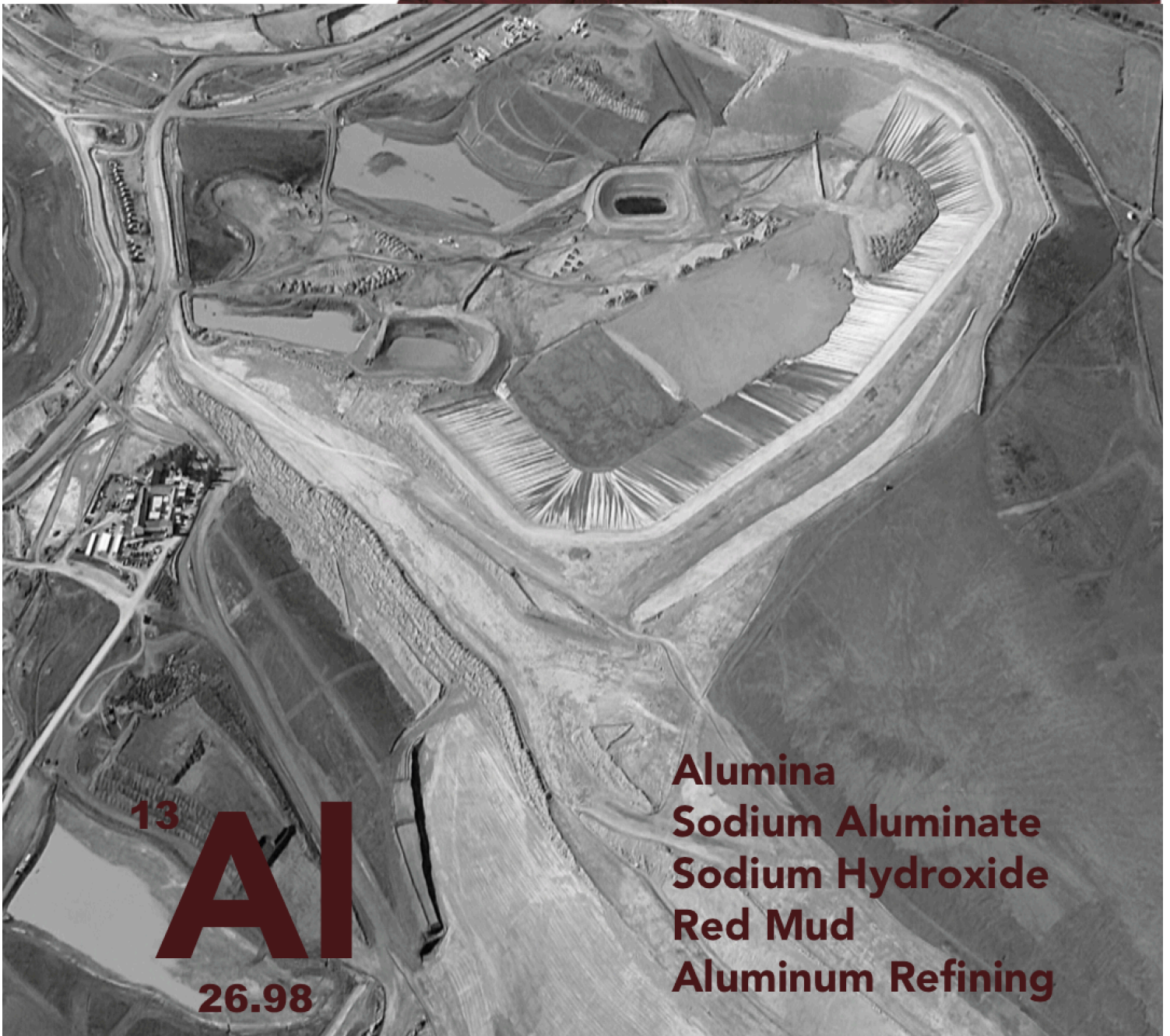


SPECIFIC FORMULATION PROJECTS
ATARFIL EVO



13

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**Alumina
Sodium Aluminate
Sodium Hydroxide
Red Mud
Aluminum Refining**

AN ATARFIL INTRODUCTION

ATARFIL is a multinational manufacturer of high performance **GEOMEMBRANES** (HDPE –VLDPE-LLDPE-PP) by **FLAT-DIE extrusion**, with the most advanced **in-house developed technology** for our products, which allows us to provide the best adapted products to the demands of the applications and the needs from our Customers.

We have production plants in Europe, Middle East and North America and sales operations in Spain, UAE, USA, Mexico, Turkey, India, South Africa and Australia. We are active in five continents with clients in 50+ countries.

25 years of world wide experience, progressing sustainable and environmentally beneficial solutions. Specialising in **SAFE CONTAINMENT** solutions in:

MINING (e.g. heap leach pads, tailing dams, mine closures)

WASTE (e.g. landfills, environmental protection, waste disposal, capping)

WATER (e.g. reservoirs, ponds, tanks, canals, water treatment),

Atarfil EVO represents an EVOlution of Geomembrane Performance with enhanced geomembrane formulations, improved predictive testing methodologies and augmented service lifetimes.

Atarfil are proud to provide solutions that challenge the thinking of containing the highest risk contaminants. At the core of our values is the way we do things, **Care, Respect and Commitment**.

FUTURE GEOMEMBRANES FOR CHALLENGING CONTAMINANTS?

Since 1995, Atarfil has invested heavily in R&D, intent on establishing the best product to meet the environmental need of it's customers and ensuring that this process can be replicated by our factories around the globe. Atarfil has three GAI-LAP accredited laboratories with the latest testing technology, and a small-scale pilot flat-die geomembrane machine that allows the technical team to create and evaluate geomembranes with different resins and formulas without full-scale manufacturing trials. The future of Geomembranes is formula specific.

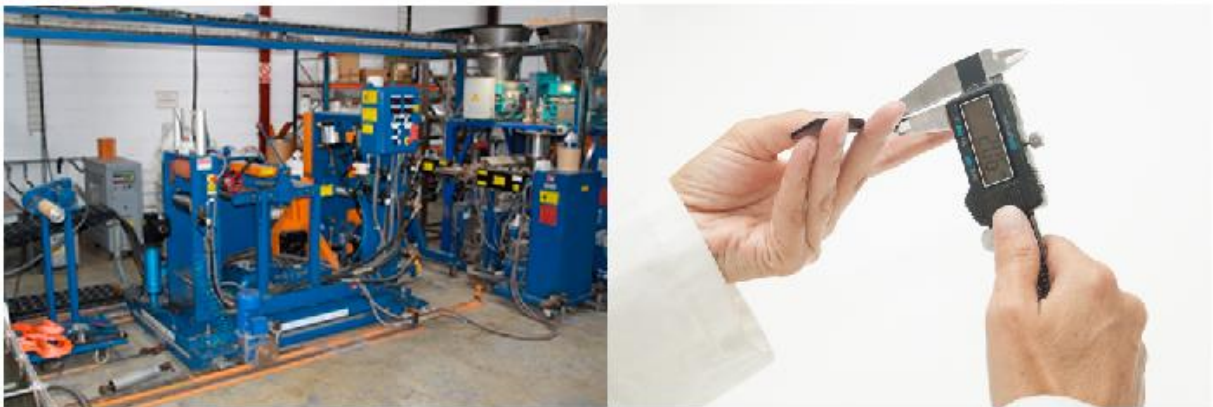


Figure 1: Atarfil Pilot machine

SPECIFIC SITE FORMULATIONS

This capability for site specific formulations, also allows key partnerships with asset owners and designers to pre-screen and test a set of liners under site-specific environmental conditions that include short and long-term immersion testing. When assessed by index tests and performance tests at different concentrations and temperatures, an Arrhenius longevity prediction can be linked to ambient exposure to provide reliable lifetime prediction. It benefits the client both technically and economically by creating and customizing the most suitable Geomembrane for the site needs. The future of Geomembranes is site specific.

MEASURING SITE DEGRADATION

In partnership with key polymer experts who can categorize the mechanisms of degradation, a thorough pre-evaluation model for Atarfil's products in critical applications also allows an assessment of long-term durability risk onsite. If sufficient project specific testing is carried out during the design phase, the opportunity is to sample the

product installed onsite over time (using fully-immersed coupons in the actual service environment), creating a direct measure of degradation performance against the design expectation. Degradation and premature service life issues can be forecasted rather than simply acting upon after a problem manifests. This is predictive monitoring rather than reactive monitoring.

The future of Geomembranes allows a direct measure of degradation onsite, not risk assessment in design alone.

DEFORMULATION

The future for Geomembranes in critical applications must also link to deformation testing of the additive package. If the best environmental choice is to create a specific tailored Geomembrane formulation for the project, then the capacity to measure constituent loss by analysing the Geomembrane post testing is at the heart of identifying the recipe changes that establishes longevity. Polymer laboratories such as ExcelPlas Pty Ltd. are now set up with this deformation capability and expertise in the Australian landscape, and again this must be considered a key initiative to measure Geomembrane degradation in critical applications moving forward.

The future of Geomembranes is knowing all the constituent additives and being able to measure them when testing.

CORRELATING SHORT TERM TO LONG TERM TESTING

The final piece of the challenging contaminant puzzle defines the need to be able to measure long-term testing outcomes by utilizing short term testing measures.

Inevitably with increasing contaminant exposure risk, Geomembranes that have enhanced durability properties will take much longer for traditional testing models to evaluate. The expectation would be HDPE Geomembrane specifications will increasingly demand much higher longevity measures in the form of OIT and HPOIT values, and Stress Crack Resistance (NCTL-SCR) values than those presently required by GRI-GM13.

The Atarfil initiatives are to correlate key longevity measures as follows;

• IMMERSION

Thin Film Immersion (TFI) Testing (1 month duration) to Long Term Pot Immersion Testing (up to 12 months) for a range of site conditions that include – elevated Acid / Base chemistries and elevated ionic salts (i.e. Brines).

• STRESS CRACK RESISTANCE

Rapid Strain Hardening Modulus (SHM) Testing to provide a direct correlation to long-term Stress Crack Resistance ASTM D5397.

• OXIDATION DEGRADATION QC/QA TESTING

HP-OIT and Oven Aging Curves established over 30 / 60 and 90 days to establish failure risk after just 30 days.

The future of Geomembranes is managing testing risk through short and long-term test correlations.

In the remainder of this document, projects are described that Atarfil has supplied in the last years specifically for critical and demanding chemistry applications.

RioTinto

Project Name

Yarwun Refinery Caustic Bladder

Location

Yarwun alumina refinery in Gladstone, Queensland, Australia

Customer

Rio Tinto Refinery at Yarwun

Designer

Rio Tinto

Construction Date

2019

Project Details

Yarwun alumina refinery is located in the region of Queensland (Australia), it produces more than three million tonnes of alumina per year, which is exported to customers in Asia, the Middle East and the Pacific region. The Yarwun Refinery includes two Caustic Bladders (No.1 and No.2) near the Fisherman’s Landing wharf. In 2018 refinery management made a decision to replace Caustic Bladder No.1 due to being near the end of its life. These caustic bladder storage facilities needed a high-performance lining system that was able to resist the extreme high percentage of caustic solution (50% w/w sodium hydroxide).

Solution

Atarfil R&D department created a specific *caustic-tolerant* Atarfil HD geomembrane with an antioxidant package that allowed the geomembrane to be exposed to very high pH (pH = 14) and high environmental temperatures. Providing a superior geomembrane with caustic-tolerant antioxidants and stabilizers greatly increased its endurance properties.

Rio Tinto carried out an accelerated performance testing program, by the external NATA and ISO accredited laboratory ExcelPlas, to make an informed decision on the relative behavior of ATARFIL geomembrane samples in a concentrated caustic environment. Based on the results in this study, Atarfil geomembrane was the chosen product providing a membrane with maximum durability. It exceeded the minimum required project service life in the caustic containment bladder application.

Materials

Quantity	Facility	Material	Year
59,400 m ²	Caustic Bladders (No.1 and No.2)	Atarfil HD White 2.5mm	2019



Project Name

Ma'aden Residue Storage Cell 3,

Location

Ras Al-Khair, Saudi Arabia.

Customer

Ma'aden Aluminium Company – Alcoa World Alumina

Designer

Worley Parsons Limited

Construction Time

2019

Project Details

In 2009, Ma'aden established a joint venture with Alcoa, the world's third-largest aluminum producer, to build the world's most efficiently integrated aluminum project in Saudi Arabia. This USD 10.8 billion (over SAR 40 billion) project includes a bauxite mine, a refinery, a smelter and one of the world's most advanced rolling mills. Its product, aluminum of the highest international standards, is sold to both domestic and global markets and is encouraging the development of additional downstream aluminum based industries within the Kingdom

Ma'aden required, for this new Residue Storage Cell 3 facility, high performance liner which was able to be suitable for use with bauxite residue (highly alkaline red mud), a waste product composed mainly of iron oxide that is generated in the industrial production of alumina.

Solution

Atarfil R&D department created a specific *caustic tolerant* Atarfil HD geomembrane with an antioxidant package that allowed the geomembrane to be exposed to the waste product composed with elevated pH. This provided superior geomembrane endurance properties under the combined challenging service conditions of high pH and high ambient temperatures.

Materials

Quantity	Facility	Material	Year
600,600 m ²	Residue Storage Cell 3	Atarfil HD 1.5mm	2019
290,250 m ²		Atarfil HD TMT 1.5mm	2019
280,500 m ²		Atarfil LLD TMT 1.5mm	2019



Project Name

Al Taweelah Alumina (Aluminium Refinery)

Location

Abu Dhabi - United Arab Emirates

Customer

Emirates Global Aluminium (EGA)

Designer

Golder Associates Ply Ltd

Construction Date

2017

Project Details

Emirates Global Aluminum developed a bauxite residue storage area (BRSA) disposal site approximately 40 km inland of the proposed refinery site on the Arabian Gulf coast of Abu Dhabi. Golder Associates Ply Ltd was commissioned to prepare the design of the lining system.

The lining system proposed contained a HDPE smooth and textured geomembrane. The geomembrane had to include stabilizers and antioxidant additives suitable for long term expose to very high pH environment (pH 12.5) as the bauxite residue.

Solution

Atarfil R&D department created a specific *caustic tolerant* Atarfil HD geomembrane with an antioxidant package that allowed the geomembrane to be exposed to bauxite residue. This provided superior geomembrane endurance properties under the combined challenging service conditions of high pH and high ambient temperatures.

Materials

Quantity	Facility	Material	Year
651,263 m ²	Bauxite Residue Storage Area	Atarfil HD 2mm	2017
154,200 m ²		Atarfil HD TMT 2mm	