EFFECT OF SOLUTION PROPERTIES ON THE TERPOLYMERIZATION OF 2-ACRYLAMIDO-2-METHYLPROPANE SULFONIC ACID, ACRYLAMIDE & ACRYLIC ACID

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The water-soluble terpolymerization of 2-acrylamido-2-methylpropane sulfonic acid (AMPS), acrylamide (AAm) and acrylic acid (AAc) is an interesting and largely unstudied system. This new terpolymer has only recently appeared in the literature, with applications ranging from enhanced oil recovery [1] to controlled drug delivery [2]. Typically, existing studies focus on the final properties of the material (swelling behavior, thermal and mechanical stability, etc.), but investigating the terpolymerization kinetics is equally important [3]. The bulk polymer properties (and, by extension, properties relevant to the final application) depend on the terpolymer microstructure, therefore a clear understanding of the terpolymerization kinetics is invaluable.

The kinetics of an associated copolymer, acrylamide/acrylic acid, have been well-studied [4]. It has been shown that experimental conditions (that is, the pre-polymerization solution properties) can significantly impact the polymerization kinetics and the resulting copolymer. Since the AAm/AAc copolymer is a polyelectrolyte, solution pH, ionic strength, and monomer concentration are all influential variables during synthesis [5] [6] [7] [8]. AMPS also exhibits polyelectrolyte behavior, so one might expect that solution properties will also affect AMPS/AAm/AAc terpolymerization.

In looking at extensions to the AMPS/AAm/AAc terpolymer, it is important to note that binary observations do not always apply to the ternary system. In the past, many researchers have used copolymerization results to predict terpolymerization behavior. This is an approximation at best, and it effectively ignores the presence of the third comonomer. This will inevitably change the reaction conditions and, ultimately, the polymerization kinetics. Therefore, although we can look to the AAm/AAc system for guidance, new terpolymer-specific investigations are needed.

The current study examines the effects of solution properties on the terpolymerization of AMPS/AAm/AAc. Specifically, optimally designed experiments (using EVM design [9]) allow us to select feed compositions with high information content, so that we can learn about the entire system in just a few experimental runs. Ternary reactivity ratio estimates can be obtained using the error-in-variables-model (EVM), and those reactivity ratio estimates provide information about the resulting terpolymer microstructure.

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