

Tunnel Lining Systems

TUNNEL WATERPROOFING
WITH AGRUFLEX®





The Plastics Experts.

Our tunnel lining product group offers a complete, top-quality range of waterproofing and concrete protective liners that have a special focus on protecting tunnels from leakage as well as aggressive and abrasive media. These liners along with their ancillary components are specifically designed to meet the stringent demands and extended life requirements mandated for tunnels.

The AGRU success story has been unfolding for seven decades. Founded in 1948 by Alois Gruber, who set the company on the course for plastic manufacturing, AGRU has become one of the world's most important single-source suppliers for piping systems, semi-finished products, concrete protection liners, and lining systems made from engineered plastics. We use only top-grade thermoplastic polymers as our raw materials. When it comes to application-technical consulting, we are your best partner in the field.



Quality

Customer satisfaction comes first at AGRU. Technical consultations are an essential part of our customer service. The AGRU quality assurance system is compliant with multiple international standards and AGRU's procedures help ensure that products meet or exceed international standards, on an ongoing basis.

The start-to-finish attention to quality ensures that the products meet and beat the strictest technical specifications, giving safe operation within transportation, water, and wastewater infrastructures.

Overview

Water does not have to be a major obstacle during tunnel construction. With AGRU's complete tunnel lining system, you can expect superior water resistance that virtually eliminates the maintenance cost to repair water spots, dripstones from lime diffusion, and external corrosion. AGRUFlex, an integral part of our lining system, is the perfect partner in SEM/NATM or conventional bored tunnel constructions. Its primary purpose is to protect concrete tunnel structures against the infiltration of water and/or gases, and aggressive soils and groundwater.

AGRU tunnel lining systems use high-grade resins made with advanced polyolefins, giving AGRUFlex its highly flexible mechanical properties, a long service life, and ease of installation. In addition, polyethylene does not produce toxic fumes which could cause health and safety concerns in the confined space of tunnel environs.

Efficient waterproofing in tunnels

AGRUFlex is manufactured from very low density polyethylene and supports:

- Bored, SEM/NATM, and cut-and-cover tunnels
- Protection against aggressive ground water
- Extended tunnel longevity/life expectancy.

Signal layer advantages

AGRU coextrudes AGRUFlex with a white/colored signal layer.

- Exposed white surface reflects light to enhance visibility.
- The colored signal layer improves damage detection.

Advanced installation methods

AGRUFlex supports innovative insulation technologies, with benefits such as:

- Physiologically safe welding/no harmful fumes
- Alternative attachment methods (e.g., induction welding)
- An easy installation thanks to the product's excellent elongation and flexibility ratings.

One-stop shopping

Purchase liners, water stop profiles, attachment discs, and drainage pipes from under one roof.

- A complete product catalogue for the perfect waterproofing system
- Including welding rod, water stop profiles, attachment systems, grouting plates, and more
- Drainage systems using polyethylene (PE) for area and strip drainage.



Applications

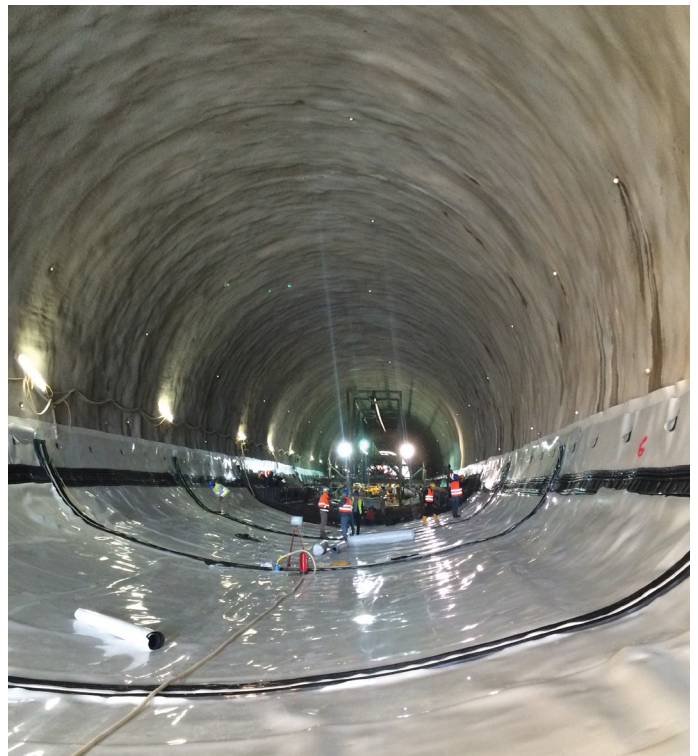
AGRU's tunnel waterproofing liners are perfectly suited for any type of tunnel construction including cut-and-cover, drill-and-blast (SEM/NATM), and TBM bored methods. AGRUFlex is the preferred waterproofing liner system for all types of tunnel applications including highway, rail, light rail, hydro, and more.

Underground Stations

Underground stations, caverns, and cross-passages need many of the same concrete protection as the connecting tunnels. AGRUFlex serves as the primary liner against corrosion and water penetration in these applications as well.

Waterproofing Monolithic Systems

Water stop profiles give the necessary redundancy in waterproofing tunnels throughout the lifetime of the construction. Modern tunnel lining is designed to support discrete repairs of hollow or leaky areas through the use of injection grouts. Water stop profiles are installed between the liner and concrete to create separate compartments. Integrated injection hoses can then be used to inject grout at repair sections.



Installation Methods

AGRUFlex tunnel liners are versatile with respect to tunnel construction methods and can be attached to the tunnel substrate using a variety of innovative systems:

New Austrian Tunnel method

With the SEM/NATM approach, the rock is secured with rock bolts, steel arches, or other construction elements after excavation. Shotcrete then covers the rock to create the tunnel shape. The seal carrier, which is a finely graded shotcrete, forms the surface for the interior construction work. To protect the liner and for drainage purposes, nonwovens geotextiles are installed between the shotcrete and the liner.

Cut-and-cover approach

With the cut-and-cover method, either a HDPE geomembrane or the flexible VLDPE tunnel membrane are recommended depending on the project requirements. In most cases, the liner can simply be spread over the tunnel without being attached, but in certain cases, it is fixed to the outer wall of the tunnel. Fastening with the use of water stop profiles is a cheap and technically sophisticated choice in such cases.

Membrane Attachment Method

The protective nonwoven geotextile is fastened to the wall of the tunnel using mounting discs anchored to the tunnel wall in a specified pattern. Following this, the liner is attached to the mounting discs using hot-air welding method. The VLDPE tunnel membranes are joined using hot-wedge welding. The white signal layer reliably indicates any damage that occurs during the installation. The tunnel can be segmented by partitioning off the block joints using the AGRU water stop profile.

The Easyfix System

This innovative system incorporates a nonwoven geotextile fabric onto the back of the AGRUFlex liner. The “loop” nature of the fabric allows the liner to be supported using VELCRO® tabs which replace the traditional discs, thereby eliminating the requirement for hand welding to the discs and allowing for wider liner widths and less seams. With the Easyfix system the fabric backed-liner may also be affixed using hot air or hot melt systems.

Induktofix® Welding Discs

The AGRU Induktofix system was developed so that thermoplastic linings could be fastened to concrete structures using electro-magnetic induction without the lining system being penetrated. In a tunnel, this enables wider membranes to be installed, which in turn offers speed of installation benefits and increased system safety during installation by reducing the number of welds required. Induktofix welding technology incorporates a wire mesh in the attachment discs and works in conjunction with Induktofix welding processor. Workers weld liners to discs to simplify and improve the process, allowing for wider liner widths and fewer seams as well as a more secure attachment.



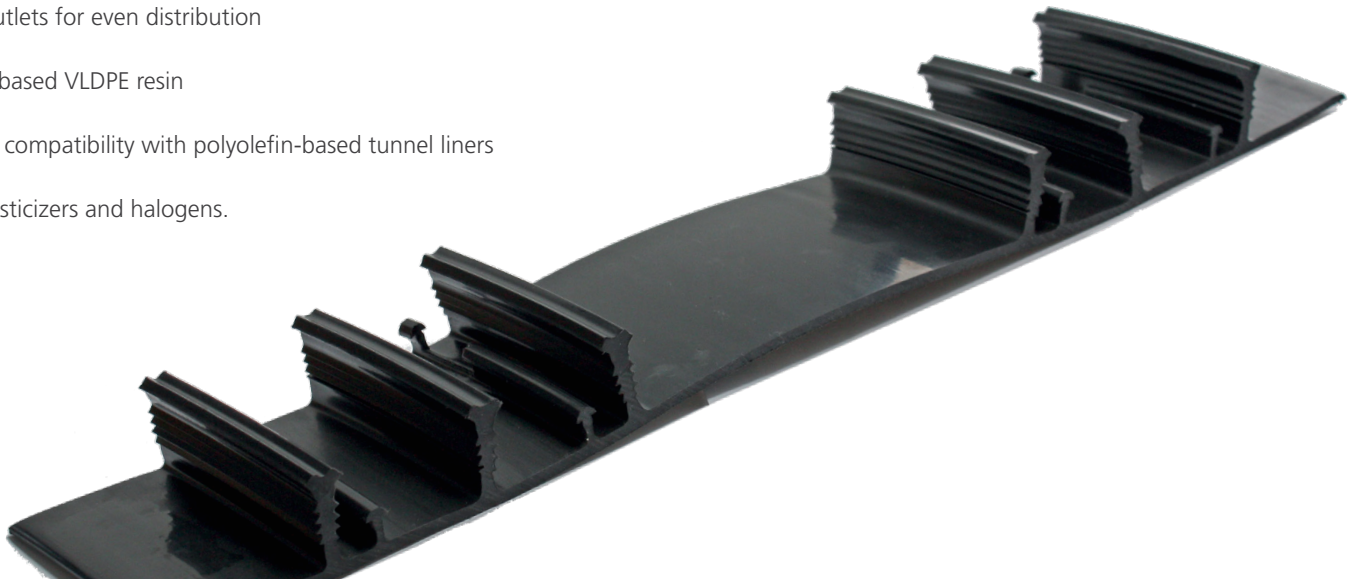
Complementary Products

In addition to waterproofing liners, AGRU also offers a full line of complementing accessories.

AGRU Water Stop Profiles

The perfect solution for compartmentalizing areas for future, low-intrusive repairs. Benefits include:

- Integrated injection hose clamp for grout tubes 9–12 mm
- Defined outlets for even distribution
- Polyolefin based VLDPE resin
- Optimized compatibility with polyolefin-based tunnel liners
- Free of plasticizers and halogens.



AGRUTEX® Nonwoven Geotextile

Geotextile for cushioning tunnel constructions that are currently undrained, partially drained, or fully drained. AGRU manufactures a range of nonwoven geotextiles, composite drainage materials, and piping systems at various dimensions to support the construction of even the most complex systems.

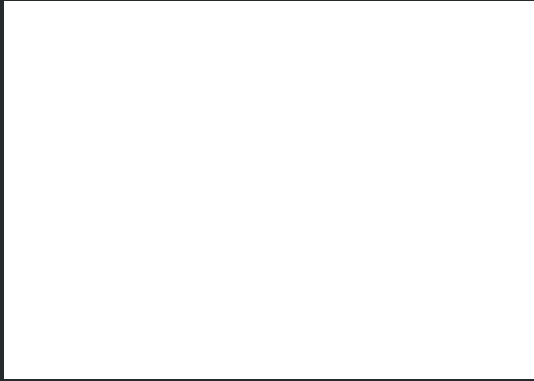
- Lengthens tunnel lifetime
- Gives cushioning for the membrane
- Highly customizable to fit project requirements.

AGRU GeoClay® geosynthetic clay liners (GCL)

AGRU GeoClay offers an additional means of waterproofing to support the integrity of the structure. This GCL offers simplified ease of installation which requires no welding and may be applicable for many structures such as cut-and-cover tunnels.

- Available in a variety of configurations
- Combined with a reinforced needle-punched nonwoven geotextile to add strength
- Provides easy installation for applicable waterproofing needs.





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