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TEST REPORT No: Z.W. Cheko S.P. z.o.o. 241108



Certificate No. FM37939

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SYMPHONY ENVIRONMENTAL LTD
TOTALLY DEGRADABLE PLASTICS

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1.0 AIMS

To compare the oxo degradable response of polypropylene buckets containing a prodegradant additive with respect to a non degradable control sample by means of accelerated thermal ageing.

2.0 CONCLUSIONS

The results of the thermal ageing test demonstrate that the buckets containing the d₂w[®] prodegradant additive have degraded to a greater extent than their respective control samples.

The buckets containing the additive demonstrate larger carbonyl index measurements than the respective control samples at the conclusion of the test (Figure 1). This result is consistent with the buckets containing the prodegradant additive being in a more advanced state of degradation.

This result is confirmed by observation: at the end of the ageing test the oxo-biodegradable buckets shows signs of breakdown whilst the control samples are still largely intact (Figure 2).

3.0 SAMPLE DESCRIPTION

Supplier name: Z.W. Cheko S.P. z.o.o.
Polymer type: Polypropylene.
Samples provided: A) 10L white bucket with d₂w[®] additive
B) 15L white bucket with d₂w[®] additive
C) Control 10L white bucket without additive
D) Control 15L bucket without additive
Additive system: 93389.

4.0 TEST PROTOCOL

The method involves subjecting the buckets to accelerated thermal ageing and measuring the carbonyl index (CI) of the material as a function of ageing time.

5.0 TEST METHODOLOGY

5.1 Accelerated Thermal Ageing

Thermal ageing of the bucket samples was carried out in an ASSAB oven at a temperature of 80°C in accordance with ASTM D5510 Procedure A: Gravity Convection Oven. Samples of the additive and control materials were withdrawn every 96 hours and their carbonyl index determined by FTIR spectroscopy.

5.2 Carbonyl Index Measurement

Carbonyl index is a useful technique for monitoring the accumulation of oxidation degradation reaction by-products. These include species such as carbonyl compounds (aldehydes, ketones etc.) whose presence are all indicative of degradation. Monitoring the growth of these species as a function of time provides a good indication of the relative rate of degradation of the material.

The carbonyl index of the bucket samples was determined by Fourier Transform infrared spectroscopy (FT-IR). Reflection spectra at the surface of the products were obtained by a Smart Orbit diamond ATR attachment connected to a Thermo Electron Nicolett FTIR. The carbonyl index was measured as the ratio of the carbonyl peak at 1718 cm^{-1} and the carbon –hydrogen absorption peak at 2920 cm^{-1}

6.0 RESULTS - Accelerated Thermal Ageing

Table 1: Carbonyl Index Measurement during accelerated thermal ageing

Sample	Carbonyl index								
	0 Hrs	96 Hrs	192 Hrs	288 Hrs	384 Hrs	480 Hrs	600 Hrs	696 Hrs	792 Hrs
A) 10L white bucket with d ₂ W [®]	0.048	0.042	0.046	0.047	0.048	0.059	0.071	0.076	0.079
B) 15L white bucket with d ₂ W [®]	0.062	0.068	0.074	0.073	0.076	0.083	0.090	0.108	0.159
C) Control 10L white bucket	0.043	0.044	0.045	0.045	0.048	0.048	0.050	0.071	0.068
D) Control 15L bucket	0.041	0.063	0.070	0.069	0.065	0.067	0.079	0.088	0.084

Sample	Carbonyl index								
	888 Hrs	1000 Hrs	1096 Hrs	1192 Hrs	1288 Hrs	1384 Hrs	1480 Hrs	1576 Hrs	
A) 10L white bucket with d ₂ W [®]	0.078	0.091	0.095	0.166	0.176	0.186	0.184	0.292	
B) 15L white bucket with d ₂ W [®]	0.174	0.188	0.256	0.259	0.26	0.273	0.288	0.397	
C) Control 10L white bucket	0.063	0.083	0.082	0.107	0.138	0.144	0.16	0.192	
D) Control 15L bucket	0.083	0.107	0.107	0.105	0.174	0.183	0.191	0.199	

Figure 1: Effect of accelerated thermal ageing on carbonyl index of polypropylene buckets

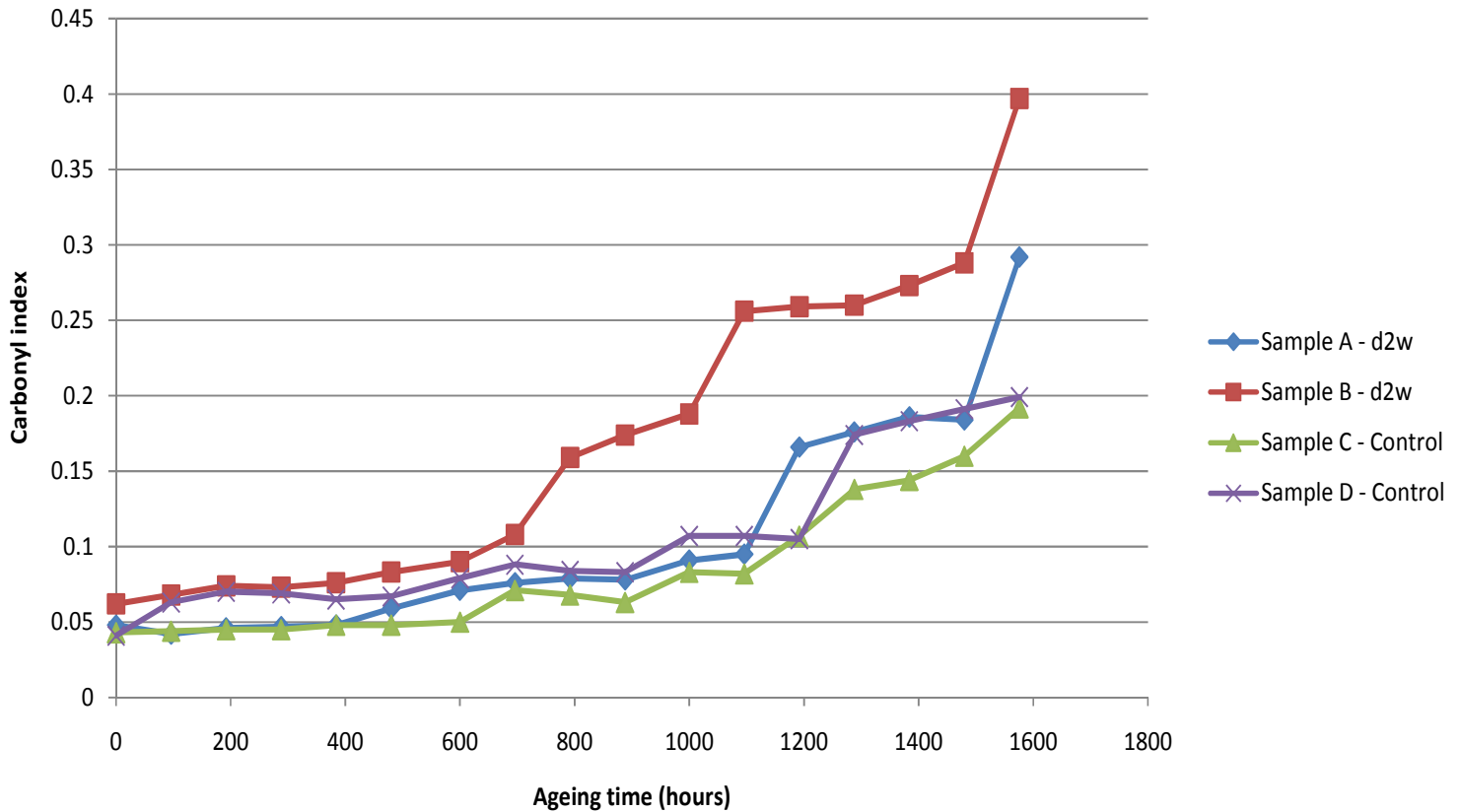
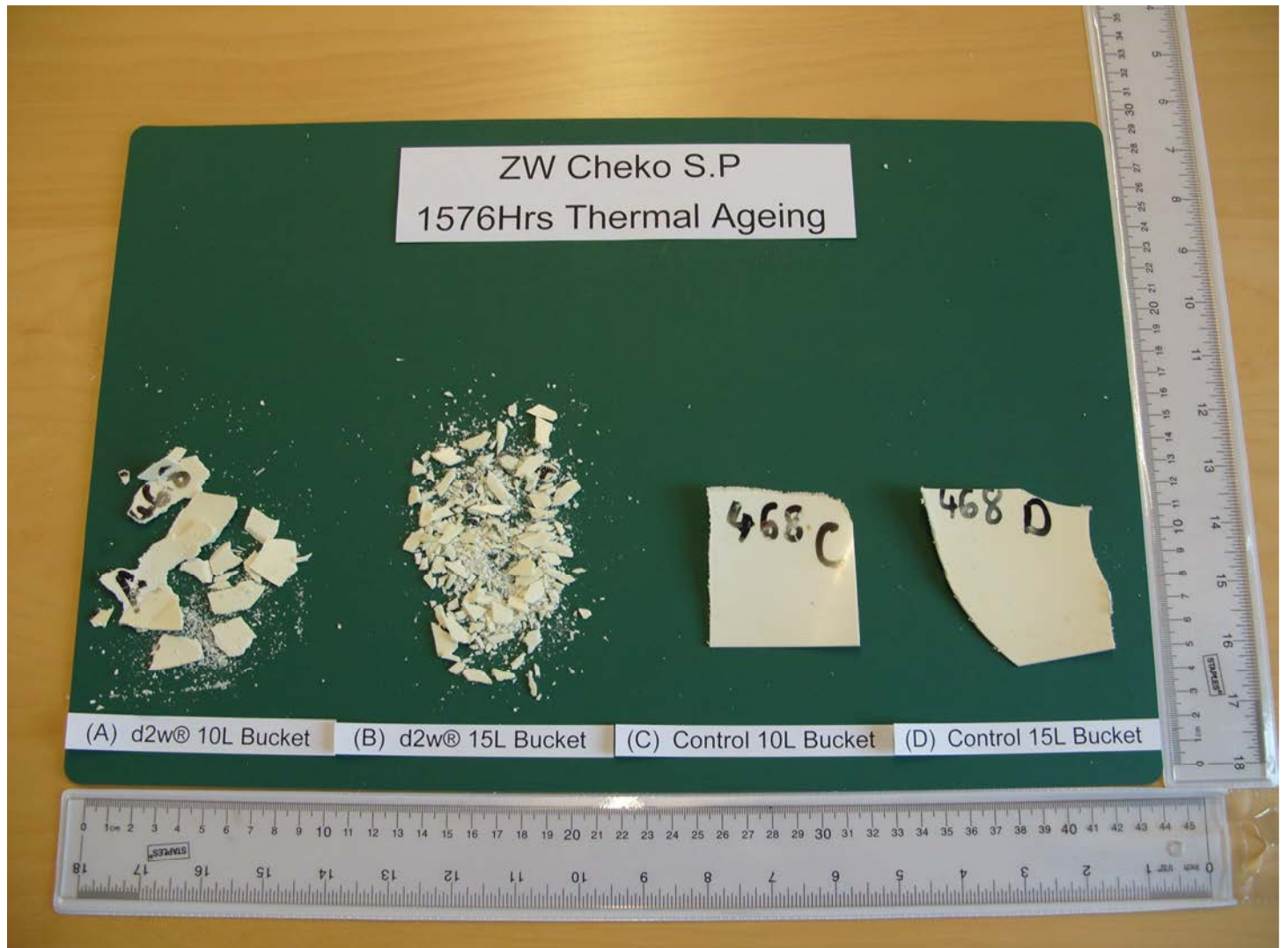


Figure 2: Comparison of degradable 10L white bucket (far left), 15L white bucket (left) against 10L control white bucket (right), 15L control white bucket (far right) after 1,576 hours thermal ageing at 80°C.



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"The information presented in this report is based on the material actually tested. Performance of finished product made with d2w(R) additive depends on the conditions under which and length of time for which the additive is stored and on the method of manufacture of the finished product and the heat, light, stress and other conditions to which the finished product is exposed. Nothing in this report constitutes or implies a licence to use Symphony's intellectual property".