

Simultaneous cure of individual thermoset samples

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INTRODUCTION

The final performance of a thermoset material depends on the matrix itself, type and load level of filler, other additives, and on the curing conditions, such as pressure, temperature and post-bake. The development of low-CTE composites (coefficient of thermal expansion) with superior heat stability was the topic of a project in this laboratory [1]. Therefore an efficient screening method of suitable matrix/filler combinations as a function of load level (and others) was needed. Primary selection criterion was the CTE of the compound; thus small samples would be sufficient for this part of the project.

EXPERIMENTAL

Fig. 1 shows parts of the eightfold mold. Eight hardened bushings are mounted in a thick brass plate. The rather

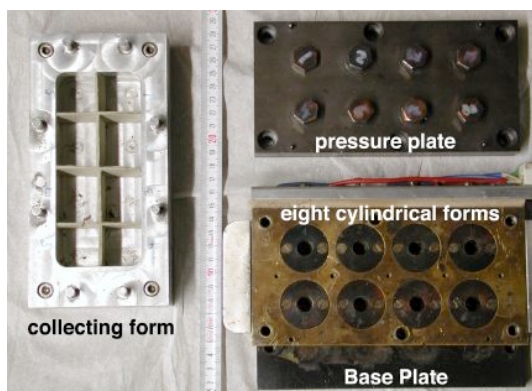


Fig. 1: View of the eightfold mold. The samples are placed in cavities in the brass plate, which is mounted between the bottom base plate and the upper pressure plate. After cure, the base plate is removed, the brass and pressure plate are placed on top of a collection form and the samples are pushed through the cavities.

soft brass plate is mounted between a bottom plate and the upper pressure plate. As shown in detail in Fig. 2, the premixed sample is sandwiched between two plates. All surfaces touching the material are polished in order to avoid sample damage by sticking to the plates during removal. Two disposable copper rings below and above the plates seal the mold.

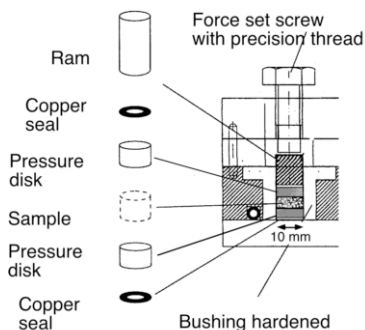


Fig. 2: Schematic drawing of one mold cavity.

The pressure is applied via a ram and force set screws, which possess a special fine thread in order to allow a sensitive adjustment of the pressure via screw displacement and ultimately torque as measured value. As shown in Fig. 3, the applied torque corresponds to a defined force/pressure

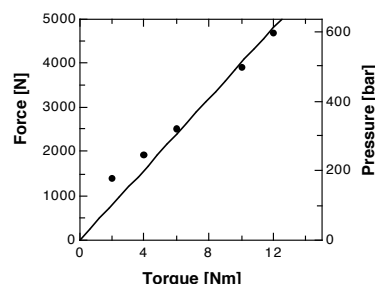


Fig. 3: Applied force as function of the screw torque. For torque values higher than 6 [Nm] a linear relationship is observed.

pressure onto the sample. The brass plate contains a thermocouple and cartridge heaters in combination with a Eurotherm 2404 programmable controller. This unit facilitates the realization of curing cycles with heating ramps, dwell times, and cooling. After a complete cure, the base plate is removed, the remaining two plates placed on a collecting form with compartments for each mold, and the samples pushed out of the mold by using the force set screws. At a fixed diameter of 10 mm, the final length (approx. 6 mm) of the cylindrical sample is governed by the amount of material placed into one mold, typically 0.8g.

RESULTS & DISCUSSION

Preliminary experiments were performed in a modified KBr press, and small cylinders of the cured thermoset compounds were obtained. However, the variety of available fillers in combination as a function of the load level required more efficient sample preparation. Thus an eightfold mold was designed which permits the fabrication of eight different samples of one matrix polymer. As shown in Fig. 4, fifteen samples with different fillers were prepared during only two curing cycles. Thus for screening purposes in particular, a very efficient samples preparation was achieved.

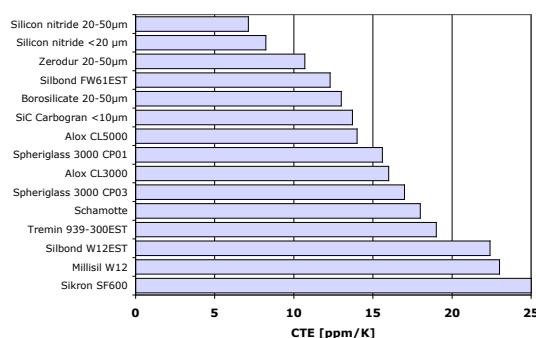


Fig. 4: CTE of samples prepared in the eightfold mold containing 80 wt% filler as specified. Matrix: LaRC-RP46. [1]

REFERENCES

[1] Johann Wippl, Hans-Werner Schmidt, Reiner Giesa, *Macromol. Mater. Eng.* **2005**, 290, 657-668

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