The continual increase in road transport produces an inevitable process of degradation of road pavements. As a result, the considerable maintenance problems arising from this degradation assume the proportions of a real emergency because of their repercussions both in economic terms and with regard to road safety.

Italian legislation assigns precise personal, civil and penal liability to managers at provincial, municipal and autostrada company level, for accidents which occur through poor or nonexistent maintenance of the roads under their control. This gives rise to a large increase in the insurance costs of the responsible bodies and an incentive to reduce maintenance costs in the longer term.

In the last ten years, since Judgement no. 156 of 10 May 1999 by the Constitutional Court, the direction taken by magistrates has changed, with decisions establishing, for example, that roads forming part of urban territory are "under the custody" of the owner of the road, implying that, in the event of an accident, the onus of proving unlawful conduct on the part of the municipal administration is no longer on the injured party: civil liability is now assigned to municipalities, and penal liability to the mayor and technical staff of the competent department, who must demonstrate that they have taken all necessary measures to avoid damage.
The continual increase in road transport produces an inevitable process of degradation of road pavements. As a result, the considerable maintenance problems arising from this degradation assume the proportions of a real emergency because of their repercussions both in economic terms and with regard to road safety.

Mechanisms causing degradation of the road pavement
The principal mechanisms causing degradation of the road pavement can be summed up under the following headings:
- fatigue cracking
- rutting
- reflection cracking.

Fatigue cracking is indicated by an extensive web of cracks affecting the road surface, and is manifested when the pavement is subjected to repeated cycles of loading. Rutting consists of longitudinal furrows along the lines most travelled by the wheels, and is due to an accumulation of permanent deformations which can be initiated by plastic deformation of the bonded layers or by subsidence of the unbonded layers.

A typical example of reflection cracking is the cracks which appear in the bituminous conglomerate pavement of airport runways at the joints between the underlying concrete slabs, caused by differential subsidence of the latter under the heavy load of aircraft wheels.

Restoration of the carrying capacity
Restoration of the carrying capacity of road superstructures is the commonest reason for intervention at all levels, from autostradas to urban streets managed by local authorities. Maintenance of a road pavement normally consists of laying one or more layers (generally of bituminous conglomerate) after removing the damaged existing material by milling.

The need to optimise intervention costs, combined with the difficulties usually encountered in completely removing the superstructure and the necessity of not damaging the existing levels of drivable surface, have given rise over time to a growing interest in and consensus in favour of the application of reinforcement systems in the form of various kinds of mesh.

This is confirmed by the numerous international research projects (e.g. RILEM TC SIB-237/TG4) which are currently in progress. These initiatives are all directed at providing responses, from a scientific point of view, on the potential and benefits deriving from the application of reinforcing elements to combat the principal mechanisms causing degradation of road pavements. There is in fact a unanimous consensus for the belief that, through the correct use of reinforcement systems, it is possible to obtain a reduction in costs as a result of prolonging the useful life of road pavements.

The pumping effect
On the basis of past experience and an analysis of the problems encountered, it was decided to design a high-performance geocomposite, capable of combining the reinforcing function conferred by a glass fibre mesh with the (anti-pumping) waterproofing function performed by a geomembrane. In practice, it had been observed that cracks in the bonded layers produce accelerated deterioration of the pavement because of the infiltration of water into the unbonded layers below. The passage of vehicles, in particular, makes the water and fine-grained material rise (pumping effect – Fig. 1), causing the progressive collapse of the loadbearing structure and the consequent subsidence of the road surface.

The use of this new generation of high-performance geocomposites achieves the objective of making it possible to design a new stratigraphy for road pavements whose purpose is to allow both a saving in the thickness of the bonded layers and the creation of a structure with better performance and greater durability.

**Figure 1. PUMPING EFFECT**

1. Unbonded layer
2. Bituminous conglomerate
3. Damaged wear layer
Research
In order to optimise the characteristics of a high-performance geocomposite, the company INDEX has financed a programme of experimental research conducted under the guidance of Prof. Francesco Canestrari of the Marche Polytechnic University at Ancona, Italy. This study investigated the composition, among various available alternatives, of the bitumen-polymer mix of the geomembrane, and the type and position of the glass fibre reinforcing mesh. In particular, the laboratory investigation had as its object the characterisation of the performance of various geocomposites through the performance analysis of a double-layer system with the membrane embedded in a traditional closed bituminous conglomerate characterised by the presence of different types of interface. The variables analysed made it possible to evaluate the influence of different types of interface (varying with the physical, geometrical and dimensional properties of the glass fibre mesh, the geomembrane and the laying method used), by the use of advanced test protocols capable of investigating the behaviour in shear (Fig. 2), under dynamic bending (Fig. 3) and under static bending (Fig. 4) of the double-layer bituminous system.

The experiment, which was conducted using the above-mentioned latest-generation equipment, was designed with the objective of evaluating the benefit deriving from the use of a geocomposite in a pavement, through the joint evaluation of the following performances:

- resistance to reflection cracking and to traction stresses induced by bending in the superstructure;
- verification of the maintenance of adequate levels of shear continuity at the interface.

On the basis of the results obtained in the course of the experiments, it was possible to predict the performance level for the products investigated in the case of road applications at real scale.

Summary of the main results of the experiment
The geocomposite which emerged from the research, called AUTOTENE ASFALTICO ANTIPUMPING HE/TVP, can be thought of for all practical purposes as the synergistic union between a geogrid and a SAMI (Stress Absorbing Membrane Interlayer) geomembrane. The waterproofing geomembrane protects the lower layers from water penetration and the upper layers from the phenomenon of pumping, preventing the water and fine material from rising as a result of the "pumping" due to vehicular traffic. It also prevents the phenomenon of reflection of cracks and thermal cracking. As regards the function of the SAMI, note that field research conducted by Carl L. Monismith, one of the greatest world experts on roads, led to the conclusion that a 5 cm wear layer laid over a SAMI elastomeric membrane of 2.5 mm thickness (which coincides with the thickness of AUTOTENE ASFALTICO ANTIPUMPING HE/TVP), spread over an old cracked pavement, corresponds to a wear layer of 19 cm. It has been established that a 5 cm wear layer, laid without SAMI on an old cracked pavement, reflects the surface cracks after less than two years, whereas the same layer with SAMI has a life expectancy of more than ten years.

The reinforcing geogrid contributes to the absorption of the tensions and deformations induced inside the pavement by the vehicular and environmental loads, reducing the tension/deformation state of the individual layers that make up the superstructure and consequently prolonging the useful life of the pavement. In the course of the research, the type of reinforcement was the subject of particular attention, in order to identify, for a given mechanical strength, the best geometry for the reinforcement. The image below (Fig. 5) demonstrates that the resistance to repeated mechanical loads of the 12.5×12.5 mm geogrid of AUTOTENE ASFALTICO ANTIPUMPING HE/TVP is considerably superior to that of a comparable geocomposite, of equal strength but reinforced with a geogrid with a 5×5 mm mesh.

Application method and fields of use
Experimental research and on-site experience have confirmed that the geocomposite AUTOTENE ASFALTICO ANTIPUMPING HE/TVP, acting as reinforcement, contributes to slowing down the formation of holes and superficial cracks in bituminous conglomerate pavements, at the same time waterproofing the underlying layers in order to avoid water and fine-grained material rising (pumping effect). The materials, experimentally optimised, used for the manufacture of the geocomposite consist of a geomembrane made up of a continuous-phase elastomer and distilled bitumen. The membrane is durable and resistant to the heat of the hot-spread bituminous conglomerate, and is reinforced with a non-woven polyester fabric coupled to a special composite reinforcement consisting of a glass fibre mesh. The coupling of this mesh with the geomembrane, which performs the waterproofing function, endows the pavement with high resistance to reflection cracking, and in addition enables it to reduce the stresses induced by traffic, consequently prolonging its useful life. To facilitate perfect laying, AUTOTENE ASFALTICO ANTIPUMPING HE/TVP is provided with a heat-self-adhesive treatment to increase its adhesion as a result of the heat of the bituminous conglomerate during laying, and of the action of traffic in operation and solar radiation. Operationally, the geocomposite is applied dry to the road pavement (with 60 mm overlaps between contiguous elements), after removal of the siliconised protective sheet resulting from the auto-thermo-adhesive treatment. The upper surface of the geocomposite is protected by a thin mineral layer which means that during work on site it can be driven over by site vehicles. This layer is later incorporated into the upper layer by the hot-spread bituminous conglomerate. Final adhesion to the laying surface is effected by the subsequent operations of hot-spreadng the bituminous conglomerate layer.

AUTOTENE ASFALTICO ANTIPUMPING HE/TVP is compatible with all types of bituminous conglomerate, it is totally recyclable within the processing cycle of the bituminous conglomerate itself, and is easily removed during the operation of milling the wear surface. It has been demonstrated by experimental studies and by application on site that the use of this geocomposite is effective both in repair work to existing roads (e.g., reinforcing or widening the carriageway), and in the construction of new pavements which will be subjected to high volumes of commercial vehicles.
Repairs to existing cracked pavement
Typical repair applications include laying AUTOTENE ASFALTICO ANTIPUMPING HE/TVP under a layer of bituminous conglomerate (draining or otherwise) of a minimum thickness of 4 cm (case D - page 8).

Repairs to existing cracked pavement (milled)
In the case of repairing existing pavements, the geocomposite can also be laid over a surface of milled bituminous conglomerate. This requires the application of a special primer ECOVER ANTIPUMPING (case B - page 6).

Repairs to pavement with reprofiling
If, after milling, the remaining thickness of the bonded layers is insufficient or too irregular, it will be necessary to perform a reprofiling with bituminous conglomerate with a maximum particle diameter of 10 mm for at least 2 cm of thickness (case C - page 7).

Repairs to pavement (with total milling)
When the geocomposite forms part of a new stratigraphy, or in the case of resurfacing with complete demolition of the bonded layers, it should be positioned below a layer of bituminous conglomerate at least 4 cm in thickness, or ideally of greater thickness, in order to protect it from subsequent milling of the wear surface, and in any event it should be positioned above a layer of conglomerate (case E - page 9).

AUTOTENE ASFALTICO ANTIPUMPING HE/TVP can also be used to advantage for protecting joints in the case of widening the carriageway, and for reinstating the carriageway over trenches cut for repairing underground services (case E - page 9; case F - page 10; case G - page 12).
Reinforcing and waterproofing a new road pavement by laying, at the interface between layers of hot-spread bituminous conglomerate, a reinforced geocomposite of type AUTOTENE ASFALTICO ANTIPUMPING HE/TVP. This geocomposite consists of a prefabricated elastomeric heat-self-adhesive antipumping geomembrane, whose adhesion is activated by the heat of the upper layer of hot-spread bituminous conglomerate, based on distilled bitumen and elastomeric polymers, with composite reinforcement consisting of a geogrille woven in glass fibre (mesh size 12.5 x 12.5 mm) and high-strength non-woven polyester fabric, with its lower face heat-self-adhesive, protected by a siliconised film and its upper face covered with a fine mineral layer.

The geocomposite has the following characteristics: thickness 2.5 mm (EN 1849-1); resistance to compaction of the bituminous conglomerate (EN 14692); impermeability to a pressure of 500 kPa (EN 14694); resistance to traction L/T of 40 kN/m (EN12311-1); elongation to break L/T of 4% (EN12311-1); shear resistance $\geq 0.30$ N/mm$^2$ (EN 13653).

The double-layer system in bituminous conglomerate reinforced with this geocomposite is characterised, finally, by a peak shear resistance at the interface measured by the ASTRA (UNI/TS 11214/2007) test as $\geq 0.30$ MPa ($T = 20^\circ$C; normal force $F = 0.2$ MPa).

The geocomposite is laid directly on the new layer of bituminous conglomerate without a binding coat, with the sheets arranged along the direction of travel in the case of reinforcement of a standard road carriageway, or in a radial direction in the case of reinforcement of roundabout intersections. The sheets are laid with a longitudinal overlap of 6 cm along the overlap strip provided on the upper face, and a transverse overlap of 10 cm at the ends of the sheets. After laying, the siliconised film protecting the lower face and the siliconised strip protecting the longitudinal overlap zone of the upper face are removed, and the geocomposite is pressed together sufficiently to promote adhesion. Subsequently the material is covered with layers of hot-spread bituminous conglomerate to a total thickness of at least 4 cm; the wear layer can be of closed or draining type.
Reinforcing and waterproofing an old road pavement by applying to the milled surface a reinforced geocomposite of type AUTOTENE ASFALTICO ANTIPUMPING HE/TVP.

This geocomposite consists of a prefabricated elastomeric heat-self-adhesive antipumping geomembrane, whose adhesion is activated by the heat of the upper layer of hot-spread bituminous conglomerate, based on distilled bitumen and elastomeric polymers, with composite reinforcement consisting of a geogrid woven in glass fibre (mesh size 12.5 x 12.5 mm) and high-strength non-woven polyester fabric, with its lower face heat-self-adhesive, protected by a siliconised film and its upper face covered with a fine mineral layer.

The geocomposite has the following characteristics: thickness 2.5 mm (EN 1849-1); resistance to compaction of the bituminous conglomerate (EN 14692); impermeability to a pressure of 500 kPa (EN 14694); resistance to traction L/T of 40 kN/m (EN12311-1); elongation to break L/T of 4% (EN12311-1); shear resistance \( \geq 0.30 \) N/mm\(^2\) (EN 13653).

The double-layer system in bituminous conglomerate reinforced with this geocomposite is characterised, finally, by a peak shear resistance at the interface measured by the ASTRA (UNI/TS 11214/2007) test as \( \geq 0.30 \) MPa (T = 20°C; normal force 0.2 MPa).

In the case of reinstatement of the milled pavement the geocomposite may be laid directly on the milled layer if the residual thickness of the underlying bituminous conglomerate is at least 4 cm. After reinstating, where necessary, the flatness of the milled surface (e.g. by filling holes with bituminous conglomerate, partial reprofiling etc.) and after cleaning with mechanical brushes, a binding coat is laid consisting of a bituminous emulsion of type ECOVER ANTIPUMPING, containing elastomeric resins and additives, suitable for laying the antipumping geocomposite. This bituminous emulsion is characterised by a dry residue (UNI EN ISO 3251) of 35% and a DIN 4 cup viscosity at 20°C (UNI EN ISO 2431) of 20-30 s. The binding coat is applied by spreading this bituminous emulsion over the dry surface at the rate of 0.5 kg/m\(^2\). The next step is to apply the geocomposite, after the binding coat has had time to dry as per the product specification.

The geocomposite is applied to the milled surface which has been treated with bituminous emulsion, with the sheets arranged along the direction of travel in the case of reinforcement of a standard road carriageway, or in a radial direction in the case of reinforcement of roundabout intersections. The sheets are laid with a longitudinal overlap of 6 cm along the overlap strip provided on the upper face, and a transverse overlap of 10 cm at the ends of the sheets. After laying, the siliconised film protecting the lower face and the siliconised strip protecting the longitudinal overlap zone of the upper face are removed, and the geocomposite is pressed together sufficiently to promote adhesion. Subsequently the material is covered with layers of hot-spread bituminous conglomerate to a total thickness of at least 4 cm; the wear layer can be of closed or draining type.
Reinforcing and waterproofing an old road pavement by applying, to the reprofiling layer in hot bituminous conglomerate, a reinforced geocomposite of type AUTOTENE ASFALTICO ANTIPUMPING HE/TVP.

This geocomposite consists of a prefabricated elastomeric heat-self-adhesive antipumping geomembrane, whose adhesion is activated by the heat of the upper layer of hot-spread bituminous conglomerate, based on distilled bitumen and elastomeric polymers, with composite reinforcement consisting of a geogrid woven in glass fibre (mesh size 12.5 x 12.5 mm) and high-strength non-woven polyester fabric, with its lower face heat-self-adhesive, protected by a siliconised film and its upper face covered with a fine mineral layer.

The geocomposite has the following characteristics: thickness 2.5 mm (EN 1849-1); resistance to compaction of the bituminous conglomerate (EN 14692); impermeability to a pressure of 500 kPa (EN 14694); resistance to traction \( L/T \) of 40 kN/m (EN12311-1); elongation to break \( L/T \) of 4% (EN12311-1); shear resistance \( \geq 0.30 \) N/mm² (EN 13653). The double-layer system in bituminous conglomerate reinforced with this geocomposite is characterised, finally, by a peak shear resistance at the interface measured by the AASTRA (UNI/TS 11214/2007) test as \( \geq 0.30 \) MPa (T = 20°C; normal force \( f_r = 0.2 \) MPa).

If, following milling of the old road pavement, the residual thickness of the existing milled bituminous conglomerate proves to be insufficient (< 4 cm), a reprofiling layer in bituminous conglomerate (Dmax = 10 mm) must be created, with a thickness of at least 2 cm. This reprofiling layer is laid after reinstating, where necessary, the flatness of the milled surface (e.g. by filling holes with bituminous conglomerate, partial reprofiling etc.), and after applying a binding coat consisting of a bituminous emulsion of type ECOVER ANTIPUMPING, containing elastomeric resins and additives. This bituminous emulsion is characterised by a dry residue (UNI EN ISO 3251) of 35% and a DIN 4 cup viscosity at 20°C (UNI EN ISO 2431) of 20-30 s. The binding coat is applied by spreading this bituminous emulsion over the dry surface at the rate of 0.5 kg/m². The next step is to lay the reprofiling layer, after the binding coat has had time to dry as per the product specification.

The geocomposite is laid directly onto the reprofiling layer without a binding coat, with the sheets arranged along the direction of travel in the case of reinforcement of a standard road carriageway, or in a radial direction in the case of reinforcement of roundabout intersections. The sheets are laid with a longitudinal overlap of 6 cm along the overlap strip provided on the upper face, and a transverse overlap of 10 cm at the ends of the sheets. After laying, the siliconised film protecting the lower face and the siliconised strip protecting the longitudinal overlap zone of the upper face are removed, and the geocomposite is pressed together sufficiently to promote adhesion. Subsequently the material is covered with layers of hot-spread bituminous conglomerate to a total thickness of at least 4 cm; the wear layer can be of closed or draining type.
Reinforcing and waterproofing an old road pavement by applying to the existing cracked surface a reinforced geocomposite of type AUTOTENE ASFALTICO ANTIPUMPING HE/TVP.

This geocomposite consists of a prefabricated elastomeric heat-self-adhesive antipumping geomembrane, whose adhesion is activated by the heat of the upper layer of hot-spread bituminous conglomerate, based on distilled bitumen and elastomeric polymers, with composite reinforcement consisting of a geogrille woven in glass fibre (mesh size 12.5 x 12.5 mm) and high-strength non-woven polyester fabric, with its lower face heat-self-adhesive, protected by a siliconised film and its upper face covered with a fine mineral layer.

The geocomposite has the following characteristics: thickness 2.5 mm (EN 1849-1); resistance to compaction of the bituminous conglomerate (EN 14692); impermeability to a pressure of 500 kPa (EN 14694); resistance to traction L/T of 40 kN/m (EN12311-1); elongation to break L/T of 4% (EN12311-1); shear resistance ≥0.30 N/mm² (EN 13653).

The double-layer system in bituminous conglomerate reinforced with this geocomposite is characterised, finally, by a peak shear resistance at the interface measured by the ASTRA (UNI/TS 11214/2007) test as ≥0.30 MPa (T = 20°C; normal force = 0.2 MPa).

If the road surface is in fair condition, such as not to require removal of the layer, and there are no height restrictions for the new carriageway surface, the geocomposite can be laid directly on the old road surface provided that the thickness of the underlying bituminous conglomerate is at least 4 cm.

After reinstating, where necessary, the flatness of the existing surface (e.g. by filling holes with bituminous conglomerate, partial reprofiling etc.) and after cleaning with mechanical brushes, the geocomposite is laid on the cleaned and dry old pavement, an assessment being made in each case of the need to apply a binding coat.

The geocomposite is applied to the existing surface with the sheets arranged along the direction of travel, in the case of reinforcement of a standard road carriageway, or in a radial direction in the case of reinforcement of roundabout intersections. The sheets are laid with a longitudinal overlap of 6 cm along the overlap strip provided on the upper face, and a transverse overlap of 10 cm at the ends of the sheets. After laying, the siliconised film protecting the lower face and the siliconised strip protecting the longitudinal overlap zone of the upper face are removed, and the geocomposite is pressed together sufficiently to promote adhesion. Subsequently the material is covered with layers of hot-spread bituminous conglomerate to a total thickness of at least 4 cm; the wear layer can be of closed or draining type.
Reinforcing and waterproofing a road pavement affected by excavations for repairing/installing underground services, by laying at the interface between layers of bituminous conglomerate a reinforced geocomposite of type AUTOTENE ASFALTICO ANTIPUMPING HE/TVP.

This geocomposite consists of a prefabricated elastomeric heat-self-adhesive antipumping geomembrane, whose adhesion is activated by the heat of the upper layer of hot-spread bituminous conglomerate, based on distilled bitumen and elastomeric polymers, with composite reinforcement consisting of a geogrid woven in glass fibre (mesh size 12.5 x 12.5 mm) and high-strength non-woven polyester fabric, with its lower face heat-self-adhesive, protected by a siliconised film and its upper face covered with a fine mineral layer. The geocomposite has the following characteristics: thickness 2.5 mm (EN 1849-1); resistance to compaction of the bituminous conglomerate (EN 14692); impermeability to a pressure of 500 kPa (EN 14694); resistance to traction L/T of 40 kN/m (EN12311-1); elongation to break L/T of 4% (EN12311-1); shear resistance $\geq 0.30$ N/mm² (EN 13653). The double-layer system in bituminous conglomerate reinforced with this geocomposite is characterised, finally, by a peak shear resistance at the interface measured by the ASTRA (UNI/TS 11214/2007) test as $0.30$ MPa (T = 20°C; normal force $0.2$ MPa). The pavement over the trench must be milled over a surface area 50 cm wider (25 cm per side) than the zone affected by the excavation, and to a depth equal to the thickness of the layers of bituminous conglomerate which will be constructed over the geocomposite. In this way the site is constructed for the subsequent application of the geocomposite. Following the work to repair/install the underground services, a layer of bituminous conglomerate is laid over the zone affected by the excavations with, a minimum thickness of 4 cm. Subsequently the geocomposite is positioned in such a way that it overflows onto the existing milled bituminous conglomerate surface in order to discourage reflection of the crack at the joint between the old and new layers of bituminous conglomerate. After cleaning with mechanical brushes, the milled perimeter strip will be treated with a binding coat consisting of a bituminous emulsion of type ECOVER ANTIPUMPING, containing elastomeric resins and additives. This bituminous emulsion is characterised by a dry residue (UNI EN ISO 3251) of 35% and a DIN 4 cup viscosity at 20°C (UNI EN ISO 2431) of 20-30 s. The binding coat is applied by spreading this bituminous emulsion over the dry surface at the rate of 0.5 kg/m². The next step is to spread the geocomposite, after the binding coat has had time to dry as per the product specification. The geocomposite therefore ends up being applied to the new layer of bituminous conglomerate over the area of the excavation without a binding coat, and overflows onto the prepared site around the perimeter which has been pretreated with a binding coat. The sheets are laid with a longitudinal overlap of 6 cm along the overlap strip provided on the upper face, and a transverse overlap of 10 cm at the ends of the sheets. After laying, the siliconised film protecting the lower face and the siliconised strip protecting the longitudinal overlap zone of the upper face are removed, and the geocomposite is pressed together sufficiently to promote adhesion. Subsequently the material is covered with layers of hot-spread bituminous conglomerate to a total thickness of at least 4 cm; the wear layer can be of closed or draining type.
When widening the roadbase, it is advisable to make provision for the reinforcement and waterproofing of the pavement of the new carriageway, which is destined to take heavy traffic, and of the joint which is created with the old adjacent pavement. This function is performed by laying at the interface between layers of bituminous conglomerate a reinforced geocomposite of type AUTOTENE ASFALTICO ANTIPUMPING HE/TVP.

This geocomposite consists of a prefabricated elastomeric heat-self-adhesive antipumping geomembrane, whose adhesion is activated by the heat of the upper layer of hot-spread bituminous conglomerate, based on distilled bitumen and elastomeric polymers, with composite reinforcement consisting of a geogrid woven in glass fibre (mesh size 12.5 x 12.5 mm) and high-strength non-woven polyester fabric, with its lower face heat-self-adhesive, protected by a siliconised film and its upper face covered with a fine mineral layer.

The geocomposite has the following characteristics: thickness 2.5 mm (EN 1849-1); resistance to compaction of the bituminous conglomerate (EN 14692); impermeability to a pressure of 500 kPa (EN 14694); resistance to traction L/T of 40 kN/m (EN12311-1); elongation to break L/T of 4% (EN12311-1); shear...
resistance ≥0.30 N/mm² (EN 13653). The double-layer system in bituminous conglomerate reinforced with this geocomposite is characterised, finally, by a peak shear resistance at the interface measured by the ASTRA (UNI/TS 11214/2007) test as ≥0.30 MPa (T = 20°C; normal force σ = 0.2 MPa).

In order to provide a site for laying the geocomposite along the joint between old and new pavement, an area of the old pavement should be milled at the preparatory stage, at least 25 cm wide, to a depth which equates to the correct height for positioning the geocomposite. After cleaning with mechanical brushes, the milled area will be treated with a binding coat consisting of a bituminous emulsion of type ECOVER ANTIPUMPING, containing elastomeric resins and additives. This bituminous emulsion is characterised by a dry residue (UNI EN ISO 3251) of 35% and a DIN 4 cup viscosity at 20°C (UNI EN ISO 2431) of 20-30 s. The binding coat is applied by spreading this bituminous emulsion over the dry surface at the rate of 0.5 kg/m². The next step is to spread the geocomposite on the new pavement and on the old milled surface, after the binding coat has had time to dry as per the product specification.

On the bitumen-bonded base layer of the new carriageway, the geocomposite is applied directly without a binding coat, with the sheets arranged along the direction of travel so that they overflow onto the joint area, pretreated with the binding coat, formed in the old adjacent pavement. The sheets are laid with a longitudinal overlap of 6 cm along the overlap strip provided on the upper face, and a transverse overlap of 10 cm at the ends of the sheets. After laying, the siliconised film protecting the lower face and the siliconised strip protecting the longitudinal overlap zone of the upper face are removed, and the geocomposite is pressed together sufficiently to promote adhesion. Subsequently the material is covered with layers of hot-spread bituminous conglomerate to a total thickness of at least 4 cm; the wear layer can be of closed or draining type.
When widening the roadbase, provision can be made for reinforcing and waterproofing both the pavement of the new carriageway and the adjacent old pavement by laying reinforced geocomposite of type AUTOTENE ASFALTICO ANTIPUMPING HE/TVP.

This geocomposite consists of a prefabricated elastomeric heat-self-adhesive antipumping geomembrane, whose adhesion is activated by the heat of the upper layer of hot-spread bituminous conglomerate, based on distilled bitumen and elastomeric polymers, with composite reinforcement consisting of a geogrille woven in glass fibre (mesh size 12.5 x 12.5 mm) and high-strength non-woven polyester fabric, with its lower face heat-self-adhesive, protected by a siliconised film and its upper face covered with a fine mineral layer.

The geocomposite has the following characteristics: thickness 2.5 mm (EN 1849-1); resistance to compaction of the bituminous conglomerate (EN 14692); impermeability to a pressure of 500 kPa (EN 14694); resistance to traction L/T of 40 kN/m (EN12311-1); elongation to break L/T of 4% (EN12311-1); shear resistance ≥0.30 N/mm² (EN 13653).
The double-layer system in bituminous conglomerate reinforced with this geocomposite is characterised, finally, by a peak shear resistance at the interface measured by the ASTRA (UNI/TS 11214/2007) test as $\geq 0.30$ MPa ($T = 20^\circ$C; normal force $\sigma_0 = 0.2$ MPa).

One possible process specifies that the base layer of the new carriageway should be executed in a lean concrete mix, and that it should terminate at the height of the road surface of the old pavement. In this way, the geocomposite can be applied simultaneously on the new base layer and on the adjacent old pavement, and is covered with layers of hot bituminous conglomerate with a total minimum thickness of 4 cm.

The base layer of the new carriageway in a lean concrete mix must be treated in advance with a binding coat consisting of a bitumen emulsion of type Ecover Antipumping, containing elastomeric resins and additives. This bituminous emulsion is characterised by a dry residue (UNI EN ISO 3251) of 35% and a DIN 4 cup viscosity at 20°C (UNI EN ISO 2431) of 20-30 s. The binding coat is applied by spreading this bituminous emulsion over the dry surface at the rate of 0.5 kg/m². The next step is to spread the geocomposite, after the binding coat has had time to dry as per the product specification.

On the road surface of the adjacent old pavement, after reinstating, where necessary, the flatness of the existing surface (e.g. by filling holes with bituminous conglomerate, partial reprofiling etc.) and after cleaning with mechanical brushes, the geocomposite can be laid without the application of a binding coat.

When laying the geocomposite on the existing pavement, cleaned and dry, and on the adjacent new base layer, the sheets are arranged along the direction of travel. The sheets are laid with a longitudinal overlap of 6 cm along the overlap strip provided on the upper face, and a transverse overlap of 10 cm at the ends of the sheets. After laying, the siliconised film protecting the lower face and the siliconised strip protecting the longitudinal overlap zone of the upper face are removed, and the geocomposite is pressed together sufficiently to promote adhesion. Subsequently the material is covered with layers of hot-spread bituminous conglomerate to a total thickness of at least 4 cm; the wear layer can be of closed or draining type.
AUTOTENE ASFALTICO ANTIPUMPING HE/TVP

Reinforcing and waterproofing a road pavement by laying, at the interface between layers of bituminous conglomerate, a reinforced geocomposite consisting of a prefabricated elastomeric heat-self-adhesive antipumping geomembrane, whose adhesion is activated by the heat of the upper layer of hot-spread bituminous conglomerate, based on distilled bitumen and elastomeric polymers, with composite reinforcement consisting of a geogrid woven in glass fibre (mesh size 12.5×12.5 mm) and high-strength non-woven polyester fabric, with its lower face heat-self-adhesive, protected by a siliconised film and its upper face covered with a fine mineral layer.

The geocomposite has the following characteristics: thickness 2.5 mm (EN 1849-1); resistance to compaction of the bituminous conglomerate (EN 14692); impermeability to a pressure of 500 kPa (EN 14694); resistance to traction L/T of 40 kN/m (EN12311-1); elongation to break L/T of 4% (EN12311-1); shear resistance ≥0.30 N/mm² (EN 13653) and peak shear resistance at the interface measured by the ASTRA (UNI/TS 11214/2007) test as ≥0.30 MPa (T = 20°C; normal force = 0.2 MPa).

ECOVER ANTIPUMPING

Binding coat in the case of laying the reinforcing geocomposite on milled surface, consisting of a bituminous emulsion, containing elastomeric resins and additives, suitable for laying the antipumping membrane, with dry residue (UNI EN ISO 3251) of 35% and a DIN 4 cup viscosity at 20°C (UNI EN ISO 2431) of 20-30 s, spread over a dry surface at the rate of 0.5 kg/m², following cleaning with mechanical brushes.
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• for correct use of our products, see index technical specifications • for further information or special uses, consult our technical office •

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