

Virantage®



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Virantage® PESU

Tougheners for Thermoset Matrix Systems

**SPECIALTY
POLYMERS**

Virantage® polyethersulfone (PESU) tougheners are amorphous, high-temperature thermoplastics used to improve the toughness of thermoset matrix systems while retaining high modulus, high temperature capability, hot-wet performance and resistance to aggressive environments. Functionalized (r-PESU) and non-functionalized powders are available in a range of particle sizes.

Rheology

Adding high molecular weight PESU increases the viscosity of an epoxy solution. The change in viscosity depends on the concentration and molecular weight of the additive and may require some modifications to the subsequent composite preparation processes.

The solution viscosity of Virantage® PESU as a function of temperature and concentration in a TGAP (triglycidyl-p-aminophenol) epoxy system at 75 °C (167 °F) is shown in Figure 2. Lower molecular weight VW-10700 RP epoxy solutions are substantially lower in viscosity, which provides enhanced processability.

Toughening Performance

The effect of varying the concentration of three Virantage® PESU grades on the fracture toughness (K_{1C}) of a TGAP epoxy system cured with DDS (4, 4'-diaminodiphenylsulfone) is shown in Figure 3. As expected, the slightly higher molecular weight VW-10200 RP gives higher K_{1C} values compared to the same loading with the lower molecular weight VW-10700 RP and implies more effective toughening. The non-functionalized VW-10300 P offers toughening capability up to certain loading levels.

Figure 1: Repeating unit for functionalized r-PESU

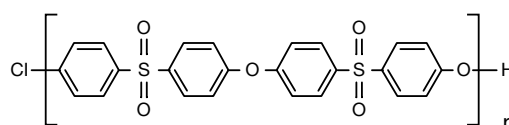


Figure 2: Solution Viscosity of PESU-TGAP at 75 °C

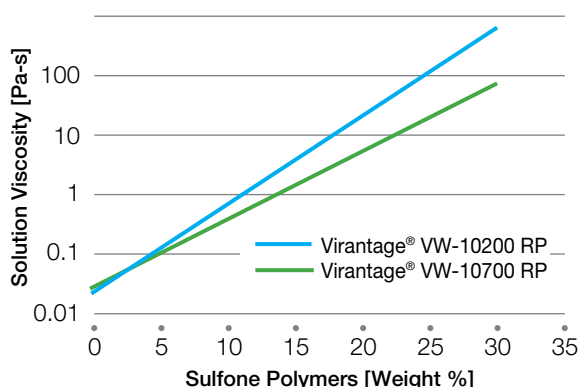


Figure 3: Effects of PESU concentration and MW on fracture toughness for TGAP-PESU-DDS

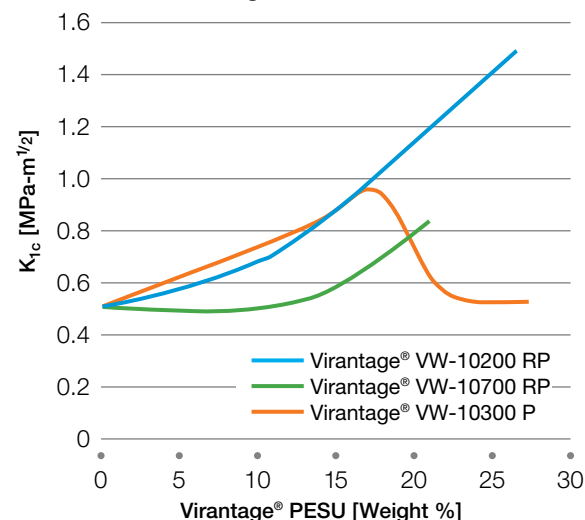


Table 1: Virantage® PESU tougheners

| Grade | Molecular Weight [g/mole x 1,000] | Solution Viscosity 25 % in DMAc at 40 °C [cP] | OH-End Groups [micro-equiv/g] | Residual Solvent [%] | Typical Particle Size D90 [µm] | | |
|-------------|--------------------------------------|---|----------------------------------|-------------------------|-----------------------------------|----|-----|
| | | | | | P | FP | SFP |
| VW-10200 RP | 45 | 600 | 70 | < 0.3 | 500 | 65 | 40 |
| VW-10700 RP | 22 | 80 | 160 | < 0.3 | 500 | 75 | 45 |
| VW-10300 P | 55 | 700 | < 10 | < 0.5 | 500 | 75 | 45 |

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