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**The Conference is dedicated to the  
100th Anniversary of the academician Pavle Savić birthday  
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# INFLUENCE OF BENTONITE FILLER ON THE THERMAL STABILITY OF GLYCIDYL METHACRYLATE BASED COMPOSITE

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## Abstract

Macroporous crosslinked copolymer of glycidyl methacrylate, GMA, and ethylene glycol dimethacrylate, EGDMA, poly(glycidyl methacrylate-co-ethylene glycol dimethacrylate) and its composites were synthesized by suspension copolymerization. Composites were obtained by introducing 10 mass % of either raw bentonite (S<sub>0</sub>) or acid modified bentonite (S<sub>A</sub>) into reaction system. The composite synthesized with S<sub>A</sub> as filler showed superior thermal stability comparing to starting copolymer and composite with S<sub>0</sub> embedded in copolymer matrix.

## Introduction

Polymer/clay nanocomposites (PCN) were invented at Toyota Central R&D Labs, Inc. (Toyota) in 1985 [1, 2]. PCN have become increasingly important because they combine the structural, physical, and chemical properties of both clay and polymer [3]. PCN modify different properties of polymers i.e. thermal and mechanical endurance with minimal loss of ductility, flame, abrasion and chemical resistance, alter electrical, electronic and optical properties [4]. Several studies on nanocomposites demonstrated that introducing clay minerals into a polymer, if it results in intercalated or exfoliated structures, leads to thermal degradation shifted towards higher temperatures. Moreover, this improvement can arise at very low filler content (< 1 mass %) [5].

## Experimental

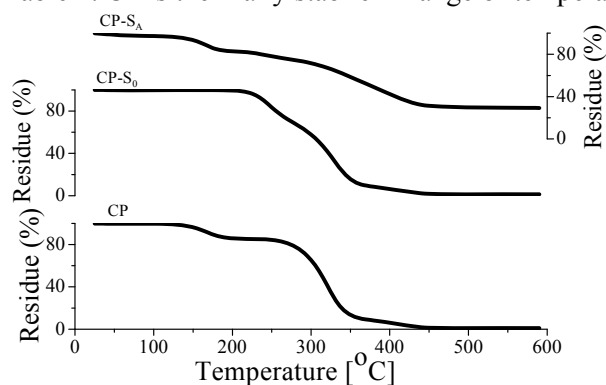
Macroporous crosslinked copolymer of glycidyl methacrylate, GMA, and ethylene glycol dimethacrylate, EGDMA, poly(glycidyl methacrylate-co-ethylene glycol dimethacrylate), was synthesized by suspension copolymerization [6]. The monomer phase containing reaction mixture (20.8 g of GMA and 13.8 g EGDMA), AIBN as an initiator (0.35 g), 45.4 g of inert components (36.3 g cyclohexanol and 9.1 g of tetradecanol) was suspended in the aqueous phase which consisted of 240 g of water and 2.4 g of polyvinylpyrrolidone (Sigma-Aldrich). The copolymerization was carried out at 70 °C for 2h and at 80 °C for 6 h with stirring rate of 300 rpm. After reaction, the copolymer particles were washed with distilled water and vacuum dried at 40° C and denoted as CP. Composites were obtained in same

manner as CP, only 10 mass % of monomer mixture of either raw bentonite S<sub>0</sub> or acid modified S<sub>A</sub> was introduced into reaction system [7, 8]. The obtained composites were denoted CP-S<sub>0</sub> and CP-S<sub>A</sub>. Grafting of organic groups into bentonite structure of synthesized composites was confirmed by IR analysis [9]. The presence of inorganic constituents in composites was performed after the organic constituent was removed by heat treatment. The inorganic residues were 3.26 and 6.50 mass % for CP-S<sub>0</sub> and CP-S<sub>A</sub>, respectively [9].

The thermogravimetric measurements were performed with heating rate 10 °C/min on SDT 2090 (TA Instruments) thermal analyzer under air atmosphere. The heating was performed from the ambient temperature up to 600 °C [9].

## Results and Discussion

Results obtained by TGA for copolymer and composites are given in Fig. 1 and Table 1. CP is thermally stable in range of temperatures from 50 to 100 °C.



**Fig.1.** TGA for CP, CP-S<sub>0</sub> and CP-S<sub>A</sub>.

**Table 1.** Thermal stability of samples.

Sample	$\Delta m_{350\text{ }^\circ\text{C}}$ [%]	$\Delta m_{600\text{ }^\circ\text{C}}$ [%]
CP	86.5	99.8
CP-S <sub>0</sub>	84.3	96.7
CP-S <sub>A</sub>	41.4	70.7

Where:  $\Delta m_{350\text{ }^\circ\text{C}}$  and  $\Delta m_{600\text{ }^\circ\text{C}}$  are mass loss on denoted temperatures.

For CP it was observed 10 % mass loss in the first step of degradation (~200 °C). In the second step, (200-350°C) mass loss was significant ~86.5 %. In the temperature range 350-450 °C there was a continual mass loss.

For CP-S<sub>0</sub> was observed continual mass loss in the second step of degradation, while CP-S<sub>A</sub> shows continual mass loss in range 130-450 °C. Mass residues at 600 °C were much different for CP-S<sub>0</sub> and CP-S<sub>A</sub>. In CP-S<sub>A</sub> amount of residue after decomposition is 29.3 mass %, which is almost five times more than amount of embedded inorganic component (6.5 mass %). The residue for CP-S<sub>0</sub> was equal to its inorganic constituent.

## Conclusion

Composites of macroporous crosslinked poly(glycidyl methacrylate-*co*-ethylene glycol dimethacrylate) and bentonite-clays were synthesized by suspension copolymerization. Mass losses at 600 °C were much different for composite with raw clay (96.7%) from the composite having acid modified bentonite as filler (70.7%). In latter the amount of residue of 29.3 mass % was almost five times more than amount of embedded inorganic component (6.5 mass %). The assumption was that by embedding acid modified bentonite into copolymer matrix, polymer chain splitting was prevented. In this way, thermal decomposition of composite was lowered in temperature range 200-400 °C.

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