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Atarfil

Atarfil is a Global Leader in the Manufacturing of Geomembranes by FLAT-DIE, with the most advanced in-house technology developed for our products. This expertise allows the Atarfil product range to be manufactured with specific formulations and properties that provide state of the art environmental solutions for our Customers.

Atarfil products meet the most demanding worldwide standards for traditional containment sectors like Water and Waste. However, the increasing environmental focus on Mining and emerging contaminants, requires specialty products to meet evolving best practice.

Since 1995, Atarfil has always invested in R&D, trying to provide the best product to meet the needs of its Customers. The last five years, it has done several investigations evaluating many types of recipes assessing the depletion of the antioxidant package. Thanks to this research, it has been possible to create an outstanding set of liners and assess them both by index tests and performance tests such immersions in solutions with different concentrations and temperatures to end up with the best formulas for critical projects – ATARFIL EVO geomembranes. Atarfil has developed the EVOLUTION range to exceed the most demanding best-practice environmental guidelines. These geomembranes provide unrivaled resin properties demonstrated by Stress Crack Resistance > 3000hrs and HDPE formulations that increase key longevity properties established by Std OIT & HP OIT, Oven Aging and UV resistance testing. Creating a set of geomembranes with higher protection to High Temperature, UV and Chemicals.



Atarfil EVOLUTION Geomembranes

Atarfil EVO geomembranes has gone beyond minimum specs including an antioxidant additive package which extends liner long-term performance in critical sites. Given to our Cus-

Geomembranes formulation includes: PE resin; Carbon black/ Pigment that acts as a UV screen; and an Additive Package (antioxidants and stabilizers) added to inhibit oxidation and extend the induction period to onset of degradation. Since PE gmbs are manufactured and welded at high temperatures (above 200 °C), antioxidants are needed that function at these high temperatures as well as the lower temperatures associated with in-service applications (below 150 °C). Consequently, gmb recipes to provide complete stability should include a combination of antioxidants and stabilizers. All of them are fundamentally important used for a specific function. The different between all PE geomembranes in the industry will be the specific amount, relative percentage and types of these additives as well as the specific resin and carbon black/pigment chosen. For long-term performance of the geomembrane it is very important how they will interact with each other (synergistic mixtures) and with the

tomers technical evidences such as presenting both HP OIT & Std OIT initial and final values after Oven Aging. A detailed proved screen to our EVO outstanding antioxidant package.

environment will be in contact with. It will be necessary to select the right combination of additives to protect the geomembrane to ensure their long life. Different types of antioxidants and temperatures of service are shown below:



The test for assessing the resistance of polyolefin gmbs to oxidative degradation and evaluates the quality of the antioxidant additive package is the OIT test. This test is conducted at 200 °C and since this temperature is above some antioxidant's effective temperature, they can be volatilized or degraded when testing by this standard OIT test. Consequently, the HP OIT was created to be performed at a lower temperature in a pressurized oxygen atmosphere. Hence the Std-OIT and the HP-OIT are the two necessary tests to assess the complete antioxidant additive package in a HDPE geomembrane. As such, to provide to our Customers technical evidences of our EVO geomembrane long term performance is presented both HP OIT & Std OIT initial and final values after Oven Aging. A detailed proved screen to our EVO outstanding antioxidant package.





Lifetime prediction extrapolations via the Arrhenius equation

Lifetime Prediction – Stage A

		Atal In The LVO Stage A							
Temp (°C)	Time (years)	Temp (°C)	Time (years)						
20	208	20	325						
30	97	30	147	_					
40	46	40	70						
70	4	70	10	x2.5					
80	2	80	5						
100	0.7	100	2						

Atarfil HD EVO Stage A

Atarfil HD EVO includes more than **2.5 times lifetime** than a HD GM13 with extreme Temperatures

Chemical Resistance

Atarfil HD EVO range includes specific chemical resistant geomembranes:

Atarfil HD EVO Alkaline Resistance

Caustic tolerant Atarfil HD EVO geomembrane with an antiox idant 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. Examples - Bauxite residue (red mud) containment and heap leach mining like sodium cyanide for gold/silver mines.

Atarfil HD EVO Acid Resistance

Atarfil HD EVO 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 very low pH and high ambient temperatures. Examples - Acid Gold Mine drainage containment and heap leach mining with sulphuric acid (acidic solution) for copper/nickel mines.





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Safe Containment

Waste Water Mining

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ATARFIL HD EVO

ATARFIL HD EVO geomembranes are manufactured from best in class Polyethylene (HDPE) resins coupled with specific antioxidant package by the most advanced in-house flat-die technology. This result in a quality and consistency product with maximum durability and long term performance. Scoring the highest STRESS CRACK RESISTANCE value in the industry, together with an unrivalled mechanical and chemical properties, makes it the best choice for any application.

Atarfil has developed the EVOLUTION range to exceed the most demanding best-practice environmental guidelines. These Geomembranes provide unrivaled resin properties demonstrated by Stress Crack Resistance > 3000hrs and HDPE formulations that increase key longevity properties established by Std OIT & HP OIT, Oven Aging and UV resistance testing.

PHYSICAL PROPERTIES											
Property	Test Method	Unit	Value	Frequency ¹							
Density of Raw Material	ASTM D 792	g/cc	≥ 0.932	-							
Melt Flow Index	ASTM D 1238 (190°C/2.16 Kg)	g/10 min	< 0.40	1 per batch							
Density of Geomembrane	ASTM D 792	g/cc	0.946 ± 0.004	200,000 lb							
Carbon Black Content	ASTM D 4218	%	2.0 – 2.5	Per roll							
Carbon Black Dispersion	ASTM D 5596	Category	Note 3	45,000 lb							
Dimensional Stability	ASTM D 1204 (100°C/1h)	%	± 1.5	Per day							
Low Temperature Brittleness (t* -70°C)	ASTM D 746	-	No cracks	Per formulation							

ENDURANCE PROPERTIES										
Property	Test Method	Unit	Value	Frequency ¹						
Stress Crack Resistance	ASTM D 5397/ IS018488 ⁽⁴⁾	h	≥ 3,000	200,000 lb						
Oxidative Induction Time (OIT) Std OIT HP OIT	ASTM D 3895 ASTM D 5885	min	≥ 120 ≥ 500	200,000 lb						
Oven Aging at 85°C. % retained aft 90days: Std OIT HP OIT	ASTM D 5721 ASTM D 3895 ASTM D 5885	%	≥ 55 ≥ 80	Per formulation						
UV Resistance HP OIT % retained after 1600h	ASTM D 7238 ASTM D 5885	%	≥ 75	Per formulation						

MANUFACTURING PROPERTIES										
Property	Test Method	Unit			Va	lue			Frequency ¹	
Thickness (Nominal)		mil	30	40	60	80	100	120		
Thickness (Minimum Average)	ASTM D 5199	mil	30	40	60	80	100	120	Per roll	
Thickness (Minimum Individual Value)		mil	27	36	54	72	90	108		
	Mechanical Properties ²									
Tensile Strength at Yield		lb/in	74 (63)	103 (91)	148 (137)	199 (182)	251 (228)	303 (274)		
Elongation at Yield	ASTM D 6693	%			20.000 lb					
Tensile Strength at Break	Type IV	lb/in	137 (114)	182 (154)	274 (228)	365 (304)	456 (382)	548 (456)	20,000 เม	
Elongation at Break		%	800 (700)							
Tear Resistance	ASTM D 1004	lb	≥ 21	≥ 30	≥ 45	≥ 60	≥ 75	≥ 91	45,000 lb	
Puncture Resistance	ASTM D 4833	lb	≥ 60	≥ 78	≥ 110	≥ 144	≥ 182	≥ 220	45,000 lb	

STANDARD SIZES											
Thickness (mil)	30	40	60	80	100	120					
Roll Width (ft)		Roll Length (ft)									
19.7	1332	999	663	498	399	333					

(1) Indicated frequency is minimum

(2) Indicated values are average. In brackets minimum values with 95% confidence level.

(3) Carbon black dispersion (only near spherical agglomerates) for 10 different views: in Categories 1 or 2 only.
(4) Additional information regarding correlation between Test Methods ISO 18488 and ASTM D 5397 available upon request.

This product specifications meet or exceed GRI GM13.

This Geomembrane meet or exceed EPA Victoria's Best Practice Environmental Management Publication Siting, design, operation and rehabilitation of landfills (Landfill BPEM) The information contained in this document is provided for informational purposes only. Atarfil reserves the right to change this information without prior notice. ATARFIL HD M EVO GRI, ASTM USA ENG MIL Rev1



Manufacturing plants: Atarfil | Europe | Middle East | America Sales offices: Spain, UAE, USA, Mexico, Turkey, India, South Africa and Australia.





ATARFIL HD TM-TMT EVO

ATARFIL HD TM-TMT EVO is structured textured geomembrane manufactured from best in class Polyethylene (HDPE) resins coupled with specific antioxidant package by the most advanced in-house flat-die technology. This result in a quality and consistency product with maximum durability and long term performance. Its unique texturing pattern with shapes of spikes in X and V, and different heights, ensure a extreme friction angle with different interfaces, making it the best choice. It also includes non-textured smooth edges for ease of QC testing.

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Atarfil has developed the EVOLUTION range to exceed the most demanding best-practice environmental guidelines. These Geomembranes provide unrivaled resin properties demonstrated by Stress Crack Resistance > 3000hrs and HDPE formulations that increase key longevity properties established by Std OIT & HP OIT, Oven Aging and UV resistance testing.

PHYSICAL PROPERTIES										
Property	Test Method	Unit	Value	Frequency ¹						
Density of Raw Material	ASTM D 792	g/cc	≥ 0.932	-						
Melt Flow Index	ASTM D 1238 (190°C/2.16 Kg)	g/10 min	< 0.40	1 per batch						
Density of Geomembrane	ASTM D 792	g/cc	0.946 ± 0.004	200,000 lb						
Carbon Black Content	ASTM D 4218	%	2.0 – 2.5	Per roll						
Carbon Black Dispersion	ASTM D 5596	Category	Note 3	45,000 lb						
Dimensional Stability	ASTM D 1204 (100°C/1h)	%	± 1.5	Per day						
Low Temperature Brittleness (t ^a -70°C)	ASTM D 746	-	No cracks	Per formulation						

ENDURANCE PROPERTIES											
Property	Test Method	Unit	Value	Frequency ¹							
Stress Crack Resistance ⁽⁵⁾	ASTM D 5397/ IS018488 ⁽⁴⁾	h	≥ 3,000	200,000 lb							
Oxidative Induction Time (OIT) Std OIT HP OIT	ASTM D3895 ASTM D 5885	min	≥ 120 ≥ 500	200,000 lb							
Oven Aging at 85°C, % retained aft 90days: Std OIT HP OIT	ASTM D 5721 ASTM D 3895 ASTM D 5885	%	≥ 55 ≥ 80	Per formulation							
UV Resistance HP OIT % retained after 1600h	ASTM D 7238 ASTM D 5885	%	≥ 75	Per formulation							

ROUGHNESS										
Property	Test Method	Unit	Value	Frequency ¹						
Asperity Height	ASTM D 7466	mil	30	Every 2 nd roll						
Friction Angle ⁽⁶⁾	ISO 12957-1	0	≥ 29	-						
Spikes Density	-	Spikes/ ft ²	1,997	-						

MANUFACTURING PROPERTIES									
Property	Test Method	Unit			Va	alue			Frequency ¹
Thickness (Nominal)		mil	30	40	60	80	100	120	
Thickness (Minimum Average)	ASTM D 5994	mil	29	38	57	76	95	114	Per roll
Thickness (Minimum Individual Value)		mil	27	36	54	72	90	108	
Mechanical Properties ²									
Tensile Strength at Yield		lb/in	≥ 63	92 (85)	140 (130)	187 (173)	230 (215)	280 (260)	
Elongation at Yield	ASTM D 6693	%	≥13						
Tensile Strength at Break	(Type IV)	lb/in	60 (45)	75 (60)	105 (90)	135 (120)	165 (150)	200 (180)	20,000 เม
Elongation at Break		%		300 (100)					
Tear Resistance	ASTM D 1004	lb	≥ 21	≥ 30	≥ 45	≥ 60	≥ 75	≥ 91	45,000 lb
Puncture Resistance	ASTM 4833	lb	≥ 47	≥ 62	≥ 92	≥ 125	≥ 160	≥ 195	45,000 lb

STANDADD SIZES

	3	0	4	40		60		80		100		120	
Roll Width (ft)	Roll Ler	ngth (ft)	(ft) Roll Length (ft)										
	ТМ	тмт	ТМ	тмт	тм	тмт	ТМ	тмт	ТМ	ТМТ	ТМ	ТМТ	
19.7	981	624	864	570	669	495	504	432	405	384	339	333	

(1) Indicated frequency is minimum.

(2) Indicated values are average. In brackets minimum values with 95% confidence level.
(3) Carbon black dispersion (only near spherical agglomerates) for 10 different views: in Categories 1 or 2 only.

(4) Additional information regarding correlation between Test Methods ISO 18488 and ASTM D 5397 available upon request.

(5) Test conducted on representative smooth membrane samples. (6) Using a polypropylene geotextile of 32 oz/yd².

This product specifications meet or exceed GRI GM13.

This Geomembrane meet or exceed EPA Victoria's Best Practice Environmental Management Publication Siting, design, operation and rehabilitation of landfills (Landfill BPEM). The information contained in this document is provided for informational purposes only. Atarfil reserves the right to change this information without prior notice ATARFIL HD TM-TMT E EVO GRI, ASTM USA ENG MIL Rev 1

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