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RESEARCH ARTICLE

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INFLUENCE OF INITIATOR CONCENTRATION ON CONVERSION DURING BATCH AND SEMI-CONTINUOUS SUSPENSION COPOLYMERIZATION OF METHYL METHACRYLATE AND BUTYL ACRYLATE

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ABSTRACT
This study investigates the impact of varying initiator concentrations on the conversion efficiency during the suspension copolymerization of Methyl Methacrylate (MMA) and Butyl Acrylate (BA). The copolymerization process was performed under controlled conditions using Azobisisobutyronitrile (AIBN) as the initiator. A series of experiments were conducted for both batch and semi-continuous processes at constant temperature and varying initiator concentrations. The results demonstrate a significant increase in conversion with higher initiator concentrations for both process modes, with the semi-continuous process consistently yielding higher conversions.
Keywords: Suspension polymerization, initiator concentration, Methyl Methacrylate, Butyl Acrylate, AIBN, copolymer conversion, batch process, semi-continuous process.

1. Introduction

Initiator concentration plays a crucial role in determining the rate and extent of polymerization reactions. In suspension copolymerization, particularly involving MMA and BA, the initiator governs the radical formation and propagation mechanism. Despite the extensive literature available on polymerization techniques, limited attention has been given to the effect of initiator concentration on MMA-BA copolymer systems, especially under suspension conditions. This paper addresses this gap by evaluating how different initiator concentrations affect conversion in both batch and semi-continuous suspension copolymerization modes.

2. Experimental Details

A. Materials

- Monomers: MMA (hydroquinone removed), BA (99% pure)
- Initiator: Azobisisobutyronitrile (AIBN)
- Stabilizers: Potassium salt of MMA and Polyvinyl Alcohol (PVA)
- Solvent: Toluene
- Purification: Methanol used to extract unreacted monomers
- Atmosphere: Nitrogen used to prevent oxygen inhibition

B. Procedure

Experiments were conducted in a 3-liter four-neck round-bottom reactor. The reaction mixture included water, stabilizers, and monomers (MMA and BA in 3:1 ratio). The polymerization was initiated by varying AIBN concentrations (0.2%, 0.4%, 0.6%, 0.8% w/w) at a constant reaction temperature of 74 °C. The monomer mixture was introduced batch wise and semi-continuously process type. The conversion was determined gravimetrically by drying and weighing the polymer product.

3. Analysis and Testing

Conversion:

Samples at fix time interval were taken out from reactor for determination of intermediate fractional conversion. Samples from the reactor were taken out with the help of widely open mouth pipette with rubber ball on the top. The pipette was cleaned after each sample withdrawn in order to remove the sticky mas inside the pipette which might get chocked and sampling would have been difficult for next interval. The sample takes out form the reactor was collected in a cylinder that contained 10 ml toluene. The sample taken was analyzed till the next sample withdrawn. In order to determine the progress of polymerization reaction sample were taken out at every fix time interval from the start of polymerization reaction.

4. Results and Discussion

The influence of initiator concentration on conversion is summarized in Table 1 for both batch and semi-continuous processes.

Initiator Concentration (%)	Conversion (%) (Batch Process)	Conversion (%) (Semi-Continuous Process)
0.2	60	65
0.4	76	80
0.6	90	93
0.8	92	95

5. Graphical Analysis

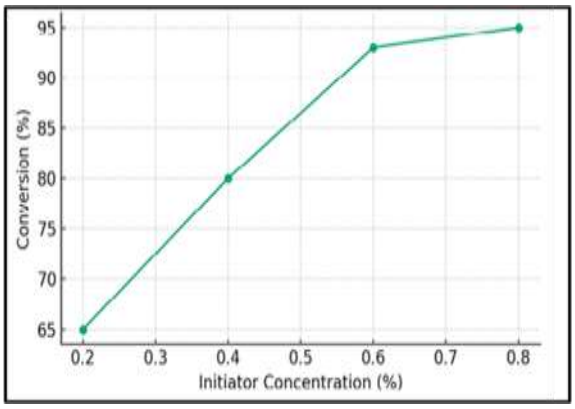

Figure 1: Conversion vs Initiator Concentration (Semi-Continuous Process)

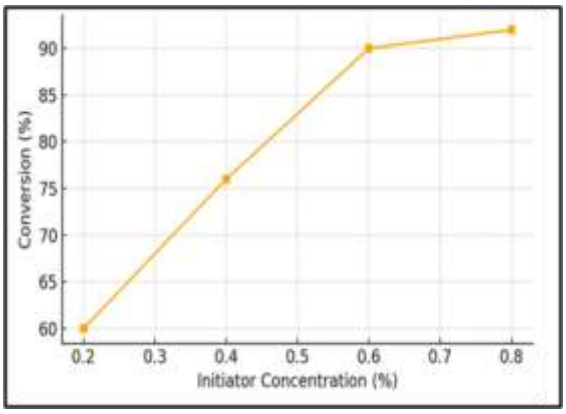

Figure 2: Conversion vs Initiator Concentration (Batch Process)

6. Conclusion

Initiator concentration has a direct and significant influence on the conversion efficiency of MMA-BA suspension copolymerization. Higher initiator levels result in increased conversion for both batch and semi-continuous processes, with the semi-continuous process exhibiting superior performance. The optimal conversion (95%) was achieved at 0.8% AIBN in the semi-continuous mode. These findings are valuable for optimizing industrial polymerization processes for MMA-BA copolymers.

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