

Evaluation of Effect of Solvents in Solution Polymerization of Polyvinyl Acetate

M.A.Semsarzadeh, M.R.Kalaei, E.Vasheghani-Farahani

Polymer Engineering Group, Tarbiat Modares University (TMU), P.O.Box 14155/111, Tehran, Iran
kalaeem@modares.ac.ir

Introduction

The most usage of PVAc, beside floors covering, glues and paper covers, is PVA. The effects of alcohol it depends on the kind of it on PVA agglomeration. Therefore consideration of alcohol effecting in solution polymerization of PVAc has been down. In this paper consideration has been down that solution polymerization of PVAc in two different kind of solvent, in 60^oc with AIBN. Therefore by using viscometer the change of Weight average molecular weight with time is calculated and considered.

Experimental

Materials. The monomer Vinyl acetate (Merk) was distilled under vacuum at the most 24 h before use. The first 20-50 ml of distillate were discarded and was stored at 5^oc when not in use. Methanol and Isopropyl and AIBN (Merk), were also used as packaged.

Polymerization. Experiment were performed in a four-necked round bottom flask at 60^oc, with constant agitation with magnet (300 rpm). The temperature was controlled by means of a heater. The flask, reactor, was washed with THF and dried with acetone before each experiment. The monomer and solvent (less 5-10 mL of solvent used for initiator injection) were introduced into the reactor, heated, and degassed with nitrogen for 10-15 min. The initiator dissolved in the remaining solvent is then injected, at which point the reaction is assumed to have started. [1,4]

Table 1. parameters for solution polymerization of Vinyl Acetate

Materials	Weight (gr)	Volume (CC)
Methanol	47.52	60
Isopropyl	48	60
VAC	46.5	50
AIBN	0.07	-

Analytical techniques. The purity of VAC was evaluated by GC. PVAc was also analyzed by ¹H-NMR and ¹³C-NMR.

Results and discussion

Modeling. In the classical representation of free radical polymerization kinetics, the rate of reaction in a batch reactor is given by the following expression [5]:

$$R_p = -\frac{[M]_0 \alpha (1-x)}{\alpha} = k_p [M]_0 (1-x) \left(\frac{2fk_d [I]_0 e^{-k_d t}}{k_t} \right)^{1/2} \quad (1)$$

where $[M]_0$ is the initial monomer concentration, x the conversion, $[I]$ the initiator concentration, k_d the initiator decomposition constant, k_p the propagation constant and f is the initiator efficiency.

Rate data. Conversion was estimated using the well-known gravimetric technique. Rate data (conversion vs, time) is presented in (Figure 1), for solution polymerization in Methanol and Isopropyl with AIBN.

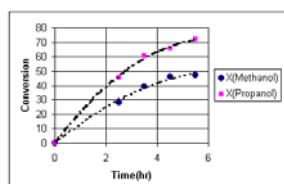


Figure 1. effect of solvents in solution polymerization of VAC

In analyzing the results of a single polymerization experiment, eq.(1), should be used: one plots $-\ln(1-x)$ against t , and from the slope determines either k_p^2/k_t^2 if fk_d is known. The data regressed using eq.(1) and results showed in (Table 2).

Table 2. Evaluation of Effect of Solvents in Rate and Kinetic Parameter of Reaction

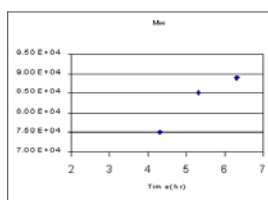
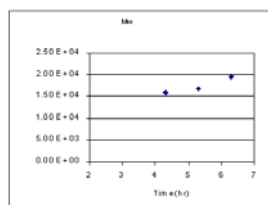
Concentration (AIBN)	Solvent	$\frac{2fk_p}{k_t}$	R_p (1/hr)
0.0034	Methanol	4.44	0.0901
0.0034	Isopropyl	16.17	0.1333

Molecular Weight. Molecular Weight measurements were performed on a Ostwald viscometer. (Table 3) showed the Mark Houwink parameters for Poly Vinyl Acetate[1].

Table 3. Mark Houwink parameters for Poly Vinyl Acetate.

Solvent	Temp	$K \times 10^{-4}$	a	Mw Range (Me-4)
Aceton	30	1.01	0.73	6-150

Measured value of the weight average molecular weight of PVAc against time in Methanol and Isopropyl, showed in (Figure 2) and (Figure 3).

**Figure 2-** Measured Values of the Mw of PVAc in Methanol**Figure 3 -** Measured Values of the Mw of PVAc in isopropyl

Conclusion

Solution polymerization of Vac in Methanol and isopropyl has shown different conclusion. As you saw above, rate of polymerization in isopropyl is more than as methanol, also the viscometer's calculation is shown that Weight average molecular weight in methanol is more than any other solvent, therefore chain transfer to solvent of isopropyl was more than as methanol.□

References

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