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### TBM soil conditioning

## Earth Pressure Balance Shield

### CONDITIONING AGENTS

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<th>Description</th>
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<tr>
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<td>(concentrated foaming agent, extra high properties)</td>
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<tr>
<td>FOAMEX EC</td>
<td>(foaming agent and polymer mixture)</td>
</tr>
<tr>
<td>FOAMEX HS</td>
<td>(foaming agent and dispersant)</td>
</tr>
<tr>
<td>FOAMEX VG</td>
<td>(foaming agent and polymer mixture, long lasting foam)</td>
</tr>
<tr>
<td>FOAMEX SXC</td>
<td>(foaming agent glycol free)</td>
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</tbody>
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<table>
<thead>
<tr>
<th>Polymers</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DRILLAM MV</td>
<td>(organic polymer, liquid form);</td>
</tr>
<tr>
<td>CARBOCEL C190</td>
<td>(natural polymer, powder form);</td>
</tr>
<tr>
<td>BIOGEL 5000C</td>
<td>(natural polymer, liquid form);</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Defoamer</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEFOMEX</td>
<td>(liquid form)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Clay treatment</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAMSPERSE HS</td>
<td>(dispersant - liquid form);</td>
</tr>
<tr>
<td>SHIELD CLEANER</td>
<td>(drilling detergent - liquid form)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Superabsorbents</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>LAMSEAL G</td>
<td>(granular form)</td>
</tr>
<tr>
<td>LAMSEAL L</td>
<td>(liquid form)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sealing Greases</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAMSHIELD SAL</td>
<td>(tail seal grease; hydrocarbons free)</td>
</tr>
<tr>
<td>LAMSHIELD SAL-P</td>
<td>(tail seal grease)</td>
</tr>
<tr>
<td>LAMSHIELD DSP</td>
<td>(cost/performing tail seal grease; hydrocarbons free)</td>
</tr>
<tr>
<td>LAMSHIELD FIRSTFILL</td>
<td>(first filling tail seal grease)</td>
</tr>
<tr>
<td>LAMSHIELD HEAD-P</td>
<td>(main bearing labyrinth grease)</td>
</tr>
</tbody>
</table>
**FOAMEX TR**

FOAMEX TR is a high performance liquid foaming agent based on biodegradable anionic surfactants.

FOAMEX TR is biodegradable with minimal environmental impact.

| Application | FOAMEX TR can be used for the preparation of foam for shield tunnelling, giving very stable foam, which is easily injected in low permeability soils. FOAMEX TR is fully compatible with our stabilizing polymers. FOAMEX TR is very easy to handle and to mix in both fresh and brackish waters, even with a high degree of hardness. The use of FOAMEX TR allows tunnelling even in fractured and extremely permeable areas (conglomerated formations) where otherwise there would be a total loss of circulation. Using FOAMEX TR eliminates dust in air drilling. Additionally FOAMEX TR prevents clays from plugging, thus keeping the whole shield face clean. During mucking operations, the presence of FOAMEX TR is useful in order to reduce the friction between soil particles. Moreover the lubrication capacity of the bubbles created with FOAMEX TR minimize the friction of muck particles on the metallic parts of the shield. |
| Treatment | As foaming agent for EPBS: 0.8 – 1.2 % Wherever it is necessary to increase the stability and strength of the foam and the stability of the spoil, it is suggested usage in combination with a stabilizing polymer, such as our CARBOCEL C190 (powder) or BIOGEL 5000 C (liquid). |
| Typical Properties | Appearance: clear homogeneous liquid Specific gravity: about 1.06 pH 1% solution: 5.5 – 9.0 Solubility: completely soluble in water Flammability: not flammable |
| Packaging | 50, 200 kg plastic drums or in 1000 kg plastic tanks. |
| Shelf life, storage | 12 months from the date of dispatch if properly stored in the original sealed containers, protected from precipitations, direct sunlight and in a temperature range between 5 and 40 °C. |
FOAMEX EC is a liquid foaming agent based on biodegradable anionic surfactants and a high efficiency polymer. The foam generated has a high mechanical resistance.

FOAMEX EC is readily water soluble, biodegradable and with minimal environmental impact.

### Application

FOAMEX EC can be used for the preparation of foam for shield tunnelling, giving a very stable foam which is easily injected in every type of soil (acid or basic) with a high permeability (alluvial ground) to a very low permeability (clayed ground).

The use of FOAMEX EC allows tunnelling even in fractured and extremely permeable areas where otherwise there would be a total loss of front shield pressure.

Additionally FOAMEX EC prevents clays from plugging, thus keeping the whole shield face clean. During mucking operations, the presence of FOAMEX EC is useful in order to reduce the friction of muck particles on the metallic parts of the shield.

Moreover the lubrication capacity of the bubbles created with FOAMEX EC minimise the friction between soil particles, reducing the cutter head torque and material density.

FOAMEX EC is an “easy to handled” product being immediately soluble in water (fresh or hard water) and it doesn’t request any mixing device.

In hard rock TBM the usage of FOAMEX EC prevent dust formation and reduce consumption of cutters.

FOAMEX EC can be used in combination with any kind of polymer in order to produce a “stiff foam” with an increased stability and increased lubricating properties.

### Treatment

FOAMEX EC has to be used with dosages from 1.5% to 3%; its FER (Foam Expansion Ratio) is ranging from 10:1 to 50:1 (it is dependant from soil moisture content and foam generator properties).

Lamberti Spa laboratories will run test on ground sample before the start-up to establish the quantity of foam to be injected into the ground (Foam Injection Ratio), and the ratio between air and foaming solution to be used related to the moisture content of ground (Foam Expansion Ratio). These tests are necessary in order to properly condition the ground achieving the plastic status.

Once these parameters are set it will be necessary to make in-field the proper correction related to the different pressure condition existing in the excavation chamber in order to maintain the same ratio between foam and ground (accordingly to Boyle-Mariotte’s law).
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FOAMEX HS

FOAMEX HS is a liquid foaming agent based on biodegradable anionic surfactants and a high efficiency dispersant polymer.

**Application**
- FOAMEX HS can be used for the preparation of foam for shield tunnelling, giving a very stable foam which is easily injected in every type of soil (acid or basic) with a high permeability (alluvial ground) to a very low permeability (clayed ground).
- Additionally FOAMEX HS prevents clays from plugging, reducing the spoil consistency and cutter torque. Advance rate is therefore improved even in clayed ground.
- FOAMEX HS is easy to handle being immediately soluble in water, It is possible to avoid the usage of two chemicals separately like foaming agent and clay dispersant.
- FOAMEX HS help to keep cleaned the cutting tools reducing abrasion.

**Typical Properties**

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appearance</td>
<td>clear homogeneous liquid</td>
</tr>
<tr>
<td>pH 1% solution</td>
<td>7 – 9</td>
</tr>
<tr>
<td>Solubility</td>
<td>completely soluble in water</td>
</tr>
<tr>
<td>Toxicity</td>
<td>not toxic</td>
</tr>
<tr>
<td>Flammability</td>
<td>not flammable</td>
</tr>
</tbody>
</table>

**Packaging**
- 50, 200 kg plastic drums or in 1000 kg plastic tanks

**Shelf life, storage**
- 6 months from the date of dispatch if properly stored in the original sealed containers, protected from precipitations, direct sunlight and in a temperature range between 5 and 40 °C.
- Separation of liquid phase can take place over time, shake or stir appropriately to ensure homogeneity of the product before use.

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FOAMEX VG is a liquid foaming agent based on biodegradable anionic surfactants and innovative polymer that allow to generate an extra long lasting and compacted foam.

**Application**

FOAMEX VG can be used for the preparation of foam for shield tunnelling, giving a very stable foam which is easily injected in soil with low permeability (clayed ground) or in presence of rock that can generate fine particles.

Additionally FOAMEX VG prevents clays from plugging, thus keeping the whole shield face clean. During mucking operations, the presence of FOAMEX VG is useful in order to reduce the friction of muck particles on the metallic parts of the shield and to soften the conditioned mass.

FOAMEX VG minimize dust formation when used in rock formation. It also decreases cutter consumption due to its lubricating and cleaning effect on metal surface.

FOAMEX VG is an “easy to handle” product being immediately soluble in water (fresh or hard water) and it doesn’t request any mixing device.

FOAMEX VG can be used in combination with any kind of polymer in order to produce “stiff foam” with an increased stability and increased lubricating properties.

**Treatment**

FOAMEX VG has to be used with dosages from 1.5% to 3%.

**Typical Properties**

- **Appearance:** liquid
- **pH 1% solution:** 7 approx
- **Solubility:** completely soluble in water
- **Toxicity:** not toxic
- **Flammability:** not flammable

**Packaging**

50, 200 kg plastic drums or in 1000 kg plastic tanks.

Shelf life and storage indication: 12 months from the date of dispatch if properly stored in the original sealed containers, protected from precipitations, direct sunlight and in a temperature range between 5 and 40 °C.
FOAMEX SXC is a liquid foaming agent based on biodegradable anionic surfactants. The foam generated has a high mechanical resistance. FOAMEX SXC is readily water soluble, biodegradable and with minimal environmental impact.

### Application
FOAMEX SXC can be used for the preparation of foam for shield tunnelling, giving a very stable foam which is easily injected in every type of soil (acid or basic) with a high permeability (alluvial ground) to a very low permeability (clayed ground).

The use of FOAMEX SXC allows tunnelling even in fractured and extremely permeable areas where otherwise there would be a total loss of front shield pressure.

Additionally FOAMEX SXC prevents clays from plugging, thus keeping the whole shield face clean. During mucking operations, the presence of FOAMEX SXC is useful in order to reduce the friction of muck particles on the metallic parts of the shield.

Moreover the lubrication capacity of the bubbles created with FOAMEX SXC minimise the friction between soil particles, reducing the cutter head torque and material density.

FOAMEX SXC is an “easy to handled” product being immediately soluble in water (fresh or hard water) and it doesn’t request any mixing device.

In hard rock TBM the usage of FOAMEX SXC prevent dust formation and reduce consumption of cutters.

FOAMEX SXC can be used in combination with any kind of polymer in order to produce a “stiff foam” with an increased stability and increased lubricating properties.

### Treatment
FOAMEX SXC has to be used with dosages from 1.5% to 2.0%; its FER (Foam Expansion Ratio) is ranging from 10:1 to 20:1 (it is dependant from soil moisture content and foam generator properties).

Lamberti Spa laboratories will run test on ground sample before the start-up to establish the quantity of foam to be injected into the ground (Foam Injection Ratio), and the ratio between air and foaming solution to be used related to the moisture content of ground (Foam Expansion Ratio). These tests are necessary in order to properly condition the ground achieving the plastic status.

### Typical Properties
- **Appearance:** liquid
- **pH 1% solution:** 6.0 approx
- **Relative density:** 1.02 kg/l @ 20°C
- **Solubility:** completely soluble in water
- **Flammability:** not flammable

### Packaging
50, 200 kg plastic drums or in 1000 kg plastic tanks

### Shelf life, storage
12 months from the date of dispatch if properly stored in the original sealed containers, protected from precipitations, direct sunlight and in a temperature range between 5 and 40 °C.

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DRILLAM MV

DRILLAM MV is an organic polymer, with a high molecular weight, in liquid form developed for quick and easy preparation of water-based fluids for drilling and civil engineering.

**Application**

DRILLAM MV is an organic polymer, with a high molecular weight, in liquid form developed for quick and easy preparation of water-based fluids for drilling and civil engineering. DRILLAM MV has a stabilizing effect on incoherent or very altered formations. DRILLAM MV furthermore has an encapsulating and an inhibiting effect on active clays. DRILLAM MV has a lubricating effect on drill pipe, reducing torque and drag and eliminating mechanical vibrations.

The use of DRILLAM MV has the following advantages:

- due to its liquid form, it enables a fast fluid preparation and, because of its excellent dispersability, a quick use even without adequate mixing plants;
- it does not form lumps or deposits of unreclaimable polymeric material;
- easy handling due to the reduced dimensions of the kegs, which are easy to transport and to handle;
- excellent cuttings carrying capacity and inhibition of hydratable formations;
- it is non toxic and does not damage the formations.

**Tunnelling:**

DRILLAM MV can be used in addition to our foaming agent range FOAMEX having an excellent stabilizing action on the foam, improving compactness and strength.

The usage of DRILLAM MV, due to its cohesion properties, allow to operate in soil where finer particles (lime, clay) doesn’t allow to homogenize the spoil. Injected as it is, it adsorb water giving compactness to the spoil allowing pressure control through screw conveyor.

**Treatment**

- As water based drilling mud: from 2 to 5 kg for 1 cubic meter of water (already at 4 kg/m³ a viscosity of about 47 seconds is obtained with Marsh Funnel).
- As foam stabilizer: from 1 to 3 kg for 1 cubic meter of foaming solution.

**Typical Properties**

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appearance</td>
<td>white liquid</td>
</tr>
<tr>
<td>Density</td>
<td>1.05 g/cm³ approx.</td>
</tr>
<tr>
<td>pH sol.0.5%</td>
<td>6 - 8.</td>
</tr>
<tr>
<td>Toxicity</td>
<td>not toxic</td>
</tr>
<tr>
<td>Flammability</td>
<td>not flammable</td>
</tr>
</tbody>
</table>

**Packaging**

25, 200 kg plastic drums or in 1000 kg plastic tanks

**Shelf life, storage**

6 months from the date of dispatch if properly stored in the original sealed containers, protected from precipitations, direct sunlight and in a temperature range between 5 and 40 °C. Separation of liquid phase can take place over time, shake or stir appropriately to ensure homogeneity of the product before use.
CARBOCEL C190
CARBOCEL C190 is a natural polymer based on cellulose used as a viscosifier, stabilizing agent and shale inhibitor in fresh or brackish water-based fluids.

### Application
CARBOCEL C190 has an excellent stabilizing action on the foams for EPB Shield tunnelling.

CARBOCEL C190 acts on the foam bubbles, gluing them together, improving foam compactness before, and during, the injection. Moreover, during mucking operations, CARBOCEL C190 improves the stability of the spoil, inhibiting the settling of excavated solids.

CARBOCEL C190 is fully compatible with our FOAMEX range.

In Hydro Shields, because CARBOCEL C190 is a high viscosity product, it can effectively replace bentonite, thus enabling the preparation of fluids with no solids content. Moreover, CARBOCEL C190 has an inhibiting action on swelling clays and can avoid undesirable viscosity increases and fine solids dispersion in the fluid.

Fluids prepared with CARBOCEL C190 have a high lubricating and cooling effect.

CARBOCEL C190 has an excellent tolerance to a variety of ions including Mg++, Ca++, so4=, Cl- and can be used even in highly contaminated grounds (e.g. by spilled oils).

### Treatment
- **For foam stabilizing**, from 0.2 to 1 %.
- **For viscous slurry**, from 0.2 to 0.5 %.

### Typical Properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appearance</td>
<td>whitish, free flowing powder</td>
</tr>
<tr>
<td>Moisture</td>
<td>10 % maximum</td>
</tr>
<tr>
<td>pH sol. 1%</td>
<td>6.0-10</td>
</tr>
<tr>
<td>Marsh Funnel viscosity</td>
<td>min 40 sec (0.4 % in tap water)</td>
</tr>
<tr>
<td>Toxicity</td>
<td>non toxic</td>
</tr>
<tr>
<td>Dispersibility</td>
<td>very good</td>
</tr>
</tbody>
</table>

### Packaging
25 kg multiply paper bags internally polyethyleneed, palletised, wrapped and strapped (40 bags per pallet)

### Shelf life, storage
12 months from the date of dispatch if properly stored in the original sealed containers, protected from precipitations, direct sunlight and in a temperature range between 5 and 40 °C.
**BIOGEL 5000C**

BIOGEL 5000 C is a liquid product based on natural polymer used as a viscosifier, stabilizing agent and shale inhibitor in fresh or brackish water-based fluids. BIOGEL 5000 C is biodegradable. Moreover it is polyacrilamid and hydrocarbons free.

### Application
- BIOGEL 5000 C has an excellent stabilizing action on the foams for EPB Shield tunnelling.
- BIOGEL 5000 C acts on the foam bubbles, gluing them together, improving foam compactness before, and during, the injection.
- BIOGEL 5000 C is fully compatible with our FOAMEX range.
- BIOGEL 5000 C can be injected as antisticking water solution in order to minimize friction, lowering cutter torque and avoiding spoil temperature increase. Spoil become plastic, lubricated and easy to be removed from screw conveyor, belt and muck trucks because it doesn’t remain attached to metal surface.
- Fluid prepared with BIOGEL 5000 C has a high lubricating and cooling effect.
- BIOGEL 5000 C can be injected as it is in the excavation chamber or in the screw in order to absorb free water and increase the plasticity of the spoil. Dosage is dependant from water content and type of soil. Typical dosage is 1 to 5 kg per cubic meter of soil.
- BIOGEL 5000 C has an excellent tolerance to a variety of ions including Mg++, Ca++, so4=, Cl- and can be used even in highly contaminated grounds (e.g. by spilled oils) and prepared with salt or sea water.

### Treatment
- BIOGEL 5000 C is easily to dissolved in water and it doesn’t need high shear mixer.
- As foam stabilizing: from 0.2 to 0.4 % in the water line to foam generators.
- As antisticking water solution: from 0.1 to 0.3 % in water.

### Typical Properties
- Appearance: viscous liquid
- Density: 1.1 – 1.4 kg/l
- Toxicity: non toxic
- Dispersibility: very good

### Packaging
- 25, 200 kg plastic drum or 1000 kg plastic tank

### Shelf life, storage
- 6 months from the date of dispatch if properly stored in the original sealed containers, protected from precipitations, direct sunlight and in a temperature range between 5 and 40 °C.
- Separation of liquid phase can take place over time, shake or stir appropriately to ensure homogeneity of the product before use.
TBM soil conditioning             defoamer

**DEFOMEX**

DEFOMEX is a silicon based defoaming agent, which is used in every type of mud and drilling foams.

<table>
<thead>
<tr>
<th><strong>Application</strong></th>
<th>DEFOMEX has been developed to obtain the best performance with the lowest possible dosages. Moreover DEFOMEX can be used in a broad range of pH and temperatures.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Treatment</strong></td>
<td>The recommended dosage ranges from 0.3 to 1.5 kg/m³ depending on the volume and consistency of the foam. Add directly to the system as a preventive measure to avoid foam formation; to destroy foam after it is formed spray the product, as is, directly onto the foam or spray a solution of the product diluted 1:10 in water.</td>
</tr>
</tbody>
</table>
| **Typical Properties** | Appearance: white liquid  
Specific gravity (20 °C): about 1.0  
Pour point: less than 0°C  
Flammability: not flammable  
pH 1%: 6.0 – 8.0  |
| **Packaging** | 50 kg plastic kegs or 200 kg plastic drums. |
| **Shelf life, storage** | 12 months from the date of dispatch if properly stored in the original sealed containers, protected from precipitations, direct sunlight and in a temperature range between 5 and 40 °C. |

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LAMSPERSE HS is a synthetic polyelectrolyte used in drilling and tunnelling to prevent the aggregation of clay particles by dispersion and avoiding coalescence due to electrostatic effects.

**Application**

LAMSPERSE HS has an immediate breaking action better than polyphosphates.

LAMSPERSE HS completely breaks down any filter cake formed by the action of drilling fluids on oil, gas and water producing formations; it cleans the formation and reduces damage.

Injected on the excavation front or in the pressure chamber, it keep the metal surface clean avoiding clay adhesion and lumps formation.

LAMSPERSE HS allow to reduce the consinstency and stickness of spoil, reducing the cutter torque.

**Treatment**

**Drilling:**

0.1 - 0.6 % in water. Bring the solution to contact the producing layers and leave to soak for about 6-8 hrs. In the stimulation of waterbeds, wash abundantly with water before using the produced water.

**Tunnelling:**

Add the LAMSPERSE HS to the foaming solution line or to the water line and inject at 0,5 - 1,0 liter per minute of excavation.

**Typical Properties**

- **Appearance:** clear brown liquid
- **Specific gravity:** about 1.3 g/cm³
- **pH:** 7 - 10.

**Packaging**

- 50 kg plastic kegs, 250 kg plastic drums or 1200 kg plastic tanks

**Shelf life, storage**

12 months from the date of dispatch if properly stored in the original sealed containers, protected from precipitations, direct sunlight and in a temperature range between 5 and 40 °C.
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**LAMSEAL G**

LAMSEAL G is an organic polymer capable of absorbing water 50 - 200 times its own weight. That causes the swelling of the granules from mm to cm.

<table>
<thead>
<tr>
<th>Application</th>
<th>Once the polymer has absorbed water, it can be released only by chemical action and not by squeezing the swollen granules.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment</td>
<td>LAMSEAL G can be used in several applications:</td>
</tr>
<tr>
<td></td>
<td>- Lubricant for pipe jacking: Improve the lubricating power of traditional polymer fluids.</td>
</tr>
<tr>
<td></td>
<td>- Sealing for lost circulation: Carried by the mud into the fractures and voids of permeable ground, increasing volume and avoiding any lost of circulation.</td>
</tr>
<tr>
<td></td>
<td>- Disposal of waste fluids: Added to aqueous wastes it transforms them into a solid mass that can be easily removed.</td>
</tr>
<tr>
<td></td>
<td>- Tunnelling: Add to the pressure chamber before prolonged stoppages in order to avoid finding the chamber full of liquid material on start-up.</td>
</tr>
</tbody>
</table>

In presence of salts the effectiveness of the polymer can be reduced.

**Appearance:** granular  
**Solubility:** insoluble in water

**Packaging**  
25 kg multiply paper bags internally poliethylenied, palletised, wrapped and strapped (40 bags per pallet)

**Shelf life, storage**  
12 months from the date of dispatch if properly stored in the original sealed containers, protected from precipitations, direct sunlight and in a temperature range between 5 and 40 °C.
LAMSEAL L

LAMSEAL L is an polymer capable of absorbing water in order to decrease the fluidicity of the ground in which it is injected. Once the polymer has absorbed water, it can be released only by chemical action and not by squeezing the ground.

LAMSEAL L can absorb 200 time its own weight in water. 60% of hydration is reached in 5 minute approx.

### Application

<table>
<thead>
<tr>
<th>Application</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Lubricant for pipe jacking:</td>
<td>Improve the lubricating power of traditional polymer fluids.</td>
</tr>
<tr>
<td>- Sealing for lost circulation:</td>
<td>Carried by the mud into the fractures and voids of permeable ground, increasing volume and avoiding any lost of circulation.</td>
</tr>
<tr>
<td>- Disposal of waste fluids:</td>
<td>Added to aqueous wastes it transforms them into a solid mass that can be easily removed.</td>
</tr>
<tr>
<td>- Tunnelling:</td>
<td>Inject into the pressure chamber or in the screw to change the consistency of the soil from liquid to plastic. Added to the pressure chamber before prolonged stoppages in order to avoid finding the chamber full of liquid material on start-up.</td>
</tr>
</tbody>
</table>

### Typical Properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appearance:</td>
<td>light cream</td>
</tr>
<tr>
<td>Bulk density:</td>
<td>1.0 – 1.4 g/cm³</td>
</tr>
<tr>
<td>Solubility in water:</td>
<td>dispersible</td>
</tr>
</tbody>
</table>

### Packaging

25, 200 kg plastic drums or 1000 kg plastic tanks.

### Shelf life, storage

6 months from the date of dispatch if properly stored in the original sealed containers, protected from precipitations, direct sunlight and in a temperature range between 5 and 40 °C.

Separation of liquid phase can take place over time, shake or stir appropriately to ensure homogeneity of the product before use.

The information given represents the Seller’s best knowledge, however the conditions of use of this product are beyond the Seller’s control and affected by numerous factors. The Seller will not give any warranty, expressed or implied, on any specific use of the product. The Purchaser shall evaluate if the product is suitable for the use and assume any and all responsibility and risks of its use. The Seller will not be liable for any damages howsoever caused by this product and/or its use.

Lamberti SpA - Reg. office: Via Piave, 18 - 21041 Albizzate (VA) – Italy
Commercial & Administrative offices: Via Marsala, 38/d - 21013 Gallarate (VA) - Italy
LAMSHIELD SAL is the latest generation ecofriendly Tail Seal Compound developed to offer the TBM operators a hydrocarbon free tail seal grease with excellent adhesion and sealing properties.

### Application

Tail seal greases are normally hydrocarbon based, and therefore have an environmental impact. LAMSHIELD SAL has been developed taking into consideration that TBM’s commonly operate in urban area and under aquifer; it is manufactured with environmental friendly materials designed to respect of the environment. Specifically designed for the TBMs where two component grouting is adopted to fill the annular gap between the precast lining extrados and the soil being excavated.

LAMSHIELD SAL is non toxic or harmful to the user.

### Usage

LAMSHIELD SAL is injected under pressure between the tail seal brushes, it maintains sealed the TBM preventing the ingress of grout, water, foam, liquefied soil or any external pressurised liquid or solid material.

LAMSHIELD SAL is capable of adhering to wet metal and wet concrete surface, granting an exceptional seal properties in every condition.

LAMSHIELD SAL highlighted properties:
- impermeable to water even under high pressure;
- high resistance against water wash off;
- high resistance against pressure, mechanical stress and wear;
- easy to be pumped;

### Treatment

Standard usage is 0.5 – 1.5 kg/m² of segment external surface. Consumption can change due to different factors like: segment ring surface condition, brush condition, segment alignment etc. Due to its special formulation it has been reported lower consumption compared to hydrocarbons based tail seal greases.

### Typical Properties

- **Appearance:** homogeneous, fibrous paste
- **Density:** 1.45 approx.
- **Solubility:** not soluble.
- **Consistency:** 255 ± 10 at 25°C (ASTM D217-10; 1/10mm)

### Packaging

75 or 260 kg iron drums.

### Shelf life, Storage

6 months from the date of dispatch if properly stored in the original sealed containers, protected from precipitations, direct sunlight and in a temperature range between 5 and 40 °C.

Being based on vegetable and not hydrocarbons derivatives, it can be pumped only at a temperature higher than 10°C. In order to bring the temperature of the product into the interval in which it is pumpable it is necessary to keep the drum inside the tunnel or in a warm place for one day before usage. Do not use if TBM is exposed at temperature below 5°C.

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LAMSHIELD SAL-P

LAMSHIELD SAL-P is a Tail Seal Compound developed to offer the TBM operators a tail seal grease with excellent adhesion and sealing properties.

**Application**
LAMSHIELD SAL-P has been developed with exceptional stickiness and is capable of adhering to wet metal and wet concrete surface, granting an exceptional seal properties in every condition.

Specifically designed for the TBMs where two component grouting is adopted and injected under pressure to fill the annular gap between the precast lining extrados and the soil being excavated.

LAMSHIELD SAL-P is non toxic or harmful to the user.

LAMSHIELD SAL-P is fire self extinguish.

**USAGE**
LAMSHIELD SAL-P is injected between the tail seal brushes. It maintains sealed the TBM preventing the ingress of grout, water, foam, liquefied soil or any external pressurized liquid or solid material.

LAMSHIELD SAL-P highlighted properties:
- impermeable to water even under high pressure;
- high resistance against water wash off;
- high resistance against pressure, mechanical stress and wear;
- easy to be pumped;

**Treatment**
Standard usage is 0,5 – 1,5 kg/m² of segment external surface. Consumption can change due to different factors like: segment ring surface condition, brush condition, segment alignment etc.

**Typical Properties**
- **Appearance**: homogeneous, fibrous paste
- **Density**: 1,33 approx.
- **Solubility**: not soluble.

**Packaging**
70 or 250 kg iron drums.

**Shelf life, Storage**
6 months from the date of dispatch if properly stored in the original sealed containers, protected from precipitations, direct sunlight and in a temperature range between 5 and 40 °C.

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Lamberti SpA - Reg. office: Via Piave, 18 - 21041 Albizzate (VA) – Italy
Commercial & Administrative offices: Via Marsala, 38/d - 21013 Gallarate (VA) - Italy
LAMSHIELD DSP is the latest generation ecofriendly Tail Seal Compound developed to offer the TBM operators a hydrocarbon free tail seal grease with good adhesion and sealing properties.

**Application**

Tail seal greases are normally hydrocarbon based, and therefore have an environmental impact. LAMSHIELD DSP has been developed taking in consideration that TBM’s commonly operate in urban area and under aquifer; it is manufactured with environmental friendly materials designed to respect of the environment. Specifically designed for the TBMs where two component grouting is adopted to fill the annular gap between the precast lining extrados and the soil being excavated.

LAMSHIELD DSP is non toxic or harmful to the user.

**USAGE**

LAMSHIELD DSP is injected under pressure between the tail seal brushes, it maintains sealed the TBM preventing the ingress of grout, water, foam, liquefied soil or any external pressurised liquid or solid material.

LAMSHIELD DSP highlighted properties:
- impermeable to water even under high pressure;
- high resistance against water wash off;
- high resistance against pressure, mechanical stress and wear;
- easy to be pumped;

**Treatment**

Standard usage is 0.5 – 1.5 kg/m² of segment external surface. Consumption can change due to different factors like: segment ring surface condition, brush condition, segment alignment etc. Due to its special formulation it has been reported lower consumption compared to hydrocarbons based tail seal greases.

**Typical Properties**

- Appearance: homogeneous, fibrous paste
- Density: 1.43 approx.
- Solubility: not soluble.

**Packaging**

75 or 260 kg iron drums.
LAMSHIELD FIRSTFILL

LAMSHIELD FIRSTFILL is the latest generation ecofriendly Tail Seal Compound developed to offer the TBM operators a first filling tail seal grease with excellent adhesion and sealing properties.

<table>
<thead>
<tr>
<th>Application</th>
<th>Specifically designed for the TBMs where two component grouting is adopted to fill the annular gap between the precast lining extrados and the soil being excavated.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LAMSHIELD FIRSTFILL is a first filling tail seal grease.</td>
</tr>
<tr>
<td></td>
<td>LAMSHIELD FIRSTFILL is non toxic or harmful to the user.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Average consumption is in the range of 50 kg/m of brushes (3 rows).</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Typical Properties</th>
<th>Appearance: homogeneous, fibrous paste; Colour: grey; Density: 1.41 approx.; Solubility: not soluble.</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Packaging</th>
<th>75 or 260 kg iron drums.</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Storage and usage</th>
<th>6 months from the date of dispatch if properly stored in the original sealed containers, protected from precipitations, direct sunlight and in a temperature range between 5 and 40 °C.</th>
</tr>
</thead>
</table>
### LAMSHIELD HEAD-P

LAMSHIELD HEAD-P is a main bearing grease for tunnel boring machines with excellent adhesion and sealing properties.

<table>
<thead>
<tr>
<th><strong>Application</strong></th>
<th>LAMSHIELD HEAD-P protect the main bearing preventing any ingress of water, mud, soil or dust. LAMSHIELD HEAD-P has excellent lubrication and sealing properties.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Typical Properties</strong></td>
<td><strong>Appearance:</strong> homogeneous paste; <strong>Colour:</strong> black; <strong>Density:</strong> 1.24 approx.; <strong>Consistency (ASTM D217 – 10):</strong> 305±10 (1/10mm); <strong>Solubility:</strong> not soluble.</td>
</tr>
<tr>
<td><strong>Packaging</strong></td>
<td>60 or 220 kg iron drums.</td>
</tr>
<tr>
<td><strong>Shelf life, storage</strong></td>
<td>6 months from the date of dispatch if properly stored in the original sealed containers, protected from precipitations, direct sunlight and in a temperature range between 5 and 40 °C.</td>
</tr>
</tbody>
</table>

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