

# MANUFACTURING AND AGING OF TOUGH EPOXY COMPOSITE MATRICES

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#### INTRODUCTION

Tough epoxy polymers that don't crack are useful

Technology of toughening epoxy polymers is widespread

Rubber

Silica

Nano-carbon

Commercial drivers: Reduce mould time, Manufacture faster

## **Question 1:**

Is a composite matrix resin cured at high speed as tough as one cured at low speed?

In-house formulation resin

In-house formulation hardener

## **Question 2:**

Is a toughened composite as tough after aging as when it was manufactured?



Toughened with a polysiloxane core shell rubber (CSR) nanoparticle

Cured at different temperatures, hotter = faster cure



increase in toughness



#### Thermal aging reduces free volume



#### Fracture energy decreases with aging time



epoxy polymer

Answer 1: No

#### CONCLUSIONS

The toughness of rubber-toughened epoxies is **significantly** 

adversely affected by cure rate

Matrix formulations should be chosen by considering **speed of cure** as a commercial driver

Thermal rejuvenation demonstrates recovery of fracture energy lost via thermal aging

Answer 2: No

Physical aging **negatively** affects the toughness of rubber modified epoxy polymers

The effects of physical aging on toughened epoxy polymers are **recoverable**