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Synthesis and Characterization of the Terpolymer of Itaconic Acid with Acrylamide and 2-Acrylamido-2-methylpropanesulfonic Acid

Yu Min WU[1,2]*, De Jun SUN[1], Tao WU[1], Chun Guang ZHANG[1]

[1] Key Lab for Colloid and Interface Chemistry of Education Ministry, Shandong University, Jinan 250100
[2] Department of Chemical Engineering, Shandong Institute of Light Industry, Jinan 250100

Abstract: The terpolymer of itaconic acid, acrylamide and 2-acrylamido-2-methyl-1-propane sulfonic acid was synthesized through the free-radical polymerization. The IR spectra confirmed that there was no olefinic band, while the TGA results revealed that the terpolymer was of high thermal stability.

Keywords: Itaconic acid, acrylamide, 2-acrylamido-2-methyl-1-propane sulfonic acid, TGA.

The thermal stability of the polymer is of great significance in paper, ceramics and oil industry[1]. Conventional polymers such as polyanionic cellulose can not meet high temperature limitations[2-4]. Aggour[5-6] and Collette[7] *etc*. have conducted extensive research on synthesis and characterizations of the copolymer or terpolymer containing 2-acrylamido-2-methyl-1-propane sulfonic acid (AMPS). Till now, very few research works have been reported on the terpolymer of itaconic acid (IA), acrylamide (AM) and AMPS.

The polymerization of the terpolymer was carried out under the nitrogen atmosphere. 425 g of deionized water, 200 g of a 50% solution of AM, 30 g of a 40% solution of disodium IA and 276 g of a 50% solution of AMPS were added into a 1 L reactor. Then 52.5 g of a 5% solution of sodium persulfate was drop-fed into the reactor uniformly over a period of 2 h at 75°C. At the end of the initiator addition, 75°C was maintained for an additional 2 h. The precipitated polymer was isolated by 2 L acetone and dried under vacuum at 40°C. The molecular weight of the terpolymer was about 500,000 as measured by the limiting viscosity method and calculated through the relation as follows:

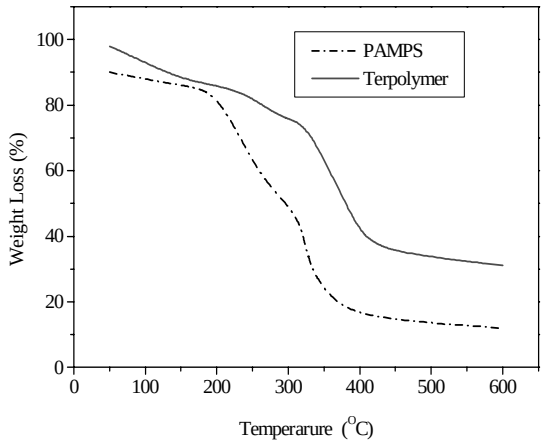
$$[\eta] = 3.73\times10^{-4} M_w^{0.66}$$

In the IR spectra of the IA-AM-AMPS terpolymer, there was a band at 1406 cm^{-1} due to C-O stretching of COO^- groups. The AMPS units were revealed by CO at 1558 cm^{-1}, SO_2 at 1217 cm^{-1}, CH at 1451 cm^{-1} and NH at 3211 cm^{-1}. The AM units were characterized by CO at 1665 cm^{-1}, CH at 579 cm^{-1} and NH_2 at 3339 cm^{-1}. There was no olefinic band at 1635-1620 cm^{-1}.

The TGA curves for the IA-AM-AMPS terpolymer and the AMPS homopolymer

(PAMPS) were showed in **Figure 1**. Obviously, the terpolymer was of higher thermal stability than PAMPS. The thermal degradation of the terpolymer became appreciable at approximately 240°C while PAMPS began to degrade at 182°C. The terpolymer sample turned yellow at first, later fused, and the rate of degradation gradually decreased. The terpolymer exhibited three degradation stages. The first degradation stage occurred in the range of 240~330°C corresponding to the decomposition of amide and carboxyl groups. The second stage appeared at 340~420°C due to the decomposition of sulfonic groups, while the third stage demonstrated smoothly at the higher temperature than 430°C in correspondence with the decomposition of the terpolymer backbone.

Figure 1 TGA curves for the IA-AM-AMPS terpolymer and PAMPS



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