

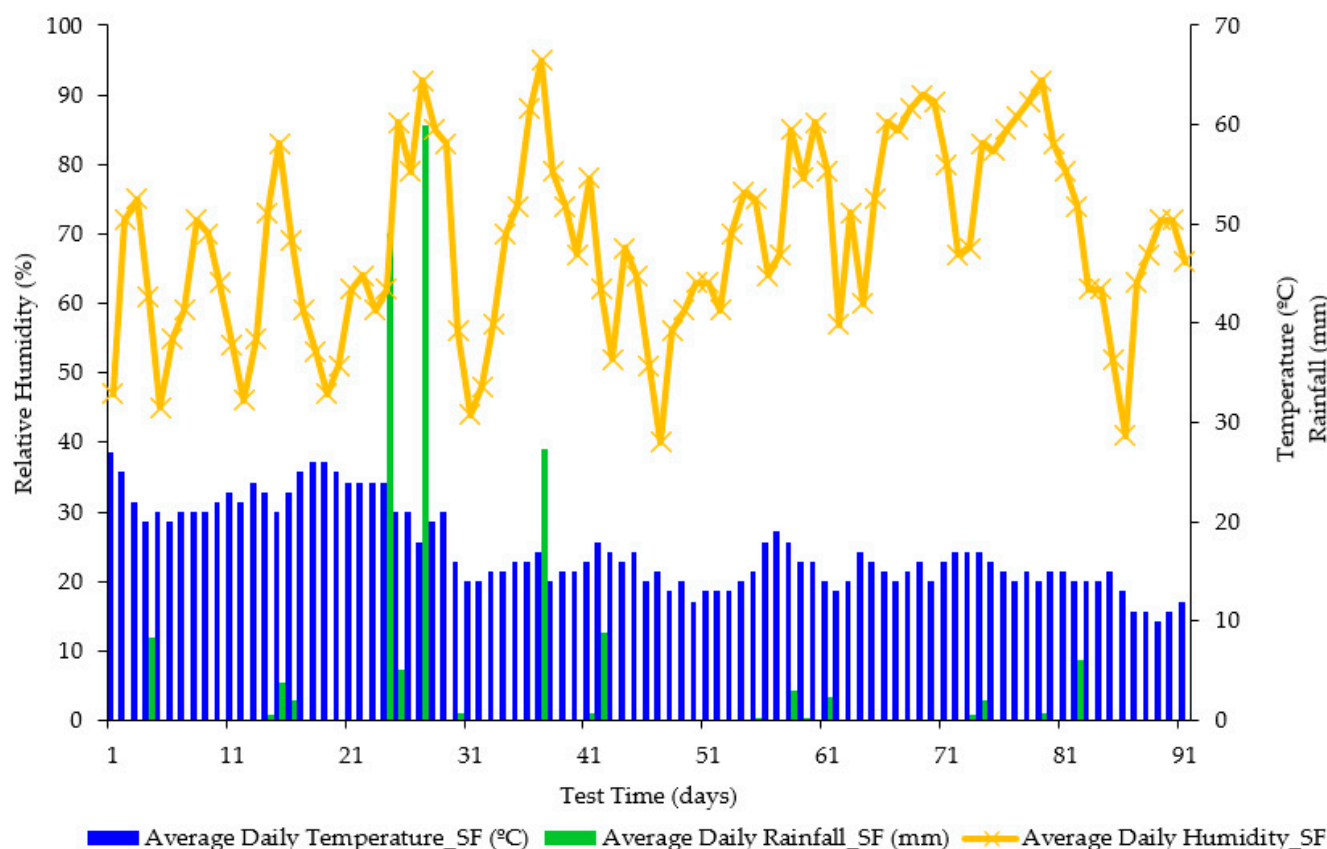
Supplementary Materials

# Temperate UV-Accelerated Weathering Cycle Combined with HT-GPC Analysis and Drop Point Testing for Determining the Environmental Instability of Polyethylene Films

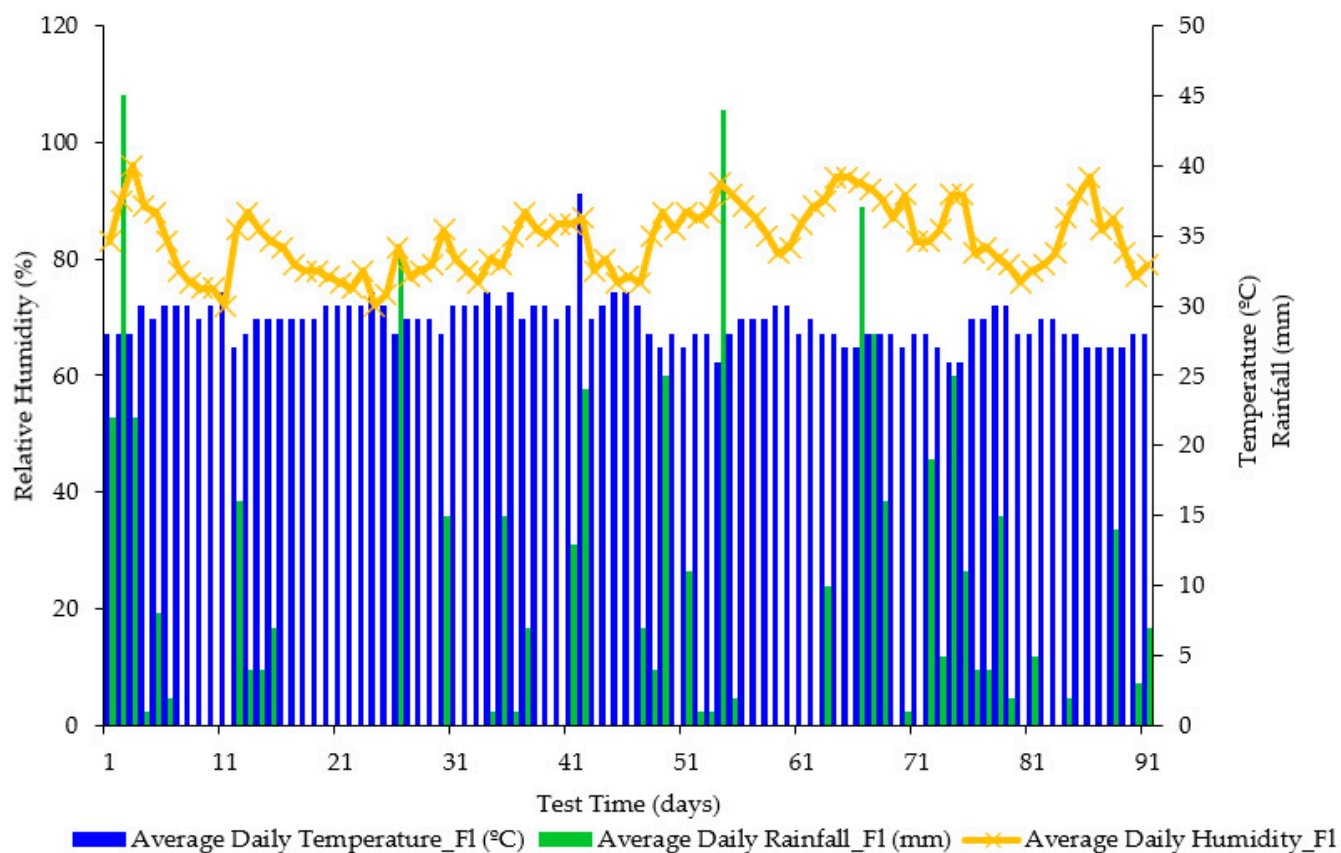
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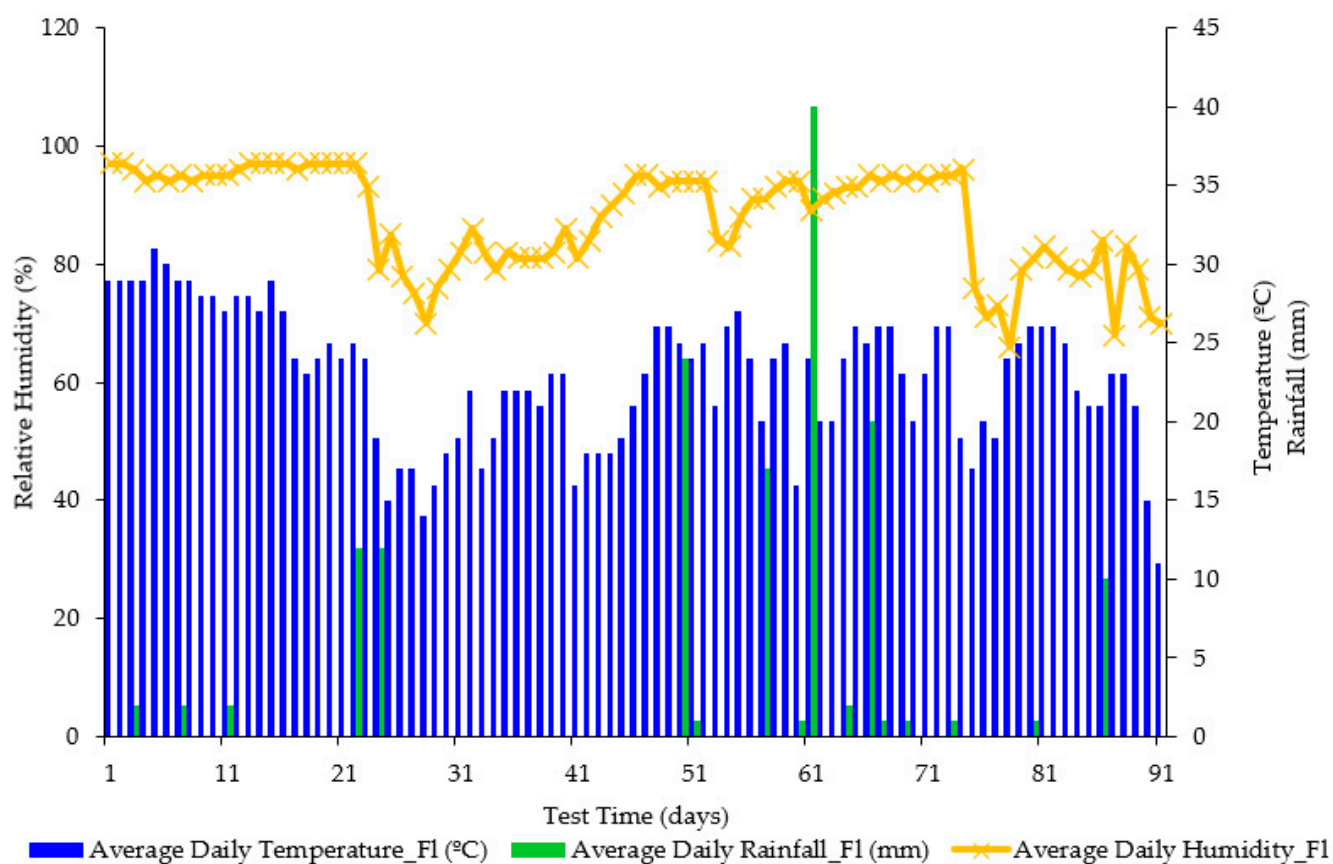
## S1. Weathering Data



**Figure S1.** Data showing temperature, levels of precipitation and relative humidity for South of France up to 91 days.



**Figure S2.** Data showing temperature, levels of precipitation and relative humidity for Florida (Summer) up to 91 days.



**Figure S3.** Data showing temperature, levels of precipitation and relative humidity for Florida (Winter) up to 91 days.

**Table S1.** Average weather conditions over the exposure period.

Expsoure Site	Calendar period of tempore during expsoure of sample	Average daily temperature during testing exposure period	Average daily humidity during testing exposure period	Total rainfall during testing exposure period
Sanary Sur Mer, France <sup>[b]</sup>	27 <sup>th</sup> August – 25 <sup>th</sup> Decemeber 2020	15.5°C	70.5%	217 mm
Homestead, Florida <sup>[a]</sup>	21 <sup>st</sup> July – 19 <sup>th</sup> October 2020	28.8°C	83.2%	498 mm
Homestead, Florida <sup>[a]</sup>	24 <sup>th</sup> October 2019 – 22 <sup>nd</sup> January 2020	22.9°C	87.8%	149 mm

## S2. Molecular Weight Analysis

**Table S2.** Table showing the results of the PE films during the temeptrate UV-accelerated laboratory weathering.

	Runtime Fraction	PE-01					PE-02				
		CI	Mn	Mw	Mw Loss (%)	Mz	CI	Mn	Mw	Mw Loss (%)	Mz
0	0	0.12	37,616	110,018	0	251,393	0.09	21,554	151,588	0	459,400
0.92	0.067	0.06	31,011	109,470	28%	281,419	0.15	8,571	24,746	78%	47,063
3	0.21	0.07	33,679	105,799	30%	241,274	0.75	3,266	9,815	91%	19,873
6	0.43	0.07	32,869	114,936	24%	311,659	0.91	3,107	8,099	93%	16,581
7	0.5	0.11	34,453	107,947	29%	254,525	0.69	2,936	7,301	93%	14,260
10	0.71	0.03	34,616	103,704	32%	230,252	1.39	1,979	5,397	95%	11,052
12	0.86	0.14	31,349	105,529	30%	246,260	1.19	2,062	5,663	95%	12,884
14	1	0.22	32,366	110,671	27%	279,801	1.60	1,956	5,397	95%	11,929

**Table S3.** Table showing the results of the PE films samples from Outdoor Weathering in France.

Time	Runtime Fraction	PE-03					PE-04				
		CI	Mn	Mw	Mw Loss (%)	Mz	CI	Mn	Mw	Mw Loss (%)	Mz
0	0	0.12	37,616	110,018	0%	251,393	0.09	21,554	151,588	0%	459,400
30	0.25	0.10	26,871	85,523	22%	193,906	0.32	5,175	19,494	87%	44,833
60	0.5	0.21	21,156	100,249	9%	262,538	0.44	3,451	16,779	89%	38,360
90	0.75	0.49	11,172	37,029	66%	87,500	0.52	3,319	11,566	92%	26,857
120	1	0.26	8,479	36,198	67%	104,311	0.62	2,119	9,532	93%	25,834

**Table S4.** Table showing the results of the PE films samples from Outdoor Weathering in Florida Summer and Winter.

Time	Runtime Fraction	PE-05					Time	Runtime Fraction	PE-06				
		CI	Mn	Mw	Mw Loss (%)	Mz			CI	Mn	Mw	Mw Loss (%)	Mz
0	0	0.09	21,554	151,588	0	459,400	0	0	0.09	151,588	21,554	0	459,400
6	0.078	0.09	26,454	90,062	41%	232,866	12	0.13	0.47	5,342	18,611	87%	43,886
19	0.21	0.37	4,412	17,068	89%	48,171	25	0.28	0.76	3,036	19,173	87%	63,950
39	0.43	1.03	2,487	8,574	94%	19,450	30	0.33	1.16	1,485	8,318	95%	18,668
45	0.50	1.07	1,676	6,241	96%	13,190	42	0.47	0.73	1,083	6,907	95%	16,550
64	0.71	1.36	1,485	5,529	97%	12,690	60	0.67	0.80	1,648	7,676	95%	16,912
77	0.86	1.39	1,306	4,850	97%	10,955	72	0.80	1.29	727	4,475	97%	10,325
90	1	1.53	1,020	4,694	97%	16,885	90	1	1.45	697	3,936	97%	9,179

**Table S5.** Table showing the drop point testing results of the PE films samples in triplicate with standard deviation.

Material	Time	Runtime Fraction	Dropping Point if below 140°C (°C)	Mean Dropping Point (°C)	Standard Deviation
Initial Blank	0	0	N/A	> 140 °C	N/A
			N/A		
			N/A		
Initial PLM	0	0	N/A	> 140 °C	N/A
			N/A		
			N/A		
PE-01	14	1	N/A	> 140 °C	N/A
			N/A		
			N/A		
PE-02	14	1	111	113	1.53
			113		
			114		
PE-03	60	0.5	N/A	> 140 °C	N/A
			N/A		
			N/A		
PE-03	120	1	N/A	> 140 °C	N/A
			N/A		
			N/A		
PE-04	60	0.5	116	114	1.53
			114		
			113		
PE-04	120	1	114	114	0.58
			115		
			114		
PE-05	45	0.5	113	112	1.53
			112		
			110		
PE-05	90	1	118	113	4.73
			111		
			109		
PE-06	45	0.5	115	113	1.53
			113		
			112		
PE-06	90	1	116	112	3.79
			110		
			109		

## S3. Outdoor exposure Testing Certificates



Atlas Material Testing Technology B.V.  
890 Chemin les Hautes du Lancon  
83110 Sanary sur Mer  
France  
rachida.hajaji@ametec.com  
Phone: +33 130 68 89 08  
Fax: +33 1 30 68 89 99  
R.C. Meaux B 329 572 903



**Confidential**

POLYMATERIA LIMITED  
Mrs Celine Moreira  
80 Wood Lane  
W120BZ London  
UK

## TEST REPORT

### INSPECTION DATA AT 120 Days

Sanary, January 04, 2021

Purchase Order Number: N/A; Release Number: N/A  
Client Code: UKPOLCM

**Test Number:** SS10897

**Report Number:** 4  
**Test Type:** INLAND WEATHERING  
**Test Location:** Sanary, France  
**Specimens Inspected:** 32  
**Description:** 104 samples received ok

**Exposure Type:** Exposure testing is performed in Sanary, France in accordance with ISO877-1 "Plastics - Method of exposure to solar radiation - General Guidance" at a tilt angle(s) of 45° from the horizontal facing south. The specimens are mounted backed on 3mm exterior grade plywood on a 1643 x 3586 mm aluminum exposure rack, with grass groundcover, and the coded side facing the sun.

#### Observations, Deviations and Waivers

Notes contained in relevant documents are an integral part of a test, and shall be included by the client in discussions, correspondence, and presentation of test results to a third party. This Test Report represents only one part of the test documentation. Interim reports and other test documentation may have been submitted prior to this date. Test results reported are pertinent only to the items tested and are not relevant to other specimens of the same type, or in the same lot, which are not being tested. Test Reports, and/or other pertinent test documentation, shall not be reproduced, except in full, without the written approval of Atlas Weathering Services Group and so certified by the client.



ISO/IEC 17025  
717.07

**Figure S4.** Atlas certificate for the 120-day outdoor exposure of PE-03 and PE-04 in France.



Q-Lab Weathering Research Service  
1005 S.W. 18 Avenue  
P. O. Box 349490  
Homestead, FL 33034

**TEST CERTIFICATE**  
**Natural Weathering**



Test Program Number: *PLL-4-TP-1*  
Company: *Polymateria Limited*  
Address: *Imperial College London I-HUB White City Campus 80 Wood Lane  
London W12 0BZ,  
UNITED KINGDOM*  
Attention: *Ms. Celine Moreira*  
Your Reference: *Project Plan 2*  
No. Of Specimens: *68*  
Specimen Identification: *See following page.*  
Test Method: *ASTM G7 2013*  
Deviations: *None*  
Exposure Date: *July 21, 2020*  
Completion Date: *October 19, 2020*  
Exposure Duration: *2 Months 28 Days*  
Exposure Type: *Direct Weathering- Florida  
45° South  
Backed*  
Radiation Exposure: *Total = 1,449.89 MJ/m2 TUVB = 81.53 MJ/m2*  
  
By:   
Rosie Rosario  
Test Set Up Supervisor  
  
Approved By:   
Michael Crewdson  
General Manager

Figure S5. Q-Lab certificate for the 90-day outdoor exposure of PE-05 in Florida.



**Q-Lab Weathering Research Service**  
1005 S.W. 18 Avenue  
P. O. Box 349490  
Homestead, FL 33034

**TEST CERTIFICATE**  
**Natural Weathering**

**Test Program Number:** PLL-1-TP-1  
**Company:** Polymateria Limited  
**Address:** Imperial College London I-HUB White City Campus 80 Wood Lane  
London W12 0BZ  
UNITED KINGDOM  
**Attention:** Ms. Celine Moreira  
**Your Reference:**  
**No. Of Specimens:** 10  
**Specimen Identification:** See following page.  
**Test Method:** ASTM G7 2013  
**Deviations:** None  
**Exposure Date:** October 24, 2019  
**Completion Date:** January 22, 2020  
**Exposure Duration:** 2 Months 29 Days  
**Exposure Type:** Direct Weathering- Florida  
45° South  
Backed  
**Radiation Exposure:** Total = 1,632.64 MJ/m<sup>2</sup> TUV<sub>R</sub> = 69.52 MJ/m<sup>2</sup>  
**By:**   
Rosie Rosario  
Test Set Up Supervisor  
**Approved By:**   
Michael Crewdson  
General Manager

**Figure S6.** Q-Lab certificate for the 90-day outdoor exposure of PE-06 in Florida.