

Análise Técnica - Ensaaios de Liners HDPE com V-lock

1. Ensaio de Arrancamento - HDPE Amarelo

Relatório 1: Pull Out Test - HDPE Amarelo com V-lock (2.5mm)

- Método: Ensaio de arrancamento com máquina universal de tração.
- Período do ensaio: 25 a 27 de setembro de 2019.
- Amostras: 6 unidades com pinos amarelos individuais embutidos em concreto.
- Média de força máxima registrada: 1.355 kN.
- Densidade de ancoragem: 430 pinos/m², resultando em 582.7 kN/m².

Observação: Esse resultado mostra uma excelente resistência de ancoragem do liner ao concreto.

2. Propriedades do HDPE Preto

Relatório 2: Caracterização do HDPE Preto com V-lock (2.5mm)

Testes executados conforme normas ASTM, com resultados principais:

- Densidade: 0.950 g/cm³
- Teor de negro de fumo: 2.18%
- Resistência ao rasgo (N/mm): Longitudinal 176, Transversal 181
- Resistência à perfuração: 378 N/mm
- Resistência à tração:
- Alongamento na ruptura: até 1762%
- Tensão de ruptura: até 31 N/mm²
- Absorção de água: 0.031%
- Porosidade: Aprovado a 7kV
- Expansão térmica: 1.957×10^{-5} a 40-60°C; 1.465×10^{-5} a 110-120°C
- Tempo de indução oxidativa: Não oxida
- Conteúdo de plastificante: 0.03%
- Resistência química: perda de massa inferior a 0.06% em diversos reagentes (ácidos, álcalis, detergentes).

Conclusão: O liner preto apresenta excelente desempenho físico-químico, ideal para aplicações exigentes em ambientes agressivos e alta durabilidade.



SUBJECT:

Testing of HDPE Liners

TESTED FOR:

Union Plastics Corporation
7th Floor, Number 3, Lane 16, Section 1,
Da'an Road, Taipei, Taiwan

Attn: Ms. Julie chu

SAMPLE DESCRIPTION:

One lot of 2.5mm Black HDPE liner with 'V'-lock sample was submitted by Union Plastics Corporation for testing.



Photo 1: Submitted sample

TEST METHOD:

1. Density

ASTM D792 : 2008 - Standard Test Method for Density and Specific Gravity (Relative Density) of Plastic by Displacement.

No. of tested specimen : 3

2. Carbon Black Content

ASTM D1603 : 2006 - Standard Test Method for Carbon Black Content in Olefin Plastics

No. of tested specimen : 3

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TEST METHOD (CONT'D):

3. Tear resistance

ASTM D1004 : 2009 - Standard Test Method for Tear Resistance (Graves Tear) of Plastic Film and Sheeting

Nominal specimen dimensions : ASTM D1004, Figure 1
Length of grips separation : 25.4 mm
Crosshead speed : 51 mm/min
No. of tested specimen : 10 per Longitudinal and Transverse directions

4. Puncture Resistance

ASTM D4833 : 07 - Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products

Nominal specimen dimensions : 150 mm x 150 mm x 3mm
Crosshead speed : 300 mm/min
No. of tested specimen : 10

5. Tensile Properties

ASTM D6693 : 2004 (2010) - Standard Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes

Nominal specimen dimensions : ASTM D6693, Type IV Dog Bone Specimen
Gauge length : a) 33 mm (Yield)
b) 50 mm (Break)
Crosshead speed : 50 mm/min
No. of tested specimen : 5 per Longitudinal and Transverse directions

6. Water Absorption

ASTM D570 : 1998 (Reapproved 2010) - Standard Test Method for Water Absorption of Plastics

Nominal specimen dimensions : 76.2 mm x 25.4 mm x 3 mm
Conditioning of test specimens : 50 °C for 24 h
Immersion condition : 23 °C for 24 h
Reconditioning of test specimens : 50 °C for 24 h
No. of tested specimen : 3

7. Porosity

Machine : Pinhole detector
Voltage : 7 kV

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TEST METHOD (CONT'D):

8. Coefficient of Thermal Expansion by Thermomechanical Analysis (TMA)

ASTM E831 : 2012- Standard Test Method for Linear Thermal Expansion of Solid Materials by Thermochemical Analysis

Load	:	0.02 N (2 g)
Temperature range	:	Ambient to 120 °C
Heating rate	:	5 °C/min
Atmosphere	:	Nitrogen

9. Oxidative Induction Time

ASTM D3895 : 2007

Standard Test Method for Oxidative Induction Time of Polyolefins by Differential Scanning Calorimetry

Instrument used	:	Differential Scanning Calorimetric Analyser
Test temperature	:	200 °C
Scanning rate	:	20 °C / min
Atmosphere	:	Nitrogen / Oxygen

10. Plasticiser Content

ASTM D1203 : 1994 (2003)

Standard Test Method for Volatile Loss From Plastics Using Activated Carbon Methods

Nominal specimen dimensions	:	Dia. 50 mm x 3 mm
Test method	:	Method B
Conditioning of test specimens	:	100 ± 2 °C for 24 h
No. of determinations	:	3

11. Chemical Resistance

ASTM D543 : 2006 - Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents

Nominal specimen dimensions	:	76.2 mm x 25.4 mm x 3 mm
Reagent used	:	a) 1% sodium hypochlorite b) 1% ferric chloride c) 5% sodium chloride d) 20% sulphuric acid e) 1% nitric acid f) 5% sodium hydroxide g) 5% ammonium hydroxide h) 2% soap & detergent solution
Test condition	:	20 °C for 7 days
No. of tested specimen	:	3 per reagent

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TEST RESULTS:

Table 1 – Density Test

Test	Unit	Union Plastic Black HDPE 2.5mm Thick
Density of Finished Product, average	g/cm ³	0.950

Table 2 – Carbon Black Content Test

Test	Unit	Union Plastic Black HDPE 2.5mm Thick
Carbon Black Content, average	%	2.18

Table 3 – Tear Resistance Test

Test	Unit	Union Plastic Black HDPE 2.5mm Thick	
		Longitudinal	Transverse
Tear Resistance, average	N/mm	176	181

Table 4 – Puncture Resistance Test

Test	Unit	Union Plastic Black HDPE 2.5mm Thick
Puncture Resistance, average	N/mm	378

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TEST RESULTS (CONT'D):

Table 5 – Tensile Properties Test

Test	Unit	Union Plastic Black HDPE 2.5mm Thick	
		Longitudinal	Transverse
Tensile Strength at Yield, average	N/mm ²	19	18
Tensile Strength at Break, average	N/mm ²	31	29
Elongation at Yield, average	%	14	15
Elongation at Break, average	%	1496	1762

Table 6 – Water Absorption Test

Test	Unit	Union Plastic Black HDPE 2.5mm Thick
Water Absorption, average Increase in Weight Soluble Matter Loss	%	0.031

Table 7 – Porosity Test

Test	Unit	Union Plastic Black HDPE 2.5mm Thick
Porosity Test	7kV	Passed

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TEST RESULTS (CONT'D):

Table 8 – Coefficient of Thermal Expansion Test

Test	Unit	Union Plastic Black HDPE 2.5mm Thick
Coefficient of Thermal Expansion a) 40 to 60 °C	°C ⁻¹	1.957 x 10 ⁻⁴
b) 110 to 120 °C		1.465 x 10 ⁻³

Table 9 – Standard Oxidative Induction Time Test

Test	Unit	Union Plastic Black HDPE 2.5mm Thick
Standard Oxidative Induction Time	minute	Sample does not oxidize

Table 10 – Plasticiser Content Test

Test	Unit	Union Plastic Black HDPE 2.5mm Thick
Plasticiser Content, average	%	0.03

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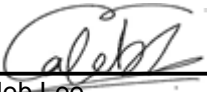
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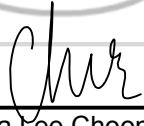


TEST RESULTS (CONT'D):

Table 11 – Chemical Resistance test

Test	Unit	Union Plastic Black HDPE 2.5mm Thick
a) 1% (v/v) sodium hypochlorite	%	0.01
b) 1% (m/v) ferric chloride		0.04
c) 5% (m/v) sodium chloride		0.02
d) 20% (v/v) sulphuric acid		0.02
e) 1% (v/v) nitric acid		0.06
f) 5% (m/v) sodium hydroxide		0.04
g) 5% (v/v) ammonium hydroxide		0.05
h) 2% (v/v) soap & detergent solution		0.02


Caleb Lee
Testing Officer

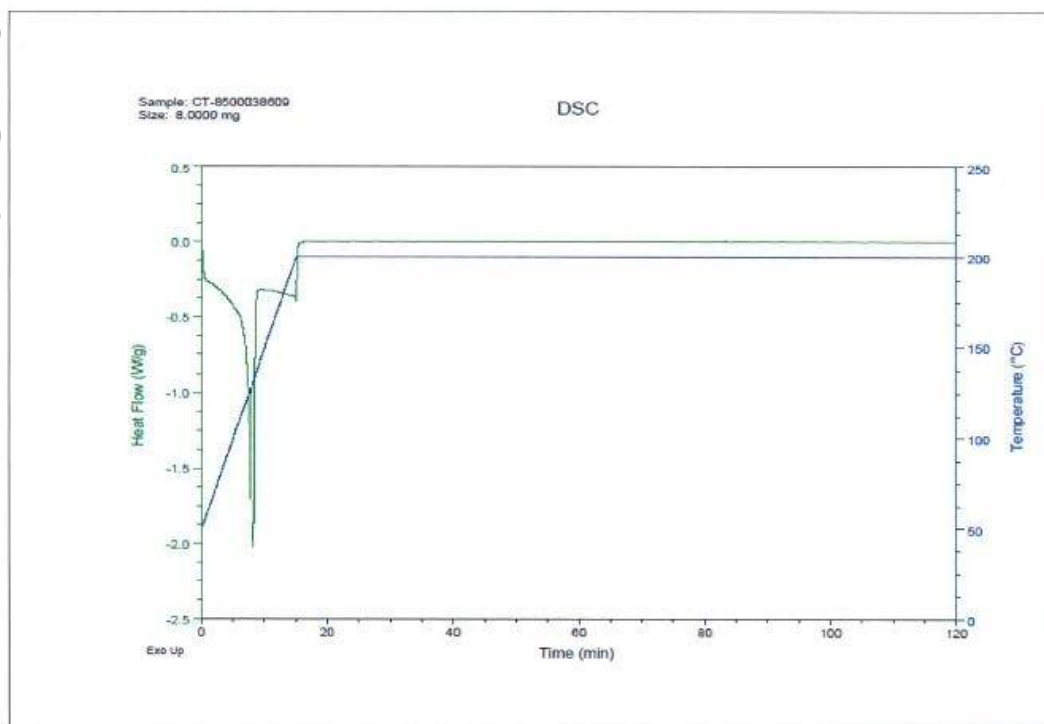
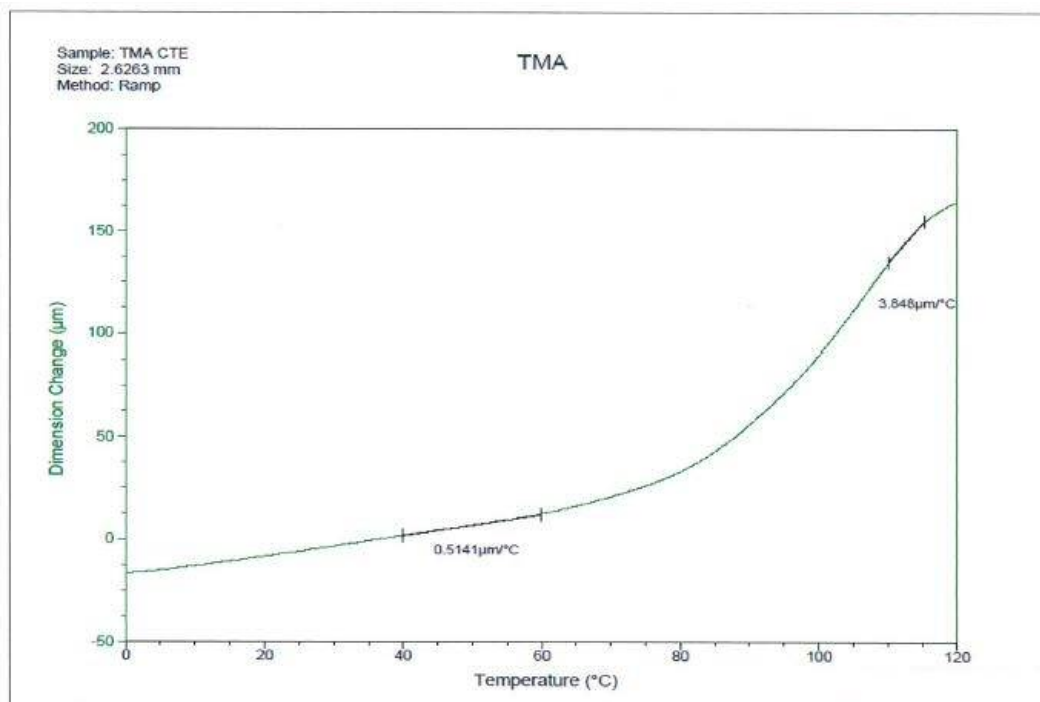

Chua Lee Choong
Senior Manager

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Appendix:



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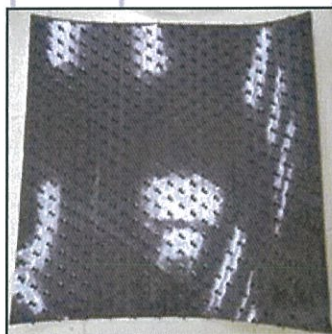


Photo: Submitted sample

METHOD OF TEST:

1. Oxidative Induction Time

ASTM D5885/D5885M-17

Standard Test Method for Oxidative Induction Time of Polyolefin Geosynthetics by High-Pressure Differential Scanning Calorimetry

Instrument used	:	TA Instruments DSC Q20
Test temperature	:	150 °C
Scanning rate	:	20 °C / min
Atmosphere	:	Oxygen

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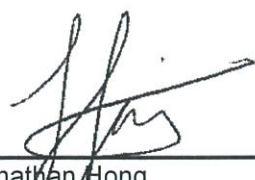
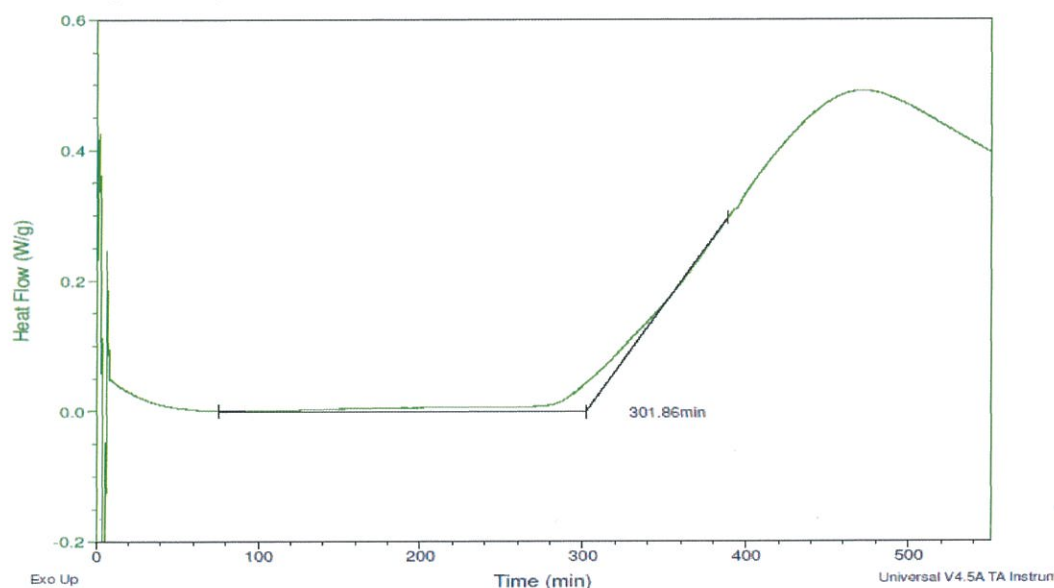
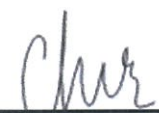
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**RESULTS:****Table 1 – High-Pressure Oxidative Induction Time Test**

Test	Unit	Union Plastic Black HDPE 2.5mm Thick
High-Pressure Oxidative Induction Time (HP OIT)	minute	302

Sample: HDPE lining samples
Size: 4.8800 mg
Method: HP Oxygen induction time
Comment: (5573-001S-1) 31358

DSC


Jonathan Hong
Engineer
Chua Lee Choong
Senior Manager**Terms and conditions:**

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