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Weathering & Strength of Oyster Baskets – Interim Report

Report Date: 30/06/2009

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Report Prepared By: [redacted]

BACKGROUND & TESTING

[redacted] is to be used in the manufacture of Oyster Baskets. There were two areas requiring validation before volume production can commence. These are long term weathering and general strength of the baskets over time.

1.0 Long Term Weathering :

Long term weathering was done in two ways, taking advantage of established data for [redacted] carbon black pigments. These were :

1.1 Literature search within and outside [redacted] data on carbon black filled [redacted]

1.2 Accelerated Atlas Xenon Arc testing of supplied oyster baskets & laboratory samples.

1.1 Literature Search

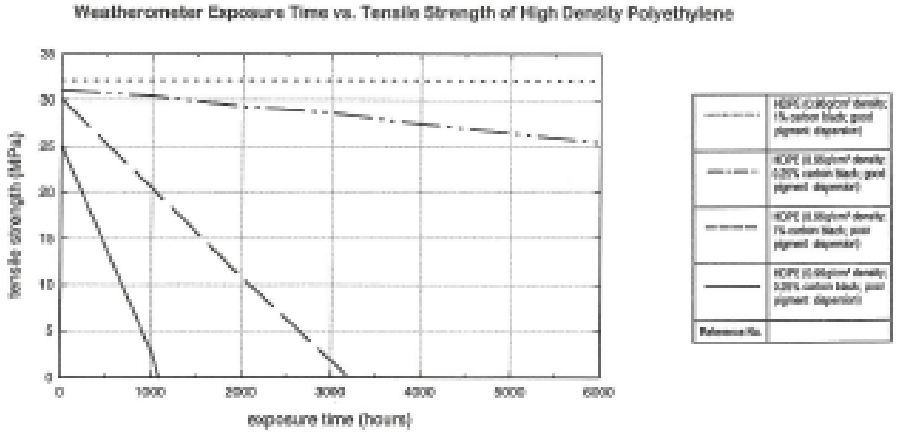
The system used is [redacted] + 5.0 wt % Superblak PE40/035 RO2 masterbatch (40% carbon black with no additional UV). This effectively gives a 2% carbon black loading.

2.5% is regarded as the saturation point for carbon black additions (no real benefit at higher loadings). 2.0% would be expected to give excellent performance. Blends with only 0.5% have been reported to undergo 10,000 hours in a weatherometer with no change to tensile strength. Samples containing 1.5% carbon black have shown excellent results after 48 months outside exposure at the Florida weathering station (ref Table 1 on page 2). Figure 1 shows tensile strength retainment for [redacted] containing between 0.25% & 1% carbon black. Good dispersion of the carbon black is a key to improved weathering performance, especially at low carbon black additions. This is not so important at levels of over 2.0%. Generally, it would be expected that the combination of injection moulded [redacted] would show adequate carbon black dispersion.

Test Property	As Moulded	12 months Florida	24 months Florida	48 months Florida
Tensile Strength (MPa)	29	29	30	31
Flexural Modulus (GPa)	1.1	1.1	1.1	1.2
Elongation to Fail (%)	450	436	389	312
Durometer Hardness (D)	65	65	67	67
Izod Impact Strength (kJ/m^2)	8.0	7.2	7.5	6.2

(Source : The Effect of UV light & Weather – PDL Handbook Series, 2004)

Table 1: Literature HDPE Weathering (Containing 1.5% Carbon Black)



(Source : The Effect of UV light & Weather – PDL Handbook Series, 2004)

Figure 1: HDPE Weathering (Effect of Pigment Loading & Dispersion)

1.2 Accelerated Xenon Arc Weathering.

Marplex evaluate the UV colour stability of polymers using an Atlas CI35A Xenon Arc Accelerated Weatherometer. It is possible to vary the weatherometer settings and the filter combination to produce a spectrum that closely replicates natural sunlight over the more damaging UV portion of the spectrum. The program used for polymers intended for external applications is based on an SAE international specification for the Accelerated Exposure of Automotive Exterior Materials, SAE J1960. Atlas Ci35A settings for this program are given in Table 2 on page 3.

Oyster baskets supplied were sectioned and exposed as per Table 2. Laboratory test pieces were also produced and are being tested. All these have been exposed for 200, 500 & 1000 hrs. Visual observation has been carried out & key property testing has been carried out. Taken from the automotive industry, a Grey Scale Rating was used as the colour change assessment tool. These results are shown in Table 4 (refer page 3). No major differences in appearance or properties are visually observed to 1,000 hours weathering.

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PARAMETER	Exterior settings	
	Light Cycle	Dark Cycle
Lamp Filters	Quartz inner, Borosilicate outer	Quartz inner, Borosilicate outer
Cycle	120 min, (40min light, 20min light with water spray, 60 min light)	60 min
Irradiance	0.55 W/m^2	-
Black Panel Temperature	70°C	38°C
Dry Bulb Temperature	47°C	38°C
Wet Bulb Depression	12°C	0
Relative Humidity	50 ± 5 %	95 ± 5 %
Conditioning water	45°C	40°C
Specimen Spray	On	On
Rack Spray	On	On

Table 2: Atlas Weatherometer Settings (SAE J1960 Automotive Exterior Program)

Grey Scale Rating relative to an unexposed control of the same material is shown below in Table 3. This is a comparative visual system used in the automotive and textile sectors. A rating explanation follows :

Rating of 5 : No noticeable change (nnc)
Rating of 4 : Slight change, hard to see by eye
Rating of 3 : Some change, able to be seen by most people
Rating of 2 : Significant change
Rating of 1 : Major change.

Exposure Time (hrs)	Grey Scale Rating	
	Sectioned Oyster Baskets Pieces	[redacted] + 2.0% Carbon Black masterbatch
200	5 nnc	5 nnc
500	5 nnc	5 nnc
1000	5 nnc	5 nnc
1500	tba	Tba
2000	tba	Tba

Table 3: Colour Shift in Grey Scale Rating Units Following Atlas Exposure

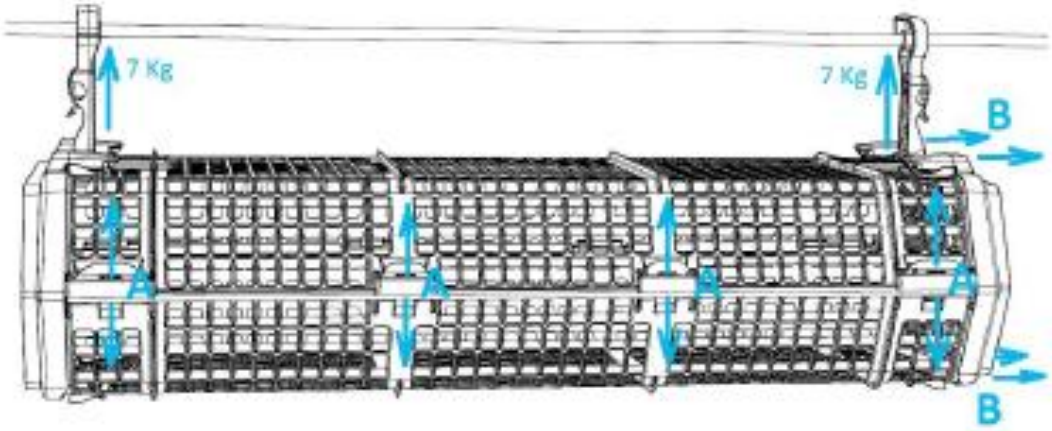
Test Property	As Moulded	500 hours	1,000 hours	2,000 hours
Tensile Strength (MPa)	28.4	28.6	28.9	tba
Flexural Modulus (MPa)	1,080	1,070	1,030	tba
Elongation to Fail (%)	414	402	390	tba
Durometer Hardness (D)	66	66	67	tba
Izod Impact Strength (J/m)	86	76	71	tba

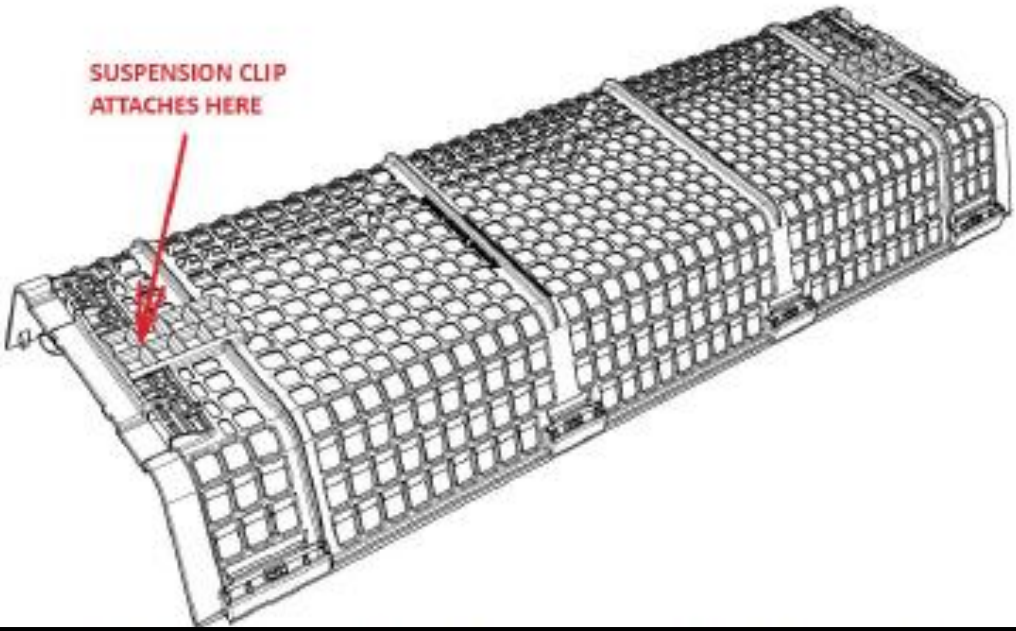
Table 4: [redacted] Masterbatch Weathering (2.0% carbon black)

[redacted] Oyster Baskets

2.0 Strength of Oyster Baskets :

It was decided to combine a thermocycling test with a loaded drop impact test to gauge the strength of oyster baskets. No customer specifications exist, rough guidelines for loading were provided ex [redacted] in early April (sketches below). Thermocycle conditions are -20°C to +50°C for several cycles. This testing is expected to be completed shortly.





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