The Plastics Experts.

Water Conservation

WATER AND WASTEWATER SOLUTIONS BY AGRU

The Plastics Experts.

AGRU is committed to solving modern problems through the development of innovative solutions. Many issues surrounding water conservation and preservation—both key pillars for AGRU—stem from deficiencies in water and wastewater infrastructure. To help overcome these problems, AGRU has developed a line of products for impactful water and wastewater solutions.

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 protective liners, and lining systems made from engineered plastics. We use only the finest grade thermoplastic polymers as our raw materials. When it comes to application-technical consulting, we are your best partner in the field.

Quality

The AGRU quality assurance system is compliant with multiple international standards and AGRU's procedures help ensure that products meet or exceed these international standards, on an ongoing basis. The start-to-finish attention to quality ensures that the products meet and beat the strictest technical specifications, providing safe operation within industrial, water, and wastewater infrastructures.

Water Conservation and Unintended Consequences

The United Nations (UN) lists water as an essential resource that is core to continued sustainable development of human society. In fact, the UN associates water as one of the key factors in managing risks such as famine, epidemics, inequalities, and political instability (1).

The conservation of water has become a major point of focus for many countries including the United States. The U.S. Environmental Protection Agency (EPA), for instance, recently implemented a range of water conservation initiatives throughout its operations to reduce its own water usage footprint.

One of the most significant sources of waste when it comes to water conservation is water loss through leakage. However, there are many areas that can be improved. The EPA offers the following water conservation planning goals for municipalities (2):

- Eliminating, downsizing, or postponing the need for capital projects.
- **Improving the utilization and extending the life of existing facilities.**
- **Lowering variable operating costs.**
- Avoiding new source development costs.
- **Improving drought or emergency preparedness.**
- Educating customers about the value of water.
- **Improving reliability and margins of safe and dependable yields.**
- **Protecting and preserving environmental resources.**

The emboldened items in the list indicate goals that are associated with water or wastewater infrastructure. However, some water conservation efforts carry unintended consequences.

Take, for instance, low-flow fixtures. These showerheads, faucets, and toilets not only reduce water waste from overconsumption, but also—unintentionally—increase the concentration of corrosives in wastewater. The increased concentration of corrosive substances can greatly reduce the service life of existing infrastructure. Fortunately, many of the same solutions that can be used to solve leakage in water infrastructure can also be used to improve wastewater infrastructure to better resist microbial-induced corrosion (MIC).

AGRU Solutions in Practice

As early as 2015, the Capital Region District (CRD), which comprises 13 municipalities, sought to construct a new tertiary wastewater treatment plant that would help protect and maintain local waterways. The Wastewater Treatment Project officially began in April 2015, with Harbour Resource Partners as the project lead. The project comprises several components, including a new wastewater treatment facility, outfall system, and residual treatment facility. The new outfall pipe, which would be responsible for discharging the tertiary-treated effluent, would need to support high-volume flow.

Engineers on the project initially specified an 1800 mm steel pipe for the outfall system. However, the project requirements included burying the pipe up to 60 m deep and across a 2 km distance to reach the ocean, which posed numerous challenges for a steel pipe including the logistical difficulty in regard to maintenance. To address this issue, designers sought a long-lasting, low-maintenance alternative.

Midway through the project, AGRU helped outline an effective solution based on its new XXL HDPE pipes. Ultimately, the design narrowed in on a 2250 mm OD HDPE pipe at SDR 21/26 manufactured by AGRU. The outfall pipe would be among the first structures to use this new size category of HDPE pipes. While HDPE pipes of these sizes have not achieved widespread usage in the North American market, the CRD project helps illustrate the value of this product and size category for high-volume flow applications.

Project designers cited PE-100 as one of the biggest reasons for the change. Pipes made with this resin offer increased flexibility, durability, and longevity over competing products of the same size category. These physical properties also facilitate installation. Furthermore, the resin's other properties can significantly reduce maintenance costs and downtime due to its chemical stability and resistance to corrosion. Finally, because AGRU's XXL HDPE pipe is extruded rather than spiral winded, CRD was able to meet EN 12201 and ISO 4427 standards.

AGRU's solution incorporated everything to build a complete outfall system, including the pipe, all associated fitting components (elongated stub ends, elbow, a wall spool, a pump spool, and diffuser pipes), and fusion welding technicians trained by AGRU.

Water Solutions

Common problems with water infrastructure include exfiltration from leaking pipes or pipe joints as well as inadequate storage. These problems are associated with the following issues:

- **Higher variable operating costs**—a leaky system will not only waste critical water resources, but also cost more to manage.
- **Lower utilization and decreased life of existing facilities**—leaks can reduce the service life of treatment and conveyance systems by requiring system expansions that would not otherwise be required.
- **Poor drought or emergency preparedness**—ineffective potable water and reservoir storage facilities limits access to water throughout droughts or emergencies.
- **Poor reliability and low margins of safe and dependable yields**—inadequate storage and leaky pipes will lower overall reliability of the water infrastructure.

Water shortages can extend beyond infrastructure issues. During the 2018 South Africa water crisis, for instance, an extended drought and the public's tendency to treat water as unlimited led to a "Day Zero" calculation—the date when the city of Cape Town would run out of water. Day Zero was avoided in South Africa thanks to a combination of public awareness campaigns, policy changes, consumption restrictions, and a high degree of public support.

As seen in South Africa and around the globe, water conservation requires a combination of solutions. Beyond public policy and general awareness, municipal infrastructure requires the use of the right products in specific water systems to minimize leaks and ensure long-term efficiency.

Transmission Systems

The typical U.S. water system presents an average leakage rate of about 14% to 18%, which is relatively high for a developed country (3). Developed countries on average lose between 8% and 24% of the water produced. In developing countries, the water loss can reach as high as 68% of the total amount of water produced. The World Health Organization attributes most of the physical losses to poor network design, construction, and quality control; aging pipe network; and leakage at connections joints, valves, and fittings (4). Reducing water lost to leakage by creating leak-proof joints with HDPE pipes and fittings can significantly improve the performance of water transmission systems and promote water conservation.

HDPE Pipes and Fittings

Unlike other pipes and fittings made with traditional materials like concrete, high-density polyethylene (HDPE) pipes and fittings can be welded together to create joints with virtually no leakage. Pipes made with HDPE are lightweight and flexible, facilitating a number of installation methods such as horizontal directional drilling (HDD) and transport options such as ocean towing. HDPE pipes have recently been manufactured at XXL dimensions reaching 3,500 mm in outer diameter and 600 m in length.

The durability of HDPE pipes improves as its size increases, and these pipes have shown high resistance to seismic forces. In one case study of the Kobe 1995 earthquake, while all other pipes in the city's infrastructure showed at least one failure every four miles of pipe, HDPE pipes demonstrated zero failures across the entire system. XXL HDPE pipes would demonstrate even greater seismic resistance if manufactured with PE100-RC (5). Seismic resistance is especially important for pipes buried deep underground in regions known to experience earthquakes.

See page 15 for more information about AGRU HDPE Pipes and Fittings.

Potable Water Storage

More than 2.1 billion people don't have access to potable water (6). A consequence of inadequate water access is poor sanitation and hygiene, which contributes to the spread of disease. For this reason, potable water storage has become a central focus in the World Health Organization's (WHO) Sustainable Development Goals for 2030. Target 6.1 aims to achieve "universal and equitable access to safe water and sanitation for all." With the right combination of products, engineers are now able to create potable water storage solutions that are longer lasting and more reliable. Additionally, specialized concrete protective liners can be used to rehabilitate existing tanks.

Concrete Protection
For new installations, Ultra Grip CPL produced with NSF 61 compliant Hydro+ PE resin provides a long-term solution to prevent corrosion and to provide a surface that is easily cleanable and resistant to deposits.

Rehabilitation
Many existing potable water storage solutions in the United States require refurbishment or rehabilitation due to leakage and/or corrosion. However, replacing a concrete protective coating with another coating can be a nonstarter in many situations. HydroClick is specially designed for rehabilitating these systems to provide up to a 50-year design life.

HDPE Pipes and Fittings
For supporting piping, HDPE pipes and fittings provide a lightweight, leak-proof solution that is corrosion resistant and durable.

See pages 13, 14, and 15 for more information about HydroClick, Ultra-Grip, and HDPE pipes, respectively.

2.1 Billion

People without access to potable water

Reservoir Storage

For large-scale needs, a potable water storage unit is often not sufficient. Water reservoirs are essential to meet the long-term demand for water in larger municipalities. Additionally, water reservoirs are critical to agriculture, industry, and mining. The creation of these reservoirs relies on geosynthetic liners, geotextiles, and concrete protective liners for water containment.

Geosynthetic Liners
AGRU Smooth Liner, Conductive Liner, and textured liners like MicroSpike offer an impermeability layer to help contain the water to within the reservoir. Smooth Liner is the standard liner for an impermeability layer. Conductive Liner is a specialized version that incorporates a conductive layer to facilitate construction quality assurance by testing for leaks in the liner that may have occurred during installation. MicroSpike integrates asperities to the liner to increase slope stability and/or to provide an anti-slip surface.

Geotextiles
To protect the geosynthetic liners and prolong their service life, geotextiles and geocomposites can be used for cushioning and gas venting as well as numerous other beneficial uses.

Concrete Protection
Some reservoir designs incorporate concrete structures. CPL like Ultra Grip can protect concrete from water infiltration.

See pages 16 and 14 for more information about AGRU geosynthetic liners, AGRUTEX, and Ultra Grip, respectively.

172 Billion

Cubic meters of water stored by the U.S. Bureau of Reclamation

Wastewater Solutions

Common problems with wastewater infrastructure include inflow and infiltration (I&I), and corrosion. These problems are associated with the following issues:

- **Higher variable operating costs**—a leaky system will cost more to manage since I&I results in unnecessary additional treatment costs.
- **Lower utilization and decreased life of existing facilities**—leaks and MIC can reduce the service life of concrete structures.
- **Environmental safety**—wastewater can harm local ecology.

Wastewater infrastructure problems are compounded by the fact that out of the 51,356 community water systems serving the America public, only about 8,674 of these systems are sufficiently funded. The other 83%, which serves about 8% of the U.S. population, often lacks the funding or technical capacity to meet U.S. Safe Drinking Water Act standards (7).

Fortunately, a right combination of products in specific wastewater systems enable a number of long-term solutions that will not only prevent issues like MIC, but can also help significantly reduce the amount of maintenance required to support the system. Thus, smaller water systems will be able to maintain Safe Drinking Water Act standards.

Wastewater Collection Systems

One of the biggest sources of inefficiencies in wastewater collection is having to treat clean water that gets mixed into the system. Commonly referred to as wastewater infiltration, the problem stems from water entering wastewater collection systems via manholes, pumping stations, wet wells, and lift stations. These access points used to service or support the wastewater collection system, also presents opportunities for groundwater or rain to enter the system.

The problem is significant. AGRU estimates a municipality with 1,000 access point and an average infiltration leakage rate of 10 gallons per minute, per structure, will spend about $4.4 million a year in to treat water infiltration. Solving this problem requires rethinking access point architecture and implementing tested products in innovative new ways.

Concrete Protection

Concrete protection is necessary to help prevent inflow and infiltration as well as concrete corrosion. Due to high backpressure in some systems, spray-on concrete protection tend to lose their effectiveness over time. In its place, concrete protective liners (CPL) can offer a more long-term solution. For areas that experience significant backpressure—which significantly reduces the service life of spray-on coatings—Ultra-Grip offers an even stronger anchor to the underlying concrete.

See page 14 for more information about Ultra-Grip.

Exposed Structures

Structures like lift stations and manholes are typically made with concrete. Over time, these structures can experience wear and tear due to water infiltration and MIC. Replacing these concrete structures with high-density polyethylene pipes and fittings offers a watertight solution thanks to the weldability of these products. Large diameter HDPE pipes can be used in place of exposed concrete structures.

$4.4 Million

Annual cost to treat water infiltrating a wastewater collection system (1,000 structures)

Wastewater Treatment Systems

The goal of the estimated 14,748 publicly owned treatment works (POTWs) or wastewater treatment systems is to protect human and ecological health from waterborne diseases (8). However, much of the existing wastewater infrastructure, including collection systems, treatment plants, and equipment, has deteriorated and is in need of repair or replacement. The treatment of wastewater typically involves the use of headworks, digesters, and biosolids management, which requires concrete protection for the structures exposed to corrosive media.

The major point of weakness with many concrete protective systems is often high backpressure in structures located below the water table, which can be solved with the use of a concrete protective liner. Many components in these treatment systems can benefit from being made with HDPE pipes and fittings, which solves many issues with corrosion and leaking. Finally, semi-finished products offer a way to fabricate high-quality thermoplastics into a finished, custom product to fit specific applications.

See pages 14, 15, and 16 for more information about Ultra Grip, HDPE pipes and fittings, and semi-finished products, respectively.

Waste and Chemical Storage

Waste and chemical storage is a top priority to meet OSHA safety guidelines in labs, schools, and manufacturing and storage facilities. Beyond the practical need to protect individuals from coming into contact with harmful substances, these guidelines also help ensure proper storage procedures are being followed to avoid dangerous cross-contamination. An essential piece to meeting these safety standards is proper waste and chemical storage equipment.

Waste and chemical storage is a multilayered problem. First, getting waste into the storage systems requires a piping or other transport system that is capable of holding up to the aggressive media while also offering leak-proof joints. HDPE pipes and fittings are a durable, lightweight, and chemically stable alternative to traditional piping systems.

Next, the storage systems themselves must be made to withstand prolonged exposure to waste and chemicals. Most concrete structures will corrode in this situation, requiring a concrete protective liner. And when a liner is not sufficient—e.g., storing hydrofluoric acid—containers can made with metal alloys. However, metal alloy containers can be heavier, more expensive, and costly to maintain. An alternative is to construct these specialized chemical storage containers from semi-finished products made with a fluoropolymer like perfluoroalkoxy (PFA) or ethylene chlorotrifluoroethylene (ECTFE). ECTFE offers significant chemical and temperature resistance.

See pages 15, 14, and 16 for more information about HDPE pipes and fittings, Ultra Grip, and semi-finished products, respectively.

Wastewater Lagoon

Wastewater lagoons offer a large-scale solution to wastewater containment, treatment, and storage. One major downside to wastewater lagoons is the need to implement robust containment systems to prevent contaminants from seeping into the water table or surrounding environment. The most common product used in this effort is an HDPE liner, which can be used to line wastewater ponds, lagoons, and reservoirs. Smooth Liner is the standard HDPE liner offered by AGRU, providing high durability, flexibility, strength, impermeability, and weldability (page 16).

AGRU also offers specialty liners with design modifications for added features. Conductive Liner, for instance, can be used to support post-installation Construction Quality Assurance Testing through ASTM D7240 (page 17). Textured and/or structured liners like MicroSpike, Super Gripnet and Micro Gripnet introduce asperities at varying heights that promote higher veneer stability, improving slope stability and anti-slip safety for lagoons with steeper slopes (page 16). Ultra Grip concrete protective liner and embedment strips can be used for concrete structures that are part of the lagoon's design (page 14). Finally, to manage gas flow and offer cushioning against localized pressure that could damage the underlying liner, geotextiles and geocomposites are available.

Fabrication of Custom Components
Create your own high-quality customized components, using AGRU semi-finished products as a starting point. See 16 for more information about AGRU semi-finished products.

Product Overview

AGRU HYDROCLICK®

Hydroclick is a specialized polyethylene product with patented click profiles that are used to attach the liner to existing concrete structures for fast, precise rehabilitation of potable water storage.

HydroClick Features

- Enhanced leakage control when compared with a spray-applied material.
- Rapid installation thanks to unique click profiles, weldability, and ability to be prefabricated.
- Long service life, durable, and reliable with high inherent resistance to trace chemicals.
- Easily cleaned and maintained.
- NSF 61 designated product—safe for portable water systems.

For complete details about AGRU HydroClick, visit: https://agruamerica.com/products/hydroclick/.

SURE-GRIP®

An industry leader for more than 30 years, Sure-Grip concrete protective liners are made with PVDF, or ECTFE and serves as a long-term alternative to spray-applied concrete protection products in highly corrosive environments such as chemical storage or industrial wastewater applications.

Sure-Grip Features

- Comes standard as Type 560, with a 13 mm anchor height.
- Reliable with long service history.

For complete details about Sure-Grip, visit:
https://agruamerica.com/products/sure-grip/.

AGRU-ULTRA GRIP®

The latest innovation on Sure-Grip, Ultra Grip offers unparalleled backpressure resistance through a revolutionary redesign of the 13 mm Sure-Grip anchor.

Ultra Grip Features

- Comes standard as Type 562, with 13 mm stud height.
- Pull out resistance of up to 820 kN/m2 with PE 80 at 20°C in 3,000 psi concrete.
- Manufactured with HDPE, HDPE-el, or PP, depending on project requirements.
- Distinctive V-shape anchor can resist long-term sustained backpressure of up to 1.75 bar (at 20°C or 68°F).
- Product is available in rolls and sheets of up to 10’ (3.05 m) in width and up to 5 mm (200 mils) in thickness.

For complete details about Ultra Grip, visit:
https://agruamerica.com/products/ultra-grip/.

HDPE Pipes

HDPE pipes made with PE 100 and PE 100-RC.

HDPE Pipes Features

- Pipes made with HDPE have a density that ranges from 930 to 970 kg/m3—about seven times less than steel.
- The high strength-to-density ratio in these products makes them easier to transport and install, while still being durable enough to handle a wide array of pressure and non-pressure applications.
- HDPE pipes are flexible, making it suitable for a number of installation methods including horizontal directional drilling (HDD) and making it resistant to seismic events.
- Pipes made with HDPE are immune to electrochemical-based corrosion processes, promoting a long-term smooth surface (consistent flow rate) that is less susceptible to biological growth and other forms of fouling.
- For enhanced durability and strength, AGRU HDPE pipes can be manufactured using PE100-RC.

For complete details about AGRU HDPE Pipes, visit:
https://agruamerica.com/product/pipe-fitting-systems/.

HDPE Fittings

Ball valves, transition fittings, electro-fusion couplers, tapping saddles, and more made with approved materials.

HDPE Fittings Features

- Transition Fittings
- Electro-Fusion Couplers
- Tapping Saddles
- Ball Valves.

For complete details about AGRU HDPE Fittings, visit:
https://agruamerica.com/product/pipe-fitting-systems/.

Sheet Stock and Semi-Finished Products

AGRU manufactures semi-finished products made of high-grade thermoplastics offering acid and alkali resistance across a range of applications. This resistance enables lower lifecycle costs thanks to reduced maintenance needs and the long service life of the product.

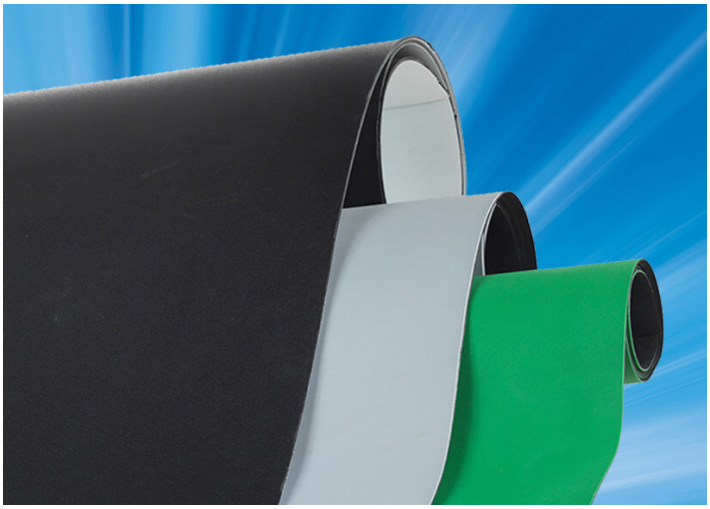
Sheet Stock and Semi-Finished Products Features

- Available in PE and PP as well as a range of fluoropolymers such as PVDF, ECTFE, PFA, and FEP
- Available in a wide range of thickness and sheet dimensions
- Also available in round bars.

For complete details about AGRU Sheet Stock and Semi-Finished Products, visit:
https://agruamerica.com/product/semi-finished-products/.

AGRU Smooth Liner®

AGRU Smooth Liner is manufactured using the flat die-cast extrusion method, which allows the company to produce among the most consistent smooth and textured geomembranes on the market. Smooth Liner is available in high-density polyethylene (HDPE) and linear low-density polyethylene (LLDPE). All AGRU Smooth Liner material is rolled on 23' wide plastic cores to ensure ease of installation while also eliminating the problem of collapsed cores.



HDPE Smooth Liner Product Features

- Available in thicknesses ranging from 30 mils to 100 mils
- Available in black, white, and green.

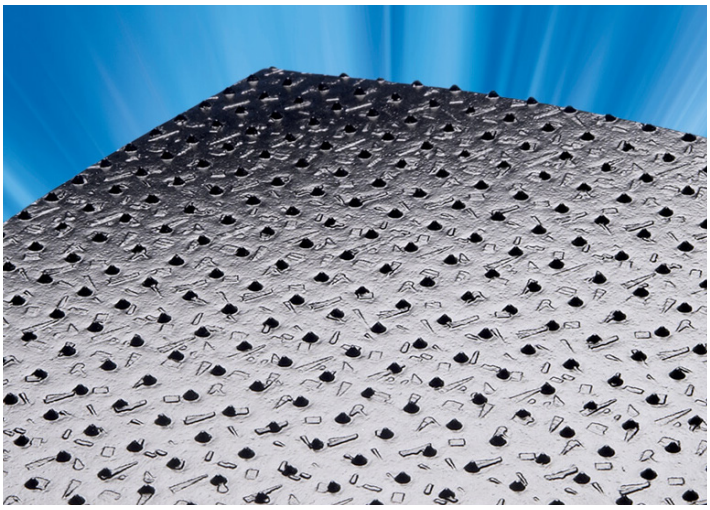
LLDPE Smooth Liner Product Features

- Available in thicknesses ranging from 40 mils to 100 mils
- Available in black, white, and green.

For complete details about AGRU Smooth Liner, visit:
https://agruamerica.com/products/agru-smooth-liner/.

AGRU MicroSpike®

AGRU MicroSpike is the only HDPE and LLDPE geomembrane liner featuring consistent texture and friction angle values and is the product of choice in containment applications where slope stability is critical. Consistent texturing patterns and asperity height allows for more reliable and predictable interface shear strength. MicroSpike features smooth edges to allow for high-quality thermal fusion welding between adjacent sheets.



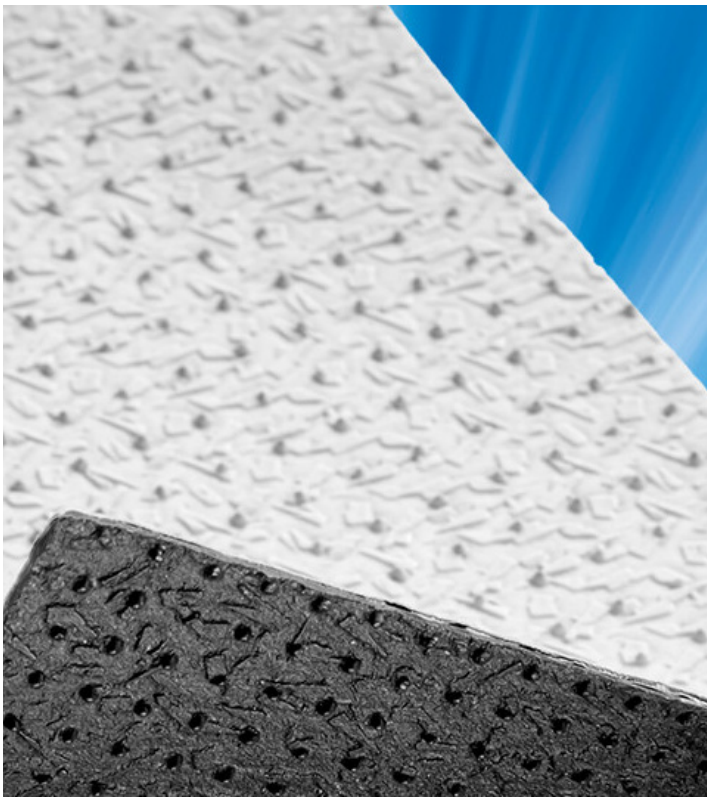
HDPE Smooth Liner Product Features

- Available in thicknesses ranging from 30 mils to 100 mils
- Available in HDPE or LLDPE
- Available in black, white, and green
- Available as single- or double-sided.

For complete details about AGRU MicroSpike, visit:
https://agruamerica.com/products/microspike-liner/.

AGRU Conductive Liner

AGRU Conductive Liner possesses higher carbon loading compared with other polyethylene-based liners, allowing this specialty liner to conduct electrical charges. This feature supports construction quality assurance testing by facilitating the search for possible holes, punctures, tears, cuts, cracks, and similar breaches over the partial or entire area of an installed geomembrane using test method ASTM D7240.



Conductive liner is implemented for improved quality control processes by removing the reliance on the human eye for post-installation inspections. One unique feature of AGRU's Conductive Liner is its improved strength and elongation strength qualities when compared with the industry standard.

Conductive Liner Product Features

- Conductive geomembrane incorporates a thin coextruded conductive bottom layer that allows for spark testing per ASTM D7240 without the need for water.
- The area is swept with a brush-like test wand to locate points where the capacitor discharges through a leak. When the system senses the discharge current, it is converted to a visible spark and audible alarm.

For complete details about AGRU Conductive Liner, visit:
https://agruamerica.com/products/agru-conductive-liners/.

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