Changing Geomembrane Specifications in 2025 – Prescribing The Atarfil Innovation Path

INTRODUCTION

In the past few years and continuing in 2025, there is clear and rapid industry change to the specification of Polyethylene (HDPE) and other Polymeric Geomembranes used in containment.

The GRI-GM13 HDPE Industry Guideline will likely observe the most significant changes in decades, with increasing emphasis on project specific Geomembrane recipes, and much higher design focus on Immersions, Shear Testing and analysis of site Environmental, Temperature and Stress Conditions.

The question becomes, how can Atarfil as a Geomembrane Manufacturer enable the industry to transition smoothly from Index Tests to Performance Tests that demonstrate site specific HDPE Geomembranes?

WHY CHANGE GEOMEMBRANE SPECIFICATIONS?

The obvious question is why change?
The simple response is that the way HDPE Geomembranes are being used in 2025, does not reflect the period of development of the GRI-GM13 Guideline, and it has been used beyond its intent. It clearly states:

1.4 *This standard specification is intended to ensure good quality and performance of HDPE geomembranes in general applications, but is possibly not adequate for the complete specification in a specific situation. Additional tests, or more restrictive values for test indicated, may be necessary under conditions of a particular application.*

No-one would doubt the success of the GRI-GM13 Standard, but 2025 challenges historic processes:

1. THE MEASURE OF SUCCESS HAS CHANGED.
   The most critical Geomembrane installations are buried, and clients are now having to demonstrate long term leakage risk of their tailings dam, or landfill facility. If the liner cannot be inspected over time, the obvious result is a need for greater material accountability in terms of chemistry, temperature and stress in the design phase.

   In exposed Geomembrane installations that present an ability to inspect the liner, you cannot simply look at a Geomembrane lined pond and measure success. Sites that have failures to the naked eye. have been failing their design criteria for years. If the design strategy of Geomembranes is based on eg. 2-5 holes (<5mm diameter) per Hectare, the likelihood is “nil” that a visual inspection will identify unacceptably increasing leakage rates. The result is an increased focus on the specification of UV, Chemistry, and Stress impacts.

2. GEOMEMBRANES ARE USED IN HIGHER RISK APPLICATIONS
   Geomembrane use in 2025 is in design conditions not considered during the development of GRI-GM13. Landfills are becoming steeper and deeper, and HDPE is the industry-accepted liner for Concentrated Brines, Heap Leach and Tailings Dams. The result is increasing need for immersion testing in both short (preferably long term) to enable Geomembranes with specific Project Life.

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3. THE INDUSTRY NOW ACTIVELY MEASURES LEAKS
   In the past decade, the ability to measure the design performance of Single Liners through Leak Collection Systems allows an asset owner to qualify their leaks and therefore (ALR) over time. Leakage collection is the only true measure of ALR compliance, and success has been demonstrated for catastrophic leaks, but difficulty observed in capturing minor leak changes.
   The result is increasing use of Leak Surveys, Leak Detection, and greater emphasis on the impacts of things like Aggregate Stress on the Geomembrane's potential to Stress Crack.

   Leak Surveys have also changed the perception of Geomembrane success based on an acceptable number of holes per Hectare. Leak surveys carried out on bare liner but particularly post aggregate placement, have revealed discrepancies depending on who carries out the survey, and even in the most regulated Australian EPA environments, are detecting significant and sizeable Geomembrane holes. This implies that in unregulated installations without high end prescriptive HDPE Specifications, the design ALR is likely never being met.
   The result is conservative HDPE Prescription of Specifications and an emphasis on high-cost/blanket Independent CQA that includes Leak Analysis.

4. USE OF ALTERNATIVE POLYMERIC GEOMEMBRANES
   The growth and use of other Polymer Geomembranes and particularly Bituminous Geomembranes have also invigorated the design focus on HDPE and highlighted the limitations of GRI-GM13. It is a failing of the Geosynthetic Industry and its inability to educate consumers that has led to issues with modern Geomembranes and reinvigorated the focus on HDPE Specification.

   These failures are being quantified with technical papers in 2025, but nothing is surprising or new. Overlap Hydraulic Performance, Temperature Induced Shear failures (internally and interface), and UV and Chemical degradation of these liners is replicating HDPE Geomembrane use some 20+ years ago. The result is a move away from GRI-GM13 due to a revised focus on these design parameters not captured in the guideline.

It is therefore not a limitation of the guideline that is driving change, GRI-GM13 has only ever prescribed itself as a minimum industry benchmark that presents Index Properties and suitable QC frequencies. The Guideline's lack of hydraulic performance measures and inability to make Lifetime Predictions are simply being emphasized by incorrect use and consequential increased leakage in high-risk applications.

HOW DO HDPE GEOMEMBRANE FAILURES OCCUR?

It is important to consider what constitutes an HDPE Geomembrane "failure". A designer would ordinarily have a target for leakage, and then a reference point at which leakage becomes unacceptably high.
Geomembrane failures have been historically categorized by environmental risk, and loss of performance in water containments has largely been ignored. In 2025 however, the cost of water and water assets is seeing asset owners demanding demonstration of the Action Leakage Rate (ALR) and much stricter accountability in terms of potential leaks. There is consistent industry demand to demonstrate leak risk.

HOW DO WE LIMIT HOLES?

All holes that are created in a HDPE Geomembranes onsite are a result of some sort of stress applied. The fundamental design aim is to remove or mitigate the site constraints that increase stress risk.

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These conditions can be summarised as follows;

- Environmental and chemical aging factors that make the polymer more susceptible to stress
- Mechanical damage during construction
- Thermal stresses during welding/exposure
- Insitu temperatures and wrinkles
- Aggregate point loads over time
- Liner configuration casusing concentrated stresses

Poorly specified Geomembranes will therefore rapidly observe holes and increased leakage, due to their inability to resist the site factors that accelerate stress impacts onsite.
High Specification HDPE Geomembranes are materials less susceptible to stress but can also resist the factors that catalyse the impacts of stress.

HOW IS ATARFIL ADDRESSING THE CHANGING SPECIFICATION LANDSCAPE

In 2025, HDPE Specifications will require products (proposed GRI-GM13) that are formulated for specific applications. This requires the manufacturer to be able to demonstrate performance in Chemistry such as Concentrated Brines, Landfill Leachates, Tailings, Heap Leach and Chlorinated water but also tested in conjunction with Stress, UV, Temperature and in contact with Site Soils.

In critical applications, the aim of Atarfil is to categorise Geomembranes by specific HDPE formulations, with Technical Datasheets that identify specific testing relevant to the project. These products will have a library of specific test data that enables pre-qualification and enables lifetime prediction.

In terms of specific testing development that will need to accompany these products:

STRESS CRACK RESISTANCE

The fundamental measure of Geomembranes under stress, has been Environmental Stress Crack Resistance (ESCR) testing. This is fundamentally a notched HDPE Sample that is applied with a Uniaxial force and immersed in a Chemical known to accelerate degradation. There are multiple issues with this test moving forward (eg Igepal) but also a clear need to fast-track testing timeframes.

The main question for ESCR-NTCL testing in terms of project longevity is does it correlate to stress onsite, and why is it difficult to establish an ESCR correlation to products when they undergo immersions?

Atarfil testing is investigating new Stress Crack Methods, a greater understanding of short timeframe testing of SCR, and an aim to review SCR pre and post stress and immersion.
The opportunity is to build a correlation between long and short term ESCR, that can be tested in rapid timeframes and benchmarked against site stresses and chemical immersions for performance prediction.

CHEMISTRY

Atarfil has a library of immersions undertaken on site liquors across multiple tailings and contaminant streams, including high and low pH, Emerging Contaminants, Critical Minerals and a range of Salt and Heavy Metal Concentrations. Immersion results to date indicate that traditional measures of performance like OIT and HPOIT consumption, can be refined to provide much more robust predictions of specific additive loss measured by HDPE Deformulation.
The Atarfil Innovation Team are committed to undertaking future immersions that replicate changing regulation of tailings and waste and enable more robust predictions of Product Life.

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UV AND TEMPERATURE – LIFE OF HDPE IN CAPPING APPLICATIONS

There is also an ever-growing need to provide a Landfill or Mining Client extreme Geomembrane Lifetime Prediction for Closure Applications (demands of 1000 years are not uncommon). This requires a correlation between initial UV exposure, understanding Thermal effects correlated to Stress, and the results to be related to potential adverse interactions with wicking mine chemistry or gas generation.

The fundamental Index measures of UV and Thermal performance do not categorise Additive Loss in relation to Chemical/Gas effects or Stress over time. These highlight the fundamental limitations of Index Tests vs Performance Testing. Design conditions in closure are often replicated across sites in terms of stress, temperature and UV, providing an opportunity to model these conditions in isolation, and simply apply chemical and gas constraints specific to the site. This is the most robust method to demonstrate Lifetime Predictions that exceed 100 years for modern day mine and landfill closures.

THE LIMITATION OF GEOMEMBRANE WELDS

There is increasing and perhaps alarming evidence of a specific mode of Geomembrane failure in 2025. Site exhumations are observing longitudinal Stress Cracks alongside welds that indicate sudden and brittle failure. This has been well documented for Extrusion Welds and in the Heat Affected Zone of Fusion Welds, observed in conditions of elevated chemistry, temperature and stress.

The fundamental problem is that the process of evaluating weld quality during installation does not provide any surety as to weld performance long term. The GRI-GM19 Guideline (also likely to change 2025) evaluates weld quality through simple Shear and Peel Tensile Tests. A weld that is overheated and left with residual stresses long term, can simply pass a mechanical test yet is at high risk of failure.

Atarfil are undertaking comprehensive weld studies that are evaluating weld OIT retention, thickness consistency, Geomembrane temperature differentials, squeeze-out quality, microcracking, and crystallinity changes—factors that directly correlate with long-term weld durability. By incorporating parameters like those outlined in DVS 2225-4, the industry can adopt a more holistic approach to assessing seam quality and mitigating premature failures.
This will allow direct correlation between weld parameters and the HDPE Masterbatch properties moving forward to ensure that the welds are directly comparable to the sheets in terms of Predicted Longevity.

CONCLUSION

HDPE Geomembrane Specifications will observe inevitable change**.** This will be seen in key Industry Guidelines like GRI-GM13 and GRI-GM19 that have performed remarkably well, but are possibly failing to meet industry demands in 2025. A move towards application specific HDPE Specifications will present a challenge to categorise them with the same Index Tests. Atarfil are intent on building an R&D Database that categorises this need for Performance Based Testing rather than traditional Index Properties, and build rapid test methods to facilitate fast analysis.

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Documents for those with further interest;

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