

FINAL REPORT AGA-1

UV-A weathering test on Degradable Polyethylene Anguiplast Bags

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2 Introduction

The purpose of this test is to evaluate the effects of ultraviolet (UV) exposure on a test material. The material is exposed to a weathering cycle that consists of 20 hours UV-A light (0.89 W/m² at 340 nm) at 50°C followed by 4 hours condensation at 40°C according to the American standard ASTM D5208 *Standard Practice for Fluorescent Ultraviolet (UV) Exposure of Photodegradable Plastics* (2014). The 24-hour cycle is repeated continuously until the desired total exposure is reached. According to the American standard specification ASTM D6954 *Standard Guide for Exposing and Testing Plastics that Degrade in the Environment by a Combination of Oxidation and Biodegradation* (2018) the oxidation phase (UV weathering) can be shut down when the molecular weight reaches a low level (e.g. 5,000 g/mol or less) and/or when the film reaches 5% or less elongation at break.

The weathering is performed in a QUV accelerated weathering tester (Figure 1).



Figure 1. Visual presentation of weatherometer

3 Results

Test item Degradable Polyethylene Anguiplast Bags was weathered for 50 days (= 1200 hours) according to ASTM D5208 (2014) Cycle A.

The degradation of test item Degradable Polyethylene Anguiplast Bags started after 12.5 days (300 hours) of weathering. The film had become brittle and big tears were observed (Figure 2). 12.5 days later (after 600 hours) the test material had become so brittle that pieces of film had fallen out of the frames (Figure 3). The film pieces were collected and placed in aluminum boxes for the remainder of the test. After 900 hours (37.5 days) the test material was reduced to rather small and brittle pieces (Figure 4). The photodegradation continued and at the end of test (50 days) the sample was reduced to powder (Figure 5).

According to ASTM D6954 (2018) the oxidation phase (UV weathering) can be shut down when the molecular weight reaches a low level (e.g. 5,000 g/mol or less) and/or when the film reaches 5% or less elongation at break. Based on the observations it can be concluded that after 600 hours of UV-A weathering the elongation at break was less than 5% as the material broke down when slightly touched. The results of the molecular weight analysis at the start and after 25, 37.5 and 50 days of weathering are given in Table 1. After 25 days the molecular weight was reduced considerably from 223,000 g/mol to 15,700 g/mol. At the end of the test (50 days) the molecular weight was reduced even further to 10,200 g/mol, but was still higher than the by ASTM D6954 (2018) suggested value of 5,000 g/mol. A visual presentation of the molecular weight distribution of Degradable Polyethylene Anguiplast Bags is given in Figures 6 up to 8.

Table 1. Molecular weight analysis at the start and after 25, 37.5 and 50 days of UV-A weathering

Sample	Mw (g/mol)	Mn (g/mol)
Degradable Polyethylene Anguiplast Bags at start	223,000	57,600
Degradable Polyethylene Anguiplast Bags after 25 days	15,700	4,010
Degradable Polyethylene Anguiplast Bags after 37.5 days	11,600	2,460
Degradable Polyethylene Anguiplast Bags after 50 days	10,200	2,900

4 Conclusion

The photooxidation of test item Degradable Polyethylene Anguiplast Bags was evaluated in a UV-A weathering test according to ASTM D5208 (2014). The total test duration was 50 days.

After 25 days (600 hours) the test material had become so brittle that pieces of film had fallen out of the frames. After 50 days (1200 hours) of UV-A weathering test item Degradable Polyethylene Anguiplast Bags was reduced to powder.

According to the American standard specification ASTM D6954 (2018) the oxidation phase (UV weathering) can be shut down when the molecular weight reaches a low level (e.g. 5,000 g/mol or less) and/or when the film reaches 5% or less elongation at break. Based on the observations it can be concluded that after 600 hours (25 days) of UV-A weathering the elongation at break was less than 5%. The molecular weight of Degradable Polyethylene Anguiplast Bags was reduced considerably from 223,000 g/mol at start to 10,200 g/mol after 50 days, but was still significantly higher than the by ASTM D6954 (2018) suggested value of 5,000 g/mol.

Gent, December 27th, 2019

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