International Journal of Engineering Research-Online
A Peer Reviewed International Journal
Articles available online http://www.ijoer.in; editorijoer@gmail.com

Vol.11, Issue.4, 2023
July-Aug

RESEARCH ARTICLE

ISSN: 2321-7758

OPTIMIZATION OF MELT FLOW INDEX IN SUSPENSION COPOLYMERIZATION OF METHYL METHACRYLATE AND BUTYL ACRYLATE: INFLUENCE OF THERMAL AND INITIATOR PARAMETERS

RAKESH VASAVA
Lecturer, Chemical Engineering Department
Shri K J Polytechnic, Bharuch, Gujarat, India
Email: vasava_rakesh@yahoo.com
DOI: 10.33329/ijoer.11.4.10

ABSTRACT

This study investigates the optimization of melt flow index (MFI) for copolymers of Methyl Methacrylate (MMA) and Butyl Acrylate (BA) synthesized via suspension copolymerization. The influence of varying thermal conditions and initiator concentrations on the MFI is systematically explored. Experiments were conducted using a 3-liter batch glass reactor under controlled parameters, analyzing the role of Azobisisobutyronitrile (AIBN) as an initiator. Results indicated a significant rise in MFI with both increasing temperature and initiator concentration, allowing optimal tuning of polymer flow properties for targeted applications.

Keywords: Optimization, Suspension Copolymerization, MMA, BA, Melt Flow Index, Initiator Concentration, Temperature

1. Introduction

The melt flow index (MFI) of a polymer directly reflects its processability and is an essential parameter for various industrial applications. In suspension copolymerization, optimizing operational conditions is crucial to achieve desirable polymer characteristics. MMA and BA are widely used monomers for acrylic-based polymers, known for their clarity, impact resistance, and flow characteristics.

This work emphasizes optimizing the MFI through variation in reaction temperature and initiator concentration, two controllable factors that directly impact polymer chain length, molecular weight, and flow behavior.

2. Experimental Methodology

2.1 Materials

Monomers: MMA (inhibitor-free) and BA (99% purity)

Initiator: Azobisisobutyronitrile (AIBN)

Stabilizers: Potassium salt of MMA and Polyvinyl Alcohol (PVA)

Solvent: Toluene

Medium: Double-distilled water

Purging Gas: Nitrogen

2.2 Procedure

Suspension copolymerization was carried out in a 3-liter, four-neck, round-bottom, flat-flanged glass reactor equipped with a mechanical stirrer, thermometer, condenser, and sampling port. The reactor was purged with nitrogen to eliminate oxygen.

Monomers and initiator were prepared separately

International Journal of Engineering Research-Online
A Peer Reviewed International Journal
Articles available online http://www.ijoer.in; editorijoer@gmail.com
Vol.11, Issue.4, 2023
July-Aug

and added to the heated suspension medium once it reached the desired temperature (70 °C, 74 °C, or 80 °C). After 6–7 hours of polymerization, the reaction was terminated, and the polymer beads were isolated, washed, and dried. The MFI was measured at 230 °C using a Ray-Ran MFI tester.

3. Analysis and testing

Melt Flow Index:

7 grams of the material was loaded into the barrel of the melt flow index apparatus, which has been heated to a temperature at 230 °C for the material. A weight of 3.8 kg for the material was applied to a plunger and the molten material was forced through the die. A timed extrudate was collected and weighed. Melt flow rate values were calculated in gm/10 min by using following equation. [8]

Melt Flow Rate = (600/t) * weight of extrudate, (gm/10 min)

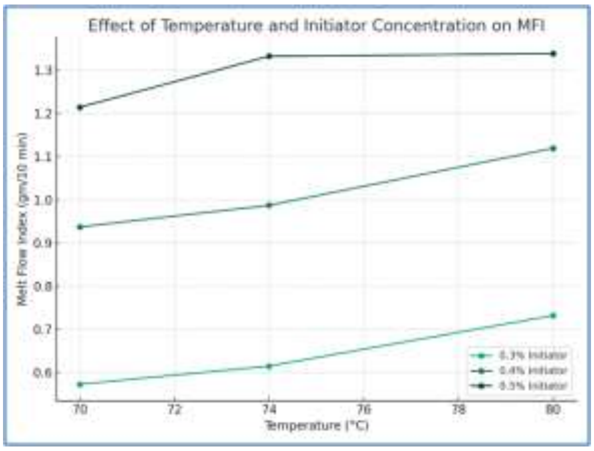
Where, t = time of extrudate in seconds

4. Results and Discussion

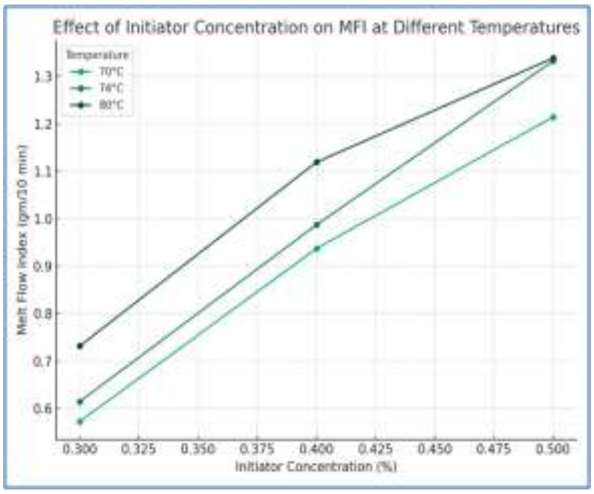
4.1 Experimental Matrix and MFI Data

Experiment No.	Reaction Temperature (°C)	Initiator Concentration (% of monomer weight)	Melt Flow Index (gm/10 min)
1	70	0.3	0.573
2	74	0.3	0.615
3	80	0.3	0.732
4	70	0.4	0.937
5	74	0.4	0.987
6	80	0.4	1.119
7	70	0.5	1.214
8	74	0.5	1.332
9	80	0.5	1.338

4.2 Effect of Temperature and Initiator Concentration on MFI



4.3 Effect of Initiator Concentration on MFI at Different Temperatures



5. Conclusion

This research demonstrates that MFI of MMA–BA copolymer synthesized via suspension copolymerization is significantly influenced by both temperature and initiator concentration. Optimal MFI was achieved at higher values of both parameters, crucial for industrial applications requiring specific flow behaviors. Future work may include analysis of mechanical strength and thermal stability of the produced copolymers under these optimized conditions.

Acknowledgment

The author thanks Dr. R. C. Dikshit and the Chemical Engineering Department of M.S.

University of Baroda, along with GSFC Ltd. and IPCL, for materials and support.

References

[1]. Billmeyer, F. W., Jr. (1984). *Textbook of polymer science* (3rd ed.). Wiley-Interscience.

[2]. Gowariker, V. R., Viswanathan, N. V., & Sreedhar, J. (1996). *Polymer science*. New Age International.

[3]. Kirk, R. E., & Othmer, D. F. (Eds.). (1978). *Encyclopedia of chemical technology* (3rd ed.). Interscience.

[4]. Sharma, D. N., Sharma, P. P., & Arora, A. (1990). Suspension copolymerization of styrene-MMA. *Chemical Engineering World*.

[5]. Cywar, D. A., & Tirrell, D. A. (1989). Copolymerization of MMA and acrylonitrile. *European Polymer Journal*.

[6]. Cardovi, C. M., Tavares, M. I. B., & Valente, A. J. M. (1997). Stirring speed influence. *Journal of Macromolecular Science Part A: Pure and Applied Chemistry*.

[7]. Madan, R. N., & Dikshit, R. C. (2003). Monomer addition modes. *Indian Journal of Chemical Technology (IJCT)*.

[8]. Vasava, R. (2004). *Suspension copolymerization of MMA-BA* (Master's dissertation, Maharaja Sayajirao University of Baroda).