

# MSE-1: Failure Mode Analysis of Elium® Composite Resin System

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## Problem Statement:

Arkema, Inc. developed the first type of thermoplastic resin that is liquid at room temperature, trademarked as Elium®. The goal of the project was to study the weathering behavior of Elium® reinforced with fiberglass after exposure to outdoor/atmospheric conditions.

## Approach:

Analyzed two sets of samples 3 and 9 (pure Elium® and Elium® + activator) and determined the differences between the control and weathered samples (1000 and 5000 kJ/m<sup>2</sup>).

- Samples cut into 3 sections (top, middle and bottom).
- All samples characterized *via* SEM, TGA, DSC, GPC, FTIR and UV-Vis.
- 3-point bending test performed using a Hybrid Rheometer.

## Discussion & Conclusions:

- The decomposition temperature of sample 3-control was higher than that of the weathered samples. For sample 9, the decomposition temperature of the most exposed sample (5000 kJ/m<sup>2</sup>) was higher than the control.
- DSC analysis showed a similar trend, the  $T_g$  of weathered samples 3 and 9 increased relative to the control samples.
- It can be inferred that by exposing the samples to UV radiation, further crosslinking of the samples occurred. Moreover, this effect was largely seen in sample 9 due to the addition of an activator.

## Results:

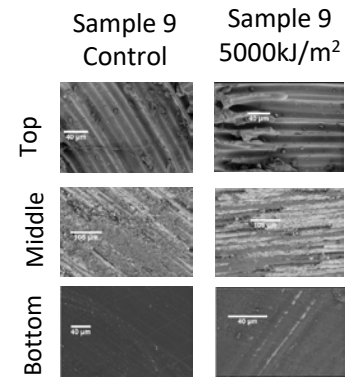
Table 1:  $T_g$  results for samples 3 and 9

Section	$T_g$					
	Sample 3			Sample 9		
	Control	1000 kJ/m <sup>2</sup>	5000 kJ/m <sup>2</sup>	Control	1000 kJ/m <sup>2</sup>	5000 kJ/m <sup>2</sup>
Top	105	109	105	98	105	103
Middle	105	108	105	100	104	105
Bottom	110	109	115	98	103	100
Average	107	108	108	99	104	103
STD	3	1	6	1	1	3

Table 2: TGA results for samples 3 and 9

Section	Decomposition Temperature					
	Sample 3			Sample 9		
	Control	1000 kJ/m <sup>2</sup>	5000 kJ/m <sup>2</sup>	Control	1000 kJ/m <sup>2</sup>	5000 kJ/m <sup>2</sup>
Top	363	348	365	319	315	331
Middle	312	319	304	306	313	311
Bottom	323	328	310	306	311	353
Average	332.79	331.50	326.50	310	313	332
STD	26.84	14.59	33.66	7.72	2.07	21.14

- **TGA** – the average decomposition temperature of sample 3 was higher than sample 9.
- **DSC** – the  $T_g$  of the control was lower than that of the weathered samples.
- **SEM** – showed different morphologies of each section and the bottom section had the highest amount of resin.



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