

Don't Overlook or Forget to Consider PVC Geomembranes in Mining

by GNA Editor



While HDPE liners have long been the default choice for mining applications due to their broad chemical resistance and low cost, PVC geomembranes offer compelling advantages that deserve serious consideration. This is particularly true for heap leach pads, acid lagoons, brine storages and other harsh environments where strong acids and UV exposure are prevalent.

Chemical Resistance

PVC geomembranes demonstrate outstanding resistance to both acids and strong salt solutions, making them suitable for many mining and mineral processing applications. Although HDPE is known for its excellent broad-spectrum chemical resistance, PVC's outstanding performance in acidic environments is often underestimated. PVC linings known as Plasteline™ have been successfully used to protect concrete pipes from acid condensate for over 50 years in Australia.

Advancements in PVC Technology

Modern PVC geomembranes have overcome historical limitations through several key improvements:

1. **Enhanced Stabilizers:** New generation PVC liners incorporate fortified heat and UV stabilizer packages, significantly improving their resistance to degradation.
2. **Non-migratory Plasticizers:** The use of non-migratory plasticizers, such as Elvalloy EIA, addresses the issue of plasticizer loss that plagued earlier PVC formulations.
3. **Increased Thickness:** Contemporary PVC geomembranes are available in thicker grades, moving beyond the thin 0.5-0.75 mm liners of the past. Processing by spread coating can produce reinforced or unreinforced materials 3 mm thick or more.

HDPE materials have progressed from simple formulations of polyethylene and carbon black to metallocene or bi-modal resins with more characteristics of lower density materials which are heavily supplemented by a variety of additives. The old comparisons of additive content of PVC and HDPE are no longer valid.

Superior Mechanical Properties

PVC geomembranes offer several distinct property advantages over HDPE:

- **No Stress Cracking:** PVC liners simply do not stress crack which can be a major issue with HDPE.
- **Puncture Resistance:** PVC liners exhibit incredible puncture resistance, crucial for applications like heap leach pads where massive loads are placed on the liner.
- **Multi-axial Elongation:** PVC's superior multi-axial elongation properties allow it to better withstand differential settlement, a common issue in mining applications.

Performance in Heap Leach Applications

Heap leaching, particularly for copper extraction, subjects liners to extreme conditions. PVC geomembranes excel in this environment due to their ability to:

- Withstand the dilute sulfuric acid solutions used in copper heap leaching.
- Adapt to differential settlement caused by varying soil compressibility, extreme heap heights, or local settlement from leaks.

- Handle multi-axial strains exceeding 80%, compared to ‘old fashioned’ HDPE's typical 15% limit and some current modified HDPE capacity at 30%.
- This flexibility, multiaxial strain capacity and puncture performance mean that PVC geomembranes do not need the absolutely perfect prepared subgrades that are required by HDPE. Any cost comparison should include the earthworks and subgrade preparation.

Cost-Effectiveness

Throughout South America, relatively low-cost PVC liners are being successfully used in aggressive mining applications with rare instances of failure. This track record demonstrates PVC's viability as a cost-effective alternative to HDPE in many scenarios.

Reinforced or Not?

PVC materials can be made unreinforced in order to maximise the flexibility and multiaxial strain capacities mentioned above. They can also have non-woven geotextile attached during the manufacturing process to enhance the potential for adhesion to substrates.

However PVC materials can also be reinforced to give an initial tensile modulus similar to HDPE. The reinforced materials also lie very flat on the substrate with minimal wrinkling regardless of the thermal conditions. This makes for better faster and more reliable welding. There are even reinforced PVC materials with light glass fibre reinforcement intended to duplicate the thermal expansion characteristics of concrete.

Roll Width, Panels and Seaming

Whilst PVC rolls are often not as wide as HDPE this facilitates the manufacture of pre-fabricated panels which can be handle in a similar way to HDPE rolls.

However the speed, ease and reliability of welding with modern hot air and wedge welders means that pre-fabrication is often bypassed as unnecessary.

Raincoat Liner Applications

In heap leach operations, PVC geomembranes are well-suited for use as temporary exposed geomembrane covers (EGCs), also known as raincoat liners (RCLs). These covers minimize stormwater infiltration into ore heaps and divert surface runoff to natural drainages.

Modern Heap Leach with PVC Liners

The first large scale application of modern heap leach technology with PVC liners was in the early 1980's at the Lo Aquirre Project in Chile. By the mid 1980's, most new leaching operations were using modern heap leach technology. This consisted of crushed ore (sometime agglomerated), thinly stacked lifts of ore (less than 10m), irrigation of ore with a solvent to extract the identified mineral(s) and a PVC liner system/collection system to capture the pregnant solution more efficiently.

Mining companies across the globe embraced this method as an efficient way to cut production cost and increase productivity through the development of lower grade resource projects.

Over the years, heap leach technology has continued to advance, however there still remain design and environmental challenges/considerations such as: material placement, high loads on buried liner systems and solution collection systems, high temperatures in bio-leaching, slope stability and deformation, seismicity, harsh climate and terrain, etc. Additionally, improper design, incorrect material selection, poor construction and/or bad operational practices still plague the industry.

In 2004, Ausenco began an exciting assignment with Minera Escondida Ltd at their Escondida Mine, the largest copper mine in the world. We developed both their sulfide and oxide ore heap leach facilities. Ausenco began with the development of the Sulfide Leach Project (SLP) - the largest bio-leach pad in the world (i.e. over 9.8 Mil m²) which involved the development of an air injection system to promote bio-leaching.

Ausenco then developed the Oxide Leach Expansion (OLE) that is a single use multilift pad that uses a shiftable conveyor and stacker system. This allows for the placement of the initial and interlift PVC liner and solution collection systems as the conveyor and stacking system retreats. This provides significant capital and sustaining capital savings along with maximizing copper recovery. This design results in zero delays in the operation of the leach pad and removes the need for a large construction crew.

Ausenco then went on to design Minera Escondida Ltd's Oxide Leach Area Project (OLAP) that uses an on/off pad to process oxide ore using a stacking and reclaim system. This eliminated multiple lift leach pad with interlift PVC liner systems, which saved the client additional sustaining and operating capital costs along with providing a very efficient copper oxide heap leach operation and that maximizes copper recovery.

To learn more about PVC Liner heap leach technology please contact Scott.Elfen@ausenco.com

Quality Manufacturers

Several reputable manufacturers produce high-quality PVC geomembranes suitable for mining applications, including Renolit, Mapei, and Soprema in Europe and Cooley and ESquared in the USA. For example, RENOLIT ALKORPLAN Hydro H 35254 is a high performance PVC liner specifically designed for lagoons, dams, and canals, offering high UV resistance, puncture resistance and excellent adaptability to irregular surfaces.

In conclusion, while HDPE remains a viable option for many mining applications, the advancements in PVC geomembrane technology make it a compelling alternative that should not be overlooked. Its superior flexibility, multi-axial elongation, and proven performance in aggressive environments position PVC geomembranes as a strong contender for various mining and mineral processing applications.

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