

TUNNEL LINING SYSTEMS

AgruFlex® Liner + Easyfix Systems

Whether used in blast and bored or conventional tunnel constructions, AgruFlex® Tunnel Liner protects concrete tunnel structures against the infiltration of water, aggressive soils and root penetration.



For more information about Agru America and our products, visit agruamerica.com



Agru America Tunnel Liners

Water is a natural enemy when constructing tunnels. Due to its superior water resistance, however, AgruFlex® reduces the maintenance required to repair water spots, dripstones from lime diffusion and external corrosion.

At Agru America, we provide high-quality product lines that are continuously improving and expanding. Our extensive experience in producing geosynthetic liners has enabled us to develop durable tunnel lining systems made from the highest-quality materials and backed with the know-how and support our customers and partners have grown to expect from us.

- High-grade resins made with selected raw material
- Highly flexible mechanical properties
- Long service life
- No toxic fumes in case of fire
- Easy to install and weld





Conventional Construction

- Shotcrete layer
- Sealing with Agru America thermoplastic liners
- Reinforced inner concrete shell

AgruFlex® Tunnel Liners

Polyolefins

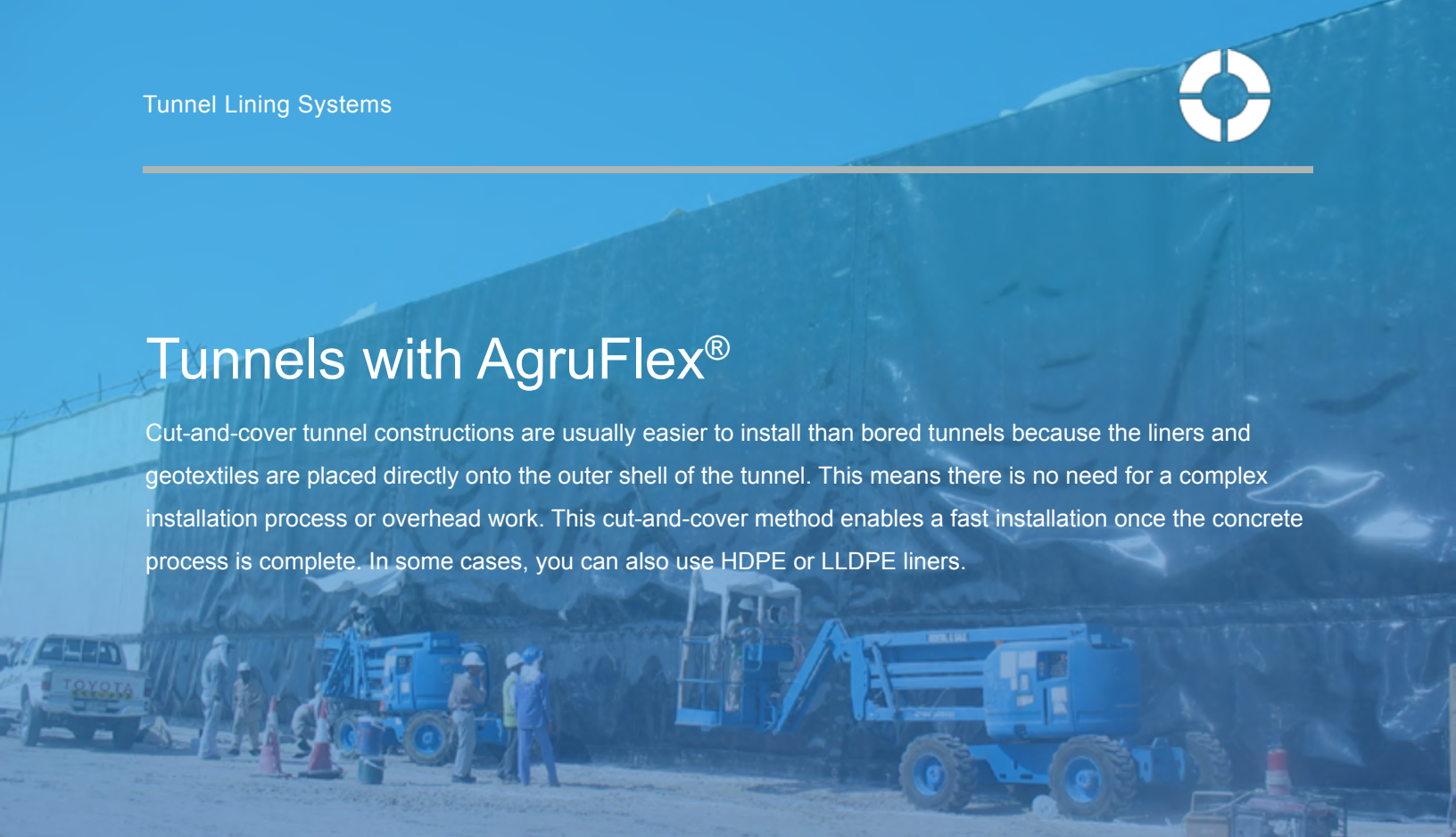
The co-extruded VLDPE tunnel liner is produced by flat die calendering. The liner has a black base layer and a white or brightly colored signal layer. VLDPE's excellent flexibility guarantees a perfect fit to the tunnel structure, as well as easy installation, resistance to aggressive groundwater and leak-proof joints between the polyolefin tunnel liners.





Tunnels with AgruFlex®

Cut-and-cover tunnel constructions are usually easier to install than bored tunnels because the liners and geotextiles are placed directly onto the outer shell of the tunnel. This means there is no need for a complex installation process or overhead work. This cut-and-cover method enables a fast installation once the concrete process is complete. In some cases, you can also use HDPE or LLDPE liners.



For Cut-and-Cover Tunnel Constructions:

Step	Procedure
Step 1	The protective geotextile, which can weigh up to 1,000 g/m ² (30 oz/sy), is attached to the fabricated concrete shell.
Step 2	We place the AgruFlex® tunnel liner over the geotextile.
Step 3	The liners are welded by hot wedge. Manual hot gas welding and extrusion welding are used for connecting smaller areas and waterstop profiles.
Step 4	Once the joints have been tested and the componets are installed, we place an additional protective geotextile over the tunnel liner.
Step 5	Finally, we compact gravel around the tunnel.



For Drilled Tunnel Construction:

Step	Procedure
Step 1	The geotextile used for protection and drainage weighs up to 1000 g/m ² (30 oz/sy) typically. It is attached to the tunnel wall by thermoplastic discs. The discs are arranged in a special grid to ensure proper coverage.
Step 2	The AgruFlex® tunnel liners are fixed onto the discs by hot gas welding or by means of the Agru Easyfix System (Velcro® effect).
Step 3	The AgruFlex® tunnel liners are joined by hot wedge welding and tested for leaks. Manual hot gas welding and extrusion welding are used for patches and waterstop profiles.
Step 4	After testing all welding seams, the placement of the inner concrete shell is done. The fixation discs have a predetermined breaking point to avoid damage to the tunnel liner caused by settlements. The discs serve as a temporary fixation until the placement of the inner concrete shell is completed.





Installation with Agru Easyfix System

A complete solution by Agru America for tunnel constructions. Easyfix delivers fast and reliable installation of VLDPE fabric backed tunnel liners.

In comparison to the conventional method, discs and strips backed with Velcro® are attached to the shotcrete in a certain pattern.

Beginning at the tunnel floor the fabric backed liner is attached to the tunnel walls. This requires that sufficient pressure is applied to the Velcro® areas. Subsequent adjustments of the liner are possible with this installation method.

Advantages of Easyfix

- No influence of the liner's mechanical properties caused by adhesive bonding
- Installation with semi-automatic formworks
- Flexible installation methods
- Up to 40% reduction in installation time with easy and precise placement of the tunnel liner
- Liner widths up to 4m

Installation Methods

Disc Profile



Hot Air Mounting System

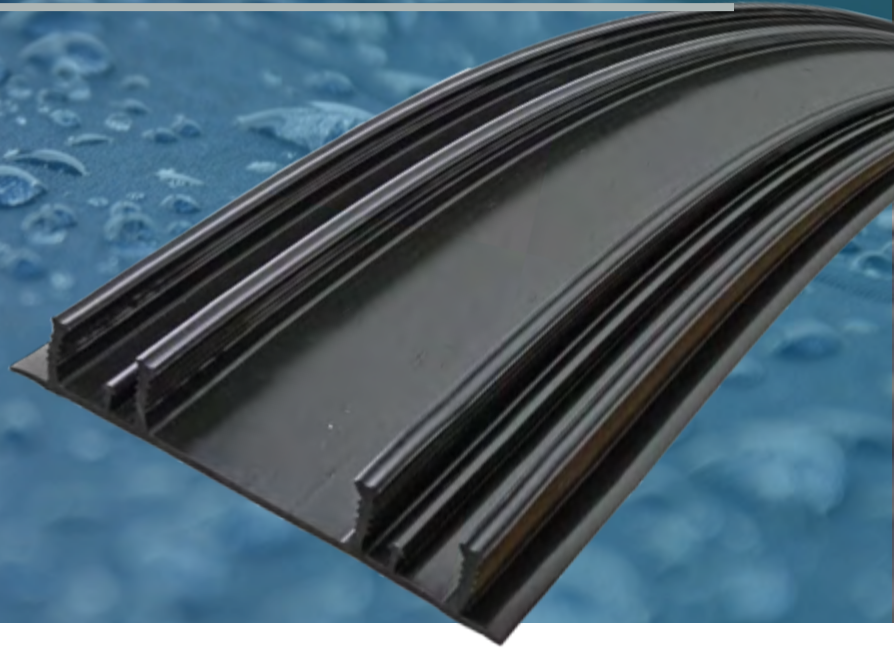


Hot Weld Joint
In Tub Construction





Monolithic Systems



Advantages of water stop profiles

The perfect solution for attaching the liners and concrete protective liners to concrete constructions and compartmentalizing areas in case of future repairs.

- Integrated injection hose clamp for OD 9 - 12 mm
- Defined outlets for even distribution
- Polyolefin based VLDPE resin
- Optimized compatibility with polyolefin based tunnel liners
- Free of plasticisers and halogens

Agru water stop profiles

Waterproofing of tunnels is essential for the lifetime of the construction. Modern tunnel lining is designed to allow for the possibility of repair work of hollow spots or leaky areas with special injection resins.

Waterstops are installed when casting the joints of the inner shell to create separate compartments.

Agru waterstop profiles with integrated injection outlets provide a perfect anchoring to the concrete to withstand highest backpressure. Integrated injection hoses enable the injection of resins at repair sections.

Dimensions: 120/2 - 240/4 - 250/3 - 500/3 - 500/6 - 600/6



Drainage

Different drainage systems are available for tunnel constructions (undrained, partially drained and drained) which have to be adjusted to the local and structural conditions. The choice of material and dimensions of the drainage system are of great importance. Bright colored inside walls provide for optimal illumination during camera inspections. Smooth surfaces have to be chosen to avoid depositions. Projects without drainage may cause damage to the complete system

For more information on Agru Tunnel Lining Systems and other Agru products, please reach out to us.



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