Flexible Geomembranes and Factory Fabrication: Advancing Performance and Installation Efficiency

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Although many geomembrane types exist, most installers are mainly experienced with HDPE or LLDPE in 40, 60, and 80 mil (1.0, 1.5, 2.0 mm) thicknesses. HDPE offers excellent UV stability and chemical resistance, but various containment applications require more flexible materials. Flexible geomembranes vary by polymer, density, structure, and thickness, and can be reinforced with an internal fabric scrim or non-reinforced. These different types of flexible geomembranes provide higher yield elongation, multiaxial and flex-cycling properties in addition to specific advantages with mechanical property including tensile break, tear and puncture strengths.

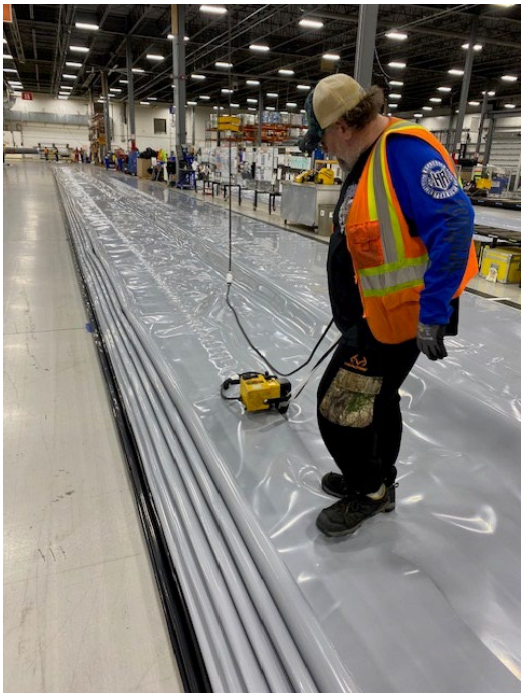
Most flexible materials can also be factory fabricated into larger custom size panels. This process includes factory welding, seam testing and packaging under controlled factory conditions. For installers who normally install thicker gauges of HDPE, it can be challenging to weld and install other more flexible and thinner gauge geomembranes without adequate training and experience.

To support industry standards, **IAGI offers its Certified Welding Technician (CWT)** program for most standard-grade geomembranes, including HDPE, LLDPE, PVC, and most of the standard Reinforced Flexible Geomembranes.

Benefits of Factory Fabrication

Factory fabrication joins factory roll stock into large panels under ideal controlled conditions primarily using thermal fusion including wedge and hot air welding. Factory fabricated panels can be rectangular or square and produced to custom widths and lengths to optimize installation deployment and field welding efficiencies.

The factory fabrication process includes cutting rolls to length, prequalification of welded seams, factory welding, folding, winding, and packaging the liner under ideal indoor conditions. On mid to larger scale projects, factory fabrication can typically reduce field welding by up to 75%, significantly lowering installation time and cost. Smaller scale projects under 75,000 ft2 (7,000 m2) can often be done in one or two larger factory fabricated panels.



Many modern fabrication plants utilize special smooth, low-friction floors and automated welding and winding systems capable of handling large panels up to 10,000 lbs. (4,535 kg). Based on 30 mil (0.75 mm) geomembrane, this is the equivalent to 65,000 ft^2 (6,000 m2) in a single fabricated panel. Maximum panel sizes will vary based on material type, thickness and fabrication equipment.

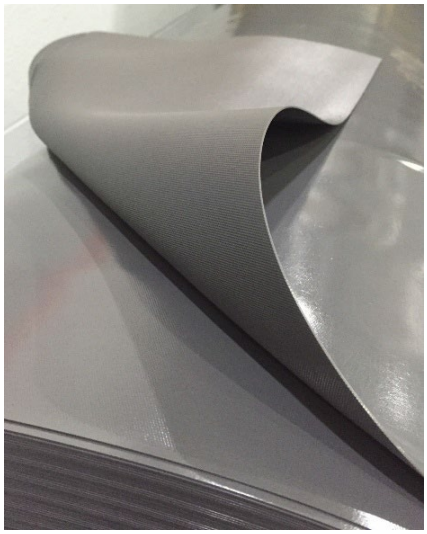
Past industry studies have shown approximately 80% of leaks occur within 3 ft (0.91 m) of field seams, and 55% of leaks and failures are at seams. Reducing field welds improves seam integrity and minimizes damage risk.

Factory fabrication also simplifies complex geometries such as tank transitions, sumps, and pipe penetrations and addresses material limitations. Unreinforced geomembranes provide excellent elongation for weak subgrades, while reinforced types offer high tensile and tear strengths for durability, especially with steep and vertical slopes.

Flexible Geomembrane Materials

The performance property of flexible geomembranes differ by polymer material type and structure (reinforced and unreinforced) each offering unique mechanical and endurance properties. Selection should consider chemical resistance, UV stability, and application performance needs. These include geomembrane earth lined ponds, underground concrete clearwells, above ground tanks, floating covers, and baffle curtains. Standard flexible geomembrane thickness for unreinforced materials are 20, 30, 40, 60 mil (0.5, 0.75, 1.0, 1.5 mm) and reinforced at 30, 36, 45 and 60 mil (0.75, 0.91, 1.14, 1.5 mm).

Common material types include:



- **PVC** – Polyvinyl Chloride (Unreinforced)
- **PVC EIA** – PVC & Ethylene Interpolymer Alloy - (Reinforced)
- **RPP** – Flexible Reinforced Polypropylene (Reinforced)
- **RPE** – Reinforced Polyethylene LLDPE (Reinforced)
- **WCPE** – Woven Coated Polyethylene (Reinforced)
- **LLDPE** – Linear Low-Density Polyethylene (Unreinforced)
- **CSPE -** Chlorosulfonated Polyethylene (Reinforced)
- **EPDM** – Ethylene Propylene Diene Monomer (Unreinforced)

Applications for Flexible Geomembranes

Factory-welded panels are widely used for a diverse range of environmental containment applications including municipal water, wastewater, stormwater, agriculture, oil and gas, mining, and waste management, and environmental remediation.

Flexible geomembrane applications using liners, covers, floating covers and baffle curtain applications include:

- Wastewater Ponds, Dams & Reservoirs
- Canal and Irrigation Liners
- Decorative Landscape ponds
- Tailings Ponds & Heap Leach Pads
- Above-Ground Storage Tank Liners (water/brine)
- Stormwater Retention Basins & Bioswale
- Agricultural Waste Lagoons & Digesters
- Municipal Wastewater Reservoirs
- Clearwell & Reservoir Liners and Baffles
- Secondary Containment - Chemicals
- Environmental Remediation Soil Liners & Covers
- Vapor Barriers for Moisture, Radon and Methane
- Temporary and permanent Landfill Covers & Caps

Importance of Flexibility

Flexibility is essential for factory fabrication and for applications requiring higher elongation and multiaxial properties. This is important where you have concerns with cyclic loads, subgrade deformation, bending and folding the geomembrane at sharp transitions of grade e.g., at tank floor to wall transitions, or around features including inlet and outlet structures, pipes and columns.

- **HDPE**: is noted for its higher crystalline structure (40 – 60%) and density providing very good overall chemical resistance and UV stability but a low yield point of (12 - 15%) and yield elongation. This can result in HDPE not being the best choice for applications requiring higher elongation and flexibility including where there are poorly compacted subgrades, applications requiring liner movement or flex cycling, or for factory fabrication.
- **PVC, PVC EIA, & RPP. RPE, LLDPE**: These materials have lower crystallinity, more amorphous, providing improved flexibility. They are also very good for factory fabrication and subject to the specific material and application, can also provide very good overall chemical resistance and UV stability. It is important to note that there can be important performance tradeoffs associated with flexibility including less chemical and UV resistance unless specially formulated materials.

Summary

HDPE is widely recognized for its very good overall chemical resistance and UV stability. However, many containment applications benefit from alternative geomembranes with different performance properties. Flexibility is a key performance factor when selecting liners for many ponds, tanks, or floating cover applications. Flexibility varies by polymer type and whether the geomembrane is reinforced or non-reinforced. Materials such as PVC, PVC-EIA (Ethylene Interpolymer Alloy), RPP, RPE and CSPE offer very good flexibility. Most flexible geomembranes can be factory-fabricated into custom panels, streamlining deployment and reducing the number of challenging field welds and installation time.

Many of today's leading installers are becoming skilled in working with a wider range of geomembrane types, both reinforced and non-reinforced, providing versatility of their services across diverse containment applications. ***Remember, there is no single geomembrane liner material suited for all containment applications*.**

To support industry quality standards, **IAGI offers its Certified Welding Technician (CWT)** program for common industry geomembranes, including HDPE, LLDPE, PVC, and most reinforced products such as PVC-EIA, RPP, and WCPE. **Please contact CWT@iagi.org for more information on our CWT program for PVC and Reinforced Geomembranes.**

Photos Courtesy *– Hallaton Environmental, Layfield Geosynthetics, Environmental Protection Inc (EPI), Flexible Geomembrane Institute (FGI), Colorado Lining, Concept Tanks, Intertape Polymer Group (IPG)*