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SHORT COMUNICATION

The influence of methoxypropanol on the Out-Life of carbon / epoxy prepregs

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Abstract: One of the properties of epoxy prepregs is the so-called Out-Life, defined as the maximum accumulated time allowed at room temperature between removal from the freezer and cure. Here we investigate the influence of methoxypropanol addition on the Out-Life of DICY / Uron based epoxy prepregs.

Keywords: composites, epoxy, prepreg, methoxypropanol, out-life

1. INTRODUCTION

Epoxy prepregs are composed of partially cured ("B" staged) epoxy resins. Prepregs are stored in the refrigerated state and may be processed after defrosting only for a specific shelf-life or so-called out-time. This limitation in processing time reduces the efficiency of the entire production, for example due to the waste of material during production stops. To improve the production effectiveness the shelf-life should be as high as possible.
Among the most commonly used prepreg curing agents there are DICY / Urea systems. These systems have generally an Out-Life at room temperature of about 2-6 weeks. Increases in shelf life are generally achieved by selecting different curing agents (such as DDS). In this preliminary study we evaluated the possibility of increasing the shelf life of a DICY/Urea system by adding methoxypropanol (C4H10O2) to formulation.

2. MATERIAL AND METHODS

Test 1: A mix of solid, bisphenol-A based epoxy resin, + liquid, bisphenol-A based epoxy resin, + DICY/Urea curing agents
Test 2: A mix of solid, bisphenol-A based epoxy resin, + liquid, bisphenol-A based epoxy resin, + DICY/Urea curing agents, + 7 pbw methoxypropanol
The 2 tests differ only in the addition or not of methoxypropanol.
In both cases the formulations were used to make carbon fiber prepregs, with the same RC% and the same manufacturing conditions . These samples were storage in a climatic chamber at 21±3°C and 45±5% HR.

Differential scanning calorimetry (DSC) is a method for performing thermochemical analysis. DSC can readily be applied to epoxy prepregs for observing the kinetics of the curing reaction.
In this study, the practical aspects of such method is used to evaluate the Out-Life of the material, defined as the maximum accumulated time allowed at room temperature between removal from the freezer and cure.
At predefined time intervals (every 7 days), a dynamic DSC analysis was carried out on Test 1 and Test 2 prepreg samples, with: heat ramp of 10°C/min, from -40 to +40°C.
The analysis was carried out until the Tg of prepregs reached a value higher than 8 ° C, which corresponded to a rigid-dry prepreg, that was no longer usable. (Table 1)
To further evaluate the influence of the addition of methoxypropanol on the properties of the prepregs, a comparison of the samples is carried out with isothermal DSC analysis.
After aging in a climatic chamber at 21±3°C and 45± % HR of 14 days, the materials are subjected to a curing cycle of:

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heat ramp of 1°C/min from 40 to 85°C, isotherm of 4 hours @ 85°C, cool ramp of 20°C/min from 85 to 0°C, heat ramp of 20°C/min from 0 to 200 °C. The Tg of the samples are evaluated. (Table 2)

3. RESULTS AND DISCUSSION

Table 1:

Days	Tg (°C) of Test 1	Tg (°C) of Test 2
0	2.12	-3.23
7	3.49	-2.11
14	4.00	-1.50
21	4.05	-0.90
28	6.88	0.28
35	8.20	0.29
42	/	1.76
49	/	1.80
56	/	1.82
63	/	1.90
70	/	2.34
77	/	2.45
84	/	3.01
91	/	3.50
98	/	3.50
105	/	3.63
112	/	4.15
119	/	4.18
126	/	5.11
133	/	6.44
140	/	7.90
147	/	9.16

Table 2:

Tg after curing cycle (°C)	Tg of Test 1	Tg of Test 2
	94.01	99.17

4. CONCLUSION

The increase of the Out-Life of the prepreg - without a significant change in reactivity during a curing cycle - after the addition of methoxypropanol suggests the need for prepreg producers to analyze in more detail the effect of this constituent on other properties of the prepregs, to evaluate the most appropriate quantities of this constituent to improve the properties, and to determine the reasons why this solvent has this effect on DICY / Urea based epoxy prepregs.

REFERENCES

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