

Q 6.19 Predict Strength and describe failure process for two unidirectional fibre reinforced composites under axial tensile stress...

(a) 10% E-Glass fibre in thermoset polyester

(b) 50% E-Glass fibre in thermoset polyester

$$\sigma_f^* = 1.8 \text{ GPa} \quad E_f = 76 \text{ GPa}$$

$$\sigma_m^* = 0.055 \text{ GPa} \quad E_m = 3 \text{ GPa}$$

$$\epsilon_f^* = \sigma_f^* / E_f = \frac{1.8}{76} = 0.02368$$

$$\epsilon_m^* = \sigma_m^* / E_m = \frac{0.055}{3} = \underline{\underline{0.01833}}$$

ϵ_m^* smaller \Rightarrow brittle matrix

$$(a) \sigma_f' = \epsilon_m^* E_f = (0.01833)(76,000) = 1393 \text{ MPa}$$

$$\sigma_i = (\phi_f \sigma_f') + (\phi_m \sigma_m^*) = 188.8 \text{ MPa}$$

fibre alone

$$\boxed{\epsilon_i^* = \epsilon_m^*}$$

$$\phi_f^* \sigma_f^* = (0.1)(1800) = 180 \text{ MPa}$$

$$180 < 188.8$$

$\sigma_i^* = 188.8 \text{ MPa}$ & total failure occurs at that pt.

$$(b) \sigma_i = (0.5)(1393) + (0.5)(55) = 724 \text{ MPa}$$

$$\boxed{\epsilon_i^* = \epsilon_f^*}$$

$$\sigma_i = \phi_f \sigma_f^* = (0.5)(1800) = 900 \text{ MPa}$$

$\Rightarrow \sigma_i^* = 900 \text{ MPa}$, matrix fails, then fibre fails later