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Thermic Behaviour of two Copolymers used as Viscosity Improvers for SAE 10W Mineral Oil

Ioana Stanciu

Universitatea Bucureşti, Bd. Regina Elisabeta 4-12, 030018, Bucureşti, România
e-mail: ioasta@yahoo.com

Abstract

Differential scanning calorimetry was used to determine the glass transition temperatures of two copolymers (KELTAN 4200 – a etilene-co-propilene copolymer and INFINEUM SV 260 – a hydrogenated isoprene-co-styrene one) recommended as viscosity improvers, while TG and DTA to evaluate their heat resistance.

Key words: *Differential scanning calorimetry, glass transition temperatures, heat resistance*

Introduction

Differential scanning calorimetry is widely used in the study polymer industry. For the polymer chemist, DSC is a handy tool for studying curing processes, which allows the fine tuning of polymer properties. The cross-linking of polymer molecules that occurs in the occurring process is exothermic, resulting in a positive peak in the DSC curve that usually appears soon after the glass transition [1-3]. Among the most common analytical techniques, the differential scanning calorimetry is commonly used for monitoring the exothermal processes because it requires a small sample size and a short analysis time [4, 5]. Thermic behaviour of two copolymers used as viscosity improvers for SAE 10W mineral oil were determined using analysis of a DSC, TG and TGA curves. The thermogrames TG and DTA to evaluate their heat resistance.
The object of the present paper is the determination heat resistance and glass transition temperatures of two copolymers – recommended as viscosity improvers for multi-grade oils – for which the global and partial solubility parameters and radii of interaction sphere [6], rheological behaviour of concentrated solutions [7] and viscosity indices of solutions copolymers were determined using the ASTM 2270-93 [8].

Experimental detail

The following copolymers were used as viscosity improvers: hydrogenated poly(isoprene-co-styrene) (Infieum UK LIMITED) – trade name INFINEUM SV 260 and poly(ethylene-co-propylene) (DSM Elastomers Europe B. V.) – trade name KELTAN 4200.
The experimental thermograms were obtained using a differential scanning calorimeter DSC DuPont 2000. The DSC/TG and DTA was obtained using under following experimental

conditions: the heating rate 20°C min^{-1} in non-isothermal conditions, the nitrogen atmosphere, the sample mass 0.1 mg.

Results

Differential scanning calorimetry is a technique in which the differences in energy impute into a material and a reference material is measured as a function of temperature. Figure 1 shows the DSC spectra of the KELTAN 4200. The curve indicates the glass transition temperature at -54.17^{0}C and at 53.40^{0}C.

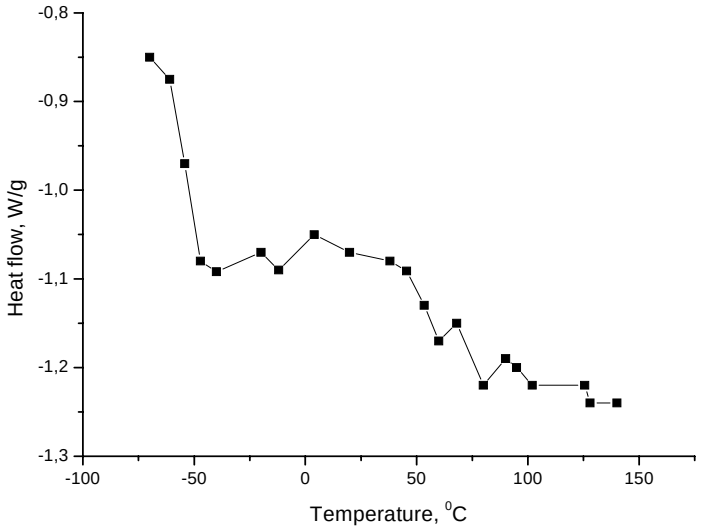

Fig. 1 The DSC thermogram of a KELTAN 4200

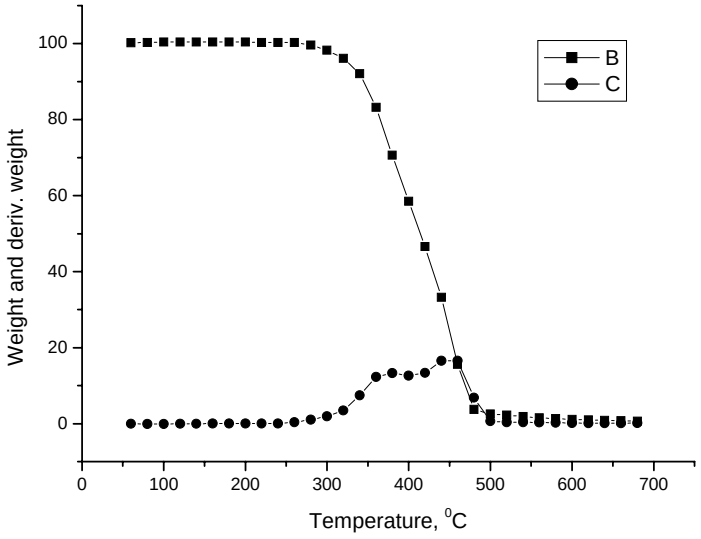

Fig. 2 TG-DTA spectra of copolymer KELTAN 4200: B- weight-temperature, C- deriv. weight-temperature

Figure 2 shows the TG and DTA thermogram of the KELTAN 4200. The mesurements are used primarily to determine the composition and heat resistance. The figure indicate: the modified weight in the temperature range 262-470^{o}C; the temperature initial of a descomposition thermic is 262,5^{o}C; the modified weight with temperature: 262,5-402^{o}C – 42,99%, 402-510^{o}C – 54,85%, 510-600^{o}C – 1,46% and rezidue – 0,42%. The DTA curve present of two maximum. The DTA curve we two point of a inflexion, the one of 357,1 and the second 435,0^{o}C and the temperature final on a descomosition thermic is 510^{o}C.
Figure 3 present thermogram DSC of a copolymer INFINEUM SV 260.

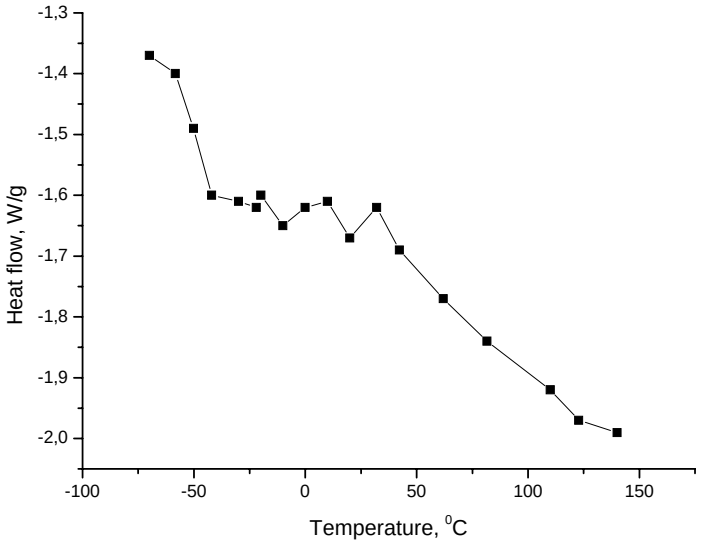

Fig. 3. The DSC curve of a copolymer INFINEUM SV 260

The curve indicates the glass transition temperature at -50,19^{0}C. The figure 4 shows the TG and DTA thermogram of the INFINEUM SV 260.

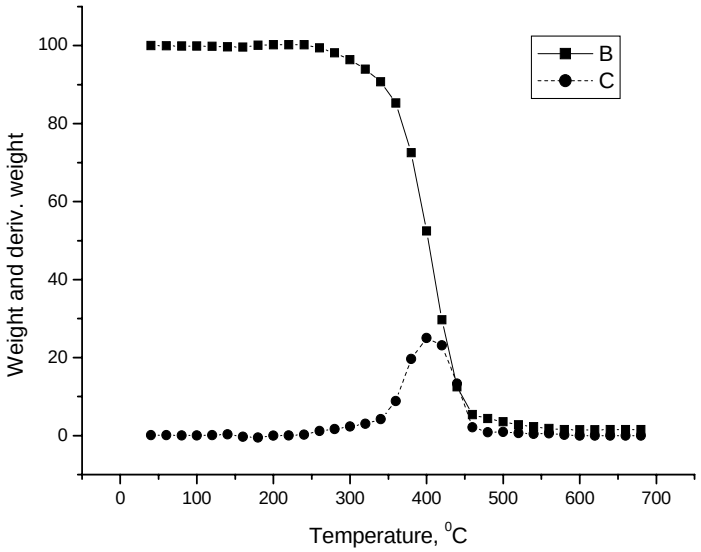

Fig. 4 The TG-DTA curves of a copolymer INFINEUM SV 260

The figure 4 indicate: the modified weight in the temperature range 238-470^{o}C; the temperature initial of a descomposition thermic is 238^{o}C; the modified weight with temperature: 238-320^{o}C – 5,55%, 320-470^{o}C – 90%, 470-600^{o}C – 3,15% and rezidue – 1,59%. The curve DTA present of one maximum, we one point of a inflexion, the one of 407,20 and the temperature final on a descomosition thermic is 600^{o}C.

Conclusions

The glass transition temperatures as well as their heat stabilities of the two copolymers are very close, with KELTAN 4200 having a bit lower glass transition temperature and higher heat resistance. Taking account of the functioning temperatures of engines, both copolymers are convenient to be used as viscosity improvers.

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Comportarea termicã a doi copolimeri utilizaţi ca modificatori de viscozitate pentru uleiul SAE 10W

Rezumat

Calorimetria dinamică diferenţială a fost metoda ultilizată pentru determinarea temperaturilor de vitrifiere ale copolmerilor(KELTAN 4200 – polietilenă-polipropilenă şi INFINEUM SV 260 – polizopren stiren-hidrogenat) recomandaţi ca modificatori de viscozitate pentru uleiul SAE 10W. Din curbele TG şi DTA a fost determinată rezistenţa termică a acestora.