1,08	0,92	26,48	40,08	40,48
2200	1,08	0,93	26,49	40,09	40,47
2300	1,09	0,93	26,49	40,07	40,55
2400	1,1	0,94	26,49	40,13	40,52
2500	1,11	0,95	26,53	40,06	40,5
2600	1,11	0,95	26,51	40,14	40,57
2700	1,12	0,96	26,56	40,14	40,49
2800	1,12	0,96	26,53	40,12	40,57
2900	1,13	0,97	26,58	40,13	40,5
3000	1,13	0,97	26,48	40,11	40,54
3100	1,14	0,98	26,49	40,19	40,58
3200	1,14	0,98	26,51	40,18	40,59
3300	1,15	0,99	26,53	40,14	40,54
3400	1,15	0,99	26,48	40,16	40,59
3500	1,15	1	26,47	40,25	40,63
3600	1,16	1	26,53	40,13	40,56
3700	1,17	1,01	26,5	40,19	40,63
3800	1,17	1,01	26,48	40,25	40,63
3900	1,17	1,01	26,47	40,22	40,62
4000	1,18	1,02	26,49	40,2	40,68
4100	1,18	1,02	26,46	40,19	40,66
4200	1,18	1,03	26,18	40,25	40,71
4300	1,2	1,03	26,47	40,19	40,66
4400	1,2	1,03	26,48	40,22	40,69
4500	1,21	1,04	26,48	40,22	40,58
4600	1,21	1,04	26,49	40,19	40,63
4700	1,22	1,04	26,5	40,29	40,66
4800	1,22	1,05	26,54	40,28	40,64
4900	1,22	1,05	26,5	40,26	40,62
5000	1,23	1,05	26,5	40,22	40,62
5100	1,23	1,06	26,48	40,24	40,66
5200	1,24	1,06	26,5	40,23	40,64
5300	1,24	1,06	26,47	40,27	40,69
5400	1,24	1,07	26,46	40,29	40,69
5500	1,25	1,07	26,51	40,31	40,65
5600	1,24	1,07	26,49	40,3	40,68
5700	1,25	1,08	26,51	40,32	40,68
5800	1,25	1,08	26,51	40,26	40,59
5900	1,25	1,08	26,49	40,32	40,65
6000	1,25	1,08	26,51	40,2	40,63
6100	1,26	1,08	26,52	40,3	40,62
6200	1,26	1,09	26,62	40,33	40,68
6300	1,26	1,09	26,52	40,35	40,72
6400	1,26	1,09	26,52	40,27	40,69
6500	1,27	1,09	26,45	40,31	40,71
6600	1,27	1,1	26,51	40,27	40,67
6700	1,27	1,1	26,52	40,33	40,73
6800	1,27	1,1	26,5	40,27	40,71
6900	1,27	1,1	26,49	40,32	40,67
7000	1,27	1,11	26,51	40,35	40,65
7100	1,27	1,11	26,51	40,27	40,68
7200	1,27	1,11	26,5	40,31	40,64
7300	1,27	1,11	26,48	40,39	40,73
7400	1,28	1,11	26,47	40,36	40,73
7500	1,28	1,11	26,49	40,44	40,73
7600	1,28	1,12	26,42	40,32	40,72
7700	1,28	1,12	26,52	40,35	40,78
7800	1,28	1,12	26,53	40,34	40,65
7900	1,28	1,12	26,46	40,41	40,8
8000	1,29	1,12	26,48	40,31	40,7
8100	1,29	1,13	26,5	40,38	40,75
8200	1,29	1,13	26,55	40,41	40,77
8300	1,29	1,13	26,52	40,38	40,76
8400	1,29	1,13	26,49	40,41	40,73
8500	1,29	1,13	26,53	40,37	40,77
8600	1,29	1,13	26,52	40,38	40,79
8700	1,3	1,13	26,51	40,33	40,73
8800	1,3	1,14	26,5	40,4	40,78
8900	1,3	1,14	26,49	40,36	40,68
9000	1,3	1,14	26,49	40,37	40,69
9100	1,3	1,14	26,51	40,43	40,73
9200	1,3	1,14	26,46	40,36	40,69
9300	1,3	1,14	26,48	40,42	40,7
9400	1,3	1,14	26,52	40,36	40,71
9500	1,31	1,15	26,59	40,38	40,74
9600	1,31	1,15	26,54	40,35	40,68
9700	1,31	1,15	26,46	40,41	40,78
9800	1,31	1,15	26,45	40,38	40,73
9900	1,32	1,15	26,46	40,44	40,76
10000	1,32	1,15	26,45	40,38	40,75

Test Ended at 10000 Passes
Sample 1 Final rut depth = 1,32 mm
Sample 2 Final rut depth = 1,15 mm
Sample 1 Mean Steady State Tracking Rate = 0,02 mm/1000 Passes
Sample 2 Mean Steady State Tracking Rate = 0,02 mm/1000 Passes

Table 0.20 Samples 41-42: Wheeltrack test results.

Wheeltracking Test Summary
Specimen Name: It samples 43 and 44 60C
Date: 01.12.2010
Test Temperature: 60
Sample 1 Thickness: 40
Sample 2 Thickness: 40

Pass No.	Rut Depth(mm) 1	Rut Depth(mm) 2	Speed (RPM)	RTD 1 Deg.C.	RTD 2 Deg.C.
0	0	0	26,5	58,35	58,31
100	0,81	0,75	26,52	58,33	58,31
200	1	0,93	26,5	58,29	58,25
300	1,12	1,03	26,48	58,29	58,35
400	1,2	1,11	26,49	58,24	58,31
500	1,26	1,17	26,51	58,24	58,3
600	1,32	1,22	26,5	58,15	58,23
700	1,37	1,26	26,5	58,12	58,3
800	1,41	1,3	26,49	58,06	58,27
900	1,45	1,33	26,56	58,11	58,42
1000	1,48	1,36	26,52	58,06	58,32
1100	1,51	1,39	26,51	58,14	58,49
1200	1,53	1,42	26,5	57,97	58,28
1300	1,56	1,44	26,49	58,18	58,5
1400	1,58	1,46	26,48	57,96	58,33
1500	1,6	1,48	26,5	58,12	58,56
1600	1,62	1,5	26,52	57,95	58,37
1700	1,64	1,52	26,53	58,18	58,62
1800	1,66	1,54	26,59	57,99	58,46
1900	1,68	1,55	26,53	58,11	58,67
2000	1,7	1,56	26,49	58,05	58,48
2100	1,71	1,58	26,52	58,15	58,67
2200	1,73	1,59	26,51	58,07	58,54
2300	1,75	1,61	26,51	58,17	58,7
2400	1,77	1,62	26,49	58,1	58,55
2500	1,78	1,63	26,49	58,14	58,71
2600	1,79	1,64	26,5	58,11	58,56
2700	1,81	1,65	26,49	58,2	58,7
2800	1,82	1,67	26,52	58,05	58,62
2900	1,83	1,68	26,51	58,13	58,78
3000	1,84	1,69	26,48	58,14	58,68
3100	1,86	1,7	26,51	58,16	58,8
3200	1,87	1,72	26,53	58,17	58,67
3300	1,88	1,72	26,49	58,16	58,8
3400	1,9	1,73	26,49	58,2	58,76
3500	1,91	1,72	26,51	58,21	58,84
3600	1,92	1,75	26,47	58,2	58,82
3700	1,93	1,76	26,5	58,2	58,85
3800	1,94	1,78	26,49	58,22	58,84
3900	1,96	1,79	26,49	58,18	58,86
4000	1,97	1,79	26,49	58,15	58,79
4100	1,99	1,81	26,53	58,26	58,88
4200	2	1,82	26,49	58,27	58,82
4300	2,01	1,83	26,54	58,27	58,88
4400	2,02	1,83	26,49	58,28	58,83
4500	2,03	1,84	26,5	58,25	58,78
4600	2,04	1,85	26,52	58,3	58,84
4700	2,05	1,86	26,51	58,29	58,83
4800	2,06	1,87	26,5	58,28	58,95
4900	2,07	1,87	26,51	58,2	58,86
5000	2,08	1,88	26,52	58,29	58,94
5100	2,09	1,89	26,5	58,24	58,92
5200	2,1	1,89	26,49	58,28	58,91
5300	2,11	1,89	26,51	58,24	58,81
5400	2,11	1,9	26,57	58,36	59
5500	2,12	1,91	26,51	58,26	58,83
5600	2,13	1,91	26,4	58,36	58,89
5700	2,13	1,92	26,45	58,24	58,9
5800	2,14	1,93	26,49	58,4	58,98
5900	2,14	1,93	26,51	58,31	58,81
6000	2,16	1,94	26,51	58,46	59,05
6100	2,16	1,95	26,49	58,31	58,92
6200	2,17	1,95	26,51	58,45	58,98
6300	2,18	1,96	26,49	58,36	58,87
6400	2,19	1,96	26,5	58,38	59,02
6500	2,18	1,97	26,41	58,31	58,89
6600	2,18	1,96	26,5	58,4	59,06
6700	2,19	1,97	26,6	58,28	58,89
6800	2,2	1,97	26,51	58,39	59,03
6900	2,21	1,98	26,48	58,27	58,83
7000	2,22	1,98	26,5	58,42	58,99
7100	2,22	1,99	26,5	58,36	58,92
7200	2,23	2	26,52	58,45	59,11
7300	2,24	2	26,49	58,3	58,92

7400	2,24	2,01	26,5	58,44	59,06
7500	2,25	2,01	26,42	58,39	59
7600	2,25	2,02	26,5	58,43	59,08
7700	2,26	2,02	26,54	58,36	58,97
7800	2,25	2,03	26,51	58,41	59,08
7900	2,26	2,04	26,44	58,36	58,9
8000	2,28	2,04	26,49	58,52	59,01
8100	2,29	2,05	26,46	58,39	58,89
8200	2,3	2,06	26,49	58,51	59,1
8300	2,3	2,07	26,52	58,36	58,89
8400	2,3	2,07	26,45	58,48	59,03
8500	2,31	2,07	26,46	58,41	59,02
8600	2,31	2,07	26,53	58,39	59
8700	2,3	2,08	26,51	58,46	59,05
8800	2,32	2,09	26,45	58,45	58,98
8900	2,32	2,09	26,51	58,44	58,97
9000	2,33	2,1	26,51	58,43	59,09
9100	2,34	2,1	26,47	58,41	59,02
9200	2,34	2,1	26,52	58,39	58,95
9300	2,35	2,1	26,52	58,5	58,99
9400	2,36	2,11	26,49	58,48	59,09
9500	2,37	2,11	26,49	58,55	59,07
9600	2,38	2,12	26,48	58,52	59,05
9700	2,38	2,12	26,39	58,56	59,11
9800	2,39	2,12	26,51	58,41	59
9900	2,39	2,13	26,51	58,49	59,02
10000	2,39	2,13	26,47	58,48	59,03

Test Ended at 10000 Passes
Sample 1 Final rut depth = 2,39 mm
Sample 2 Final rut depth = 2,13 mm
Sample 1 Mean Steady State Tracking Rate = 0,06 mm/1000 Passes
Sample 2 Mean Steady State Tracking Rate = 0,05 mm/1000 Passes

Table 0.21 Samples 43-44: Wheeltrack test results.

Wheeltracking Test Summary
Specimen Name: It samples 45 and 46 40C
Date: 02.12.2010
Test Temperature: 40
Sample 1 Thickness: 40
Sample 2 Thickness: 40

Pass No.	Rut Depth(mm) 1	Rut Depth(mm) 2	Speed (RPM)	RTD 1 Deg.C.	RTD 2 Deg.C.
0	0	0	26,5	39,66	39,68
100	0,61	0,53	26,54	40,33	40,96
200	0,78	0,66	26,56	40,37	40,91
300	0,88	0,73	26,49	40,4	40,99
400	0,94	0,79	26,53	40,36	41,04
500	0,99	0,83	26,48	40,38	40,98
600	1,03	0,86	26,49	40,35	41,04
700	1,08	0,89	26,56	40,31	40,96
800	1,1	0,91	26,5	40,33	41
900	1,13	0,93	26,53	40,31	40,93
1000	1,15	0,95	26,45	40,37	40,97
1100	1,18	0,96	26,51	40,34	40,94
1200	1,21	0,98	26,48	40,35	41,04
1300	1,25	0,99	26,49	40,4	41,03
1400	1,28	1	26,48	40,34	41,03
1500	1,31	1,02	26,52	40,4	41,14
1600	1,33	1,03	26,51	40,4	41,01
1700	1,35	1,04	26,49	40,43	41,04
1800	1,35	1,05	26,51	40,37	41,04
1900	1,37	1,06	26,51	40,44	41,02
2000	1,37	1,06	26,51	40,4	41,08
2100	1,38	1,07	26,49	40,41	41
2200	1,39	1,08	26,48	40,45	41,02
2300	1,4	1,09	26,46	40,43	41,04
2400	1,41	1,09	26,51	40,39	41
2500	1,41	1,1	26,5	40,4	41
2600	1,42	1,11	26,47	40,39	41,05
2700	1,43	1,11	26,52	40,43	41,01
2800	1,43	1,12	26,48	40,42	41,01
2900	1,44	1,12	26,49	40,37	40,94
3000	1,44	1,13	26,49	40,41	41,04
3100	1,45	1,13	26,52	40,43	41
3200	1,45	1,14	26,51	40,36	40,97
3300	1,46	1,14	26,47	40,37	40,87
3400	1,46	1,15	26,5	40,37	40,92
3500	1,47	1,15	26,5	40,35	40,92
3600	1,47	1,16	26,51	40,41	40,92
3700	1,48	1,17	26,49	40,36	40,89
3800	1,48	1,17	26,5	40,36	40,96
3900	1,48	1,17	26,49	40,41	40,96

4000	1,49	1,18	26,51	40,42	40,92
4100	1,49	1,18	26,49	40,41	40,95
4200	1,49	1,19	26,5	40,35	40,85
4300	1,5	1,19	26,48	40,38	40,92
4400	1,5	1,19	26,5	40,36	40,86
4500	1,5	1,2	26,49	40,4	40,92
4600	1,51	1,2	26,49	40,4	40,88
4700	1,53	1,2	26,47	40,36	40,92
4800	1,55	1,21	26,5	40,34	40,92
4900	1,56	1,21	26,52	40,39	40,93
5000	1,57	1,21	26,49	40,37	40,89
5100	1,57	1,22	26,49	40,37	40,82
5200	1,58	1,22	26,51	40,37	40,89
5300	1,58	1,22	26,51	40,34	40,92
5400	1,6	1,23	26,49	40,35	40,82
5500	1,61	1,23	26,51	40,33	40,89
5600	1,62	1,23	26,48	40,33	40,89
5700	1,64	1,23	26,52	40,31	40,83
5800	1,64	1,24	26,52	40,28	40,84
5900	1,65	1,24	26,5	40,35	40,88
6000	1,65	1,24	26,52	40,29	40,84
6100	1,65	1,24	26,53	40,31	40,8
6200	1,67	1,25	26,48	40,35	40,89
6300	1,69	1,25	26,48	40,3	40,77
6400	1,7	1,25	26,5	40,39	40,88
6500	1,71	1,25	26,5	40,33	40,79
6600	1,72	1,25	26,48	40,31	40,86
6700	1,72	1,26	26,52	40,28	40,86
6800	1,73	1,26	26,47	40,35	40,81
6900	1,73	1,26	26,49	40,3	40,86
7000	1,74	1,26	26,48	40,26	40,79
7100	1,75	1,26	26,49	40,33	40,78
7200	1,75	1,26	26,5	40,28	40,76
7300	1,75	1,27	26,52	40,27	40,75
7400	1,76	1,27	26,51	40,25	40,79
7500	1,76	1,27	26,5	40,23	40,77
7600	1,76	1,27	26,49	40,26	40,84
7700	1,76	1,27	26,5	40,25	40,8
7800	1,77	1,28	26,49	40,26	40,77
7900	1,77	1,28	26,44	40,3	40,79
8000	1,77	1,28	26,49	40,28	40,75
8100	1,78	1,28	26,48	40,25	40,73
8200	1,78	1,28	26,51	40,3	40,76
8300	1,78	1,29	26,51	40,27	40,83
8400	1,79	1,29	26,48	40,26	40,83
8500	1,79	1,29	26,48	40,3	40,79
8600	1,79	1,29	26,54	40,22	40,76
8700	1,8	1,29	26,51	40,24	40,77
8800	1,81	1,29	26,5	40,24	40,74
8900	1,81	1,29	26,5	40,29	40,76
9000	1,83	1,3	26,49	40,24	40,75
9100	1,84	1,3	26,49	40,28	40,76
9200	1,84	1,3	26,52	40,23	40,75
9300	1,84	1,3	26,49	40,19	40,76
9400	1,85	1,3	26,52	40,24	40,74
9500	1,85	1,3	26,49	40,23	40,71
9600	1,86	1,3	26,5	40,29	40,74
9700	1,87	1,31	26,52	40,24	40,72
9800	1,87	1,31	26,49	40,28	40,73
9900	1,88	1,31	26,56	40,3	40,81
10000	1,88	1,31	26,49	40,27	40,82

Test Ended at 10000 Passes
Sample 1 Final rut depth = 1,88 mm
Sample 2 Final rut depth = 1,31 mm
Sample 1 Mean Steady State Tracking Rate = 0,06 mm/1000 Passes
Sample 2 Mean Steady State Tracking Rate = 0,02 mm/1000 Passes

Table 0.22 Samples 45-46: Wheeltrack test results.

Wheeltracking Test Summary
Specimen Name: It samples 47 and 48 50C
Date: 03.12.2010
Test Temperature: 50
Sample 1 Thickness: 40
Sample 2 Thickness: 40

Pass No.	Rut Depth(mm) 1	Rut Depth(mm) 2	Speed (RPM)	RTD 1 Deg.C.	RTD 2 Deg.C.
0	0	0	26,5	49,14	49,98
100	0,52	0,55	26,49	49,38	50,06
200	0,66	0,68	26,51	49,51	50,12
300	0,73	0,76	26,48	49,49	50,07
400	0,78	0,82	26,51	49,54	50,16
500	0,83	0,86	26,52	49,43	50,1

600	0,87	0,9	26,54	49,53	50,28
700	0,9	0,93	26,5	49,51	50,22
800	0,92	0,95	26,78	49,52	50,28
900	0,94	0,98	26,5	49,54	50,28
1000	0,96	1	26,5	49,44	50,16
1100	0,98	1,01	26,48	49,5	50,28
1200	1	1,03	26,48	49,52	50,25
1300	1,01	1,05	26,5	49,56	50,3
1400	1,03	1,06	26,51	49,47	50,18
1500	1,04	1,08	26,26	49,45	50,26
1600	1,05	1,09	26,51	49,44	50,19
1700	1,07	1,1	26,53	49,43	50,11
1800	1,08	1,11	26,39	49,42	50,21
1900	1,09	1,12	26,51	49,43	50,18
2000	1,1	1,13	26,5	49,47	50,18
2100	1,11	1,14	26,49	49,44	50,13
2200	1,12	1,16	26,48	49,45	50,17
2300	1,12	1,16	26,51	49,47	50,16
2400	1,13	1,17	26,51	49,44	50,09
2500	1,14	1,18	26,5	49,46	50,15
2600	1,15	1,19	26,52	49,37	50,14
2700	1,16	1,2	26,51	49,42	50,17
2800	1,16	1,21	26,79	49,41	50,17
2900	1,17	1,21	26,52	49,43	50,18
3000	1,18	1,22	26,5	49,41	50,07
3100	1,18	1,23	26,47	49,46	50,19
3200	1,19	1,23	26,5	49,48	50,18
3300	1,2	1,24	26,49	49,4	50,12
3400	1,2	1,25	26,5	49,46	50,18
3500	1,21	1,25	26,51	49,34	50,01
3600	1,23	1,26	26,47	49,47	50,17
3700	1,22	1,26	26,48	49,38	50,04
3800	1,24	1,27	26,51	49,41	50,04
3900	1,26	1,27	26,51	49,42	50,14
4000	1,28	1,28	26,45	49,42	50
4100	1,29	1,28	26,51	49,4	50,09
4200	1,29	1,28	26,48	49,38	50,01
4300	1,3	1,29	26,57	49,46	50,15
4400	1,31	1,29	26,53	49,37	49,97
4500	1,31	1,3	26,51	49,49	50,13
4600	1,32	1,3	26,51	49,35	50,03
4700	1,32	1,3	26,51	49,43	50,15
4800	1,33	1,31	26,51	49,39	49,99
4900	1,33	1,31	26,48	49,38	50,09
5000	1,33	1,32	26,54	49,33	49,97
5100	1,34	1,32	26,5	49,39	50,12
5200	1,34	1,32	26,48	49,4	50,1
5300	1,35	1,33	26,49	49,38	50,07
5400	1,36	1,33	26,52	49,43	50,04
5500	1,36	1,33	26,47	49,38	50,07
5600	1,37	1,34	26,52	49,33	50,05
5700	1,37	1,34	26,51	49,35	49,97
5800	1,38	1,34	26,47	49,42	50,02
5900	1,38	1,35	26,55	49,36	49,97
6000	1,39	1,35	26,5	49,43	50,05
6100	1,39	1,35	26,51	49,31	49,97
6200	1,4	1,36	26,49	49,41	50
6300	1,4	1,36	26,5	49,36	49,97
6400	1,41	1,36	26,51	49,36	50,07
6500	1,41	1,36	26,52	49,37	49,98
6600	1,41	1,37	26,51	49,33	50,02
6700	1,42	1,37	26,51	49,35	49,98
6800	1,43	1,37	26,52	49,29	49,9
6900	1,45	1,37	26,5	49,33	50,03
7000	1,45	1,38	26,49	49,33	49,92
7100	1,45	1,38	26,49	49,33	49,98
7200	1,46	1,38	26,5	49,24	49,91
7300	1,46	1,38	26,49	49,37	50,07
7400	1,46	1,38	26,5	49,29	49,98
7500	1,46	1,39	26,51	49,32	49,92
7600	1,46	1,39	26,49	49,35	49,97
7700	1,46	1,39	26,5	49,27	49,86
7800	1,47	1,39	26,49	49,36	50,02
7900	1,47	1,4	26,46	49,33	49,93
8000	1,47	1,4	26,51	49,35	49,95
8100	1,47	1,4	26,51	49,29	49,9
8200	1,47	1,4	26,5	49,36	49,98
8300	1,48	1,4	26,52	49,25	49,84
8400	1,48	1,41	26,51	49,35	49,94
8500	1,48	1,41	26,46	49,33	49,96
8600	1,49	1,41	26,47	49,34	49,95
8700	1,49	1,41	26,56	49,27	49,88
8800	1,51	1,41	26,46	49,38	49,97
8900	1,52	1,42	26,56	49,36	49,97
9000	1,52	1,42	26,47	49,3	49,99
9100	1,52	1,42	26,55	49,36	49,97
9200	1,53	1,42	26,47	49,33	49,95

9300	1,53	1,42	26,54	49,38	50,06
9400	1,53	1,42	26,46	49,25	49,93
9500	1,53	1,43	26,51	49,33	49,92
9600	1,53	1,43	26,49	49,22	49,84
9700	1,54	1,43	26,49	49,26	49,92
9800	1,54	1,43	26,52	49,22	49,93
9900	1,54	1,43	26,53	49,31	49,95
10000	1,54	1,44	26,49	49,29	49,99

Test Ended at 10000 Passes
Sample 1 Final rut depth = 1,54 mm
Sample 2 Final rut depth = 1,44 mm
Sample 1 Mean Steady State Tracking Rate = 0,04 mm/1000 Passes
Sample 2 Mean Steady State Tracking Rate = 0,02 mm/1000 Passes

Table 0.23 Samples 47-48: Wheeltrack test results.

Wheeltracking Test Summary
Specimen Name: It samples 51 and 52 60C
Date: 06.12.2010
Test Temperature: 60
Sample 1 Thickness: 40
Sample 2 Thickness: 40

Pass No.	Rut Depth(mm) 1	Rut Depth(mm) 2	Speed (RPM)	RTD 1 Deg.C.	RTD 2 Deg.C.
0	0	0	26,5	57,91	58,57
100	0,69	0,61	26,56	57,87	58,48
200	0,85	0,76	26,46	57,93	58,53
300	0,96	0,85	26,6	57,88	58,42
400	1,02	0,93	26,5	57,94	58,5
500	1,08	0,98	26,46	57,89	58,4
600	1,13	1,03	26,49	57,92	58,46
700	1,18	1,07	26,52	57,96	58,45
800	1,22	1,11	26,5	57,96	58,53
900	1,26	1,14	26,52	58	58,57
1000	1,29	1,18	26,51	58,06	58,57
1100	1,32	1,2	26,46	58	58,53
1200	1,35	1,23	26,51	57,97	58,5
1300	1,38	1,25	26,53	58,03	58,5
1400	1,4	1,28	26,47	57,96	58,53
1500	1,42	1,3	26,48	58,03	58,58
1600	1,44	1,33	26,52	58,09	58,56
1700	1,47	1,34	26,47	58,07	58,53
1800	1,48	1,36	26,5	58,06	58,58
1900	1,5	1,38	26,52	58,04	58,53
2000	1,52	1,4	26,49	58,02	58,54
2100	1,52	1,41	26,47	58,06	58,63
2200	1,55	1,43	26,58	58,17	58,64
2300	1,57	1,45	26,51	58,19	58,69
2400	1,58	1,46	26,48	58,09	58,61
2500	1,6	1,48	26,51	58,17	58,6
2600	1,61	1,49	26,48	58,14	58,68
2700	1,63	1,51	26,49	58,12	58,61
2800	1,63	1,52	26,53	58,19	58,65
2900	1,65	1,54	26,5	58,25	58,74
3000	1,65	1,55	26,46	58,2	58,64
3100	1,68	1,56	26,52	58,27	58,78
3200	1,65	1,58	26,47	58,15	58,61
3300	1,7	1,59	26,49	58,21	58,71
3400	1,71	1,6	26,51	58,25	58,67
3500	1,73	1,61	26,5	58,37	58,81
3600	1,75	1,62	26,51	58,23	58,72
3700	1,76	1,64	26,5	58,37	58,82
3800	1,77	1,64	26,46	58,29	58,73
3900	1,78	1,65	26,49	58,28	58,81
4000	1,79	1,66	26,52	58,25	58,76
4100	1,73	1,67	26,49	58,36	58,74
4200	1,76	1,68	26,51	58,31	58,72
4300	1,77	1,69	26,53	58,4	58,8
4400	1,79	1,69	26,49	58,26	58,74
4500	1,8	1,7	26,52	58,33	58,84
4600	1,82	1,71	26,53	58,25	58,73
4700	1,82	1,72	26,47	58,36	58,88
4800	1,83	1,73	26,5	58,21	58,69
4900	1,85	1,74	26,51	58,41	58,89
5000	1,87	1,74	26,48	58,24	58,65
5100	1,88	1,75	26,49	58,43	58,84
5200	1,89	1,76	26,55	58,3	58,79
5300	1,92	1,76	26,47	58,38	58,87
5400	1,92	1,77	26,56	58,32	58,7
5500	1,94	1,78	26,5	58,41	58,79
5600	1,94	1,78	26,48	58,31	58,79
5700	1,96	1,79	26,5	58,4	58,88
5800	1,96	1,8	26,53	58,32	58,77

5900	1,97	1,81	26,51	58,34	58,8
6000	1,97	1,81	26,46	58,35	58,81
6100	1,99	1,82	26,5	58,33	58,77
6200	2	1,83	26,49	58,33	58,84
6300	2	1,83	26,5	58,39	58,77
6400	2,01	1,84	26,54	58,34	58,79
6500	2,02	1,85	26,44	58,35	58,83
6600	2,03	1,85	26,49	58,25	58,78
6700	2,02	1,85	26,54	58,41	58,79
6800	2,04	1,86	26,49	58,35	58,77
6900	2,04	1,87	26,5	58,46	58,9
7000	2,01	1,87	26,53	58,34	58,74
7100	2,02	1,88	26,51	58,51	58,86
7200	2,04	1,88	26,51	58,36	58,85
7300	2,06	1,89	26,48	58,46	58,92
7400	2,07	1,89	26,49	58,41	58,78
7500	2,08	1,9	26,51	58,48	58,97
7600	2,08	1,9	26,52	58,32	58,79
7700	2,08	1,91	26,51	58,48	59,03
7800	2,09	1,91	26,48	58,38	58,82
7900	2,09	1,92	26,51	58,53	58,95
8000	2,09	1,92	26,51	58,44	58,89
8100	2,11	1,93	26,5	58,49	58,95
8200	2,12	1,93	26,5	58,41	58,79
8300	2,11	1,93	26,5	58,49	58,95
8400	2,13	1,94	26,49	58,35	58,74
8500	2,13	1,94	26,5	58,47	58,96
8600	2,13	1,95	26,51	58,41	58,85
8700	2,13	1,95	26,5	58,52	58,97
8800	2,15	1,95	26,52	58,35	58,81
8900	2,14	1,96	26,51	58,53	58,93
9000	2,17	1,96	26,48	58,35	58,74
9100	2,19	1,97	26,5	58,55	58,89
9200	2,19	1,97	26,48	58,45	58,84
9300	2,2	1,98	26,5	58,48	58,92
9400	2,2	1,98	26,51	58,38	58,84
9500	2,21	1,99	26,5	58,53	59
9600	2,22	1,99	26,47	58,42	58,88
9700	2,22	1,99	26,51	58,48	58,86
9800	2,22	2	26,48	58,43	58,87
9900	2,23	2	26,49	58,53	59,02
10000	2,23	2,01	26,51	58,41	58,83

Test Ended at 10000 Passes
Sample 1 Final rut depth = 2,23 mm
Sample 2 Final rut depth = 2,01 mm
Sample 1 Mean Steady State Tracking Rate = 0,07 mm/1000 Passes
Sample 2 Mean Steady State Tracking Rate = 0,05 mm/1000 Passes

Table 0.24 Samples 51-52: Wheeltrack test results.

Wheeltracking Test Summary
Specimen Name: It samples 53 and 54 40C
Date: 07.12.2010
Test Temperature: 40
Sample 1 Thickness: 40
Sample 2 Thickness: 40

Pass No.	Rut Depth(mm) 1	Rut Depth(mm) 2	Speed (RPM)	RTD 1 Deg.C.	RTD 2 Deg.C.
0	0	0	26,5	40,4	41,18
100	0,38	0,44	26,55	41,14	41,44
200	0,49	0,56	26,52	41,07	41,39
300	0,55	0,63	26,49	41,12	41,35
400	0,59	0,68	26,49	40,99	41,3
500	0,63	0,72	26,46	41,06	41,29
600	0,66	0,76	26,53	40,97	41,18
700	0,69	0,79	26,54	41	41,2
800	0,72	0,81	26,5	40,89	41,12
900	0,74	0,83	26,48	40,88	41,16
1000	0,75	0,85	26,44	40,85	41,05
1100	0,76	0,87	25,95	40,8	41,09
1200	0,77	0,88	26,5	40,77	41,08
1300	0,78	0,9	26,51	40,74	41
1400	0,8	0,91	26,55	40,77	40,97
1500	0,8	0,92	26,49	40,74	40,94
1600	0,81	0,93	26,52	40,65	40,85
1700	0,82	0,94	26,5	40,67	40,87
1800	0,83	0,95	26,49	40,61	40,81
1900	0,84	0,96	26,51	40,6	40,87
2000	0,85	0,97	26,5	40,54	40,78
2100	0,85	0,98	26,56	40,51	40,8
2200	0,86	0,99	26,51	40,53	40,7
2300	0,86	0,99	26,52	40,51	40,78
2400	0,87	1	26,5	40,46	40,74

2500	0,87	1,01	26,5	40,42	40,68
2600	0,88	1,01	26,51	40,42	40,68
2700	0,88	1,02	26,49	40,38	40,62
2800	0,89	1,02	26,5	40,34	40,55
2900	0,89	1,03	26,48	40,41	40,54
3000	0,9	1,03	26,51	40,35	40,62
3100	0,9	1,04	26,49	40,3	40,58
3200	0,91	1,04	26,51	40,33	40,51
3300	0,91	1,05	26,49	40,28	40,57
3400	0,92	1,05	26,49	40,25	40,47
3500	0,92	1,05	26,51	40,23	40,51
3600	0,92	1,06	26,49	40,24	40,56
3700	0,93	1,06	26,49	40,19	40,41
3800	0,93	1,06	26,56	40,2	40,44
3900	0,93	1,07	26,5	40,21	40,4
4000	0,94	1,07	26,48	40,2	40,5
4100	0,94	1,07	26,52	40,19	40,42
4200	0,94	1,08	26,5	40,14	40,46
4300	0,95	1,08	26,5	40,09	40,36
4400	0,95	1,08	26,5	40,11	40,43
4500	0,95	1,09	26,49	40,06	40,35
4600	0,96	1,09	26,5	40,09	40,38
4700	0,96	1,09	26,49	40,11	40,35
4800	0,96	1,09	26,5	40,05	40,25
4900	0,96	1,1	26,49	40,08	40,31
5000	0,97	1,1	26,5	40,03	40,23
5100	0,97	1,1	26,49	40,06	40,28
5200	0,97	1,11	26,49	40,07	40,26
5300	0,97	1,11	26,53	40,05	40,29
5400	0,97	1,11	26,5	40,07	40,26
5500	0,98	1,11	26,5	40,01	40,26
5600	0,98	1,12	26,51	40,03	40,24
5700	0,98	1,12	26,49	39,91	40,2
5800	0,98	1,12	26,5	40,01	40,29
5900	0,98	1,13	26,49	39,93	40,2
6000	0,99	1,13	26,5	39,98	40,23
6100	0,99	1,13	26,5	39,92	40,15
6200	0,99	1,14	26,53	39,91	40,24
6300	0,99	1,14	26,5	39,92	40,16
6400	0,99	1,14	26,5	39,91	40,15
6500	0,99	1,14	26,51	39,92	40,21
6600	1	1,14	26,33	39,86	40,2
6700	1	1,14	26,75	39,82	40,19
6800	1	1,15	26,51	39,86	40,15
6900	1	1,15	26,5	39,86	40,12
7000	1	1,15	26,48	39,77	40,13
7100	1,01	1,15	26,49	39,82	40,19
7200	1,01	1,15	26,48	39,82	40,09
7300	1,01	1,16	26,48	39,84	40,12
7400	1,01	1,16	26,48	39,75	40,08
7500	1,01	1,16	26,47	39,75	40,03
7600	1,01	1,16	26,51	39,82	40,11
7700	1,01	1,16	26,52	39,72	40,03
7800	1,02	1,16	26,51	39,75	40,12
7900	1,02	1,17	26,48	39,71	40,04
8000	1,02	1,17	26,5	39,8	40,13
8100	1,02	1,17	26,5	39,71	40,09
8200	1,02	1,17	26,49	39,73	40,12
8300	1,02	1,17	26,5	39,68	40,01
8400	1,02	1,17	26,5	39,76	40,1
8500	1,03	1,17	26,45	39,69	40,08
8600	1,03	1,18	26,5	39,76	40,09
8700	1,03	1,18	26,49	39,68	40,01
8800	1,03	1,18	26,45	39,67	40,04
8900	1,03	1,18	26,49	39,74	40,11
9000	1,03	1,18	26,54	39,66	40
9100	1,03	1,18	26,46	39,78	40,09
9200	1,04	1,18	26,5	39,69	40,03
9300	1,04	1,19	26,48	39,76	40,1
9400	1,04	1,19	26,51	39,75	40,06
9500	1,04	1,19	26,52	39,71	40,09
9600	1,04	1,19	26,5	39,66	40,05
9700	1,04	1,19	26,5	39,65	40
9800	1,04	1,19	26,51	39,68	39,95
9900	1,04	1,19	26,46	39,64	39,99
10000	1,04	1,19	26,54	39,64	40

Test Ended at 10000 Passes
Sample 1 Final rut depth = 1,04 mm
Sample 2 Final rut depth = 1,19 mm
Sample 1 Mean Steady State Tracking Rate = 0,02 mm/1000 Passes
Sample 2 Mean Steady State Tracking Rate = 0,02 mm/1000 Passes

Table 0.25 Samples 53-54: Wheeltrack test results.

Wheeltracking Test Summary
Specimen Name: Gr1 og Gr3 50C
Date: 19.10.2010
Test Temperature: 50
Sample 1 Thickness: 40
Sample 2 Thickness: 40

Pass No.	Rut Depth(mm) 1	Rut Depth(mm) 2	Speed (RPM)	RTD 1 Deg.C.	RTD 2 Deg.C.
0	0	0	26,5	48,46	49,16
100	1,35	1,04	26,53	48,69	49,26
200	1,93	1,41	26,51	48,74	49,14
300	2,36	1,66	26,5	48,79	49,25
400	2,7	1,87	26,52	48,78	49,24
500	2,99	2,03	26,46	48,79	49,25
600	3,25	2,18	26,54	48,88	49,24
700	3,5	2,31	26,5	48,83	49,27
800	3,72	2,43	26,47	48,9	49,25
900	3,94	2,54	26,5	48,93	49,21
1000	4,15	2,64	26,49	49,03	49,28
1100	4,36	2,74	26,49	48,95	49,29
1200	4,57	2,83	26,49	49,06	49,4
1300	4,77	2,91	26,54	48,97	49,23
1400	4,95	2,99	26,51	49,08	49,38
1500	5,12	3,06	26,47	49,04	49,29
1600	5,28	3,13	26,52	49,11	49,36
1700	5,44	3,2	26,51	49,11	49,32
1800	5,6	3,26	26,49	49,14	49,39
1900	5,74	3,34	26,51	49,19	49,39
2000	5,88	3,4	26,51	49,15	49,37
2100	6,03	3,46	26,49	49,26	49,38
2200	6,16	3,51	26,47	49,27	49,39
2300	6,29	3,56	26,46	49,31	49,4
2400	6,41	3,62	26,49	49,33	49,44
2500	6,53	3,67	26,55	49,26	49,4
2600	6,66	3,72	26,48	49,39	49,45
2700	6,78	3,77	26,47	49,36	49,47
2800	6,91	3,82	26,51	49,31	49,45
2900	7,03	3,88	26,52	49,38	49,52
3000	7,16	3,93	26,5	49,46	49,49
3100	7,28	3,98	26,5	49,48	49,55
3200	7,4	4,03	26,51	49,43	49,4
3300	7,52	4,09	26,49	49,52	49,5
3400	7,63	4,14	26,5	49,41	49,49
3500	7,74	4,19	26,48	49,47	49,49
3600	7,86	4,23	26,54	49,48	49,46
3700	7,97	4,28	26,5	49,52	49,48
3800	8,07	4,33	26,49	49,52	49,53
3900	8,18	4,38	26,5	49,56	49,53
4000	8,28	4,43	26,51	49,57	49,58
4100	8,39	4,48	26,5	49,53	49,55
4200	8,51	4,53	26,51	49,64	49,62
4300	8,62	4,58	26,54	49,65	49,54
4400	8,73	4,63	26,5	49,72	49,65
4500	8,84	4,68	26,48	49,64	49,61
4600	8,96	4,72	26,49	49,7	49,58
4700	9,08	4,77	26,5	49,67	49,54
4800	9,19	4,81	26,49	49,7	49,68
4900	9,3	4,85	26,58	49,73	49,57
5000	9,42	4,89	26,51	49,77	49,65
5100	9,54	4,93	26,5	49,73	49,61
5200	9,65	4,97	26,53	49,69	49,55
5300	9,76	5,02	26,5	49,86	49,71
5400	9,88	5,06	26,48	49,74	49,65
5500	9,99	5,09	26,49	49,83	49,63
5600	10,1	5,13	26,49	49,75	49,6
5700	10,2	5,17	26,48	49,75	49,59
5800	10,31	5,21	26,5	49,84	49,64
5900	10,41	5,25	26,52	49,82	49,62
6000	10,52	5,28	26,5	49,8	49,68
6100	10,62	5,32	26,53	49,75	49,58
6200	10,72	5,35	26,51	49,82	49,63
6300	10,82	5,39	26,51	49,81	49,56
6400	10,92	5,43	26,5	49,86	49,68
6500	11,02	5,47	26,51	49,91	49,64
6600	11,1	5,5	26,52	49,89	49,64
6700	11,2	5,54	26,5	49,94	49,68
6800	11,29	5,57	26,5	49,94	49,63
6900	11,37	5,61	26,38	49,92	49,72
7000	11,44	5,65	26,46	49,93	49,64
7100	11,54	5,67	26,5	49,95	49,73
7200	11,62	5,71	26,47	49,97	49,64
7300	11,69	5,74	26,5	49,98	49,72
7400	11,76	5,77	26,49	49,91	49,65
7500	11,84	5,81	26,49	50,01	49,66
7600	11,9	5,84	26,52	49,93	49,61

7700	11,98	5,87	26,48	49,99	49,73
7800	12,05	5,9	26,46	50,04	49,69
7900	12,11	5,94	26,46	49,96	49,65
8000	12,19	5,97	26,51	50,03	49,66
8100	12,26	6	26,49	50,03	49,78
8200	12,32	6,03	26,52	50,07	49,8
8300	12,38	6,05	26,53	50,04	49,7
8400	12,45	6,09	26,51	50,1	49,74
8500	12,51	6,12	26,49	49,99	49,73
8600	12,58	6,15	26,51	50,06	49,77
8700	12,66	6,18	26,52	50,03	49,73
8800	12,73	6,21	26,51	50	49,63
8900	12,8	6,24	26,47	50,09	49,71
9000	12,87	6,27	26,52	50,04	49,75
9100	12,95	6,3	26,5	50,1	49,78
9200	13,02	6,33	26,51	50,01	49,67
9300	13,1	6,35	26,53	50,1	49,69
9400	13,17	6,38	26,48	50,08	49,68
9500	13,25	6,41	26,53	50,08	49,71
9600	13,34	6,44	26,52	50,14	49,71
9700	13,41	6,47	26,48	50,01	49,71
9800	13,5	6,49	26,49	50,18	49,83
9900	13,58	6,52	26,49	50,06	49,78
10000	13,65	6,55	26,49	50,07	49,78

Test Ended at 10000 Passes
Sample 1 Final rut depth = 13,65 mm
Sample 2 Final rut depth = 6,55 mm
Sample 1 Mean Steady State Tracking Rate = 0,85 mm/1000 Passes
Sample 2 Mean Steady State Tracking Rate = 0,33 mm/1000 Passes

Table 0.26 Samples G1-G3: Wheeltrack test results.

Wheeltracking Test Summary
Specimen Name: gruppe 2 50C
Date: 19.10.2010
Test Temperature: 50
Sample 1 Thickness: 40
Sample 2 Thickness: 40

Pass No.	Rut Depth(mm) 1	Rut Depth(mm) 2	Speed (RPM)	RTD 1 Deg.C.	RTD 2 Deg.C.
0	0	0	26,5	49,17	49,6
100	0,71	0	26,51	49,91	50,01
200	0,93	0	26,48	49,91	50,21
300	1,06	0	26,5	49,85	50,18
400	1,16	0	26,52	49,78	50,36
500	1,24	0	26,46	49,82	50,22
600	1,31	0	26,55	49,76	50,53
700	1,36	0	26,58	49,68	49,96
800	1,41	0	26,51	49,67	50,62
900	1,45	0	26,47	49,68	50,02
1000	1,49	0	26,49	49,63	50,72
1100	1,53	0	26,49	49,63	50,17
1200	1,56	0	26,48	49,6	50,55
1300	1,59	0	26,5	49,53	50,04
1400	1,62	0	26,55	49,62	50,72
1500	1,64	0	26,48	49,61	49,98
1600	1,67	0	26,52	49,6	50,72
1700	1,7	0	26,51	49,61	50,09
1800	1,71	0	26,47	49,63	50,67
1900	1,73	0	26,52	49,56	50,04
2000	1,75	0	26,51	49,59	50,49
2100	1,77	0	26,53	49,51	50,28
2200	1,79	0	26,5	49,62	50,35
2300	1,8	0	26,49	49,6	50,37
2400	1,82	0	26,51	49,59	50,45
2500	1,83	0	26,52	49,52	50,2
2600	1,85	0	26,49	49,57	50,4
2700	1,86	0	26,48	49,62	50,47
2800	1,87	0	26,45	49,62	50,45
2900	1,89	0	26,5	49,56	50,31
3000	1,89	0	26,51	49,59	50,33
3100	1,91	0	26,52	49,55	50,42
3200	1,91	0	26,45	49,62	50,33
3300	1,93	0	26,49	49,54	50,45
3400	1,94	0	26,5	49,6	50,17
3500	1,95	0	26,51	49,65	50,53
3600	1,94	0	26,49	49,62	50,16
3700	1,96	0	26,5	49,64	50,35
3800	1,97	0	26,51	49,62	50,26
3900	1,98	0	26,47	49,63	50,39
4000	1,98	0	26,53	49,62	50,22
4100	1,99	0	26,5	49,62	50,29
4200	2	0	26,51	49,62	50,41

4300	2,01	0	26,5	49,6	50,16
4400	2,02	0	26,51	49,65	50,43
4500	2,03	0	26,49	49,57	50,28
4600	2,04	0	26,49	49,6	50,25
4700	2,04	0	26,51	49,57	50,33
4800	2,05	0	26,49	49,59	50,41
4900	2,06	0	26,55	49,6	50,23
5000	2,06	0	26,52	49,63	50,46
5100	2,07	0	26,48	49,61	50,4
5200	2,07	0	26,5	49,57	50,31
5300	2,08	0	26,49	49,69	50,33
5400	2,08	0	26,47	49,62	50,35
5500	2,09	0	26,47	49,64	50,21
5600	2,1	0	26,53	49,64	50,76
5700	2,09	0	26,49	49,66	50,16
5800	2,11	0	26,48	49,65	50,5
5900	2,11	0	26,52	49,68	50,22
6000	2,12	0	26,47	49,6	50,53
6100	2,13	0	26,53	49,6	50,18
6200	2,13	0	26,5	49,63	50,44
6300	2,14	0	26,47	49,68	50,17
6400	2,14	0	26,52	49,65	50,39
6500	2,15	0	26,53	49,63	50,26
6600	2,15	0	26,5	49,64	50,49
6700	2,15	0	26,51	49,58	50,22
6800	2,15	0	26,53	49,64	50,41
6900	2,16	0	26,47	49,6	50,42
7000	2,16	0	26,53	49,67	50,26
7100	2,16	0	26,52	49,67	50,45
7200	2,17	0	26,48	49,67	50,27
7300	2,17	0	26,47	49,6	50,45
7400	2,17	0	26,53	49,63	50,14
7500	2,17	0	26,54	49,64	50,52
7600	2,18	0	26,5	49,63	50,27
7700	2,19	0	26,52	49,64	50,21
7800	2,19	0	26,5	49,62	50,56
7900	2,19	0	26,47	49,62	50,25
8000	2,2	0	26,51	49,66	50,62
8100	2,2	0	26,49	49,64	50,24
8200	2,21	0	26,5	49,69	50,58
8300	2,21	0	26,52	49,62	50,2
8400	2,21	0	26,51	49,64	50,56
8500	2,21	0	26,48	49,67	50,29
8600	2,22	0	26,5	49,67	50,33
8700	2,22	0	26,45	49,66	50,37
8800	2,22	0	26,5	49,65	50,4
8900	2,23	0	26,53	49,62	50,3
9000	2,23	0	26,49	49,67	50,47
9100	2,23	0	26,47	49,62	50,31
9200	2,23	0	26,46	49,69	50,51
9300	2,23	0	26,5	49,62	50,48
9400	2,24	0	26,47	49,63	50,17
9500	2,24	0	26,5	49,68	50,85
9600	2,24	0	26,52	49,64	50,22
9700	2,24	0	26,49	49,71	50,54
9800	2,26	0	26,51	49,65	50,12
9900	2,26	0	26,52	49,68	50,57
10000	2,25	0	26,49	49,64	50,12

Test Ended at 10000 Passes
Sample 1 Final rut depth = 2,25 mm
Sample 2 Final rut depth = -0,00 mm
Sample 1 Mean Steady State Tracking Rate = 0,04 mm/1000 Passes
Sample 2 Mean Steady State Tracking Rate = 0,00 mm/1000 Passes

Table 0.27 Sample G2: Wheeltrack test results.

Wheeltracking Test Summary
Specimen Name: Gr 4 og Gr 5 50C
Date: 20.10.2010
Test Temperature: 50
Sample 1 Thickness: 40
Sample 2 Thickness: 40

Pass No.	Rut Depth(mm) 1	Rut Depth(mm) 2	Speed (RPM)	RTD 1 Deg.C.	RTD 2 Deg.C.
0	0	0	26,5	49,02	49,31
100	0,86	1,1	26,52	49,11	49,2
200	1,13	1,53	26,51	49,3	49,3
300	1,3	1,82	26,51	49,21	49,24
400	1,42	2,06	26,52	49,26	49,22
500	1,52	2,27	26,49	49,27	49,23
600	1,6	2,44	26,46	49,29	49,27
700	1,69	2,61	26,52	49,34	49,33
800	1,76	2,76	26,51	49,32	49,32

900	1,81	2,91	26,49	49,41	49,37
1000	1,87	3,06	26,51	49,3	49,25
1100	1,92	3,19	26,46	49,46	49,38
1200	1,96	3,32	26,51	49,44	49,39
1300	2,01	3,45	26,48	49,48	49,43
1400	2,04	3,57	26,5	49,57	49,37
1500	2,08	3,69	26,52	49,51	49,41
1600	2,11	3,81	26,48	49,55	49,4
1700	2,15	3,92	26,48	49,55	49,45
1800	2,17	4,03	26,43	49,62	49,46
1900	2,22	4,13	26,53	49,56	49,41
2000	2,24	4,23	26,49	49,67	49,43
2100	2,27	4,32	26,52	49,62	49,43
2200	2,3	4,42	26,47	49,64	49,47
2300	2,33	4,52	26,49	49,7	49,44
2400	2,35	4,62	26,49	49,63	49,48
2500	2,38	4,7	26,51	49,78	49,53
2600	2,4	4,8	26,5	49,73	49,44
2700	2,42	4,88	26,48	49,77	49,53
2800	2,44	4,97	26,51	49,7	49,47
2900	2,46	5,06	26,51	49,78	49,54
3000	2,48	5,14	26,49	49,78	49,52
3100	2,49	5,23	26,55	49,77	49,51
3200	2,51	5,31	26,51	49,88	49,54
3300	2,52	5,38	26,46	49,78	49,44
3400	2,54	5,47	26,51	49,83	49,53
3500	2,56	5,55	26,48	49,86	49,52
3600	2,57	5,63	26,51	49,92	49,57
3700	2,58	5,7	26,52	49,84	49,5
3800	2,6	5,78	26,5	49,9	49,56
3900	2,61	5,86	26,49	49,97	49,57
4000	2,62	5,94	26,51	49,83	49,48
4100	2,63	6,02	26,51	49,95	49,58
4200	2,65	6,09	26,48	49,93	49,53
4300	2,66	6,17	26,48	50,03	49,59
4400	2,67	6,23	26,52	49,91	49,58
4500	2,67	6,3	26,5	49,96	49,59
4600	2,7	6,37	26,53	49,91	49,48
4700	2,71	6,43	26,52	50,02	49,53
4800	2,71	6,5	26,51	49,94	49,51
4900	2,72	6,56	26,51	49,97	49,53
5000	2,72	6,62	26,5	49,96	49,58
5100	2,74	6,68	26,48	49,94	49,58
5200	2,75	6,74	26,52	49,97	49,61
5300	2,76	6,8	26,52	49,93	49,54
5400	2,77	6,86	26,49	49,99	49,59
5500	2,78	6,91	26,5	49,9	49,49
5600	2,79	6,97	26,47	50,01	49,61
5700	2,8	7,02	26,49	49,91	49,55
5800	2,81	7,08	26,43	50	49,57
5900	2,82	7,13	26,5	49,97	49,52
6000	2,83	7,18	26,5	50,09	49,61
6100	2,84	7,23	26,49	49,99	49,58
6200	2,85	7,28	26,49	50,03	49,58
6300	2,86	7,33	26,49	49,99	49,59
6400	2,86	7,38	26,45	49,99	49,6
6500	2,88	7,44	26,49	50,02	49,64
6600	2,88	7,49	26,47	49,98	49,54
6700	2,9	7,54	26,49	50,07	49,64
6800	2,91	7,6	26,53	50,05	49,59
6900	2,92	7,65	26,47	50,1	49,57
7000	2,93	7,7	26,5	50	49,62
7100	2,94	7,76	26,53	50	49,58
7200	2,95	7,81	26,49	50,02	49,59
7300	2,95	7,86	26,58	50,07	49,62
7400	2,95	7,92	26,51	50,04	49,53
7500	2,96	7,97	26,51	50,1	49,65
7600	2,97	8,03	26,6	50,08	49,55
7700	2,97	8,08	26,53	50,02	49,56
7800	2,98	8,13	26,48	50,12	49,68
7900	2,99	8,18	26,53	50,07	49,57
8000	2,99	8,23	26,5	50,09	49,65
8100	3	8,28	26,48	50,02	49,61
8200	3,01	8,34	26,49	50,11	49,69
8300	3,02	8,38	26,51	50,05	49,67
8400	3,02	8,43	26,51	50,07	49,61
8500	3,02	8,47	26,52	50,07	49,56
8600	3,03	8,52	26,52	50,1	49,59
8700	3,04	8,56	26,51	50,1	49,58
8800	3,04	8,61	26,5	50,03	49,58
8900	3,05	8,65	26,54	50,09	49,68
9000	3,05	8,7	26,53	50,12	49,59
9100	3,06	8,74	26,48	50,04	49,63
9200	3,06	8,78	26,48	50,1	49,61
9300	3,07	8,83	26,49	50,09	49,68
9400	3,07	8,87	26,51	50,16	49,65
9500	3,07	8,9	26,53	50,03	49,57

9600	3,08	8,95	26,52	50,14	49,69
9700	3,08	8,98	26,5	50,06	49,56
9800	3,08	9,02	26,52	50,11	49,68
9900	3,09	9,06	26,5	50,14	49,6
10000	3,09	9,1	26,49	50,11	49,64

Test Ended at 10000 Passes
Sample 1 Final rut depth = 3,09 mm
Sample 2 Final rut depth = 9,10 mm
Sample 1 Mean Steady State Tracking Rate = 0,07 mm/1000 Passes
Sample 2 Mean Steady State Tracking Rate = 0,49 mm/1000 Passes

Table 0.28 SAmples G4-G5: Wheeltrack test results.

Wheeltracking Test Summary
Specimen Name: Gr6 50C
Date: 20.10.2010
Test Temperature: 50
Sample 1 Thickness: 40
Sample 2 Thickness: 40

Pass No.	Rut Depth(mm) 1	Rut Depth(mm) 2	Speed (RPM)	RTD 1 Deg.C.	RTD 2 Deg.C.
0	0	0	26,5	49,94	50,91
100	1,24	0	26,52	49,83	50,41
200	1,7	0	26,51	49,91	50,72
300	2,01	0	26,5	49,74	50,39
400	2,26	0	26,52	49,83	50,57
500	2,47	0	26,49	49,7	50,42
600	2,66	0	26,49	49,77	50,6
700	2,83	0	26,52	49,64	50,44
800	2,99	0	26,51	49,68	50,47
900	3,14	0	26,5	49,64	50,61
1000	3,27	0	26,59	49,68	50,4
1100	3,4	0	26,51	49,64	50,72
1200	3,52	0	26,47	49,54	50,36
1300	3,63	0	26,47	49,59	50,62
1400	3,73	0	26,5	49,54	50,5
1500	3,83	0	26,5	49,56	50,5
1600	3,93	0	26,34	49,49	50,47
1700	4,02	0	26,45	49,58	50,5
1800	4,11	0	26,54	49,52	50,63
1900	4,19	0	26,51	49,5	50,44
2000	4,27	0	26,51	49,5	50,53
2100	4,35	0	26,57	49,49	50,46
2200	4,42	0	26,49	49,54	50,56
2300	4,49	0	26,52	49,56	50,52
2400	4,55	0	26,48	49,51	50,42
2500	4,62	0	26,51	49,5	50,65
2600	4,68	0	26,46	49,49	50,41
2700	4,74	0	26,5	49,58	50,74
2800	4,81	0	26,53	49,47	50,34
2900	4,86	0	26,5	49,52	50,62
3000	4,94	0	26,48	49,46	50,28
3100	5	0	26,51	49,56	50,63
3200	5,05	0	26,51	49,5	50,41
3300	5,1	0	26,49	49,5	50,56
3400	5,15	0	26,51	49,47	50,48
3500	5,21	0	26,49	49,45	50,55
3600	5,27	0	26,29	49,46	50,51
3700	5,31	0	26,51	49,42	50,41
3800	5,37	0	26,49	49,49	50,65
3900	5,42	0	26,43	49,48	50,46
4000	5,49	0	26,49	49,46	50,68
4100	5,55	0	26,48	49,48	50,42
4200	5,61	0	26,51	49,53	50,84
4300	5,66	0	26,5	49,51	50,43
4400	5,72	0	26,5	49,52	50,81
4500	5,77	0	26,49	49,53	50,48
4600	5,82	0	26,5	49,52	50,66
4700	5,87	0	26,5	49,5	50,47
4800	5,92	0	26,5	49,55	50,6
4900	5,96	0	26,51	49,47	50,49
5000	6,02	0	26,51	49,51	50,66
5100	6,06	0	26,5	49,46	50,53
5200	6,12	0	26,49	49,51	50,52
5300	6,16	0	26,5	49,51	50,52
5400	6,21	0	26,47	49,5	50,34
5500	6,26	0	26,5	49,53	50,64
5600	6,3	0	26,51	49,48	50,37
5700	6,34	0	26,5	49,47	50,73
5800	6,39	0	26,49	49,49	50,47
5900	6,43	0	26,5	49,49	50,67
6000	6,48	0	26,47	49,48	50,42
6100	6,52	0	26,48	49,56	50,58

6200	6,56	0	26,5	49,52	50,48
6300	6,6	0	26,49	49,5	50,65
6400	6,64	0	26,49	49,47	50,49
6500	6,68	0	26,51	49,51	50,48
6600	6,72	0	26,49	49,5	50,61
6700	6,77	0	26,61	49,49	50,35
6800	6,81	0	26,54	49,53	50,58
6900	6,83	0	26,47	49,52	50,48
7000	6,87	0	26,48	49,54	50,55
7100	6,9	0	26,51	49,55	50,64
7200	6,94	0	26,49	49,54	50,55
7300	6,98	0	26,48	49,46	50,5
7400	7,01	0	26,52	49,57	50,71
7500	7,05	0	26,48	49,49	50,63
7600	7,08	0	26,5	49,51	50,49
7700	7,11	0	26,53	49,51	50,57
7800	7,15	0	26,47	49,53	50,55
7900	7,18	0	26,48	49,55	50,62
8000	7,22	0	26,52	49,46	50,45
8100	7,26	0	26,51	49,55	50,73
8200	7,29	0	26,53	49,43	50,44
8300	7,33	0	26,51	49,53	50,65
8400	7,36	0	26,47	49,5	50,57
8500	7,39	0	26,51	49,5	50,68
8600	7,42	0	26,53	49,47	50,6
8700	7,46	0	26,5	49,5	50,51
8800	7,49	0	26,55	49,51	50,75
8900	7,53	0	26,49	49,48	50,53
9000	7,56	0	26,5	49,51	50,68
9100	7,6	0	26,48	49,42	50,42
9200	7,62	0	26,48	49,55	50,69
9300	7,65	0	26,49	49,52	50,45
9400	7,69	0	26,5	49,49	50,54
9500	7,72	0	26,53	49,53	50,6
9600	7,75	0	26,51	49,47	50,58
9700	7,79	0	26,48	49,52	50,52
9800	7,81	0	26,5	49,49	50,62
9900	7,84	0	26,51	49,46	50,62
10000	7,87	0	26,48	49,52	50,54

Test Ended at 10000 Passes
Sample 1 Final rut depth = 7,87 mm
Sample 2 Final rut depth = -0,00 mm
Sample 1 Mean Steady State Tracking Rate = 0,37 mm/1000 Passes
Sample 2 Mean Steady State Tracking Rate = 0,00 mm/1000 Passes

Table 0.29 Sample G8: Wheeltrack test results.

Wheeltracking Test Summary
Specimen Name: Gr 7 og 10 50C
Date: 25.10.2010
Test Temperature: 50
Sample 1 Thickness: 40
Sample 2 Thickness: 40

Pass No.	Rut Depth(mm) 1	Rut Depth(mm) 2	Speed (RPM)	RTD 1 Deg.C.	RTD 2 Deg.C.
0	0	0	26,5	48,5	49,2
100	1,49	1,01	26,5	48,45	49,23
200	2,07	1,39	26,49	48,43	49,19
300	2,48	1,65	26,51	48,47	49,18
400	2,82	1,85	26,49	48,47	49,18
500	3,11	2,03	26,48	48,51	49,27
600	3,37	2,18	26,53	48,49	49,22
700	3,63	2,33	26,5	48,59	49,27
800	3,86	2,47	26,5	48,56	49,21
900	4,08	2,59	26,53	48,51	49,21
1000	4,29	2,71	26,51	48,63	49,37
1100	4,49	2,82	26,48	48,61	49,31
1200	4,68	2,92	26,45	48,66	49,38
1300	4,86	3,03	26,52	48,61	49,28
1400	5,04	3,12	26,46	48,61	49,28
1500	5,2	3,21	26,5	48,63	49,32
1600	5,35	3,3	26,51	48,69	49,33
1700	5,49	3,39	26,49	48,72	49,34
1800	5,63	3,47	26,5	48,64	49,3
1900	5,77	3,56	26,46	48,73	49,39
2000	5,91	3,64	26,45	48,71	49,39
2100	6,04	3,72	26,5	48,77	49,47
2200	6,16	3,79	26,54	48,81	49,38
2300	6,28	3,88	26,47	48,83	49,49
2400	6,4	3,95	26,51	48,75	49,43
2500	6,51	4,03	26,52	48,8	49,43
2600	6,62	4,11	26,5	48,84	49,43
2700	6,73	4,19	26,54	48,79	49,44

2800	6,85	4,26	26,49	48,88	49,47
2900	6,94	4,34	26,46	48,83	49,51
3000	7,05	4,41	26,52	48,9	49,57
3100	7,15	4,48	26,48	48,89	49,41
3200	7,25	4,56	26,5	48,93	49,56
3300	7,33	4,63	26,49	48,89	49,52
3400	7,42	4,7	26,48	49,02	49,56
3500	7,51	4,78	26,47	49	49,51
3600	7,58	4,85	26,46	48,98	49,57
3700	7,66	4,92	26,54	48,99	49,48
3800	7,74	4,98	26,48	48,97	49,53
3900	7,81	5,04	26,5	49,04	49,6
4000	7,89	5,11	26,55	49,01	49,56
4100	7,97	5,17	26,46	49,04	49,63
4200	8,04	5,23	26,51	49,06	49,57
4300	8,11	5,29	26,52	49,05	49,5
4400	8,17	5,36	26,49	49,11	49,57
4500	8,24	5,41	26,51	49,04	49,48
4600	8,3	5,48	26,48	49,13	49,58
4700	8,37	5,54	26,48	49,07	49,59
4800	8,42	5,6	26,46	49,12	49,63
4900	8,5	5,66	26,51	49,07	49,58
5000	8,57	5,72	26,51	49,12	49,54
5100	8,62	5,78	26,47	49,15	49,54
5200	8,69	5,84	26,52	49,16	49,63
5300	8,75	5,91	26,5	49,15	49,63
5400	8,8	5,97	26,48	49,1	49,54
5500	8,87	6,03	26,5	49,16	49,55
5600	8,92	6,09	26,45	49,16	49,51
5700	8,98	6,15	26,5	49,24	49,62
5800	9,03	6,21	27,14	49,14	49,52
5900	9,09	6,27	26,46	49,17	49,66
6000	9,16	6,32	26,53	49,11	49,55
6100	9,21	6,38	26,5	49,23	49,61
6200	9,26	6,44	26,46	49,13	49,58
6300	9,31	6,5	26,48	49,22	49,62
6400	9,37	6,55	26,51	49,23	49,61
6500	9,43	6,61	26,47	49,16	49,58
6600	9,48	6,66	26,5	49,23	49,58
6700	9,53	6,71	26,54	49,17	49,64
6800	9,58	6,77	26,51	49,27	49,6
6900	9,63	6,82	26,42	49,23	49,6
7000	9,68	6,88	26,49	49,22	49,68
7100	9,73	6,93	26,48	49,2	49,58
7200	9,78	6,98	26,5	49,23	49,68
7300	9,85	7,04	26,53	49,21	49,56
7400	9,89	7,1	26,48	49,22	49,63
7500	9,94	7,15	26,51	49,25	49,6
7600	10	7,21	26,47	49,25	49,65
7700	10,05	7,27	26,48	49,3	49,64
7800	10,11	7,32	26,49	49,22	49,57
7900	10,15	7,39	26,55	49,3	49,61
8000	10,21	7,44	26,48	49,27	49,59
8100	10,27	7,5	26,49	49,28	49,69
8200	10,3	7,56	26,54	49,26	49,63
8300	10,36	7,61	26,49	49,3	49,68
8400	10,41	7,67	26,5	49,34	49,7
8500	10,46	7,72	26,49	49,3	49,67
8600	10,49	7,79	26,55	49,37	49,65
8700	10,56	7,83	26,5	49,33	49,62
8800	10,6	7,88	26,59	49,35	49,62
8900	10,64	7,94	26,55	49,31	49,58
9000	10,69	7,99	26,51	49,36	49,71
9100	10,73	8,04	26,52	49,35	49,61
9200	10,77	8,09	26,55	49,36	49,71
9300	10,81	8,14	26,48	49,35	49,59
9400	10,85	8,19	26,42	49,34	49,68
9500	10,89	8,24	26,51	49,37	49,64
9600	10,93	8,29	26,46	49,38	49,64
9700	10,96	8,34	26,57	49,38	49,63
9800	11	8,38	26,55	49,4	49,68
9900	11,04	8,43	26,54	49,37	49,62
10000	11,07	8,48	26,59	49,39	49,58

Test Ended at 10000 Passes
Sample 1 Final rut depth = 11,07 mm
Sample 2 Final rut depth = 8,48 mm
Sample 1 Mean Steady State Tracking Rate = 0,50 mm/1000 Passes
Sample 2 Mean Steady State Tracking Rate = 0,55 mm/1000 Passes

Table 0.30 Samples G7-G10: Wheeltrack test results.

Wheeltracking Test Summary

Specimen Name: Gr 8 og Gr 9
Date: 22.10.2010
Test Temperature: 50
Sample 1 Thickness: 40
Sample 2 Thickness: 40

Pass No.	Rut Depth(mm) 1	Rut Depth(mm) 2	Speed (RPM)	RTD 1 Deg.C.	RTD 2 Deg.C.
0	0	0	26,5	48,81	49,34
100	1,62	1,72	26,47	48,79	49,33
200	2,25	2,48	26,49	48,86	49,33
300	2,71	3,06	26,49	48,87	49,29
400	3,09	3,57	26,49	48,89	49,35
500	3,41	4,02	26,54	48,94	49,38
600	3,7	4,42	26,51	48,93	49,34
700	3,97	4,8	26,5	48,88	49,36
800	4,23	5,16	26,53	48,95	49,36
900	4,46	5,49	26,49	49	49,43
1000	4,66	5,79	26,51	48,99	49,39
1100	4,85	6,1	26,5	48,99	49,48
1200	5,03	6,4	26,49	49,02	49,46
1300	5,21	6,7	26,48	49,04	49,52
1400	5,39	6,99	26,52	49,01	49,36
1500	5,56	7,29	26,51	49,14	49,48
1600	5,72	7,56	26,48	49,03	49,38
1700	5,87	7,84	26,51	49,14	49,47
1800	6,01	8,11	26,5	49,12	49,53
1900	6,15	8,36	26,5	49,18	49,5
2000	6,28	8,6	26,53	49,23	49,52
2100	6,42	8,83	26,52	49,24	49,62
2200	6,54	9,07	26,47	49,23	49,59
2300	6,67	9,3	26,51	49,27	49,51
2400	6,79	9,52	26,49	49,26	49,61
2500	6,92	9,71	26,52	49,29	49,53
2600	7,05	9,92	26,52	49,34	49,56
2700	7,19	10,12	26,49	49,33	49,51
2800	7,32	10,32	26,49	49,42	49,59
2900	7,45	10,51	26,41	49,35	49,6
3000	7,59	10,73	26,5	49,4	49,63
3100	7,73	10,94	26,49	49,36	49,64
3200	7,86	11,15	26,48	49,38	49,6
3300	7,98	11,35	26,47	49,46	49,68
3400	8,11	11,55	26,5	49,42	49,61
3500	8,23	11,76	26,51	49,51	49,6
3600	8,35	11,96	26,49	49,41	49,54
3700	8,48	12,15	26,54	49,53	49,69
3800	8,6	12,34	26,52	49,43	49,56
3900	8,71	12,52	26,53	49,52	49,69
4000	8,82	12,7	26,53	49,49	49,57
4100	8,92	12,87	26,51	49,52	49,57
4200	9,02	13,03	26,51	49,56	49,68
4300	9,12	13,17	26,49	49,58	49,64
4400	9,22	13,34	26,52	49,59	49,7
4500	9,31	13,49	26,49	49,53	49,65
4600	9,41	13,61	26,49	49,6	49,71
4700	9,5	13,75	26,54	49,53	49,65
4800	9,59	13,86	26,5	49,62	49,72
4900	9,67	13,95	26,49	49,58	49,59
5000	9,76	14,06	26,49	49,58	49,6
5100	9,84	14,15	26,51	49,67	49,63
5200	9,93	14,22	26,47	49,63	49,62
5300	10,01	14,3	26,49	49,62	49,62
5400	10,09	14,37	26,51	49,6	49,68
5500	10,16	14,44	26,51	49,68	49,72
5600	10,25	14,5	26,51	49,62	49,66
5700	10,32	14,57	26,51	49,65	49,65
5800	10,39	14,63	26,47	49,58	49,62
5900	10,46	14,7	26,49	49,69	49,65
6000	10,52	14,76	26,52	49,67	49,62
6100	10,59	14,82	26,52	49,74	49,68
6200	10,66	14,86	26,51	49,69	49,62
6300	10,72	14,9	26,51	49,76	49,64
6400	10,78	14,94	26,49	49,73	49,71
6500	10,85	14,97	26,49	49,77	49,66
6600	10,91	15	26,51	49,73	49,62
6700	10,97	15,04	26,51	49,78	49,68
6800	11,03	15,06	26,51	49,71	49,68
6900	11,09	15,09	26,5	49,72	49,68
7000	11,15	15,12	26,5	49,73	49,63
7100	11,21	15,14	26,49	49,74	49,69
7200	11,26	15,16	26,51	49,77	49,63
7300	11,32	15,18	26,49	49,73	49,71
7400	11,37	15,19	26,49	49,73	49,65
7500	11,42	15,22	26,58	49,72	49,69
7600	11,48	15,24	26,51	49,82	49,67
7700	11,53	15,25	26,48	49,77	49,62
7800	11,57	15,26	26,51	49,77	49,72
7900	11,64	15,28	26,49	49,8	49,63
8000	11,7	15,28	26,45	49,78	49,62

8100	11,75	15,3	26,49	49,79	49,73
8200	11,8	15,31	26,49	49,78	49,63
8300	11,84	15,33	26,5	49,79	49,63
8400	11,89	15,34	26,5	49,74	49,72
8500	11,93	15,34	26,5	49,86	49,7
8600	11,98	15,35	26,51	49,83	49,72
8700	12,02	15,37	26,51	49,81	49,63
8800	12,07	15,38	26,49	49,86	49,71
8900	12,12	15,38	26,49	49,83	49,73
9000	12,16	15,39	26,49	49,84	49,71
9100	12,2	15,4	26,49	49,86	49,7
9200	12,23	15,4	26,47	49,84	49,67
9300	12,26	15,4	26,51	49,83	49,66
9400	12,3	15,4	26,51	49,83	49,72
9500	12,34	15,41	26,42	49,85	49,75
9600	12,39	15,41	26,51	49,85	49,65
9700	12,42	15,41	26,5	49,89	49,67
9800	12,46	15,42	26,49	49,88	49,65
9900	12,51	15,43	26,57	49,86	49,73
10000	12,55	15,43	26,49	49,84	49,74

Test Ended at 10000 Passes
Sample 1 Final rut depth = 12,55 mm
Sample 2 Final rut depth = 15,43 mm
Sample 1 Mean Steady State Tracking Rate = 0,56 mm/1000 Passes
Sample 2 Mean Steady State Tracking Rate = 0,27 mm/1000 Passes

Table 0.31 Samples G8-G9: Wheeltrack test results.

Wheeltracking Test Summary
Specimen Name: Gr11 og Gr12 50C
Date: 25.10.2010
Test Temperature: 50
Sample 1 Thickness: 40
Sample 2 Thickness: 40

Pass No.	Rut Depth(mm) 1	Rut Depth(mm) 2	Speed (RPM)	RTD 1 Deg.C.	RTD 2 Deg.C.
0	0	0	26,5	49,77	49,86
100	0,85	0,78	26,55	49,68	49,67
200	1,13	1,01	26,51	49,76	49,75
300	1,32	1,15	26,49	49,65	49,68
400	1,47	1,27	26,51	49,6	49,65
500	1,59	1,37	26,44	49,69	49,75
600	1,69	1,45	26,45	49,61	49,63
700	1,78	1,52	26,49	49,57	49,78
800	1,85	1,58	26,51	49,51	49,68
900	1,92	1,64	26,48	49,52	49,69
1000	1,98	1,69	26,51	49,44	49,58
1100	2,03	1,73	26,5	49,52	49,77
1200	2,09	1,76	26,42	49,47	49,61
1300	2,14	1,8	26,49	49,5	49,69
1400	2,18	1,83	26,49	49,44	49,63
1500	2,23	1,86	26,48	49,44	49,63
1600	2,28	1,89	26,47	49,49	49,74
1700	2,32	1,92	26,53	49,41	49,71
1800	2,36	1,95	26,5	49,46	49,78
1900	2,4	1,97	26,5	49,43	49,63
2000	2,44	2	26,49	49,45	49,78
2100	2,48	2,02	26,49	49,46	49,66
2200	2,52	2,05	26,51	49,51	49,74
2300	2,55	2,07	26,51	49,43	49,7
2400	2,59	2,09	26,48	49,42	49,76
2500	2,62	2,11	26,5	49,41	49,63
2600	2,65	2,12	26,5	49,36	49,63
2700	2,68	2,14	26,53	49,42	49,77
2800	2,71	2,15	26,52	49,4	49,61
2900	2,74	2,17	26,51	49,47	49,81
3000	2,77	2,18	26,49	49,35	49,7
3100	2,8	2,2	26,5	49,39	49,75
3200	2,82	2,22	26,51	49,41	49,67
3300	2,85	2,24	26,49	49,41	49,73
3400	2,88	2,25	26,51	49,36	49,68
3500	2,9	2,27	26,49	49,45	49,83
3600	2,93	2,29	26,48	49,35	49,67
3700	2,95	2,3	26,52	49,48	49,83
3800	2,98	2,32	26,53	49,36	49,68
3900	3	2,34	26,5	49,43	49,7
4000	3,02	2,35	26,52	49,37	49,79
4100	3,05	2,37	26,5	49,35	49,75
4200	3,07	2,38	26,49	49,44	49,81
4300	3,09	2,4	26,5	49,35	49,76
4400	3,11	2,41	26,54	49,4	49,86
4500	3,13	2,42	26,48	49,33	49,74
4600	3,15	2,44	26,47	49,45	49,77

4700	3,17	2,45	26,5	49,32	49,73
4800	3,19	2,46	26,49	49,38	49,71
4900	3,21	2,47	26,48	49,38	49,68
5000	3,22	2,49	26,54	49,37	49,75
5100	3,24	2,5	26,5	49,41	49,72
5200	3,26	2,51	26,46	49,41	49,71
5300	3,28	2,53	26,51	49,47	49,79
5400	3,29	2,54	26,5	49,39	49,7
5500	3,31	2,55	26,49	49,47	49,79
5600	3,32	2,56	26,54	49,41	49,72
5700	3,34	2,57	26,51	49,46	49,79
5800	3,36	2,58	26,52	49,37	49,73
5900	3,37	2,59	26,5	49,42	49,83
6000	3,39	2,6	26,51	49,38	49,81
6100	3,4	2,61	26,5	49,46	49,83
6200	3,42	2,62	26,51	49,37	49,76
6300	3,44	2,63	26,51	49,43	49,74
6400	3,45	2,64	26,48	49,42	49,86
6500	3,46	2,65	26,53	49,37	49,79
6600	3,48	2,66	26,5	49,44	49,87
6700	3,49	2,67	26,51	49,44	49,8
6800	3,51	2,68	26,49	49,42	49,78
6900	3,52	2,69	26,51	49,37	49,77
7000	3,54	2,7	26,47	49,39	49,72
7100	3,55	2,7	26,46	49,43	49,84
7200	3,56	2,71	26,52	49,34	49,73
7300	3,58	2,72	26,49	49,41	49,84
7400	3,59	2,73	26,52	49,38	49,76
7500	3,61	2,74	26,58	49,45	49,85
7600	3,62	2,75	26,49	49,37	49,78
7700	3,63	2,76	26,49	49,44	49,84
7800	3,65	2,77	26,48	49,41	49,69
7900	3,66	2,78	26,48	49,44	49,74
8000	3,67	2,78	26,5	49,39	49,8
8100	3,69	2,79	26,5	49,4	49,79
8200	3,7	2,8	26,47	49,47	49,78
8300	3,71	2,81	26,51	49,41	49,69
8400	3,72	2,81	26,53	49,45	49,78
8500	3,74	2,82	26,48	49,42	49,73
8600	3,75	2,83	26,54	49,42	49,82
8700	3,76	2,84	26,49	49,39	49,69
8800	3,77	2,85	26,46	49,44	49,73
8900	3,79	2,85	26,51	49,4	49,7
9000	3,8	2,86	26,51	49,45	49,83
9100	3,82	2,87	26,41	49,37	49,73
9200	3,83	2,87	26,51	49,48	49,77
9300	3,84	2,88	26,57	49,43	49,77
9400	3,86	2,89	26,4	49,4	49,75
9500	3,86	2,9	26,51	49,45	49,86
9600	3,87	2,9	26,52	49,46	49,74
9700	3,89	2,91	26,45	49,48	49,76
9800	3,9	2,92	26,5	49,43	49,72
9900	3,91	2,92	26,48	49,45	49,83
10000	3,92	2,93	26,49	49,34	49,69

Test Ended at 10000 Passes
Sample 1 Final rut depth = 3,92 mm
Sample 2 Final rut depth = 2,93 mm
Sample 1 Mean Steady State Tracking Rate = 0,14 mm/1000 Passes
Sample 2 Mean Steady State Tracking Rate = 0,09 mm/1000 Passes

Table 0.32 Samples G11-G12. Wheeltrack test results.

Wheeltracking Test Summary
Specimen Name: Gr 16 og 13 50C
Date: 27.10.2010
Test Temperature: 50
Sample 1 Thickness: 40
Sample 2 Thickness: 40

Pass No.	Rut Depth(mm) 1	Rut Depth(mm) 2	Speed (RPM)	RTD 1 Deg.C.	RTD 2 Deg.C.
0	0	0	26,5	48,16	48,95
100	0,76	0,74	26,5	48,45	49,08
200	0,97	0,98	26,47	48,43	49,13
300	1,1	1,15	26,5	48,52	49,19
400	1,2	1,27	26,47	48,45	49,17
500	1,28	1,37	26,5	48,56	49,17
600	1,24	1,47	26,52	48,51	49,21
700	1,33	1,55	26,51	48,54	49,14
800	1,39	1,62	26,49	48,59	49,22
900	1,44	1,67	26,48	48,52	49,23
1000	1,49	1,73	26,49	48,63	49,27
1100	1,53	1,78	26,5	48,62	49,23
1200	1,57	1,82	26,5	48,68	49,29

1300	1,6	1,87	26,53	48,69	49,35
1400	1,64	1,91	26,48	48,68	49,29
1500	1,67	1,96	26,51	48,74	49,33
1600	1,69	2	26,53	48,7	49,29
1700	1,72	2,04	26,54	48,78	49,36
1800	1,73	2,08	26,51	48,78	49,43
1900	1,76	2,11	26,54	48,79	49,38
2000	1,77	2,14	26,54	48,8	49,38
2100	1,78	2,18	26,47	48,8	49,4
2200	1,8	2,21	26,51	48,91	49,51
2300	1,81	2,24	26,49	48,8	49,41
2400	1,82	2,28	26,5	48,89	49,5
2500	1,84	2,31	26,53	48,81	49,41
2600	1,85	2,33	26,49	48,91	49,6
2700	1,87	2,36	26,5	48,86	49,54
2800	1,88	2,39	26,49	48,9	49,52
2900	1,89	2,42	26,51	48,88	49,57
3000	1,91	2,44	26,49	48,92	49,55
3100	1,92	2,45	26,51	48,92	49,53
3200	1,93	2,48	26,46	48,98	49,58
3300	1,95	2,5	26,51	48,91	49,61
3400	1,96	2,52	26,47	48,91	49,63
3500	1,97	2,54	26,52	49,05	49,68
3600	1,98	2,56	26,46	48,97	49,58
3700	1,99	2,58	26,49	49,06	49,66
3800	2	2,6	26,5	48,98	49,69
3900	2,01	2,61	26,49	49,05	49,67
4000	2,02	2,63	26,5	48,96	49,62
4100	2,04	2,65	26,46	48,98	49,65
4200	2,04	2,67	26,49	49	49,69
4300	2,05	2,69	26,5	49,01	49,6
4400	2,06	2,71	26,49	49,06	49,73
4500	2,07	2,72	26,47	49,06	49,74
4600	2,08	2,74	26,49	49,07	49,76
4700	2,09	2,76	26,55	49,09	49,67
4800	2,09	2,77	26,49	49,11	49,66
4900	2,11	2,79	26,59	49,13	49,72
5000	2,11	2,81	26,54	49,07	49,7
5100	2,12	2,82	26,49	49,12	49,78
5200	2,13	2,84	26,53	49,12	49,71
5300	2,14	2,85	26,49	49,21	49,86
5400	2,15	2,86	26,47	49,08	49,81
5500	2,16	2,88	26,47	49,14	49,83
5600	2,17	2,9	26,5	49,14	49,83
5700	2,18	2,91	26,45	49,15	49,69
5800	2,18	2,92	26,49	49,21	49,81
5900	2,2	2,93	26,61	49,15	49,78
6000	2,2	2,95	26,44	49,21	49,86
6100	2,2	2,96	26,51	49,14	49,77
6200	2,21	2,98	26,51	49,22	49,95
6300	2,22	2,99	26,51	49,22	49,92
6400	2,23	3	26,49	49,3	49,95
6500	2,23	3,01	26,49	49,27	49,9
6600	2,24	3,02	26,49	49,29	49,86
6700	2,25	3,04	26,5	49,26	49,87
6800	2,26	3,05	26,52	49,28	49,85
6900	2,26	3,07	26,5	49,36	49,92
7000	2,27	3,08	26,48	49,3	49,85
7100	2,27	3,1	26,51	49,28	49,85
7200	2,27	3,11	26,48	49,28	49,9
7300	2,28	3,12	26,52	49,34	49,97
7400	2,29	3,13	26,55	49,24	49,82
7500	2,3	3,15	26,54	49,3	49,93
7600	2,31	3,15	26,47	49,28	49,91
7700	2,31	3,17	26,51	49,28	49,87
7800	2,32	3,18	26,5	49,31	49,97
7900	2,33	3,19	26,49	49,36	49,96
8000	2,34	3,2	26,52	49,37	49,97
8100	2,34	3,22	26,49	49,32	49,95
8200	2,34	3,23	26,51	49,36	49,88
8300	2,35	3,23	26,51	49,3	49,9
8400	2,35	3,25	26,49	49,35	50
8500	2,36	3,26	26,49	49,32	49,9
8600	2,36	3,26	26,5	49,37	49,89
8700	2,37	3,28	26,51	49,37	49,94
8800	2,38	3,28	26,48	49,35	49,97
8900	2,38	3,29	26,5	49,32	49,96
9000	2,38	3,3	26,52	49,29	49,88
9100	2,39	3,32	26,49	49,38	49,99
9200	2,4	3,32	26,54	49,32	49,93
9300	2,4	3,33	26,49	49,33	49,93
9400	2,41	3,35	26,48	49,33	49,88
9500	2,41	3,36	26,5	49,33	49,87
9600	2,42	3,36	26,52	49,38	49,92
9700	2,42	3,37	26,45	49,34	49,94
9800	2,42	3,38	26,49	49,37	49,98
9900	2,43	3,39	26,48	49,32	49,84

10000	2,43	3,4	26,48	49,39	49,85

Test Ended at 10000 Passes
Sample 1 Final rut depth = 2,43 mm
Sample 2 Final rut depth = 3,40 mm
Sample 1 Mean Steady State Tracking Rate = 0,06 mm/1000 Passes
Sample 2 Mean Steady State Tracking Rate = 0,12 mm/1000 Passes

Table 0.33 Samples G16-G13: Wheeltrack test results.

Wheeltracking Test Summary
Specimen Name: Gr 14 og 15 40C
Date: 26.10.2010
Test Temperature: 40
Sample 1 Thickness: 40
Sample 2 Thickness: 40

Pass No.	Rut Depth(mm) 1	Rut Depth(mm) 2	Speed (RPM)	RTD 1 Deg.C.	RTD 2 Deg.C.
0	0	0	26,5	38,17	39,13
100	0,37	0,37	26,54	38,36	39,14
200	0,51	0,5	26,47	38,34	39,15
300	0,6	0,6	26,51	38,44	39,32
400	0,67	0,67	26,53	38,47	39,32
500	0,74	0,73	26,49	38,55	39,32
600	0,79	0,77	26,5	38,56	39,35
700	0,83	0,83	26,49	38,66	39,41
800	0,87	0,87	26,51	38,69	39,53
900	0,91	0,91	26,5	38,73	39,5
1000	0,94	0,94	26,51	38,75	39,6
1100	0,97	0,98	26,48	38,85	39,6
1200	1	1,01	26,48	38,8	39,62
1300	1,02	1,04	26,49	38,9	39,69
1400	1,05	1,06	26,48	38,94	39,63
1500	1,07	1,09	26,51	38,99	39,75
1600	1,09	1,11	26,5	38,96	39,76
1700	1,11	1,14	26,47	39,05	39,71
1800	1,13	1,16	26,46	39,11	39,78
1900	1,14	1,19	26,49	39,06	39,76
2000	1,16	1,21	26,51	39,16	39,78
2100	1,17	1,23	26,49	39,16	39,8
2200	1,19	1,25	26,5	39,22	39,93
2300	1,2	1,27	26,48	39,22	39,83
2400	1,22	1,29	26,51	39,27	39,95
2500	1,23	1,31	26,52	39,25	39,91
2600	1,24	1,33	26,47	39,34	40
2700	1,26	1,34	26,48	39,38	39,98
2800	1,27	1,36	26,48	39,4	40,02
2900	1,28	1,38	26,6	39,47	39,97
3000	1,29	1,39	26,48	39,47	40,08
3100	1,3	1,41	26,5	39,48	40,12
3200	1,31	1,43	26,5	39,45	40,02
3300	1,32	1,44	26,42	39,52	40,13
3400	1,33	1,46	26,52	39,56	40,08
3500	1,34	1,47	26,5	39,59	40,18
3600	1,35	1,49	26,52	39,62	40,16
3700	1,36	1,5	26,5	39,56	40,09
3800	1,37	1,51	26,49	39,64	40,13
3900	1,38	1,53	26,44	39,61	40,19
4000	1,39	1,54	26,5	39,73	40,22
4100	1,4	1,55	26,52	39,69	40,2
4200	1,41	1,57	26,53	39,75	40,19
4300	1,41	1,58	26,51	39,69	40,24
4400	1,42	1,59	26,45	39,71	40,19
4500	1,43	1,6	26,49	39,74	40,27
4600	1,44	1,61	26,54	39,74	40,28
4700	1,45	1,62	26,55	39,81	40,24
4800	1,46	1,63	26,54	39,79	40,31
4900	1,46	1,64	26,48	39,82	40,26
5000	1,47	1,65	26,46	39,84	40,29
5100	1,48	1,66	26,52	39,81	40,25
5200	1,49	1,67	26,5	39,85	40,36
5300	1,49	1,69	26,48	39,88	40,34
5400	1,5	1,7	26,51	39,91	40,31
5500	1,51	1,71	26,48	39,88	40,29
5600	1,52	1,72	26,43	39,89	40,29
5700	1,52	1,73	26,49	39,95	40,39
5800	1,53	1,74	26,49	39,89	40,36
5900	1,53	1,75	26,52	39,94	40,3
6000	1,54	1,76	26,52	39,95	40,34
6100	1,55	1,77	26,51	39,89	40,34
6200	1,56	1,78	26,49	39,97	40,43
6300	1,56	1,79	26,45	39,99	40,34
6400	1,57	1,8	26,49	40,01	40,42
6500	1,57	1,81	26,49	39,94	40,37

6600	1,58	1,82	26,49	40,12	40,51
6700	1,59	1,82	26,53	40,03	40,45
6800	1,59	1,84	26,49	40,04	40,4
6900	1,6	1,84	26,49	40,13	40,48
7000	1,6	1,85	26,51	40,1	40,41
7100	1,61	1,86	26,5	40,08	40,5
7200	1,61	1,87	26,5	40,03	40,45
7300	1,62	1,88	26,5	40,09	40,51
7400	1,62	1,89	26,5	40,11	40,51
7500	1,63	1,89	26,51	40,1	40,52
7600	1,63	1,91	26,41	40,1	40,5
7700	1,64	1,91	26,55	40,09	40,49
7800	1,64	1,92	26,5	40,17	40,47
7900	1,65	1,92	26,5	40,08	40,49
8000	1,65	1,94	26,49	40,18	40,51
8100	1,66	1,94	26,47	40,13	40,52
8200	1,66	1,95	26,49	40,11	40,48
8300	1,67	1,96	26,5	40,15	40,46
8400	1,67	1,97	26,47	40,14	40,54
8500	1,68	1,98	26,5	40,17	40,49
8600	1,68	1,98	26,5	40,18	40,55
8700	1,69	1,99	26,5	40,14	40,53
8800	1,69	2	26,5	40,19	40,47
8900	1,69	2,01	26,49	40,21	40,48
9000	1,7	2,01	26,45	40,16	40,51
9100	1,7	2,02	26,48	40,15	40,5
9200	1,71	2,03	26,49	40,15	40,46
9300	1,71	2,03	26,53	40,15	40,5
9400	1,71	2,04	26,5	40,22	40,57
9500	1,72	2,05	26,53	40,18	40,54
9600	1,72	2,06	26,5	40,23	40,5
9700	1,73	2,06	26,48	40,23	40,53
9800	1,73	2,07	26,51	40,26	40,6
9900	1,74	2,08	26,47	40,23	40,49
10000	1,74	2,09	26,47	40,2	40,54

Test Ended at 10000 Passes
Sample 1 Final rut depth = 1,74 mm
Sample 2 Final rut depth = 2,09 mm
Sample 1 Mean Steady State Tracking Rate = 0,05 mm/1000 Passes
Sample 2 Mean Steady State Tracking Rate = 0,09 mm/1000 Passes

Table 0.34 Samples G14-G15: Wheeltrack test results.

Wheeltracking Test Summary
Specimen Name: Gr 17 og 18 50C
Date: 28.10.2010
Test Temperature: 50
Sample 1 Thickness: 40
Sample 2 Thickness: 40

Pass No.	Rut Depth(mm) 1	Rut Depth(mm) 2	Speed (RPM)	RTD 1 Deg.C.	RTD 2 Deg.C.
0	0	0	26,5	49,24	48,71
100	0,73	0,7	26,5	49,82	49,52
200	0,99	0,95	26,6	49,74	49,41
300	1,16	1,11	26,51	49,75	49,53
400	1,29	1,24	26,48	49,64	49,5
500	1,39	1,33	26,5	49,66	49,51
600	1,48	1,42	26,5	49,65	49,52
700	1,56	1,5	26,46	49,56	49,48
800	1,62	1,56	26,52	49,57	49,57
900	1,68	1,62	26,49	49,53	49,49
1000	1,73	1,68	26,47	49,57	49,55
1100	1,77	1,73	26,49	49,43	49,52
1200	1,81	1,78	26,51	49,49	49,6
1300	1,85	1,83	26,47	49,47	49,6
1400	1,89	1,87	26,49	49,45	49,54
1500	1,93	1,91	26,5	49,46	49,65
1600	1,96	1,95	26,48	49,48	49,66
1700	1,99	1,99	26,53	49,52	49,68
1800	2,03	2,02	26,57	49,46	49,6
1900	2,05	2,06	26,48	49,55	49,71
2000	2,08	2,09	26,52	49,46	49,59
2100	2,1	2,12	26,47	49,47	49,63
2200	2,13	2,14	26,47	49,5	49,64
2300	2,15	2,17	26,51	49,49	49,65
2400	2,18	2,19	26,5	49,47	49,69
2500	2,2	2,22	26,49	49,47	49,75
2600	2,22	2,24	26,5	49,52	49,8
2700	2,24	2,26	26,54	49,49	49,77
2800	2,26	2,29	26,5	49,52	49,8
2900	2,28	2,31	26,51	49,51	49,72
3000	2,3	2,33	26,48	49,54	49,86
3100	2,31	2,35	26,49	49,51	49,77

3200	2,33	2,37	26,54	49,53	49,74
3300	2,35	2,39	26,47	49,55	49,82
3400	2,36	2,41	26,49	49,58	49,86
3500	2,38	2,43	26,44	49,52	49,87
3600	2,4	2,44	26,51	49,55	49,87
3700	2,41	2,46	26,45	49,58	49,88
3800	2,43	2,48	26,52	49,6	49,85
3900	2,44	2,5	26,47	49,52	49,84
4000	2,46	2,51	26,46	49,63	49,89
4100	2,47	2,53	26,5	49,58	49,84
4200	2,49	2,54	26,54	49,62	49,91
4300	2,5	2,56	26,52	49,58	49,92
4400	2,51	2,57	26,5	49,54	49,79
4500	2,52	2,59	26,49	49,64	49,93
4600	2,53	2,6	26,5	49,56	49,9
4700	2,55	2,61	26,52	49,58	49,88
4800	2,56	2,63	26,54	49,62	49,88
4900	2,57	2,64	26,5	49,66	49,94
5000	2,58	2,65	26,48	49,56	49,89
5100	2,59	2,67	26,49	49,56	49,91
5200	2,6	2,68	26,48	49,57	49,86
5300	2,62	2,69	26,49	49,62	49,86
5400	2,63	2,7	26,51	49,67	49,95
5500	2,64	2,71	26,48	49,62	49,83
5600	2,65	2,73	26,5	49,67	49,88
5700	2,66	2,73	26,51	49,65	49,92
5800	2,66	2,74	26,5	49,66	49,88
5900	2,68	2,75	26,49	49,57	49,88
6000	2,69	2,76	26,51	49,62	49,94
6100	2,7	2,77	26,51	49,66	49,89
6200	2,7	2,78	26,51	49,63	49,88
6300	2,73	2,79	26,52	49,6	49,87
6400	2,75	2,8	26,47	49,61	49,91
6500	2,75	2,81	26,5	49,68	49,98
6600	2,76	2,83	26,52	49,57	49,83
6700	2,77	2,83	26,49	49,64	49,94
6800	2,79	2,84	26,5	49,62	49,9
6900	2,8	2,85	26,54	49,67	49,87
7000	2,8	2,86	26,49	49,65	49,85
7100	2,81	2,87	26,48	49,62	49,92
7200	2,82	2,88	26,51	49,7	49,9
7300	2,83	2,89	26,45	49,68	49,9
7400	2,83	2,9	26,5	49,68	49,92
7500	2,84	2,91	26,53	49,65	49,86
7600	2,85	2,92	26,44	49,69	49,95
7700	2,86	2,93	26,52	49,57	49,77
7800	2,87	2,94	26,5	49,65	49,94
7900	2,88	2,95	26,5	49,68	49,86
8000	2,88	2,96	26,48	49,74	49,92
8100	2,89	2,97	26,51	49,69	49,85
8200	2,9	2,99	26,5	49,74	49,91
8300	2,91	2,99	26,49	49,63	49,83
8400	2,92	3	26,48	49,68	49,84
8500	2,93	3	26,5	49,66	49,84
8600	2,93	3,01	26,4	49,68	49,86
8700	2,94	3,02	26,5	49,71	49,86
8800	2,95	3,02	26,51	49,72	49,84
8900	2,95	3,03	26,47	49,65	49,9
9000	2,96	3,04	26,49	49,69	49,85
9100	2,97	3,05	26,51	49,69	49,88
9200	2,97	3,06	26,52	49,7	49,84
9300	2,98	3,06	26,53	49,62	49,86
9400	2,98	3,08	26,49	49,66	49,88
9500	2,99	3,09	26,45	49,68	49,83
9600	3	3,1	26,52	49,66	49,91
9700	3	3,11	26,5	49,7	49,94
9800	3,01	3,12	26,46	49,7	49,89
9900	3,02	3,13	26,51	49,71	49,97
10000	3,02	3,14	26,47	49,62	49,87

Test Ended at 10000 Passes
Sample 1 Final rut depth = 3,02 mm
Sample 2 Final rut depth = 3,14 mm
Sample 1 Mean Steady State Tracking Rate = 0,09 mm/1000 Passes
Sample 2 Mean Steady State Tracking Rate = 0,10 mm/1000 Passes

Table 0.35 Samples G17-G18: Wheeltrack test results.

Wheeltracking Test Summary
Specimen Name: Gr 19 o g 20 50C
Date: 29.10.2010
Test Temperature: 50
Sample 1 Thickness: 40

Sample 2 Thickness: 40

Pass No.	Rut Depth(mm) 1	Rut Depth(mm) 2	Speed (RPM)	RTD 1 Deg.C.	RTD 2 Deg.C.
0	0	0	26,5	48,34	49,05
100	1,12	1,22	26,51	48,89	49,58
200	1,58	1,67	26,47	48,91	49,61
300	1,89	2	26,51	48,97	49,56
400	2,16	2,27	26,49	48,96	49,61
500	2,4	2,5	26,49	48,99	49,58
600	2,6	2,7	26,51	48,97	49,53
700	2,79	2,89	26,51	48,98	49,65
800	2,95	3,07	26,47	49,02	49,57
900	3,11	3,23	26,49	48,99	49,62
1000	3,27	3,4	26,52	49,05	49,55
1100	3,4	3,55	26,49	49,06	49,68
1200	3,54	3,69	26,53	49	49,61
1300	3,66	3,83	26,5	49,15	49,65
1400	3,78	3,96	26,48	49	49,54
1500	3,89	4,09	26,49	49,19	49,65
1600	4	4,22	26,51	49,17	49,66
1700	4,1	4,34	26,5	49,16	49,63
1800	4,21	4,46	26,52	49,1	49,66
1900	4,33	4,58	26,53	49,15	49,69
2000	4,43	4,7	26,44	49,1	49,64
2100	4,53	4,82	26,49	49,19	49,72
2200	4,63	4,94	26,51	49,15	49,66
2300	4,74	5,04	26,49	49,23	49,73
2400	4,83	5,16	26,55	49,28	49,68
2500	4,93	5,26	26,53	49,28	49,66
2600	5,03	5,35	26,52	49,27	49,66
2700	5,11	5,46	26,5	49,23	49,62
2800	5,21	5,56	26,46	49,29	49,75
2900	5,29	5,66	26,48	49,3	49,72
3000	5,38	5,76	26,47	49,38	49,77
3100	5,46	5,86	26,5	49,29	49,75
3200	5,55	5,96	26,58	49,39	49,77
3300	5,64	6,06	26,57	49,3	49,64
3400	5,72	6,15	26,55	49,42	49,8
3500	5,81	6,24	26,48	49,36	49,77
3600	5,89	6,33	26,48	49,41	49,71
3700	5,97	6,42	26,51	49,35	49,7
3800	6,05	6,51	26,44	49,45	49,71
3900	6,13	6,6	26,49	49,41	49,7
4000	6,21	6,69	26,81	49,4	49,68
4100	6,29	6,79	26,49	49,47	49,81
4200	6,37	6,88	26,49	49,39	49,66
4300	6,45	6,96	26,49	49,45	49,69
4400	6,53	7,04	26,48	49,46	49,69
4500	6,61	7,12	26,48	49,44	49,71
4600	6,68	7,2	26,56	49,44	49,75
4700	6,75	7,28	26,48	49,42	49,71
4800	6,82	7,36	26,49	49,43	49,71
4900	6,89	7,44	26,54	49,44	49,75
5000	6,97	7,52	26,52	49,46	49,72
5100	7,04	7,59	26,5	49,44	49,74
5200	7,1	7,67	26,5	49,49	49,69
5300	7,17	7,75	26,49	49,49	49,8
5400	7,23	7,82	26,55	49,49	49,75
5500	7,31	7,89	26,4	49,62	49,78
5600	7,37	7,96	26,51	49,58	49,68
5700	7,43	8,04	26,47	49,57	49,71
5800	7,49	8,11	26,53	49,57	49,67
5900	7,56	8,18	26,49	49,57	49,76
6000	7,62	8,25	26,5	49,57	49,71
6100	7,68	8,32	26,51	49,56	49,74
6200	7,74	8,38	26,49	49,67	49,77
6300	7,81	8,44	26,48	49,58	49,69
6400	7,88	8,51	26,51	49,55	49,78
6500	7,93	8,58	26,52	49,53	49,68
6600	8	8,64	26,5	49,58	49,78
6700	8,06	8,7	26,55	49,57	49,74
6800	8,12	8,76	26,5	49,62	49,72
6900	8,18	8,82	26,48	49,56	49,67
7000	8,24	8,87	26,53	49,64	49,81
7100	8,29	8,93	26,49	49,6	49,79
7200	8,35	8,99	26,48	49,61	49,79
7300	8,41	9,04	26,5	49,66	49,79
7400	8,47	9,1	26,5	49,62	49,81
7500	8,53	9,14	26,52	49,73	49,8
7600	8,59	9,2	26,51	49,59	49,71
7700	8,65	9,25	26,49	49,65	49,78
7800	8,71	9,3	26,48	49,63	49,78
7900	8,77	9,35	26,48	49,68	49,85
8000	8,82	9,39	26,45	49,65	49,81
8100	8,87	9,44	26,5	49,67	49,83
8200	8,93	9,49	26,53	49,72	49,8
8300	8,98	9,53	26,51	49,71	49,73
8400	9,04	9,58	26,5	49,68	49,76

8500	9,09	9,62	26,49	49,67	49,78
8600	9,14	9,67	26,51	49,7	49,78
8700	9,19	9,71	26,48	49,65	49,77
8800	9,25	9,75	26,5	49,69	49,79
8900	9,3	9,79	26,5	49,71	49,73
9000	9,36	9,83	26,48	49,69	49,8
9100	9,42	9,87	26,51	49,73	49,77
9200	9,47	9,91	26,5	49,75	49,77
9300	9,52	9,95	26,49	49,76	49,77
9400	9,57	9,99	26,49	49,71	49,73
9500	9,62	10,02	26,49	49,73	49,83
9600	9,67	10,05	26,5	49,8	49,8
9700	9,72	10,1	26,5	49,79	49,75
9800	9,76	10,13	26,5	49,78	49,78
9900	9,82	10,16	26,49	49,78	49,81
10000	9,87	10,2	26,5	49,77	49,74

Test Ended at 10000 Passes
Sample 1 Final rut depth = 9,87 mm
Sample 2 Final rut depth = 10,20 mm
Sample 1 Mean Steady State Tracking Rate = 0,58 mm/1000 Passes
Sample 2 Mean Steady State Tracking Rate = 0,54 mm/1000 Passes

Table 0.36 Samples G19-G20: Wheeltrack test results.

Wheeltracking Test Summary
Specimen Name: Gr 21 og 22 50C
Date: 01.11.2010
Test Temperature: 50
Sample 1 Thickness: 40
Sample 2 Thickness: 40

Pass No.	Rut Depth(mm) 1	Rut Depth(mm) 2	Speed (RPM)	RTD 1 Deg.C.	RTD 2 Deg.C.
0	0	0	26,5	47,78	48,75
100	0,99	1,37	26,49	47,87	48,74
200	1,35	1,96	26,52	47,97	48,78
300	1,59	2,38	26,53	48	48,75
400	1,81	2,72	26,5	48,11	48,92
500	1,99	3,02	26,52	48,05	48,8
600	2,16	3,28	26,51	48,15	49
700	2,31	3,5	26,49	48,17	48,96
800	2,45	3,7	25,94	48,3	49
900	2,57	3,91	26,65	48,29	48,96
1000	2,69	4,1	26,49	48,36	48,96
1100	2,81	4,29	26,49	48,35	49,02
1200	2,92	4,48	26,5	48,34	49,08
1300	3,02	4,65	26,47	48,45	49,08
1400	3,12	4,81	26,51	48,39	49,04
1500	3,22	4,95	26,55	48,47	49,13
1600	3,31	5,1	26,47	48,46	49,08
1700	3,41	5,24	26,49	48,6	49,23
1800	3,5	5,36	26,51	48,52	49,22
1900	3,58	5,49	26,47	48,61	49,18
2000	3,66	5,61	26,54	48,61	49,18
2100	3,75	5,73	26,49	48,63	49,27
2200	3,82	5,84	26,56	48,71	49,3
2300	3,9	5,95	26,53	48,64	49,19
2400	3,97	6,06	26,47	48,68	49,28
2500	4,04	6,16	26,54	48,7	49,22
2600	4,11	6,27	26,5	48,74	49,32
2700	4,18	6,37	26,51	48,74	49,29
2800	4,25	6,47	26,46	48,87	49,37
2900	4,31	6,57	26,49	48,79	49,26
3000	4,38	6,66	26,48	48,81	49,32
3100	4,44	6,76	26,46	48,9	49,41
3200	4,5	6,84	26,49	48,87	49,33
3300	4,56	6,93	26,52	48,92	49,44
3400	4,62	7	26,49	48,9	49,43
3500	4,68	7,08	26,54	48,98	49,39
3600	4,73	7,16	26,53	48,95	49,43
3700	4,79	7,23	26,52	49,05	49,48
3800	4,85	7,31	26,51	49,01	49,46
3900	4,91	7,38	26,48	49	49,42
4000	4,96	7,45	26,51	49,03	49,5
4100	5,02	7,51	26,48	49	49,45
4200	5,07	7,59	26,51	49,09	49,53
4300	5,13	7,66	26,44	49,05	49,51
4400	5,18	7,72	26,46	49,15	49,55
4500	5,24	7,78	26,52	49,09	49,45
4600	5,29	7,85	26,48	49,15	49,49
4700	5,35	7,91	26,51	49,12	49,53
4800	5,4	7,97	26,49	49,18	49,48
4900	5,45	8,03	26,52	49,21	49,53
5000	5,5	8,09	26,45	49,12	49,48

5100	5,55	8,15	26,53	49,19	49,53
5200	5,6	8,21	26,53	49,21	49,5
5300	5,65	8,27	26,44	49,26	49,56
5400	5,68	8,35	26,52	49,17	49,53
5500	5,73	8,41	26,44	49,21	49,62
5600	5,77	8,47	26,49	49,18	49,51
5700	5,82	8,54	26,5	49,17	49,51
5800	5,87	8,6	26,52	49,27	49,63
5900	5,91	8,65	26,48	49,28	49,57
6000	5,96	8,71	26,49	49,27	49,68
6100	6	8,76	26,49	49,26	49,53
6200	6,04	8,81	26,49	49,31	49,58
6300	6,09	8,87	26,5	49,26	49,53
6400	6,13	8,92	26,52	49,29	49,65
6500	6,17	8,96	26,51	49,36	49,65
6600	6,22	9,01	26,51	49,24	49,56
6700	6,26	9,06	26,52	49,31	49,59
6800	6,3	9,1	26,52	49,27	49,56
6900	6,35	9,15	26,59	49,44	49,7
7000	6,38	9,19	26,53	49,36	49,59
7100	6,42	9,24	26,52	49,36	49,65
7200	6,46	9,28	26,51	49,43	49,68
7300	6,5	9,33	26,5	49,35	49,67
7400	6,54	9,37	26,51	49,4	49,72
7500	6,58	9,42	26,53	49,4	49,67
7600	6,62	9,46	26,5	49,37	49,64
7700	6,65	9,5	26,5	49,39	49,68
7800	6,69	9,55	26,47	49,44	49,63
7900	6,73	9,59	26,54	49,39	49,66
8000	6,77	9,64	26,47	49,47	49,65
8100	6,81	9,68	26,51	49,45	49,62
8200	6,85	9,72	26,46	49,48	49,65
8300	6,88	9,76	26,46	49,55	49,72
8400	6,92	9,81	26,5	49,47	49,71
8500	6,96	9,85	26,36	49,59	49,78
8600	7	9,89	26,48	49,48	49,66
8700	7,04	9,93	26,49	49,62	49,83
8800	7,08	9,97	26,49	49,52	49,79
8900	7,11	10,02	26,48	49,62	49,76
9000	7,15	10,06	26,49	49,6	49,77
9100	7,19	10,09	26,52	49,61	49,77
9200	7,22	10,13	26,57	49,52	49,8
9300	7,26	10,16	26,48	49,54	49,81
9400	7,3	10,19	26,9	49,59	49,73
9500	7,33	10,23	26,47	49,57	49,75
9600	7,37	10,26	26,5	49,62	49,82
9700	7,4	10,29	26,51	49,57	49,75
9800	7,44	10,33	26,52	49,52	49,73
9900	7,48	10,36	26,49	49,59	49,77
10000	7,51	10,4	26,48	49,52	49,77

Test Ended at 10000 Passes
Sample 1 Final rut depth = 7,51 mm
Sample 2 Final rut depth = 10,40 mm
Sample 1 Mean Steady State Tracking Rate = 0,40 mm/1000 Passes
Sample 2 Mean Steady State Tracking Rate = 0,46 mm/1000 Passes

Table 0.37 Samples G21-G22: Wheeltrack test results.

Wheeltracking Test Summary
Specimen Name: Gr 23 og 24 50C
Date: 01.11.2010
Test Temperature: 50
Sample 1 Thickness: 40
Sample 2 Thickness: 40

Pass No.	Rut Depth(mm) 1	Rut Depth(mm) 2	Speed (RPM)	RTD 1 Deg.C.	RTD 2 Deg.C.
0	0	0	26,5	48,68	49,26
100	1,87	1,38	26,48	50,02	49,77
200	2,58	1,9	26,48	49,98	49,64
300	3,08	2,27	26,48	50	49,73
400	3,47	2,56	26,46	49,85	49,63
500	3,81	2,83	26,49	49,87	49,7
600	4,11	3,06	26,53	49,75	49,6
700	4,38	3,27	26,49	49,83	49,59
800	4,62	3,48	26,51	49,8	49,67
900	4,86	3,67	26,5	49,77	49,6
1000	5,1	3,85	26,49	49,8	49,68
1100	5,32	4,03	26,5	49,69	49,67
1200	5,53	4,19	26,5	49,78	49,74
1300	5,73	4,34	26,49	49,73	49,68
1400	5,91	4,48	26,48	49,73	49,73
1500	6,09	4,61	26,54	49,69	49,7
1600	6,26	4,74	26,48	49,72	49,65

1700	6,41	4,86	26,48	49,64	49,72
1800	6,56	4,98	26,53	49,73	49,68
1900	6,7	5,1	26,5	49,73	49,73
2000	6,83	5,21	26,52	49,64	49,69
2100	6,96	5,32	26,49	49,73	49,75
2200	7,09	5,43	26,47	49,66	49,64
2300	7,22	5,53	26,51	49,72	49,68
2400	7,35	5,63	26,53	49,7	49,68
2500	7,47	5,72	26,49	49,72	49,77
2600	7,6	5,81	26,48	49,7	49,68
2700	7,71	5,92	26,52	49,71	49,69
2800	7,82	6,02	26,47	49,64	49,64
2900	7,94	6,11	26,5	49,7	49,72
3000	8,04	6,2	26,53	49,62	49,72
3100	8,17	6,3	26,49	49,74	49,77
3200	8,29	6,39	26,49	49,63	49,64
3300	8,4	6,48	26,5	49,7	49,77
3400	8,51	6,57	26,49	49,71	49,76
3500	8,62	6,66	26,5	49,71	49,74
3600	8,72	6,75	26,5	49,67	49,72
3700	8,83	6,84	26,51	49,7	49,79
3800	8,94	6,93	26,5	49,77	49,71
3900	9,05	7,01	26,52	49,71	49,74
4000	9,17	7,09	26,51	49,82	49,77
4100	9,28	7,17	26,48	49,76	49,68
4200	9,39	7,24	26,49	49,8	49,72
4300	9,5	7,33	26,5	49,77	49,75
4400	9,6	7,41	26,49	49,76	49,7
4500	9,7	7,49	26,52	49,83	49,77
4600	9,8	7,56	26,51	49,78	49,77
4700	9,89	7,62	26,46	49,8	49,72
4800	9,98	7,69	26,53	49,74	49,67
4900	10,07	7,76	26,51	49,83	49,81
5000	10,16	7,82	26,46	49,73	49,74
5100	10,26	7,89	26,47	49,83	49,83
5200	10,35	7,96	26,5	49,75	49,68
5300	10,44	8,02	26,48	49,87	49,76
5400	10,52	8,09	26,53	49,78	49,78
5500	10,61	8,15	26,49	49,84	49,74
5600	10,69	8,2	26,51	49,78	49,73
5700	10,78	8,26	26,5	49,83	49,74
5800	10,86	8,32	26,51	49,83	49,73
5900	10,93	8,37	26,49	49,79	49,78
6000	11,01	8,43	26,5	49,87	49,73
6100	11,1	8,48	26,47	49,83	49,81
6200	11,18	8,54	26,48	49,86	49,75
6300	11,27	8,6	26,5	49,78	49,69
6400	11,35	8,65	26,5	49,81	49,75
6500	11,42	8,71	26,48	49,85	49,74
6600	11,5	8,77	26,5	49,89	49,81
6700	11,58	8,83	26,59	49,84	49,81
6800	11,65	8,88	26,47	49,88	49,82
6900	11,72	8,93	26,54	49,93	49,79
7000	11,8	8,98	26,54	49,82	49,72
7100	11,87	9,03	26,48	49,89	49,75
7200	11,93	9,07	26,61	49,84	49,78
7300	12,01	9,12	26,51	49,92	49,74
7400	12,08	9,16	26,47	49,88	49,73
7500	12,15	9,21	26,5	49,87	49,73
7600	12,21	9,25	26,49	49,88	49,73
7700	12,28	9,29	26,53	49,93	49,78
7800	12,35	9,33	26,53	49,91	49,83
7900	12,43	9,37	26,49	49,91	49,83
8000	12,5	9,41	26,49	49,93	49,83
8100	12,57	9,45	26,49	49,92	49,78
8200	12,66	9,49	26,49	49,96	49,76
8300	12,73	9,53	26,49	49,93	49,75
8400	12,8	9,57	26,51	49,99	49,87
8500	12,87	9,61	26,53	49,96	49,82
8600	12,94	9,65	26,53	49,98	49,77
8700	13,03	9,69	26,52	49,87	49,77
8800	13,1	9,74	26,49	49,97	49,84
8900	13,18	9,77	26,48	49,92	49,8
9000	13,25	9,81	26,47	49,93	49,79
9100	13,32	9,86	26,52	49,99	49,76
9200	13,41	9,9	26,52	49,96	49,74
9300	13,5	9,94	26,47	49,97	49,85
9400	13,58	9,99	26,51	50,01	49,8
9500	13,65	10,04	26,51	49,95	49,84
9600	13,73	10,09	26,5	49,93	49,75
9700	13,8	10,13	26,51	50,02	49,79
9800	13,87	10,18	26,47	49,92	49,74
9900	13,94	10,23	26,48	50	49,76
10000	14	10,27	26,5	50,02	49,79

Test Ended at 10000 Passes
Sample 1 Final rut depth = 14,00 mm

Sample 2 Final rut depth = 10,27 mm
Sample 1 Mean Steady State Tracking Rate = 0,77 mm/1000 Passes
Sample 2 Mean Steady State Tracking Rate = 0,49 mm/1000 Passes

Table 0.38 Samples G23-G24: Wheeltrack test results.

Wheeltracking Test Summary
Specimen Name: Gr 25 og 26 50C
Date: 02.11.2010
Test Temperature: 50
Sample 1 Thickness: 40
Sample 2 Thickness: 40

Pass No.	Rut Depth(mm) 1	Rut Depth(mm) 2	Speed (RPM)	RTD 1 Deg.C.	RTD 2 Deg.C.
0	0	0	26,5	47,64	48
100	0,32	0,38	26,5	49	49,75
200	0,43	0,52	26,5	48,98	49,68
300	0,51	0,62	26,51	49,12	49,82
400	0,58	0,69	26,48	49,05	49,7
500	0,63	0,75	26,51	49,17	49,84
600	0,67	0,8	26,51	49,1	49,77
700	0,71	0,83	26,49	49,2	49,83
800	0,74	0,87	26,53	49,1	49,77
900	0,76	0,9	26,49	49,12	49,73
1000	0,79	0,93	26,44	49,16	49,77
1100	0,81	0,96	26,6	49,14	49,81
1200	0,83	0,98	26,5	49,21	49,85
1300	0,85	1	26,52	49,11	49,78
1400	0,87	1,03	26,48	49,16	49,85
1500	0,89	1,04	26,58	49,12	49,81
1600	0,91	1,06	26,5	49,21	49,76
1700	0,92	1,08	26,49	49,19	49,73
1800	0,93	1,1	26,52	49,22	49,84
1900	0,95	1,11	26,52	49,24	49,82
2000	0,96	1,13	26,5	49,19	49,85
2100	0,97	1,14	26,51	49,17	49,78
2200	0,98	1,15	26,5	49,15	49,76
2300	0,99	1,17	26,5	49,26	49,89
2400	1	1,18	26,5	49,14	49,71
2500	1,02	1,19	26,49	49,28	49,82
2600	1,03	1,21	26,51	49,23	49,83
2700	1,03	1,22	26,48	49,23	49,8
2800	1,04	1,23	26,51	49,24	49,77
2900	1,05	1,24	26,51	49,27	49,81
3000	1,06	1,25	26,51	49,22	49,79
3100	1,07	1,26	26,53	49,24	49,75
3200	1,08	1,27	26,51	49,33	49,89
3300	1,09	1,27	26,47	49,2	49,75
3400	1,1	1,28	26,57	49,33	49,96
3500	1,11	1,29	26,49	49,21	49,78
3600	1,12	1,3	26,5	49,29	49,89
3700	1,12	1,3	26,51	49,29	49,78
3800	1,13	1,31	26,5	49,29	49,83
3900	1,13	1,32	26,5	49,28	49,78
4000	1,14	1,33	26,48	49,28	49,88
4100	1,15	1,34	26,52	49,31	49,89
4200	1,16	1,34	26,45	49,28	49,83
4300	1,16	1,35	26,53	49,31	49,76
4400	1,17	1,36	26,51	49,3	49,81
4500	1,18	1,36	26,47	49,28	49,83
4600	1,18	1,36	26,52	49,33	49,8
4700	1,19	1,37	26,5	49,36	49,85
4800	1,2	1,38	26,45	49,31	49,79
4900	1,2	1,38	26,49	49,37	49,89
5000	1,21	1,39	26,45	49,26	49,86
5100	1,21	1,39	26,49	49,36	49,84
5200	1,21	1,4	26,51	49,26	49,71
5300	1,22	1,4	26,47	49,37	49,83
5400	1,22	1,41	26,47	49,32	49,8
5500	1,24	1,41	26,46	49,31	49,86
5600	1,24	1,42	26,48	49,32	49,77
5700	1,24	1,42	26,53	49,37	49,85
5800	1,24	1,43	26,54	49,3	49,84
5900	1,25	1,43	26,49	49,3	49,83
6000	1,26	1,44	26,5	49,32	49,9
6100	1,26	1,44	26,5	49,3	49,79
6200	1,26	1,45	26,56	49,39	49,96
6300	1,26	1,46	26,49	49,32	49,78
6400	1,27	1,46	26,5	49,42	49,91
6500	1,27	1,47	26,51	49,28	49,84
6600	1,27	1,47	26,5	49,36	49,85
6700	1,28	1,47	26,51	49,24	49,79
6800	1,28	1,48	26,49	49,37	49,84

6900	1,29	1,48	26,48	49,31	49,78
7000	1,29	1,49	26,5	49,33	49,86
7100	1,29	1,49	26,48	49,38	49,86
7200	1,3	1,49	26,48	49,29	49,74
7300	1,3	1,5	26,49	49,35	49,81
7400	1,3	1,5	26,59	49,37	49,79
7500	1,31	1,51	26,5	49,37	49,88
7600	1,31	1,51	26,49	49,31	49,76
7700	1,31	1,52	26,5	49,35	49,79
7800	1,32	1,52	26,48	49,37	49,83
7900	1,32	1,52	26,49	49,37	49,81
8000	1,33	1,53	26,51	49,35	49,81
8100	1,33	1,53	26,51	49,34	49,86
8200	1,33	1,53	26,5	49,39	49,85
8300	1,34	1,54	26,52	49,3	49,85
8400	1,34	1,54	26,51	49,38	49,92
8500	1,34	1,54	26,51	49,27	49,78
8600	1,35	1,55	26,49	49,42	49,88
8700	1,35	1,55	26,48	49,37	49,8
8800	1,35	1,55	26,5	49,44	49,88
8900	1,36	1,56	26,54	49,31	49,85
9000	1,36	1,56	26,51	49,36	49,84
9100	1,36	1,56	26,53	49,31	49,73
9200	1,37	1,57	26,5	49,4	49,86
9300	1,37	1,57	26,46	49,44	49,9
9400	1,37	1,57	26,49	49,41	49,91
9500	1,38	1,57	26,52	49,4	49,92
9600	1,38	1,58	26,51	49,4	49,93
9700	1,38	1,58	26,58	49,41	49,96
9800	1,38	1,58	26,5	49,33	49,83
9900	1,39	1,59	26,5	49,44	50
10000	1,39	1,59	26,5	49,37	49,81

Test Ended at 10000 Passes
Sample 1 Final rut depth = 1,39 mm
Sample 2 Final rut depth = 1,59 mm
Sample 1 Mean Steady State Tracking Rate = 0,04 mm/1000 Passes
Sample 2 Mean Steady State Tracking Rate = 0,04 mm/1000 Passes

Table 0.39 Samples G25-G26: Wheeltrack test results.

Wheeltracking Test Summary
Specimen Name: Gr 27 og 28 60C
Date: 03.11.2010
Test Temperature: 50
Sample 1 Thickness: 40
Sample 2 Thickness: 40

Pass No.	Rut Depth(mm) 1	Rut Depth(mm) 2	Speed (RPM)	RTD 1 Deg.C.	RTD 2 Deg.C.
0	0	0	26,5	54,67	56,84
100	0,55	0,57	26,51	57,99	58,56
200	0,72	0,75	26,48	58,12	58,54
300	0,83	0,87	26,5	58,12	58,57
400	0,9	0,95	26,55	58,09	58,45
500	0,97	1,01	26,47	58,29	58,66
600	1,03	1,07	26,53	58,18	58,54
700	1,08	1,13	26,49	58,26	58,62
800	1,12	1,17	26,5	58,15	58,6
900	1,16	1,22	26,52	58,32	58,64
1000	1,19	1,26	26,52	58,18	58,6
1100	1,22	1,29	26,48	58,29	58,62
1200	1,25	1,33	26,5	58,11	58,47
1300	1,29	1,36	26,53	58,28	58,67
1400	1,32	1,38	26,51	58,25	58,55
1500	1,34	1,41	26,48	58,29	58,7
1600	1,36	1,43	26,49	58,28	58,63
1700	1,38	1,45	26,52	58,27	58,53
1800	1,4	1,48	26,51	58,22	58,65
1900	1,42	1,49	26,52	58,26	58,58
2000	1,43	1,52	26,5	58,35	58,68
2100	1,45	1,53	26,51	58,29	58,64
2200	1,46	1,55	26,51	58,29	58,57
2300	1,48	1,57	26,44	58,33	58,67
2400	1,5	1,59	26,43	58,35	58,62
2500	1,51	1,6	26,54	58,29	58,59
2600	1,53	1,62	26,51	58,36	58,68
2700	1,54	1,63	26,49	58,32	58,62
2800	1,55	1,64	26,49	58,3	58,64
2900	1,57	1,66	26,5	58,32	58,58
3000	1,58	1,67	26,5	58,41	58,68
3100	1,59	1,69	26,52	58,37	58,68
3200	1,61	1,69	26,52	58,43	58,66
3300	1,63	1,71	26,45	58,37	58,62
3400	1,64	1,72	26,5	58,35	58,74

3500	1,65	1,73	26,5	58,41	58,64
3600	1,65	1,74	26,52	58,35	58,67
3700	1,66	1,76	26,5	58,39	58,67
3800	1,67	1,77	26,46	58,43	58,69
3900	1,68	1,78	26,38	58,38	58,62
4000	1,69	1,79	26,48	58,33	58,61
4100	1,7	1,8	26,46	58,45	58,72
4200	1,71	1,81	26,51	58,26	58,6
4300	1,71	1,82	26,52	58,47	58,72
4400	1,72	1,83	26,53	58,36	58,58
4500	1,73	1,84	26,56	58,51	58,71
4600	1,74	1,85	26,54	58,41	58,58
4700	1,75	1,86	26,51	58,49	58,79
4800	1,76	1,87	26,53	58,32	58,57
4900	1,76	1,88	26,5	58,52	58,73
5000	1,77	1,88	26,56	58,36	58,68
5100	1,78	1,89	26,52	58,57	58,8
5200	1,78	1,9	26,51	58,29	58,58
5300	1,79	1,91	26,52	58,49	58,74
5400	1,8	1,92	26,47	58,27	58,61
5500	1,8	1,93	26,5	58,49	58,75
5600	1,81	1,93	26,47	58,36	58,58
5700	1,82	1,94	26,48	58,51	58,82
5800	1,82	1,95	26,51	58,41	58,71
5900	1,83	1,96	26,5	58,49	58,85
6000	1,83	1,97	26,46	58,37	58,68
6100	1,84	1,98	26,27	58,42	58,71
6200	1,85	1,98	26,48	58,4	58,71
6300	1,86	1,99	26,46	58,45	58,69
6400	1,86	2	26,52	58,37	58,73
6500	1,86	2	26,51	58,46	58,73
6600	1,87	2,01	26,5	58,47	58,71
6700	1,88	2,02	26,47	58,52	58,78
6800	1,88	2,02	26,55	58,36	58,65
6900	1,89	2,03	26,49	58,47	58,68
7000	1,89	2,04	26,51	58,38	58,71
7100	1,9	2,04	26,53	58,54	58,74
7200	1,91	2,05	26,49	58,45	58,72
7300	1,91	2,06	26,47	58,45	58,77
7400	1,92	2,06	26,54	58,49	58,71
7500	1,92	2,07	26,48	58,44	58,74
7600	1,93	2,07	26,49	58,5	58,78
7700	1,93	2,08	26,5	58,47	58,68
7800	1,94	2,09	26,51	58,53	58,74
7900	1,94	2,09	26,5	58,48	58,72
8000	1,95	2,1	26,5	58,49	58,79
8100	1,95	2,11	26,51	58,5	58,77
8200	1,96	2,11	26,46	58,5	58,76
8300	1,96	2,12	26,53	58,39	58,62
8400	1,97	2,12	26,5	58,56	58,88
8500	1,97	2,13	26,53	58,38	58,71
8600	1,98	2,13	26,46	58,47	58,75
8700	1,98	2,14	26,46	58,47	58,71
8800	1,99	2,14	26,46	58,6	58,8
8900	1,99	2,15	26,55	58,44	58,72
9000	2	2,16	26,52	58,52	58,83
9100	2	2,16	26,45	58,38	58,71
9200	2,01	2,17	26,51	58,59	58,85
9300	2,01	2,17	26,45	58,42	58,71
9400	2,02	2,18	26,49	58,54	58,87
9500	2,02	2,18	26,53	58,51	58,73
9600	2,02	2,19	26,51	58,52	58,77
9700	2,03	2,19	26,47	58,41	58,71
9800	2,03	2,2	26,58	58,57	58,77
9900	2,04	2,2	26,42	58,52	58,68
10000	2,05	2,21	26,5	58,58	58,81

Test Ended at 10000 Passes
Sample 1 Final rut depth = 2,05 mm
Sample 2 Final rut depth = 2,21 mm
Sample 1 Mean Steady State Tracking Rate = 0,06 mm/1000 Passes
Sample 2 Mean Steady State Tracking Rate = 0,06 mm/1000 Passes

Table 0.40 SAmples G27-G28: Wheeltrack test results.

Wheeltracking Test Summary
Specimen Name: Gr29 og 30 50C
Date: 04.11.2010
Test Temperature: 50
Sample 1 Thickness: 40
Sample 2 Thickness: 40

Pass No.	Rut Depth(mm) 1	Rut Depth(mm) 2	Speed (RPM)	RTD 1 Deg.C.	RTD 2 Deg.C.
0	0	0	26,5	47,9	48,6

100	0,31	1,35	26,52	48,66	49,21
200	0,42	1,83	26,48	48,75	49,22
300	0,49	2,13	26,45	48,75	49,3
400	0,54	2,36	26,52	48,71	49,19
500	0,6	2,56	26,52	48,79	49,23
600	0,64	2,72	26,53	48,79	49,19
700	0,67	2,87	26,51	48,84	49,26
800	0,7	3	26,47	48,79	49,24
900	0,72	3,13	26,51	48,85	49,28
1000	0,75	3,23	26,55	48,8	49,28
1100	0,77	3,34	26,5	48,83	49,31
1200	0,79	3,44	26,49	48,9	49,27
1300	0,81	3,53	26,52	48,88	49,33
1400	0,83	3,62	26,44	48,88	49,28
1500	0,85	3,7	26,54	48,85	49,23
1600	0,86	3,79	26,54	48,95	49,39
1700	0,88	3,86	26,49	48,84	49,25
1800	0,89	3,94	26,47	48,95	49,29
1900	0,9	4,01	26,51	48,96	49,35
2000	0,92	4,07	26,46	48,96	49,31
2100	0,93	4,13	26,55	48,97	49,36
2200	0,95	4,19	26,52	48,99	49,38
2300	0,96	4,26	26,54	48,98	49,31
2400	0,97	4,31	26,5	49,01	49,33
2500	0,98	4,36	26,51	49,08	49,35
2600	1,01	4,42	26,5	49,05	49,34
2700	1,02	4,47	26,54	49,07	49,34
2800	1,03	4,53	26,5	49,06	49,33
2900	1,04	4,58	26,49	49,09	49,39
3000	1,05	4,64	26,37	49,01	49,39
3100	1,05	4,69	26,49	49,1	49,39
3200	1,06	4,74	26,47	49,07	49,39
3300	1,06	4,79	26,51	49,15	49,43
3400	1,07	4,84	26,49	49,15	49,39
3500	1,08	4,89	26,49	49,07	49,38
3600	1,09	4,94	26,51	49,15	49,41
3700	1,1	4,98	26,52	49,15	49,39
3800	1,1	5,02	26,46	49,15	49,39
3900	1,11	5,07	26,51	49,14	49,41
4000	1,11	5,12	26,52	49,18	49,41
4100	1,12	5,16	26,48	49,21	49,45
4200	1,13	5,2	26,51	49,15	49,46
4300	1,14	5,24	26,51	49,21	49,53
4400	1,14	5,28	26,53	49,21	49,44
4500	1,15	5,32	26,52	49,21	49,43
4600	1,15	5,36	26,51	49,27	49,49
4700	1,16	5,39	26,46	49,22	49,43
4800	1,17	5,43	26,5	49,27	49,48
4900	1,17	5,47	26,5	49,21	49,43
5000	1,17	5,51	26,5	49,26	49,46
5100	1,18	5,54	26,51	49,25	49,46
5200	1,18	5,58	26,54	49,26	49,55
5300	1,19	5,61	26,51	49,24	49,55
5400	1,19	5,65	26,51	49,25	49,47
5500	1,2	5,69	26,59	49,24	49,51
5600	1,2	5,72	26,41	49,22	49,51
5700	1,21	5,75	26,5	49,22	49,51
5800	1,21	5,79	26,52	49,2	49,48
5900	1,22	5,82	26,57	49,27	49,5
6000	1,22	5,86	26,48	49,21	49,5
6100	1,23	5,89	26,58	49,31	49,51
6200	1,23	5,92	26,46	49,21	49,48
6300	1,23	5,95	26,43	49,3	49,47
6400	1,24	5,98	26,54	49,22	49,48
6500	1,24	6,02	26,49	49,27	49,55
6600	1,25	6,05	26,51	49,3	49,48
6700	1,26	6,08	26,57	49,28	49,45
6800	1,26	6,11	26,52	49,24	49,51
6900	1,26	6,14	26,49	49,26	49,54
7000	1,26	6,17	26,51	49,31	49,48
7100	1,27	6,2	26,47	49,25	49,48
7200	1,27	6,23	26,48	49,27	49,5
7300	1,27	6,26	26,53	49,26	49,54
7400	1,27	6,3	26,5	49,33	49,58
7500	1,28	6,32	26,5	49,3	49,54
7600	1,28	6,36	26,51	49,38	49,55
7700	1,28	6,39	26,56	49,36	49,55
7800	1,29	6,41	26,46	49,34	49,59
7900	1,29	6,44	26,53	49,28	49,53
8000	1,3	6,47	26,49	49,34	49,54
8100	1,3	6,5	26,51	49,31	49,6
8200	1,31	6,54	26,5	49,35	49,56
8300	1,31	6,56	26,49	49,33	49,62
8400	1,31	6,59	26,48	49,31	49,48
8500	1,31	6,63	26,49	49,42	49,56
8600	1,31	6,65	26,47	49,34	49,55
8700	1,31	6,68	26,5	49,36	49,54

8800	1,32	6,71	26,52	49,34	49,49
8900	1,32	6,74	26,51	49,36	49,62
9000	1,32	6,77	26,51	49,32	49,49
9100	1,33	6,8	26,49	49,36	49,6
9200	1,33	6,83	26,51	49,37	49,53
9300	1,33	6,86	26,5	49,37	49,57
9400	1,34	6,89	26,52	49,42	49,58
9500	1,34	6,92	26,48	49,31	49,54
9600	1,34	6,94	26,51	49,36	49,6
9700	1,34	6,97	26,52	49,38	49,58
9800	1,35	7	26,35	49,36	49,55
9900	1,35	7,03	26,48	49,31	49,55
10000	1,35	7,06	26,54	49,4	49,56

Test Ended at 10000 Passes
Sample 1 Final rut depth = 1,35 mm
Sample 2 Final rut depth = 7,06 mm
Sample 1 Mean Steady State Tracking Rate = 0,04 mm/1000 Passes
Sample 2 Mean Steady State Tracking Rate = 0,31 mm/1000 Passes

Table 0.41 SAmples G29-G30: Wheeltrack test results.

Wheeltracking Test Summary
Specimen Name: Gr 31 og 32 50C
Date: 04.11.2010
Test Temperature: 50
Sample 1 Thickness: 40
Sample 2 Thickness: 40

Pass No.	Rut Depth(mm) 1	Rut Depth(mm) 2	Speed (RPM)	RTD 1 Deg.C.	RTD 2 Deg.C.
0	0	0	26,5	49,47	49,45
100	0,78	0,8	26,46	49,44	49,3
200	0,99	1,02	26,49	49,39	49,41
300	1,12	1,15	26,5	49,41	49,38
400	1,23	1,26	26,51	49,37	49,33
500	1,31	1,34	26,56	49,33	49,37
600	1,38	1,41	26,5	49,38	49,39
700	1,44	1,47	26,52	49,34	49,34
800	1,49	1,52	26,52	49,29	49,4
900	1,54	1,57	26,48	49,26	49,37
1000	1,58	1,61	26,47	49,21	49,3
1100	1,63	1,65	26,5	49,29	49,37
1200	1,66	1,68	26,51	49,29	49,4
1300	1,7	1,71	26,49	49,22	49,38
1400	1,74	1,74	26,51	49,19	49,45
1500	1,75	1,77	26,49	49,2	49,35
1600	1,78	1,8	26,48	49,26	49,4
1700	1,81	1,82	26,57	49,22	49,41
1800	1,84	1,85	26,51	49,26	49,39
1900	1,87	1,88	26,51	49,19	49,46
2000	1,94	1,91	26,85	49,16	49,37
2100	1,95	1,93	26,51	49,2	49,51
2200	1,99	1,95	26,47	49,15	49,42
2300	2,01	1,97	26,49	49,21	49,49
2400	2,06	2	26,53	49,21	49,4
2500	2,07	2,02	26,46	49,2	49,41
2600	2,1	2,04	26,5	49,24	49,49
2700	2,12	2,06	26,53	49,2	49,39
2800	2,14	2,08	26,5	49,2	49,41
2900	2,15	2,1	26,51	49,11	49,42
3000	2,17	2,12	26,48	49,16	49,42
3100	2,19	2,13	26,46	49,21	49,44
3200	2,2	2,15	26,51	49,17	49,44
3300	2,22	2,16	26,54	49,16	49,48
3400	2,24	2,18	26,52	49,16	49,49
3500	2,25	2,19	26,51	49,23	49,46
3600	2,27	2,21	26,54	49,16	49,42
3700	2,28	2,23	26,49	49,19	49,41
3800	2,3	2,24	26,46	49,14	49,39
3900	2,31	2,25	26,53	49,24	49,5
4000	2,33	2,27	26,43	49,22	49,48
4100	2,34	2,28	26,47	49,25	49,49
4200	2,36	2,3	26,5	49,22	49,52
4300	2,37	2,31	26,46	49,22	49,42
4400	2,38	2,32	26,5	49,25	49,47
4500	2,39	2,34	26,52	49,21	49,44
4600	2,41	2,35	26,46	49,19	49,5
4700	2,42	2,36	26,49	49,2	49,53
4800	2,43	2,37	26,49	49,16	49,5
4900	2,44	2,38	26,48	49,19	49,42
5000	2,46	2,4	26,48	49,15	49,48
5100	2,47	2,41	26,52	49,25	49,5
5200	2,48	2,42	26,5	49,24	49,5
5300	2,49	2,43	26,46	49,22	49,42

5400	2,5	2,44	26,5	49,23	49,42
5500	2,52	2,46	26,48	49,24	49,46
5600	2,53	2,46	26,49	49,23	49,45
5700	2,54	2,48	26,51	49,17	49,44
5800	2,55	2,49	26,51	49,16	49,47
5900	2,56	2,5	26,49	49,19	49,43
6000	2,57	2,51	26,51	49,26	49,48
6100	2,58	2,52	26,51	49,25	49,48
6200	2,6	2,53	26,5	49,19	49,42
6300	2,61	2,54	26,5	49,21	49,45
6400	2,62	2,55	26,47	49,23	49,43
6500	2,63	2,56	26,49	49,25	49,43
6600	2,64	2,57	26,51	49,26	49,53
6700	2,65	2,57	26,49	49,24	49,43
6800	2,66	2,58	26,49	49,22	49,52
6900	2,67	2,59	26,5	49,18	49,45
7000	2,68	2,6	26,51	49,26	49,46
7100	2,69	2,61	26,48	49,19	49,48
7200	2,7	2,62	26,5	49,27	49,46
7300	2,71	2,62	26,5	49,2	49,5
7400	2,72	2,63	26,52	49,24	49,54
7500	2,73	2,64	26,5	49,27	49,49
7600	2,74	2,65	26,49	49,22	49,44
7700	2,75	2,66	26,51	49,28	49,46
7800	2,76	2,66	26,51	49,25	49,49
7900	2,77	2,67	26,51	49,26	49,55
8000	2,78	2,68	26,48	49,23	49,52
8100	2,79	2,69	26,51	49,27	49,56
8200	2,79	2,69	26,5	49,22	49,43
8300	2,8	2,7	26,51	49,22	49,5
8400	2,81	2,71	26,52	49,21	49,48
8500	2,82	2,72	26,49	49,26	49,56
8600	2,83	2,72	26,48	49,23	49,44
8700	2,83	2,73	26,5	49,28	49,58
8800	2,84	2,74	26,57	49,28	49,53
8900	2,85	2,75	26,49	49,26	49,59
9000	2,86	2,76	26,52	49,28	49,51
9100	2,86	2,76	26,51	49,22	49,48
9200	2,88	2,77	26,47	49,28	49,57
9300	2,88	2,78	26,52	49,19	49,46
9400	2,89	2,79	26,49	49,22	49,52
9500	2,9	2,79	26,5	49,18	49,48
9600	2,9	2,8	26,49	49,28	49,59
9700	2,91	2,81	26,52	49,28	49,54
9800	2,92	2,82	26,5	49,24	49,55
9900	2,9	2,81	26,5	49,24	49,46
10000	2,93	2,82	26,51	49,26	49,44

Test Ended at 10000 Passes
Sample 1 Final rut depth = 2,93 mm
Sample 2 Final rut depth = 2,82 mm
Sample 1 Mean Steady State Tracking Rate = 0,09 mm/1000 Passes
Sample 2 Mean Steady State Tracking Rate = 0,09 mm/1000 Passes

Table 0.42 SAmples G31-G32: Wheeltrack test results.

Wheeltracking Test Summary
Specimen Name: Gr 33 og 34 50C
Date: 05.11.2010
Test Temperature: 50
Sample 1 Thickness: 40
Sample 2 Thickness: 40

Pass No.	Rut Depth(mm) 1	Rut Depth(mm) 2	Speed (RPM)	RTD 1 Deg.C.	RTD 2 Deg.C.
0	0	0	26,5	48,17	48,56
100	0,72	0,79	26,5	48,4	49,39
200	0,93	1,03	26,55	48,44	49,29
300	1,06	1,18	26,51	48,44	49,39
400	1,17	1,29	26,46	48,43	49,28
500	1,25	1,38	26,52	48,49	49,38
600	1,32	1,46	26,51	48,46	49,36
700	1,37	1,53	26,5	48,49	49,36
800	1,43	1,59	26,51	48,44	49,44
900	1,48	1,64	26,49	48,47	49,4
1000	1,53	1,7	26,51	48,53	49,44
1100	1,57	1,75	26,51	48,4	49,29
1200	1,61	1,79	26,49	48,53	49,44
1300	1,65	1,84	26,55	48,43	49,35
1400	1,68	1,88	26,52	48,48	49,32
1500	1,72	1,92	26,51	48,45	49,3
1600	1,75	1,96	26,5	48,55	49,36
1700	1,78	2	26,46	48,49	49,32
1800	1,81	2,03	26,51	48,48	49,31
1900	1,83	2,07	26,45	48,54	49,41

2000	1,86	2,11	26,5	48,57	49,34
2100	1,88	2,14	26,48	48,5	49,36
2200	1,9	2,17	26,48	48,53	49,33
2300	1,93	2,21	26,52	48,5	49,31
2400	1,94	2,24	26,52	48,57	49,34
2500	1,97	2,26	26,47	48,61	49,36
2600	1,99	2,29	26,54	48,58	49,4
2700	2,01	2,32	26,53	48,63	49,37
2800	2,02	2,35	26,52	48,61	49,44
2900	2,04	2,37	26,49	48,63	49,35
3000	2,05	2,4	26,48	48,64	49,48
3100	2,07	2,42	26,49	48,59	49,37
3200	2,09	2,44	26,48	48,63	49,39
3300	2,12	2,47	26,5	48,68	49,4
3400	2,14	2,49	26,48	48,68	49,51
3500	2,15	2,51	26,47	48,62	49,38
3600	2,17	2,53	26,5	48,74	49,44
3700	2,18	2,55	26,5	48,74	49,47
3800	2,21	2,57	26,51	48,73	49,39
3900	2,22	2,59	26,51	48,75	49,47
4000	2,24	2,61	26,47	48,79	49,43
4100	2,25	2,63	26,5	48,71	49,47
4200	2,26	2,65	26,51	48,76	49,49
4300	2,28	2,66	26,5	48,77	49,41
4400	2,29	2,68	26,52	48,78	49,41
4500	2,31	2,7	26,48	48,81	49,48
4600	2,32	2,72	26,5	48,76	49,48
4700	2,33	2,74	26,49	48,75	49,41
4800	2,34	2,75	26,45	48,75	49,46
4900	2,35	2,76	26,49	48,82	49,5
5000	2,36	2,78	26,5	48,74	49,49
5100	2,38	2,81	26,53	48,82	49,48
5200	2,39	2,83	26,51	48,77	49,48
5300	2,4	2,85	26,53	48,83	49,47
5400	2,41	2,87	26,53	48,8	49,51
5500	2,42	2,88	26,5	48,8	49,51
5600	2,43	2,9	26,5	48,79	49,4
5700	2,45	2,92	26,47	48,75	49,43
5800	2,46	2,94	26,49	48,81	49,45
5900	2,48	2,95	26,52	48,79	49,43
6000	2,48	2,97	26,5	48,83	49,47
6100	2,5	2,99	26,47	48,76	49,48
6200	2,51	3	26,53	48,86	49,55
6300	2,53	3,02	26,5	48,84	49,46
6400	2,54	3,04	26,49	48,78	49,43
6500	2,55	3,06	26,51	48,85	49,46
6600	2,56	3,08	26,49	48,84	49,4
6700	2,57	3,1	26,47	48,91	49,52
6800	2,59	3,11	26,5	48,81	49,37
6900	2,59	3,13	26,5	48,82	49,5
7000	2,6	3,14	26,46	48,8	49,42
7100	2,61	3,16	26,49	48,84	49,54
7200	2,62	3,17	26,53	48,85	49,42
7300	2,63	3,19	26,64	48,82	49,49
7400	2,64	3,2	26,51	48,85	49,43
7500	2,65	3,21	26,51	48,82	49,51
7600	2,66	3,23	26,51	48,89	49,49
7700	2,67	3,24	26,46	48,89	49,48
7800	2,68	3,26	26,48	48,89	49,51
7900	2,69	3,27	26,48	48,86	49,42
8000	2,7	3,28	26,47	48,86	49,52
8100	2,71	3,3	26,5	48,85	49,53
8200	2,72	3,31	26,5	48,87	49,47
8300	2,73	3,32	26,48	48,82	49,42
8400	2,73	3,34	26,54	48,91	49,5
8500	2,74	3,35	26,49	48,89	49,53
8600	2,75	3,36	26,52	48,87	49,49
8700	2,76	3,38	26,5	48,96	49,51
8800	2,77	3,39	26,48	48,87	49,48
8900	2,77	3,4	26,51	48,88	49,45
9000	2,78	3,42	26,52	48,87	49,48
9100	2,79	3,43	26,5	48,89	49,56
9200	2,8	3,44	26,48	48,95	49,53
9300	2,81	3,45	26,47	48,95	49,52
9400	2,81	3,46	26,5	48,87	49,53
9500	2,82	3,47	26,49	48,87	49,55
9600	2,83	3,48	26,5	48,86	49,53
9700	2,84	3,49	26,49	48,98	49,55
9800	2,85	3,5	26,46	48,9	49,46
9900	2,85	3,52	26,51	48,96	49,54
10000	2,86	3,52	26,51	48,91	49,46

Test Ended at 10000 Passes
Sample 1 Final rut depth = 2,86 mm
Sample 2 Final rut depth = 3,52 mm
Sample 1 Mean Steady State Tracking Rate = 0,10 mm/1000 Passes
Sample 2 Mean Steady State Tracking Rate = 0,15 mm/1000 Passes

Table 0.43 SAmples G33-G34: Wheeltrack test results.

Wheeltracking Test Summary
Specimen Name: Gr 35 og 36 50C
Date: 05.11.2010
Test Temperature: 50
Sample 1 Thickness: 40
Sample 2 Thickness: 40

Pass No.	Rut Depth(mm) 1	Rut Depth(mm) 2	Speed (RPM)	RTD 1 Deg.C.	RTD 2 Deg.C.
0	0	0	26,5	49,31	49,33
100	0,75	0,77	26,46	49,26	49,45
200	0,97	0,99	26,53	49,26	49,37
300	1,12	1,13	26,5	49,26	49,35
400	1,23	1,23	26,5	49,21	49,32
500	1,32	1,32	26,55	49,16	49,38
600	1,39	1,39	26,5	49,26	49,38
700	1,45	1,45	26,5	49,15	49,32
800	1,51	1,51	26,47	49,16	49,38
900	1,56	1,55	26,5	49,16	49,41
1000	1,6	1,6	26,5	49,2	49,4
1100	1,64	1,64	26,49	49,07	49,36
1200	1,68	1,68	26,48	49,15	49,39
1300	1,71	1,71	26,5	49,19	49,44
1400	1,75	1,75	26,53	49,09	49,38
1500	1,78	1,78	26,55	49,16	49,51
1600	1,81	1,81	26,5	49,15	49,45
1700	1,84	1,84	26,51	49,13	49,43
1800	1,87	1,87	26,48	49,08	49,47
1900	1,9	1,89	26,45	49,06	49,43
2000	1,92	1,92	26,57	49,11	49,43
2100	1,95	1,94	26,52	49,13	49,39
2200	1,97	1,97	26,5	49,11	49,47
2300	1,99	1,98	26,52	49,08	49,36
2400	2,02	2	26,5	49,05	49,42
2500	2,04	2,03	26,5	49,05	49,38
2600	2,06	2,05	26,51	49,07	49,46
2700	2,08	2,06	26,51	49,14	49,45
2800	2,1	2,09	26,51	49,11	49,48
2900	2,12	2,11	26,48	49,11	49,48
3000	2,13	2,13	26,52	49,11	49,54
3100	2,15	2,14	26,46	49,11	49,52
3200	2,17	2,16	26,48	49,15	49,55
3300	2,18	2,18	26,49	49,12	49,43
3400	2,2	2,2	26,47	49,17	49,54
3500	2,21	2,22	26,5	49,07	49,49
3600	2,23	2,23	26,51	49,17	49,49
3700	2,24	2,25	26,5	49,11	49,52
3800	2,25	2,27	26,53	49,09	49,44
3900	2,26	2,29	26,5	49,16	49,61
4000	2,28	2,31	26,47	49,15	49,5
4100	2,29	2,32	26,48	49,2	49,54
4200	2,3	2,34	26,49	49,08	49,44
4300	2,32	2,35	26,51	49,16	49,55
4400	2,33	2,36	26,49	49,12	49,52
4500	2,34	2,38	26,52	49,14	49,56
4600	2,36	2,39	26,47	49,09	49,51
4700	2,37	2,41	26,51	49,11	49,53
4800	2,38	2,42	26,51	49,13	49,54
4900	2,4	2,43	26,51	49,13	49,48
5000	2,41	2,44	26,51	49,08	49,45
5100	2,42	2,46	26,49	49,17	49,53
5200	2,43	2,47	26,49	49,17	49,55
5300	2,45	2,48	26,51	49,1	49,48
5400	2,46	2,49	26,51	49,12	49,52
5500	2,47	2,5	26,48	49,13	49,46
5600	2,48	2,51	26,52	49,18	49,46
5700	2,5	2,52	26,5	49,13	49,45
5800	2,51	2,54	26,51	49,14	49,56
5900	2,52	2,55	26,51	49,15	49,48
6000	2,53	2,56	26,52	49,12	49,54
6100	2,54	2,56	26,52	49,18	49,56
6200	2,55	2,57	26,51	49,21	49,52
6300	2,56	2,58	26,57	49,13	49,45
6400	2,57	2,59	26,49	49,26	49,58
6500	2,58	2,6	26,48	49,12	49,43
6600	2,59	2,61	26,49	49,19	49,6
6700	2,6	2,62	26,47	49,11	49,51
6800	2,61	2,63	26,5	49,22	49,52
6900	2,61	2,64	26,53	49,18	49,58
7000	2,62	2,65	26,5	49,16	49,56
7100	2,63	2,66	26,47	49,21	49,54
7200	2,64	2,67	26,51	49,21	49,52
7300	2,65	2,68	26,49	49,13	49,53

7400	2,66	2,69	26,5	49,19	49,57
7500	2,66	2,7	26,52	49,18	49,52
7600	2,67	2,71	26,5	49,15	49,48
7700	2,68	2,72	26,49	49,18	49,58
7800	2,69	2,73	26,52	49,17	49,47
7900	2,7	2,74	26,49	49,16	49,54
8000	2,71	2,75	26,51	49,24	49,57
8100	2,73	2,76	26,51	49,15	49,48
8200	2,73	2,77	26,51	49,15	49,55
8300	2,74	2,77	26,48	49,13	49,47
8400	2,75	2,78	26,51	49,15	49,51
8500	2,76	2,79	26,51	49,18	49,49
8600	2,77	2,8	26,47	49,13	49,48
8700	2,77	2,81	26,5	49,22	49,51
8800	2,78	2,82	26,44	49,17	49,48
8900	2,79	2,83	26,49	49,21	49,52
9000	2,8	2,83	26,49	49,11	49,53
9100	2,81	2,84	26,53	49,16	49,49
9200	2,82	2,85	26,48	49,12	49,48
9300	2,82	2,86	26,5	49,13	49,54
9400	2,83	2,87	26,52	49,18	49,47
9500	2,84	2,88	26,49	49,14	49,53
9600	2,85	2,89	26,5	49,15	49,54
9700	2,85	2,89	26,51	49,24	49,56
9800	2,86	2,91	26,47	49,12	49,53
9900	2,87	2,91	26,54	49,14	49,48
10000	2,87	2,92	26,52	49,2	49,48

Test Ended at 10000 Passes
Sample 1 Final rut depth = 2,87 mm
Sample 2 Final rut depth = 2,92 mm
Sample 1 Mean Steady State Tracking Rate = 0,09 mm/1000 Passes
Sample 2 Mean Steady State Tracking Rate = 0,09 mm/1000 Passes

Table 0.44 SAmples G35-G36: Wheeltrack test results.

Wheeltracking Test Summary
Specimen Name: Gr 37 og 38 50C
Date: 08.11.2010
Test Temperature: 50
Sample 1 Thickness: 40
Sample 2 Thickness: 40

Pass No.	Rut Depth(mm) 1	Rut Depth(mm) 2	Speed (RPM)	RTD 1 Deg.C.	RTD 2 Deg.C.
0	0	0	26,5	48,87	49,22
100	0,67	0,6	26,48	48,96	49,17
200	0,87	0,79	26,53	48,91	49,2
300	1	0,9	26,5	48,96	49,12
400	1,09	0,98	26,48	48,97	49,13
500	1,16	1,04	26,52	48,97	49,13
600	1,23	1,1	26,48	48,94	49,14
700	1,28	1,14	26,5	48,99	49,15
800	1,32	1,18	26,52	48,98	49,23
900	1,36	1,22	26,53	49	49,15
1000	1,4	1,25	26,47	49	49,26
1100	1,43	1,28	26,5	48,97	49,18
1200	1,46	1,31	26,52	48,99	49,29
1300	1,49	1,33	26,49	49,05	49,28
1400	1,51	1,36	26,5	49,03	49,27
1500	1,54	1,38	26,5	49,04	49,2
1600	1,56	1,4	26,47	49,04	49,27
1700	1,58	1,42	26,51	49,01	49,19
1800	1,6	1,44	26,51	49,08	49,3
1900	1,62	1,45	26,48	49,07	49,22
2000	1,64	1,47	26,5	49,06	49,3
2100	1,66	1,48	26,5	49,07	49,34
2200	1,67	1,5	26,49	49,06	49,27
2300	1,69	1,51	26,55	49,05	49,29
2400	1,71	1,52	26,5	49,11	49,37
2500	1,72	1,53	26,5	49,1	49,34
2600	1,74	1,55	26,51	49,13	49,36
2700	1,75	1,56	26,5	49,11	49,27
2800	1,76	1,57	26,51	49,15	49,42
2900	1,77	1,59	26,51	49,11	49,3
3000	1,78	1,6	26,5	49,18	49,3
3100	1,8	1,61	26,51	49,19	49,37
3200	1,81	1,62	26,5	49,17	49,31
3300	1,83	1,63	26,52	49,22	49,4
3400	1,82	1,63	26,49	49,17	49,41
3500	1,84	1,65	26,52	49,23	49,45
3600	1,85	1,65	26,51	49,16	49,4
3700	1,85	1,66	26,51	49,28	49,41
3800	1,86	1,67	26,51	49,21	49,33
3900	1,87	1,68	26,5	49,23	49,47

4000	1,88	1,68	26,46	49,25	49,39
4100	1,89	1,69	26,51	49,22	49,49
4200	1,9	1,7	26,51	49,22	49,39
4300	1,91	1,7	26,5	49,26	49,48
4400	1,91	1,71	26,52	49,21	49,39
4500	1,92	1,71	26,49	49,29	49,39
4600	1,93	1,72	26,49	49,22	49,33
4700	1,94	1,73	26,5	49,35	49,46
4800	1,95	1,73	26,5	49,2	49,39
4900	1,95	1,74	26,49	49,28	49,41
5000	1,96	1,74	26,5	49,3	49,47
5100	1,97	1,75	26,5	49,28	49,48
5200	1,97	1,75	26,5	49,29	49,41
5300	1,98	1,76	26,48	49,23	49,43
5400	1,99	1,76	26,51	49,31	49,44
5500	1,99	1,77	26,46	49,31	49,43
5600	2	1,77	26,5	49,26	49,41
5700	2	1,78	26,46	49,36	49,43
5800	2,01	1,78	26,49	49,31	49,41
5900	2,02	1,79	26,48	49,31	49,47
6000	2,02	1,79	26,52	49,36	49,42
6100	2,02	1,8	26,47	49,31	49,48
6200	2,03	1,8	26,5	49,37	49,49
6300	2,03	1,81	26,53	49,28	49,38
6400	2,04	1,81	26,51	49,29	49,44
6500	2,04	1,81	26,48	49,3	49,46
6600	2,05	1,82	26,52	49,35	49,52
6700	2,06	1,82	26,51	49,41	49,5
6800	2,06	1,82	26,5	49,3	49,44
6900	2,06	1,83	26,51	49,44	49,47
7000	2,07	1,83	26,47	49,38	49,49
7100	2,07	1,84	26,51	49,42	49,54
7200	2,08	1,84	26,48	49,38	49,44
7300	2,08	1,84	26,49	49,42	49,5
7400	2,09	1,85	26,5	49,37	49,51
7500	2,09	1,85	26,53	49,36	49,42
7600	2,09	1,86	26,5	49,39	49,46
7700	2,1	1,86	26,48	49,39	49,45
7800	2,1	1,87	26,55	49,37	49,5
7900	2,1	1,87	26,51	49,4	49,5
8000	2,11	1,87	26,49	49,44	49,56
8100	2,11	1,88	26,51	49,41	49,46
8200	2,12	1,88	26,49	49,41	49,53
8300	2,12	1,88	26,48	49,41	49,46
8400	2,12	1,89	26,51	49,39	49,44
8500	2,13	1,89	26,49	49,44	49,49
8600	2,13	1,89	26,48	49,36	49,49
8700	2,14	1,9	26,52	49,48	49,55
8800	2,14	1,9	26,49	49,35	49,51
8900	2,15	1,9	26,49	49,43	49,56
9000	2,15	1,9	26,51	49,34	49,46
9100	2,15	1,91	26,51	49,4	49,46
9200	2,15	1,91	26,5	49,36	49,49
9300	2,16	1,91	26,5	49,38	49,45
9400	2,16	1,92	26,53	49,38	49,46
9500	2,16	1,92	26,51	49,35	49,47
9600	2,17	1,92	26,51	49,36	49,5
9700	2,17	1,93	26,5	49,43	49,5
9800	2,17	1,93	26,49	49,36	49,53
9900	2,18	1,93	26,5	49,36	49,48
10000	2,18	1,93	26,49	49,32	49,48

Test Ended at 10000 Passes
Sample 1 Final rut depth = 2,18 mm
Sample 2 Final rut depth = 1,93 mm
Sample 1 Mean Steady State Tracking Rate = 0,04 mm/1000 Passes
Sample 2 Mean Steady State Tracking Rate = 0,04 mm/1000 Passes

Table 0.45 SAmples G37-G38: Wheeltrack test results.

Wheeltracking Test Summary
Specimen Name: Gr 39 50C
Date: 09.11.2010
Test Temperature: 50
Sample 1 Thickness: 40
Sample 2 Thickness: 40

Pass No.	Rut Depth(mm) 1	Rut Depth(mm) 2	Speed (RPM)	RTD 1 Deg.C.	RTD 2 Deg.C.
0	0	0	26,5	48,1	49,91
100	0,51	0	26,53	49,2	50,38
200	0,66	0	26,49	49,11	50,12
300	0,75	0	26,53	49,23	50,27
400	0,82	0	26,53	49,17	50,34
500	0,87	0	26,52	49,22	50,19

600	0,91	0	26,47	49,16	50,25
700	0,95	0	26,47	49,17	50,04
800	0,98	0	26,49	49,16	50,35
900	1,02	0	26,44	49,11	50,1
1000	1,04	0	26,48	49,23	50,26
1100	1,07	0	26,5	49,11	50,05
1200	1,09	0	26,46	49,17	50,25
1300	1,11	0	26,5	49,1	50,18
1400	1,13	0	26,5	49,14	50,11
1500	1,15	0	26,47	49,11	50,17
1600	1,16	0	26,51	49,18	50,21
1700	1,18	0	26,52	49,11	50,09
1800	1,2	0	26,54	49,26	50,24
1900	1,21	0	26,51	49,14	50,11
2000	1,22	0	26,51	49,22	50,31
2100	1,23	0	26,48	49,16	50,19
2200	1,25	0	26,51	49,24	50,21
2300	1,26	0	26,52	49,21	50,24
2400	1,27	0	26,31	49,18	50,15
2500	1,28	0,01	26,52	49,26	50,28
2600	1,29	0,01	26,5	49,17	50,04
2700	1,3	0,01	26,43	49,26	50,2
2800	1,31	0,01	26,51	49,2	50,11
2900	1,32	0,01	26,51	49,21	50,17
3000	1,33	0,01	26,48	49,22	50,13
3100	1,34	0,01	26,49	49,19	50,13
3200	1,35	0,01	26,52	49,21	50,14
3300	1,36	0,01	26,48	49,25	50,08
3400	1,37	0,01	26,16	49,18	50,08
3500	1,37	0,01	26,52	49,2	50,14
3600	1,38	0,01	26,48	49,23	50,13
3700	1,39	0,01	26,49	49,16	50,04
3800	1,39	0,01	26,51	49,23	50,06
3900	1,4	0,01	26,46	49,24	50,07
4000	1,41	0,01	26,49	49,23	50,2
4100	1,41	0,01	26,52	49,19	50,02
4200	1,42	0,01	26,49	49,19	50,27
4300	1,43	0,01	26,49	49,19	49,99
4400	1,43	0,01	26,51	49,24	50,28
4500	1,44	0,01	26,45	49,19	50,02
4600	1,44	0,01	26,49	49,2	50,14
4700	1,45	0,01	26,54	49,18	50,16
4800	1,46	0,01	26,47	49,2	50,11
4900	1,46	0,01	26,56	49,16	50,13
5000	1,47	0,01	26,51	49,23	49,99
5100	1,48	0,01	26,48	49,2	50,12
5200	1,48	0,01	26,49	49,16	49,97
5300	1,49	0,01	26,52	49,18	50,21
5400	1,5	0,01	26,41	49,17	49,88
5500	1,51	0,01	26,52	49,17	50,37
5600	1,51	0,01	26,51	49,19	49,89
5700	1,52	0,01	26,5	49,23	50,2
5800	1,52	0,01	26,5	49,18	49,93
5900	1,53	0,01	26,5	49,21	50,18
6000	1,53	0,01	26,46	49,17	50,04
6100	1,54	0,01	26,49	49,21	50,11
6200	1,54	0,01	26,51	49,22	50,1
6300	1,55	0,01	26,49	49,24	50,03
6400	1,55	0,01	26,49	49,14	50,04
6500	1,56	0,01	26,5	49,28	50,14
6600	1,56	0,01	26,49	49,26	50,17
6700	1,57	0,01	26,47	49,16	49,92
6800	1,58	0,01	26,57	49,19	50,25
6900	1,58	0,01	26,46	49,2	49,89
7000	1,59	0,01	26,48	49,3	50,26
7100	1,6	0,01	26,54	49,13	49,97
7200	1,6	0,01	26,51	49,17	50,25
7300	1,61	0,01	26,52	49,07	50,02
7400	1,62	0,01	26,5	49,16	50,04
7500	1,62	0,01	26,49	49,15	50,07
7600	1,63	0,01	26,47	49,21	50,03
7700	1,63	0,01	26,49	49,21	50,18
7800	1,64	0,01	26,5	49,12	50,03
7900	1,65	0,01	26,5	49,22	50,24
8000	1,66	0,01	26,55	49,11	49,95
8100	1,67	0,01	26,51	49,2	50,21
8200	1,68	0,01	26,48	49,19	49,97
8300	1,69	0,01	26,5	49,22	50,42
8400	1,69	0,01	26,47	49,18	50,08
8500	1,7	0,01	26,48	49,19	50,26
8600	1,7	0,01	26,54	49,09	50,09
8700	1,71	0,01	26,51	49,2	50,1
8800	1,71	0,01	26,47	49,15	50,18
8900	1,71	0,01	26,51	49,15	50,01
9000	1,72	0,01	26,5	49,17	50,22
9100	1,72	0,01	26,48	49,14	50,05
9200	1,73	0,01	26,5	49,16	50,25

9300	1,74	0,01	26,51	49,17	50,02
9400	1,74	0,01	26,53	49,21	50,16
9500	1,75	0,01	26,51	49,12	50,15
9600	1,76	0,01	26,57	49,16	50,03
9700	1,76	0,01	26,49	49,16	50,22
9800	1,77	0,01	26,54	49,19	50,02
9900	1,78	0,01	26,49	49,23	50,27
10000	1,78	0,01	26,47	49,09	49,96

Test Ended at 10000 Passes
Sample 1 Final rut depth = 1,78 mm
Sample 2 Final rut depth = 0,01 mm
Sample 1 Mean Steady State Tracking Rate = 0,06 mm/1000 Passes
Sample 2 Mean Steady State Tracking Rate = 0,00 mm/1000 Passes

Table 0.46 Sample G39: Wheeltrack test results.

APPENDIX D:
Determination of bulk density and void characteristics

Ab 16 Pmb_Receipt n. 13143908

Sample	m1	m2	m3	Tw	γw	ρ m	ρ b	Vm	B	ρ B	VMA	VFB
	[g]	[g]	[g]	[°C]		[kg/m^3]	[kg/m^3]	[%v/v]	[%]	[kg/m^3]	[%v/v]	[%v/v]
2A	3470,8	2076,4	3475,8	19,5	0,998	2,508	2,476	1,280	5,50	1,100	13,660	90,629
2B	3493,5	2087,5	3499,0	19,5	0,998	2,508	2,471	1,486	5,50	1,100	13,840	89,261
3A	3472,4	2066,0	3479,8	20,6	0,998	2,508	2,451	2,263	5,50	1,100	14,519	84,414
3B	3463,8	2060,1	3471,0	20,6	0,998	2,508	2,450	2,305	5,50	1,100	14,556	84,167
4A	3484,4	2077,4	3489,7	20,0	0,998	2,508	2,463	1,809	5,50	1,100	14,122	87,192
4B	3460,6	2059,8	3466,2	20,0	0,998	2,508	2,456	2,070	5,50	1,100	14,351	85,574
5A	3469,4	2047,5	3480,5	19,5	0,998	2,508	2,417	3,634	5,50	1,100	15,718	76,882
5B	3464,2	2046,2	3477,1	19,5	0,998	2,508	2,417	3,637	5,50	1,100	15,721	76,866
6A	3457,9	2051,1	3468,0	20,6	0,998	2,508	2,436	2,884	5,50	1,100	15,062	80,853
6B	3494,0	2076,8	3506,6	20,6	0,998	2,508	2,439	2,755	5,50	1,100	14,950	81,569
7A	3466,5	2061,6	3474,7	20,2	0,998	2,508	2,448	2,373	5,50	1,100	14,615	83,767
7B	3530,8	2039,2	3440,5	20,2	0,998	2,508	2,515	-0,276	5,50	1,100	12,299	102,242
8A	3515,2	2098,5	3523,1	20,2	0,998	2,508	2,463	1,800	5,50	1,100	14,114	87,246
8B	3416,3	2037,8	3423,8	20,2	0,998	2,508	2,460	1,905	5,50	1,100	14,206	86,590

Table 0.1 Receipt n. 13143908: determination of bulk density and void characteristics.

Ab 11 Pmb_Receipt n. 82212001414

Sample	m1	m2	m3	Tw	γw	ρ m	ρ b	Vm	B	ρ B	VMA	VFB
	[g]	[g]	[g]	[°C]		[kg/m³]	[kg/m³]	[%v/v]	[%]	[kg/m³]	[%v/v]	[%v/v]
9A	3434,2	2020,3	3451,8	19,5	0,998	2,543	2,395	5,826	5,70	1,100	18,235	68,053
9B	3416,3	2010,4	3433,6	19,5	0,998	2,543	2,396	5,770	5,70	1,100	18,187	68,273
10A	3271,6	1914,8	3290,8	19,5	0,998	2,543	2,373	6,666	5,70	1,100	18,965	64,851
10B	3561,9	2089,6	3582,3	19,5	0,998	2,543	2,382	6,328	5,70	1,100	18,672	66,107
11A	3542,3	2118,5	3553,2	19,5	0,998	2,543	2,465	3,078	5,70	1,100	15,850	80,580
11B	3317,0	1982,0	3329,7	19,5	0,998	2,543	2,457	3,384	5,70	1,100	16,115	79,003
12A	3304,5	1963,8	3313,0	19,5	0,998	2,543	2,445	3,855	5,70	1,100	16,524	76,672
12B	3266,4	1952,3	3281,5	19,5	0,998	2,543	2,453	3,533	5,70	1,100	16,245	78,250
25A	3400,0	2033,7	3408,4	20,6	0,998	2,543	2,468	2,933	5,70	1,100	15,724	81,345
25B	3432,7	2052,5	3442,2	20,6	0,998	2,543	2,465	3,058	5,70	1,100	15,832	80,687
26A	3419,2	2047,2	3430,0	20,6	0,998	2,543	2,468	2,958	5,70	1,100	15,745	81,216
26B	3407,2	2039,6	3415,8	20,6	0,998	2,543	2,471	2,834	5,70	1,100	15,638	81,878

Table 0.2 Receipt n. 82212001414: determination of bulk density and void characteristics.

Ab 11_Receipt n. 82212000814

Sample	m1	m2	m3	Tw	γw	ρ m	ρ b	Vm	B	ρ B	VMA	VFB
	[g]	[g]	[g]	[°C]		[kg/m³]	[kg/m³]	[%v/v]	[%]	[kg/m³]	[%v/v]	[%v/v]
13A	3418,8	2028,7	3427,2	20,6	0,998	2,543	2,440	4,058	5,70	1,100	16,700	75,703
13B	3446,1	2039,6	3455,8	20,6	0,998	2,543	2,429	4,500	5,70	1,100	17,085	73,659
14A	3488,6	2067,5	3495,8	20,6	0,998	2,543	2,438	4,142	5,70	1,100	16,773	75,309
14B	3377,1	1997,5	3384,2	20,6	0,998	2,543	2,431	4,421	5,70	1,100	17,016	74,016
15A	3380,3	2007,7	3384,5	19,5	0,998	2,543	2,451	3,621	5,70	1,100	16,321	77,814
15B	3411,7	2027,1	3415,7	19,5	0,998	2,543	2,453	3,552	5,70	1,100	16,262	78,155
16A	3423,5	2035,2	3428,8	20,6	0,998	2,543	2,452	3,588	5,70	1,100	16,293	77,978
16B	3404,0	2026,1	3410,2	20,6	0,998	2,543	2,455	3,479	5,70	1,100	16,198	78,521
17A	3380,6	2012,9	3384,6	20,2	0,998	2,543	2,460	3,268	5,70	1,100	16,015	79,593
17B	3363,3	1995,1	3369,7	20,2	0,998	2,543	2,442	3,966	5,70	1,100	16,621	76,137
18A	3497,7	2073,3	3504,8	20,2	0,998	2,543	2,439	4,098	5,70	1,100	16,736	75,511
18B	3613,5	2142,4	3620,1	20,2	0,998	2,543	2,441	4,021	5,70	1,100	16,668	75,877

Table 0.3 Receipt n. 82212000814: determination of bulk density and void characteristics.

Ab 11 Pmb_Receipt n. 82212001014

Sample	m1	m2	m3	Tw	γw	ρ m	ρ b	Vm	B	ρ B	VMA	VFB
	[g]	[g]	[g]	[°C]		[kg/m^3]	[kg/m^3]	[%v/v]	[%]	[kg/m^3]	[%v/v]	[%v/v]
19A	3570,8	2136,5	3583,6	18,5	0,998	2,552	2,464	3,457	5,70	1,100	16,224	78,693
19B	3268,8	1958,1	3278,8	19,5	0,998	2,552	2,471	3,184	5,70	1,100	15,987	80,085
20A	3285,3	1967,9	3294,7	19,5	0,998	2,552	2,472	3,142	5,70	1,100	15,951	80,299
20B	3625,6	2172,2	3635,8	19,5	0,998	2,552	2,473	3,101	5,70	1,100	15,914	80,518
21A	3304,9	1973,8	3310,3	21,0	0,998	2,552	2,468	3,302	5,70	1,100	16,089	79,477
21B	3362,0	2012,9	3368,8	21,0	0,998	2,552	2,474	3,039	5,70	1,100	15,861	80,841
22A	3384,7	2026,2	3392,3	20,6	0,998	2,552	2,473	3,105	5,70	1,100	15,918	80,495
22B	3417,5	2048,3	3423,3	20,6	0,998	2,552	2,481	2,799	5,70	1,100	15,653	82,118
23A	3574,4	2146,8	3582,7	20,6	0,998	2,552	2,484	2,648	5,70	1,100	15,522	82,938
23B	3348,0	2012,8	3353,1	20,6	0,998	2,552	2,493	2,310	5,70	1,100	15,229	84,828
24A	3386,1	2031,4	3394,9	20,2	0,998	2,552	2,479	2,872	5,70	1,100	15,716	81,727
24B	3451,7	2066,3	3461,7	20,2	0,998	2,552	2,469	3,254	5,70	1,100	16,047	79,725

Table 0.4 Receipt n. 82212001014: determination of bulk density and void characteristics.

Ska 11_Receipt n. 06209407

Sample	m1	m2	m3	Tw	γw	ρ m	ρ b	Vm	B	ρ B	VMA	VFB
	[g]	[g]	[g]	[°C]		[kg/m^3]	[kg/m^3]	[%v/v]	[%]	[kg/m^3]	[%v/v]	[%v/v]
27A	3447,1	2025,5	3458,9	19,5	0,998	2,462	2,401	2,491	6,40	1,100	16,459	84,863
27B	3239,8	1893,2	3246,8	19,5	0,998	2,462	2,389	2,952	6,40	1,100	16,854	82,482
28A	3325,6	1932,0	3332,7	20,6	0,998	2,462	2,370	3,754	6,40	1,100	17,541	78,598
28B	3339,6	1942,3	3349,4	20,6	0,998	2,462	2,369	3,789	6,40	1,100	17,570	78,438
29A	3500,0	2037,6	3512,1	19,5	0,998	2,462	2,370	3,755	6,40	1,100	17,541	78,595
29B	3273,7	1906,1	3285,5	19,5	0,998	2,462	2,369	3,771	6,40	1,100	17,555	78,518
30A	3424,8	1992,4	3437,7	19,5	0,998	2,462	2,365	3,920	6,40	1,100	17,683	77,832
30B	3339,2	1941,9	3349,9	19,5	0,998	2,462	2,367	3,840	6,40	1,100	17,614	78,202
31A	3383,9	1978,6	3394,2	20,2	0,998	2,462	2,386	3,090	6,40	1,100	16,971	81,795
31B	3344,6	1948,9	3356,8	20,2	0,998	2,462	2,371	3,691	6,40	1,100	17,487	78,891
32A	3268,9	1912,9	3278,9	20,6	0,998	2,462	2,388	2,992	6,40	1,100	16,888	82,284
32B	3155,1	1845,0	3165,8	20,6	0,998	2,462	2,384	3,165	6,40	1,100	17,036	81,423
G13A	2966,2	1728,7	2976,1	19,0	0,998	2,462	2,374	3,573	6,40	1,100	17,386	79,446
G13B	2933,3	1707,3	2943,4	19,0	0,998	2,462	2,369	3,771	6,40	1,100	17,555	78,518

Table 0.5 Receipt n. 06209407: determination of bulk density and void characteristics.

Agb 11_Receipt n. 06205205

Sample	m1	m2	m3	Tw	γw	ρ m	ρ b	Vm	B	ρ B	VMA	VFB
	[g]	[g]	[g]	[°C]		[kg/m^3]	[kg/m^3]	[%v/v]	[%]	[kg/m^3]	[%v/v]	[%v/v]
33A	3089,8	1834,1	3098,0	20,3	0,998	2,568	2,440	4,984	5,60	1,100	17,406	71,364
33B	3705,3	2195,3	3714,8	20,3	0,998	2,568	2,434	5,224	5,60	1,100	17,614	70,344
34A	3486,3	2073,7	3502,2	20,3	0,998	2,568	2,436	5,145	5,60	1,100	17,546	70,678
34B	3470,7	2063,3	3482,3	20,3	0,998	2,568	2,441	4,937	5,60	1,100	17,365	71,570
35A	3463,5	2050,5	3474,9	20,2	0,998	2,568	2,427	5,492	5,60	1,100	17,847	69,229
35B	3315,2	1962,9	3326,0	20,2	0,998	2,568	2,428	5,470	5,60	1,100	17,829	69,317
36A	3365,2	1990,9	3376,6	20,2	0,998	2,568	2,424	5,610	5,60	1,100	17,950	68,748

Table 0.6 Receipt n. 06205205: determination of bulk density and void characteristics.

Ab 11_Receipt n. 10273302

Sample	m1	m2	m3	Tw	γw	ρ m	ρ b	Vm	B	ρ B	VMA	VFB
	[g]	[g]	[g]	[°C]		[kg/m^3]	[kg/m^3]	[%v/v]	[%]	[kg/m^3]	[%v/v]	[%v/v]
G1A	2698,7	1582,3	2705,3	19,0	0,998	2,502	2,399	4,109	6,00	1,100	17,196	76,104
G1B	2796,8	1628,0	2811,0	19,0	0,998	2,502	2,360	5,664	6,00	1,100	18,538	69,449
G3A	3564,3	2129,5	3569,7	21,0	0,998	2,502	2,470	1,287	6,00	1,100	14,759	91,278
G3B	3481,4	2081,3	3488,2	21,0	0,998	2,502	2,469	1,301	6,00	1,100	14,771	91,192

Table 0.7 Receipt n. 10273302: determination of bulk density and void characteristics.

Ska 16_Receipt n. 10279502

Sample	m1	m2	m3	Tw	γw	ρ m	ρ b	Vm	B	ρ B	VMA	VFB
	[g]	[g]	[g]	[°C]		[kg/m^3]	[kg/m^3]	[%v/v]	[%]	[kg/m^3]	[%v/v]	[%v/v]
G2A	3234,0	1912,8	3243,3	21,0	0,998	2,497	2,426	2,856	6,10	1,100	16,308	82,486
G2B	3592,2	2129,9	3600,7	21,0	0,998	2,497	2,437	2,389	6,10	1,100	15,905	84,978
G4A	2905,4	1725,2	2917,7	19,0	0,998	2,497	2,432	2,587	6,10	1,100	16,075	83,910
G4B	3152,1	1872,7	3162,9	19,0	0,998	2,497	2,439	2,318	6,10	1,100	15,844	85,370

Table 0.8 Receipt n. 10279502: determination of bulk density and void characteristics.

Agb 11_Receipt n. 10275202

Sample	m1	m2	m3	Tw	γw	ρ m	ρ b	Vm	B	ρ B	VMA	VFB
	[g]	[g]	[g]	[°C]		[kg/m^3]	[kg/m^3]	[%v/v]	[%]	[kg/m^3]	[%v/v]	[%v/v]
G5A	2869,7	1691,7	2932,5	19,3	0,998	2,524	2,309	8,524	5,80	1,100	20,698	58,818
G5B	2725,8	1619,2	2772,5	19,3	0,998	2,524	2,359	6,519	5,80	1,100	18,959	65,618
G6A	2651,6	1569,5	2659,7	19,3	0,998	2,524	2,428	3,800	5,80	1,100	16,603	77,112
G6B	3027,6	1803,7	3037,9	19,3	0,998	2,524	2,449	2,974	5,80	1,100	15,887	81,278

Table 0.9 Receipt n. 10275202: determination of bulk density and void characteristics.

Agb 11_Receipt n. 10275201

Sample	m1	m2	m3	Tw	γw	ρ m	ρ b	Vm	B	ρ B	VMA	VFB
	[g]	[g]	[g]	[°C]		[kg/m^3]	[kg/m^3]	[%v/v]	[%]	[kg/m^3]	[%v/v]	[%v/v]
G8A	2731,2	1625,0	2734,3	19,3	0,998	2,542	2,458	3,308	5,60	1,100	15,821	79,092
G8B	2545,6	1519,2	2549,0	19,3	0,998	2,542	2,468	2,921	5,60	1,100	15,484	81,134
G9A	2767,8	1647,6	2772,5	19,3	0,998	2,542	2,456	3,371	5,60	1,100	15,876	78,767
G9B	2768,4	1634,2	2774,9	19,3	0,998	2,542	2,423	4,689	5,60	1,100	17,023	72,457

Table 0.10 Receipt n. 10275201: determination of bulk density and void characteristics.

Ska 11_Receipt n. 6209409

Sample	m1	m2	m3	Tw	γw	ρ m	ρ b	Vm	B	ρ B	VMA	VFB
	[g]	[g]	[g]	[°C]		[kg/m^3]	[kg/m^3]	[%v/v]	[%]	[kg/m^3]	[%v/v]	[%v/v]
G11A	3452,3	2027,4	3476,1	20,0	0,998	2,521	2,379	5,647	5,90	1,100	18,405	69,319
G11B	3441,9	2024,1	3468,2	20,0	0,998	2,521	2,379	5,631	5,90	1,100	18,392	69,381
G12A	3030,1	1803,2	3035,1	19,0	0,998	2,521	2,456	2,591	5,90	1,100	15,762	83,561
G12B	3022,1	1798,2	3026,7	19,0	0,998	2,521	2,456	2,579	5,90	1,100	15,752	83,625
G14A	3187,5	1897,2	3191,6	19,0	0,998	2,521	2,459	2,479	5,90	1,100	15,665	84,176
G14B	2832,2	1683,9	2836,3	19,0	0,998	2,521	2,454	2,672	5,90	1,100	15,832	83,123
G15A	2833,5	1656,2	2848,4	19,3	0,998	2,521	2,373	5,884	5,90	1,100	18,610	68,383

Table 0.11 Receipt n. 6209409: determination of bulk density and void characteristics.

Receipt n. 10275201

Sample	m1	m2	m3	Tw	γw	ρ m	ρ b	Vm	B	ρ B	VMA	VFB
	[g]	[g]	[g]	[°C]		[kg/m^3]	[kg/m^3]	[%v/v]	[%]	[kg/m^3]	[%v/v]	[%v/v]
G7A	3602,6	2141,4	3614,1	20,6	0,998	2,524	2,441	3,271	5,80	1,100	16,144	79,740
G7B	3477,7	2065,1	3487,2	20,6	0,998	2,524	2,441	3,302	5,80	1,100	16,171	79,581
G10A	2733,2	1623,1	2737,3	19,0	0,998	2,524	2,449	2,969	5,80	1,100	15,882	81,309
G10B	3016,3	1788,1	3022,6	19,0	0,998	2,524	2,439	3,354	5,80	1,100	16,216	79,317

Table 0.12 Receipt n. 1027520: determination of bulk density and void characteristics.

Ab 11_Receipt n. 10263302

Sample	m1	m2	m3	Tw	γw	ρ m	ρ b	Vm	B	ρ B	VMA	VFB
	[g]	[g]	[g]	[°C]		[kg/m^3]	[kg/m^3]	[%v/v]	[%]	[kg/m^3]	[%v/v]	[%v/v]
G16A	2752,8	1624,4	2757,1	19,3	0,998	2,469	2,426	1,734	6,00	1,100	14,968	88,413
G16B	2979,7	1765,2	2983,9	19,3	0,998	2,469	2,441	1,141	6,00	1,100	14,454	92,108
G17A	2970,2	1753,2	2975,7	19,3	0,998	2,469	2,425	1,762	6,00	1,100	14,992	88,246
G17B	2796,4	1652,2	2802,6	19,3	0,998	2,469	2,427	1,714	6,00	1,100	14,950	88,536
G18A	2827,3	1666,6	2830,2	19,0	0,998	2,469	2,426	1,749	6,00	1,100	14,981	88,325
G18B	3067,3	1810,2	3071,4	19,0	0,998	2,469	2,428	1,658	6,00	1,100	14,902	88,877

Table 0.13 Receipt n. 10263302: determination of bulk density and void characteristics.

Agb 11_Receipt n. 10321320

Sample	m1	m2	m3	Tw	γw	ρ m	ρ b	Vm	B	ρ B	VMA	VFB
	[g]	[g]	[g]	[°C]		[kg/m^3]	[kg/m^3]	[%v/v]	[%]	[kg/m^3]	[%v/v]	[%v/v]
G19A	3102,5	1778,6	3106,4	19,3	0,998	2,421	2,333	3,651	5,90	1,100	16,162	77,410
G19B	2564,4	1472,4	2567,6	19,3	0,998	2,421	2,338	3,448	5,90	1,100	15,986	78,430
G20A	2845,6	1632,4	2849,9	19,0	0,998	2,421	2,333	3,617	5,90	1,100	16,133	77,579
G20B	2812,2	1619,2	2816,7	19,0	0,998	2,421	2,345	3,158	5,90	1,100	15,733	79,930
G21A	2705,3	1558,5	2710,8	19,0	0,998	2,421	2,344	3,184	5,90	1,100	15,756	79,789
G21B	3008,4	1731,6	3024,9	19,0	0,998	2,421	2,322	4,075	5,90	1,100	16,531	75,349

Table 0.14 Receipt n. 10321320: determination of bulk density and void characteristics.

Agb 16_Receipt n. 10321331

Sample	m1	m2	m3	Tw	γw	ρ m	ρ b	Vm	B	ρ B	VMA	VFB
	[g]	[g]	[g]	[°C]		[kg/m^3]	[kg/m^3]	[%v/v]	[%]	[kg/m^3]	[%v/v]	[%v/v]
G22A	2881,6	1671,7	2884,3	19,3	0,998	2,443	2,372	2,892	5,70	1,100	15,185	80,955
G22B	2683,7	1560,9	2690,8	19,3	0,998	2,443	2,371	2,942	5,70	1,100	15,228	80,684
G23A	2669,4	1543,3	2672,2	19,3	0,998	2,443	2,361	3,373	5,70	1,100	15,605	78,384
G23B	2775,1	1601,6	2780,0	19,3	0,998	2,443	2,351	3,767	5,70	1,100	15,949	76,383
G24A	2779,0	1611,7	2783,3	19,3	0,998	2,443	2,368	3,072	5,70	1,100	15,342	79,976
G24B	2744,0	1594,0	2746,7	19,3	0,998	2,443	2,376	2,724	5,70	1,100	15,038	81,888
G30A	2898,8	1680,3	2901,9	19,3	0,998	2,443	2,369	3,032	5,70	1,100	15,307	80,193

Table 0.15 Receipt n. 10321331: determination of bulk density and void characteristics.

Agb 11 GIL_Receipt n. 8321125

Sample	m1	m2	m3	Tw	γw	ρ m	ρ b	Vm	B	ρ B	VMA	VFB
	[g]	[g]	[g]	[°C]		[kg/m^3]	[kg/m^3]	[%v/v]	[%]	[kg/m^3]	[%v/v]	[%v/v]
G25A	3088,4	1792,3	3092,1	19,0	0,998	2,454	2,372	3,334	5,80	1,100	15,842	78,953
G25B	2760,0	1600,7	2763,6	19,0	0,998	2,454	2,369	3,443	5,80	1,100	15,937	78,394
G26A	2946,4	1705,3	2950,4	19,0	0,998	2,454	2,363	3,727	5,80	1,100	16,184	76,969
G26B	2904,0	1687,9	2908,0	19,0	0,998	2,454	2,376	3,169	5,80	1,100	15,698	79,815
G27A	2961,1	1718,8	2964,3	19,3	0,998	2,454	2,373	3,284	5,80	1,100	15,798	79,212
G27B	2905,0	1683,5	2908,4	19,3	0,998	2,454	2,368	3,521	5,80	1,100	16,005	78,001
G28A	2912,8	1693,2	2915,6	19,0	0,998	2,454	2,379	3,058	5,80	1,100	15,601	80,400
G28B	2918,4	1687,1	2922,3	19,0	0,998	2,454	2,359	3,878	5,80	1,100	16,315	76,231
G29A	2981,4	1727,2	2984,5	19,3	0,998	2,454	2,367	3,535	5,80	1,100	16,017	77,929
G29B	2895,4	1675,3	2900,9	19,3	0,998	2,454	2,358	3,895	5,80	1,100	16,330	76,151

Table 0.16 Receipt n. 8321125: determination of bulk density and void characteristics.

Agb 11 L_Receipt n. 10317127

Sample	m1	m2	m3	Tw	γw	ρ m	ρ b	Vm	B	ρ B	VMA	VFB
	[g]	[g]	[g]	[°C]		[kg/m^3]	[kg/m^3]	[%v/v]	[%]	[kg/m^3]	[%v/v]	[%v/v]
G31A	3088,4	1792,3	3092,1	19,0	0,998	2,454	2,372	3,334	5,80	1,100	15,842	78,953
G31B	2760,0	1600,7	2763,6	19,0	0,998	2,454	2,369	3,443	5,80	1,100	15,937	78,394
G32A	2946,4	1705,3	2950,4	19,0	0,998	2,454	2,363	3,727	5,80	1,100	16,184	76,969
G32B	2904,0	1687,9	2908,0	19,0	0,998	2,454	2,376	3,169	5,80	1,100	15,698	79,815
G33A	2961,1	1718,8	2964,3	19,3	0,998	2,454	2,373	3,284	5,80	1,100	15,798	79,212
G33B	2905,0	1683,5	2908,4	19,3	0,998	2,454	2,368	3,521	5,80	1,100	16,005	78,001

Table 0.17 Receipt n. 10317127: determination of bulk density and void characteristics.

Ab 11 Grà_Receipt n. 10317124

Sample	m1	m2	m3	Tw	γw	ρ m	ρ b	Vm	B	ρ B	VMA	VFB
	[g]	[g]	[g]	[°C]		[kg/m^3]	[kg/m^3]	[%v/v]	[%]	[kg/m^3]	[%v/v]	[%v/v]
G34A	3049,1	1788,6	3052,3	19,0	0,998	2,475	2,409	2,671	5,70	1,100	15,153	82,374
G34B	2873,6	1679,4	2876,9	19,0	0,998	2,475	2,396	3,202	5,70	1,100	15,617	79,495
G35A	3046,7	1788,4	3050,5	19,0	0,998	2,475	2,410	2,624	5,70	1,100	15,113	82,635
G35B	2994,2	1754,1	2997,5	19,0	0,998	2,475	2,404	2,863	5,70	1,100	15,321	81,313
G36A	3049,5	1786,6	3053,5	19,0	0,998	2,475	2,403	2,904	5,70	1,100	15,357	81,089
G36B	3065,7	1795,4	3070,2	19,0	0,998	2,475	2,401	2,993	5,70	1,100	15,434	80,607

Table 0.18 Receipt n. 10317124: determination of bulk density and void characteristics.

Ab 11 Lp_Receipt n. 10317119

Sample	m1	m2	m3	Tw	γw	ρ m	ρ b	Vm	B	ρ B	VMA	VFB
	[g]	[g]	[g]	[°C]		[kg/m^3]	[kg/m^3]	[%v/v]	[%]	[kg/m^3]	[%v/v]	[%v/v]
G37A	2974,7	1748,6	2977,7	19,0	0,998	2,473	2,416	2,294	5,70	1,100	14,815	84,516
G37B	3076,8	1809,3	3078,9	19,0	0,998	2,473	2,419	2,164	5,70	1,100	14,701	85,279
G38A	3135,3	1842,4	3137,9	19,0	0,998	2,473	2,416	2,297	5,70	1,100	14,817	84,497
G38B	2720,6	1601,3	2723,3	19,0	0,998	2,473	2,421	2,110	5,70	1,100	14,654	85,600
G39A	3095,8	1824,3	3099,6	19,0	0,998	2,473	2,424	2,000	5,70	1,100	14,558	86,262
G39B	3219,6	1891,0	3223,7	19,0	0,998	2,473	2,412	2,471	5,70	1,100	14,969	83,494

Table 0.19 Receipt n. 10317119: determination of bulk density and void characteristics.

Drenoval HM

Sample	m1	m2	m3	Tw	γw	ρ m	ρ b	Vm	B	ρ B	VMA	VFB
	[g]	[g]	[g]	[°C]		[kg/m^3]	[kg/m^3]	[%v/v]	[%]	[kg/m^3]	[%v/v]	[%v/v]
37A	3118,2	1859,3	3121,3	19,3	0,998	2,573	2,467	4,133	6,83	1,100	19,449	78,748
37B	3017,8	1795,4	3020,9	19,3	0,998	2,573	2,458	4,457	6,83	1,100	19,721	77,401
38A	2930,2	1730,0	2934,8	19,3	0,998	2,573	2,428	5,636	6,83	1,100	20,712	72,787
38B	3088,2	1830,5	3093,0	19,3	0,998	2,573	2,442	5,093	6,83	1,100	20,256	74,855
39A	2979,1	1767,0	2984,1	19,3	0,998	2,573	2,444	5,031	6,83	1,100	20,203	75,098
39B	2926,7	1737,7	2934,8	19,3	0,998	2,573	2,441	5,143	6,83	1,100	20,297	74,663
40A	2836,2	1677,7	2841,2	19,3	0,998	2,573	2,434	5,421	6,83	1,100	20,531	73,595
40B	2991,8	1770,4	2996,6	19,3	0,998	2,573	2,436	5,334	6,83	1,100	20,458	73,927
41A	2941,4	1735,9	2945,8	19,5	0,998	2,573	2,427	5,679	6,83	1,100	20,748	72,629
41B	2781,4	1649,7	2787,0	19,5	0,998	2,573	2,441	5,116	6,83	1,100	20,275	74,767
42A	2927,2	1734,6	2933,0	19,5	0,998	2,573	2,438	5,233	6,83	1,100	20,373	74,313
42B	3121,1	1848,6	3128,0	19,5	0,998	2,573	2,435	5,353	6,83	1,100	20,474	73,854

Table 0.20 Drenoval HM: determination of bulk density and void characteristics.

Drenoval Hard HM

Sample	m1	m2	m3	Tw	γw	ρ m	ρ b	Vm	B	ρ B	VMA	VFB
	[g]	[g]	[g]	[°C]		[kg/m^3]	[kg/m^3]	[%v/v]	[%]	[kg/m^3]	[%v/v]	[%v/v]
43A	3075,6	1814,1	3088,8	19,5	0,998	2,573	2,409	6,389	6,40	1,100	20,403	68,685
43B	2844,9	1679,0	2855,5	19,5	0,998	2,573	2,414	6,183	6,40	1,100	20,228	69,432
44A	2925,1	1749,2	2951,2	19,5	0,998	2,573	2,429	5,585	6,40	1,100	19,719	71,677
44B	3069,7	1825,3	3093,6	19,5	0,998	2,573	2,416	6,097	6,40	1,100	20,155	69,748
45A	3017,6	1784,9	3037,9	19,5	0,998	2,573	2,404	6,564	6,40	1,100	20,551	68,062
45B	2873,4	1700,5	2892,2	19,5	0,998	2,573	2,407	6,452	6,40	1,100	20,456	68,459
46A	2951,6	1741,8	2962,8	19,5	0,998	2,573	2,413	6,212	6,40	1,100	20,252	69,326
46B	3055,8	1807,4	3067,4	19,5	0,998	2,573	2,421	5,907	6,40	1,100	19,993	70,456
47A	3250,3	1932,2	3259,9	19,5	0,998	2,573	2,444	5,021	6,40	1,100	19,239	73,903
47B	3120,0	1855,0	3129,9	19,5	0,998	2,573	2,443	5,053	6,40	1,100	19,266	73,775
48A	2978,7	1757,4	2984,5	19,5	0,998	2,573	2,423	5,822	6,40	1,100	19,920	70,776
48B	2838,1	1682,9	2845,5	19,5	0,998	2,573	2,437	5,289	6,40	1,100	19,467	72,833

Table 0.21 Drenoval Hard M: determination of bulk density and void characteristics.

Lowval HM 41

Sample	m1	m2	m3	Tw	γw	ρ m	ρ b	Vm	B	ρ B	VMA	VFB
	[g]	[g]	[g]	[°C]		[kg/m^3]	[kg/m^3]	[%v/v]	[%]	[kg/m^3]	[%v/v]	[%v/v]
49A	3224,3	1911,6	3229,3	19,5	0,998	2,576	2,443	5,176	6,40	1,100	19,388	73,302
49B	2962,7	1758,3	2968,1	19,5	0,998	2,576	2,445	5,099	6,40	1,100	19,322	73,613
50A	3036,9	1809,2	3043,6	19,5	0,998	2,576	2,456	4,660	6,40	1,100	18,950	75,406
50B	3124,3	1849,6	3135,3	19,5	0,998	2,576	2,426	5,830	6,40	1,100	19,944	70,767
51A	3277,6	1938,5	3288,5	19,5	0,998	2,576	2,424	5,915	6,40	1,100	20,016	70,449
51B	2781,9	1642,7	2789,3	19,5	0,998	2,576	2,422	5,978	6,40	1,100	20,070	70,213
52A	2974,6	1766,6	2980,6	19,5	0,998	2,576	2,446	5,047	6,40	1,100	19,278	73,820
52B	3245,3	1931,3	3253,5	19,5	0,998	2,576	2,450	4,883	6,40	1,100	19,139	74,485
53A	3087,9	1831,6	3093,8	19,5	0,998	2,576	2,442	5,194	6,40	1,100	19,404	73,229
53B	2976,4	1764,2	2986,8	19,5	0,998	2,576	2,430	5,658	6,40	1,100	19,798	71,421
54A	3020,4	1786,5	3024,1	19,5	0,998	2,576	2,436	5,424	6,40	1,100	19,598	72,326

Table 0.22 Lowval HM 40: determination of bulk density and void characteristics.

APPENDIX E: Maximum density

		Drenoval HM		Lowval HM 40	
		Prøve 1	**Prøve 2**	**Prøve 1**	**Prøve 2**
	Begerglass nummer	1x	4x	1x	4x
m1	Vekt av begerglass	376,9 g	368,9 g	376,9 g	368,9 g
m2	Vekt av begerglass i vann	208,1 g	203,6 g	208,1 g	203,6 g
m3	Vekt av tørr prøve + begerglass	988,6 g	967,4 g	934,8 g	936,4 g
m4	Vekt av prøve + begerglass i vann	582,9 g	570,0 g	549,8 g	551,7 g
m4-m2	Volum av prøve	374,8	366,4	341,7	348,1
m3-m1	Vekt av tørr prøve	611,7 g	598,5 g	557,9 g	567,5 g
ρmh	Hulromsfri densitet borprøve	2,574 g/cm3	2,571 g/cm3	2,573 g/cm3	2,579 g/cm3
ρmh	Midlere hulromsfri densitet borprøve	**2,573 g/cm3**		**2,576 g/cm3**	

		Sample 8A		Sample 22A	
		Prøve 1	**Prøve 2**	**Prøve 1**	**Prøve 2**
	Begerglass nummer	1x	4x	7x	8x
m1	Vekt av begerglass	376,9 g	368,9 g	422,5 g	377,7 g
m2	Vekt av begerglass i vann	208,1 g	203,6 g	232,6 g	208,9 g
m3	Vekt av tørr prøve + begerglass	1271,3 g	1179,6 g	1146,0 g	1110,5 g
m4	Vekt av prøve + begerglass i vann	746,3 g	692,6 g	672,9 g	655,9 g
m4-m2	Volum av prøve	538,2	489,0	440,3	447,0
m3-m1	Vekt av tørr prøve	894,4 g	810,7 g	723,5 g	732,8 g
ρmh	Hulromsfri densitet borprøve	2,503 g/cm3	2,512 g/cm3	2,547 g/cm3	2,556 g/cm3
ρmh	Midlere hulromsfri densitet borprøve	**2,508 g/cm3**		**2,552 g/cm3**	

Table 0.1 Determination of the maximum density for Drenoval HM, Lowval HM 40, sample 8A and sample 22A.