Asphalt without limits.

Viacore – ultra-temperature-lowered asphalt

The Vialit Group has, for the first time in Europe, made a CE-compliant ultra-temperature-lowered asphalt available that meets the requirements set out in EN 13108 – Parts 1, 2, 4, 5, 7.

The Vialit line of asphalt has been advanced to create the **Viacore** construction product using the unique technology that Vialit is able to draw on.

Viacore asphalt offers the special benefits of being very good to work with while delivering highest performances. This CE-compliant asphalt is the first that may be worked at ambient temperatures (even in cool weather). The asphalt is Europe's first genuine lower-temperature product that is easy to install and compact even in winter. It's a feature that in summer also allows roads to be opened to traffic more quickly.

The mix may be created at temperatures of less than 100°C, preferably of 60°C. The paving temperature ranges between 0°C and around 50°C.

This product is particularly suitable for use in tunnels, on bridge surfaces, for asphalts in multi-storey car parks and public thoroughfares – where the asphalted areas may be quickly opened to traffic – as well as indoor asphalting.

Viacore also delivers benefits in unfavourable weather and paving conditions, makes thin paving thicknesses possible and may be installed manually. There is practically no cooling difference (outdoor temperature / mix temperature), which allows public thoroughfares to be taken into use more quickly. This property allows very high levels of compaction to be achieved much more easily, which in turn significantly increases stability and durability. High-quality paving may also even be realised at low outdoor temperatures.

Vialit has for many decades prioritised environmentally-friendly and sustainable products. Product developments are always focused on the optimum use of resources and minimum emissions.

Energy savings and lower CO_2 emissions along with the minimisation of other emissions at the construction site were also important in the development of **Viacore**.

The low mixing and paving temperature drastically reduces the concentration of vapours and aerosols and therefore satisfy occupational-safety and environmental-protection requirements. A particular advantage is the low MAK value that is achieved while the product is being worked.

A recent study that the STENUM Forschungsgesellschaft für Umweltfragen (Research Company for Environmental Questions) carried out in conjunction with the Montanuniversität Leoben (University of Mining), Lehrstuhl für Verfahrenstechnik des industriellen Umweltschutzes (Chair of Process Engineering for Industrial Environmental Protection), showed that the production of **Viacore** requires around 50% less energy than is usually consumed during the manufacture of conventional asphalts that comply with EN 13108.

Top-quality aggregates – i.e. Categories C 90/1, LA 20, PSV 50, SI 20, F1, WA24 1 – are used to make **Viacore** asphalt for both fine and coarse aggregates. Road bitumen with renewable raw materials and temperature-reducing additives is used as the binder.

Particle sizes in **Viacore** are distributed over a square parabola in accordance with the Fuller principle.

Depending on the type of asphalt

- **EN 13108 – 1 Asphalt Concrete**
- **EN 13108 – 2 Asphalt Concrete for Very Thin Layers**
- **EN 13108 – 4 Hot Rolled Asphalt**
- **EN 13108 – 5 Stone Mastic Asphalt**
- **EN 13108 – 7 Open Pore Asphalt**

the technical suitability for use and workability are determined on the basis of the composition of the fine and coarse aggregate as well as the mix design with optimised binder content. The binder quantity is adjusted to the grain structure's specific void content within the aggregate in its compacted state and to the type of aggregate and its porosity.

The special mechanical properties and excellent processing capacities have been achieved by employing a sophisticated filler / bitumen ratio, a pioneering binder system that uses viscosity-changed road bitumen and renewable raw materials. The void content has been adjusted in such a way that, on the one hand, a high deformation resistance to the effects of external mechanical and dynamic forces and, on the other, excellent behaviour at low temperatures (cracking due to cryogenic tensile stress) may be achieved. **Viacore's** performance has been optimised to this end. The performance-oriented tests (PO) were carried out by the Straßenbautechnisches Labor am Institut für Verkehrswissenschaften der TU Wien (Road Construction Laboratory at the Institute of Transport Sciences at the Technical University of Vienna).

Performance testing

Two basic approaches exist for describing asphalt mixes that are used in road construction:

- **Formula-oriented approach (empirical):** the mix is volumetrically described on the basis of narrow grading-curve boundaries and limits for binder and void content. With suitable starting materials, appropriate production and paving quality and constant boundary conditions (climate and traffic), it may be assumed from experience that performance in the field will remain unchanged over the design life.
- **Performance-oriented (PO) approach (functional):** The mix is exposed to similar loads in the laboratory as in the field by simulating essential performance conditions (cold cracks, deformation at high temperatures, fatigue).This means that it is possible to design asphalt mixes that are already optimised for the boundary conditions that are expected in the field and to do so relatively independently of the formula. This approach allows innovative construction methods and products to be employed with low residual risk in the field after successful performance-oriented testing in the laboratory even if only limited values are available from experience for the product or the construction method at hand.

Three essential properties must be distinguished where structural performance is concerned, i.e. cold behaviour, stiffness and fatigue behaviour as well as resistance to permanent deformation at high temperatures. Due to the fact that it was designed for use in surface layers, **Viacore's** cold behaviour and resistance to permanent deformation were investigated. The following methods of investigation were used to this end:

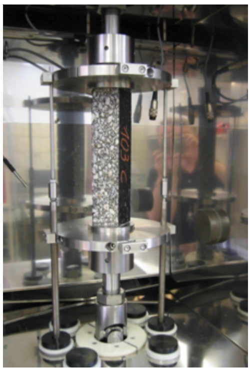
- **Cooling test (Thermal Stress Restrained Specimen Test (TSRST)) and cold tension test (Uniaxial Tension Stress Test (UTST)) in accordance with EN 12697-46** to determine the cryogenic stress depending on the temperature and the tension strength reserve.
- **Triaxial cyclic compression test (TCCT) and uniaxial cyclic compression test (UCCT) in accordance with EN 12697-25 and wheel-tracking test (WTT) in accordance with EN 12697-22** to assess resistance to permanent deformation at high temperatures.

Cold behaviour

Cold-behaviour tests are carried out to investigate resistance to cracking under combined stress as a result of rapid drops in temperature in winter (cryogenic stresses) and stresses caused by traffic loads. A combination of two test methods is used to this end.

Cooling test (TSRST)

First, the development of the cryogenic stresses produced by cooling was investigated with a secured test specimen (corresponds to seamless asphalt surface paving) using the cooling test (TSRST) as set out in EN 12697-46. A prismatic test specimen (40 x 40 x 160 mm) was secured in the testing machine, which was located in a temperature chamber, without stress at a temperature of +10°C. The temperature in the chamber was then reduced by 10°C/h while the length of the test specimen was kept constant. (Cryogenic) tensile stresses built up in the test specimen as a result of the cold; the binder's capacity for relaxation, however, meant that the specimen was still initially able to absorb these stresses. The binder became stiffer, more brittle and more elastic as the temperature dropped. These changes reduced the capacity for relaxation and the tension stresses increased until the tensile strength limits were reached and the material failed and fractured. This fracture temperature as well as the stress at fracture is characteristic of the mix. An example of a secured test specimen and the diagram for the TSRST are shown in Figure 1.



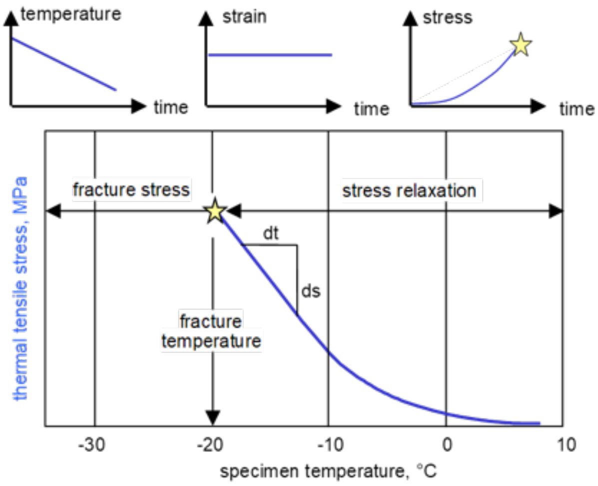


Figure 1: Secured test specimen for determining the cold behaviour (top) and diagram of the TSRST (bottom)

Uniaxial tension test (UTST)

Uniaxial tension tests (UTST) were carried out at various temperatures in accordance with EN 12697-46 to determine the temperature-dependent tensile strength. A prismatic test specimen was again secured in the testing machine and then brought up to the test temperature without stress. The tests in this case were carried out at temperatures of +5°C, -10°C, -25°C and -35°C. A tension test was performed at an elongation rate of 1%/min until fracture once the specimen had reached the required temperature. The tensile strength as a function of the test temperature is the characteristic result of this test. Figure 2 shows a diagram of the UTST.

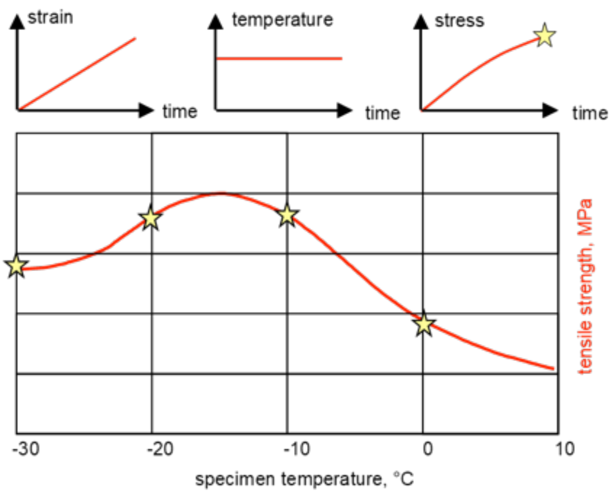


Figure 2: UTST diagram

Derivation of the tensile strength reserve

It is possible to derive the so-called tensile strength reserve from the difference between the tensile strength and the cryogenic stresses. Depending on temperature, it describes the traffic load stresses which, in addition to the temperature-related (cryogenic) stresses, can also be absorbed before the material fails due to fracture (Aarand et al., 1984). The derivation of the tensile strength reserve is shown in Figure 3.

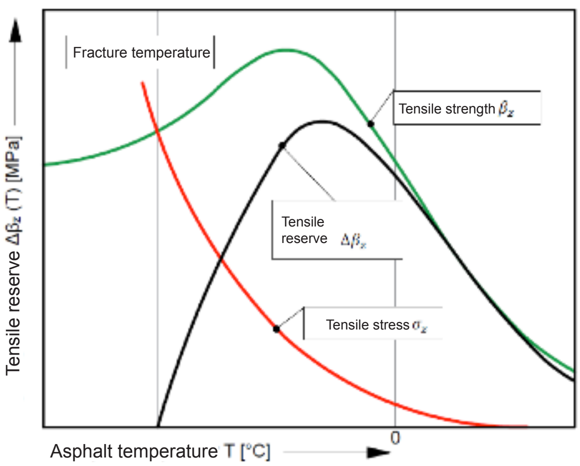


Figure 3: Tensile strength reserve

Resistance to permanent deformation

European standardisation defines several methods for determining resistance to permanent deformation. Three methods were used to determine the properties of **Viacore**.

Wheel-tracking test (WTT)

The wheel-tracking test, as set out in EN 12697-22, examines asphalt slabs using a loaded wheel that is moved repeatedly across the slabs at a constant temperature. The resulting wheel track is decisive to resistance against deformation.

The test was carried out in accordance with EN 13108-20, Table D.1, Reference Number D.1.6, i.e. with the device with small wheel in air at + 60°C across 20,000 load cycles. The proportional rut depth ($PRD_{Luft/air}$) after 10,000 load cycles is stated as the average value from two tested slabs.

Uniaxial cyclic compression test (UCCT)

European product standards specify that the UCCT as set out in EN 12697-25 must be used to test mastic asphalt (MA). This method was, however, also used for **Viacore** to further investigate deformation behaviour.

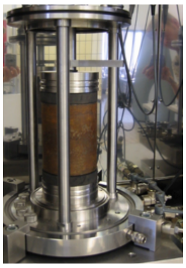
Cylindrical test specimens with diameters of 150 millimetres and heights of 60 millimetres were tested in accordance with EN 13108-20, Table D.5, Reference Number D.5.4, i.e. at +50°C for at least 5,000 load cycles (Haversine-form load curve) with a load phase of 875 N over 0.2 seconds and a load pause of 200 N over 1.5 seconds. Additional testing was also performed at +40°C.

The result is the permanent axial deformation in millimetres after 2,500 and 5,000 load cycles as the average from three individual tests.

Triaxial cyclic compression test (TCCT)

The TCCT as set out in EN 12697-25 tests cylindrical specimens possessing diameters of 100 millimetres and heights of 200 millimetres in accordance with EN 13108-20, Table D.2, Reference Number D.2.2, i.e. at +50°C for 25,000 load cycles (sinusoidal) at an amplitude of 300 kPa and a static side pressure of 150 kPa with a frequency of three hertz.

This test produces the dynamic creep curve, i.e. the permanent axial expansion over the number of load changes. The characteristic value is stated as the creep rate f_c in the quasilinear range of the creep curve as the average value from three individual tests.



As an example, Figure 4 shows a photo of the triaxial cell with fitted blind body and Figure 4.1 shows a diagram of the TCCT with the load type where σa(t) describes the sinusoidal axial load and σc the constant lateral pressure.

Figure 4: Photo of the triaxial cell

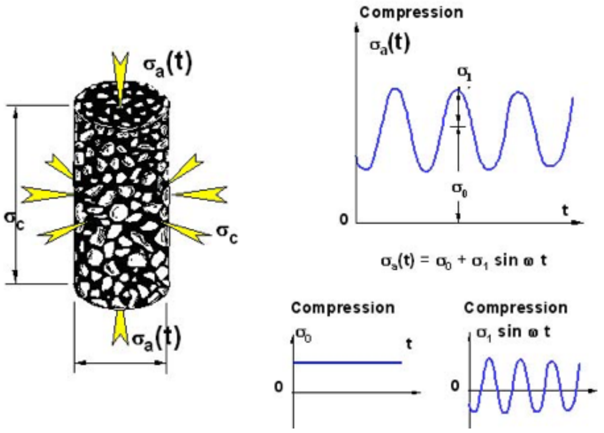


Figure 4.1: TCCT diagram

Performance of Viacore

Cold behaviour

TSRST and UTST were carried out on **Viacore** AC 8. Three individual TSRSTs were carried out and three individual UTSTs were also carried out at each temperature.

Figure 5 shows the TSRST results. It depicts the progression of the cryogenic stresses across the temperature. The individual tests are shown in colour, the average value is shown in black and the average value +/- standard deviation is represented by the dotted line. An average rounded fracture temperature of -38°C is produced, which corresponds to the highest category of $TSRST_{max-30.0}$ in accordance with EN 13108-30.Figure 5.1 shows the results from the individual TSRSTs and UTSTs in grey. The average-value curve from the TSRST is shown in blue and the tensile strength regression over time from the UTST is shown in red. The green curve represents the tensile strength reserve, with the maximum occurring at -19°C and 1.95 N/mm².

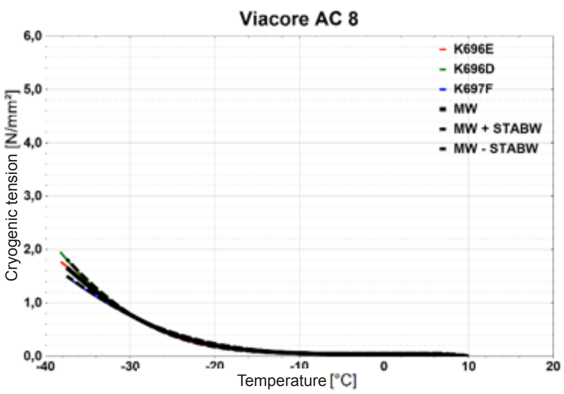


Figure 5: Progression of cryogenic stresses across the temperature in the TSRST

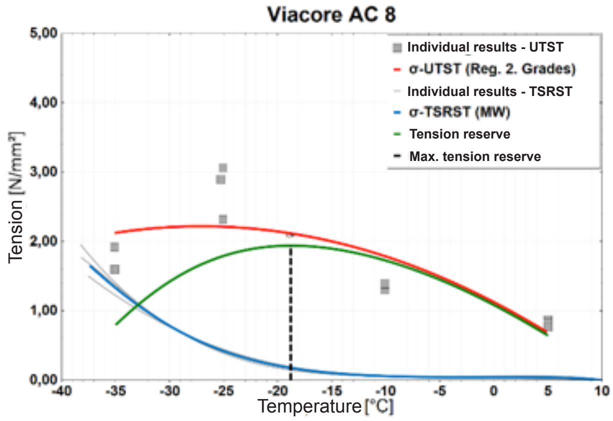


Figure 5.1: UTST and TSRST summary

Resistance to permanent deformation

Wheel-tracking tests (WTT) were carried out on **Viacore** AC 11. Figure 6 shows the development of the rut depth over the load cycles for both slabs as well as the average value. The wheel-tracking test produces an average proportional rut depth of 4.1%, which corresponds to a category of $PRD_{LUFTmax5.0}$ in accordance with EN 13108-1.

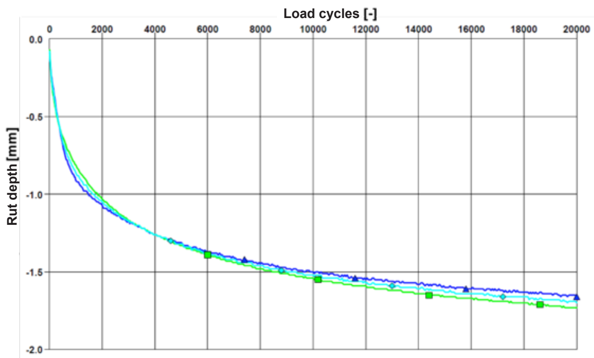


Figure 6: Result of the wheel-tracking test on Viacore AC 11

Uniaxial cyclic compression tests (UCCT) were carried out on **Viacore** AC 8. Figure 7 shows the results as permanent axial deformation after 2,500 and 5,000 load cycles at +40°C on the left and at +50°C on the right. The result is the average value from three individual tests. A permanent deformation of 1.8 millimetres was apparent after 2,500 load cycles or 1.9 millimetres after 5,000 load cycles at +50°C. This corresponds to a category of $U_{2500\ max\ 2.0}$ and $U_{5000\ max\ 2.0}$ in accordance with EN 13108-6.

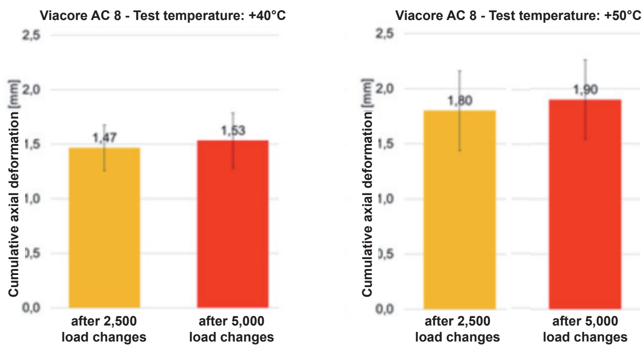


Figure 7: The results from the UCCT on Viacore AC 8 at a test temperature of +40°C (left) and +50°C (right)

Triaxial cyclic compression tests (TCCT) were performed on **Viacore** AC 11. Figure 8 shows the results in the form of the dynamic creep curve.

The coloured curves in turn depict individual tests, the black curves show averages, including standard deviation. The average creep rate f_c is 0.4. Which corresponds to a category $f_{c\,max0.4}$ in accordance with EN 13108-1.

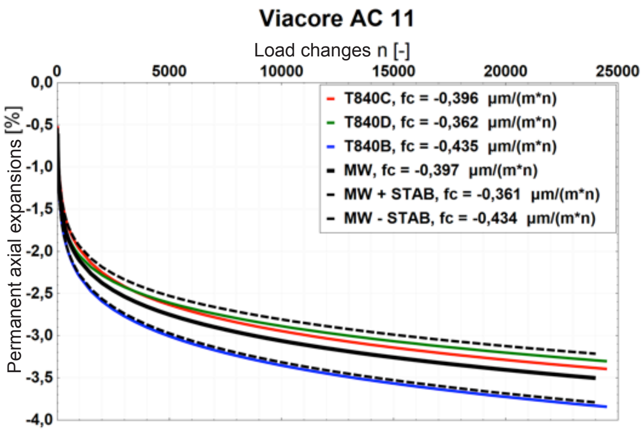


Figure 8: TCCT results for Viacore AC 11

AARAND, W., STEINHOFF, G., EULITZ, J. & MILBRADT, H. 1984. Verhalten von Asphalten bei tiefen Temperaturen; Entwicklung und Erprobung eines Prüfverfahrens (Behaviour of asphalt at low temperatures; development and testing of a test method); Forschung Straßenbau und Straßenverkehrstechnik (Road Construction and Road Traffic Technology Research), Bonn, Germany.

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Summary

A CE-compliant ultra-temperature-lowered asphalt **Viacore** that also meets the requirements set out in EN 13108 Part 1 (Asphalt Concrete), Part 2 (Asphalt Concrete for Very Thin Layers), Part 4 (Hot Rolled Asphalt), Part 5 (Stone Mastic Asphalt) and Part 7 (Porous Asphalt) has been made available for the first time in Europe.

Viacore asphalt is associated with a very low CO_2 footprint in relation to other asphalts due to minimal emissions during production and paving. The use of renewable raw materials in the binder makes **Viacore** a particularly 'green' product.

It is easily possible to work with the product (paving and compaction) at ambient temperature as well as in the most unfavourable of weather conditions. **Viacore** asphalt does not only meet the requirements set out in EN 13108 – Parts 1, 2, 4, 5, 7, it is simultaneously also highly stable with excellent behaviour at low temperatures.

The tests carried out on **Viacore** using the performance-oriented approach underline the long service life (heat and cold) that the new type of asphalt is able to achieve. This produces countless applications in which the special properties come fully into their own.

The CE-compliant **Viacore** asphalt is now available in containers and big bags.