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Polymerization with MAO and Polypropylene for Forming Stable Polymers

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ABSTRACT

Polymerization for stable polymer formation requires reactions that does not cause molecule structure to break. The catalysts play critical operation for conserving the molecule structures for stable polymer formation. This paper works towards achieving stable molecule structure corresponding to metallocene catalyst. For achieving this polypropylene with methylene supportive Metallocene The immobilization process allows the mola ratio to decrease by approximately 2 orders. This is much better as compared to homogenous system. The multi heuristic approach is followed for determining the optimal values of temperature at which stable polymers are obtained. Temperature between 25^{o}C and 75^{o}C is observed to be best at which stable polymers are obtained. Increased temperature results in molecule structure breakage.

Keywords: Metallocene Catalyst, Polypropylene, Temperature, Metaheuristic

INTRODUCTION

The demand for construction of polyolefins such as polypropylene increasing due to its excellent properties and environmental compatibility. Polyolefins are commonly used as a material for packaging such as foils, fibers etc. they are also commonly employed within automotive and electrical industries(Kalita, Konwer and Dolui, 2013).

The demand for the polyolefins is increasing and it is expected to rise 7% per annum due to its stability and environmental compatibility(Chung et al., 2002).

Polyolefins are wither generated using heterogenous catalyst Zeigler catalyst or using metallocene catalyst(Kilpatrick et al., 2018). The issue however is prediction of optimal temperature at which polymers can be generated. By applying inappropriate temperature, molecule structure can be broken, and polymers shows deviated structure(Alt, 1999).

The general structure corresponding to metallocene catalyst is given within figure 1. During the procedure of polymer formation, the metallocene/MAO mixture completely dissolve within the micro and macro pores of methylene without forming a concentrated gradient(Copéretet al., 2018).

It is also observed that while reacting with the methylene gel, MAO components itself forms a pore and they are distributed unevenly over the surface of the polymer. The primary reason for uneven distribution is asymmetrical values of temperature(Lehman et al., 2013).

This work uses metaheuristic approach for detecting optimal values of temperature and concertation of MAO for achieving stable polymers. Metallocene catalyst along with polypropylene will serve as population in this case(Bernardes et al., 2021). The fixed number of iterations are applied.

The fixed number of iterations used for optimality are 50. The temperature is varied randomly for each iteration. The optimal values of temperature and concentration are recorded after each iteration. In the final phase, either all the polymers are formed, or iteration terminates. This will give the optimal concentration size and temperature values will be obtained(Szeto et al., 2015).

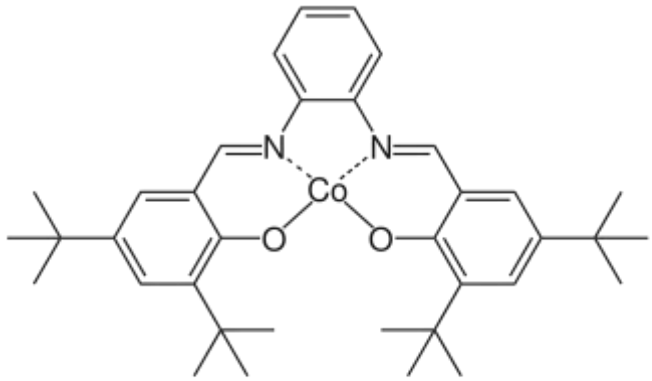

Figure 1: General structure of metallocene catalyst

Material and Method used

The material used for the proposed system includes polypropylene, metallocene catalyst and methylene(Hoff, 2018). The simulative method is used in the proposed. Work. This means that entire work of detection of optimal values of MAO concentration and temperature values is achieved with multi heuristic approach(Gagievaet al., 2017).

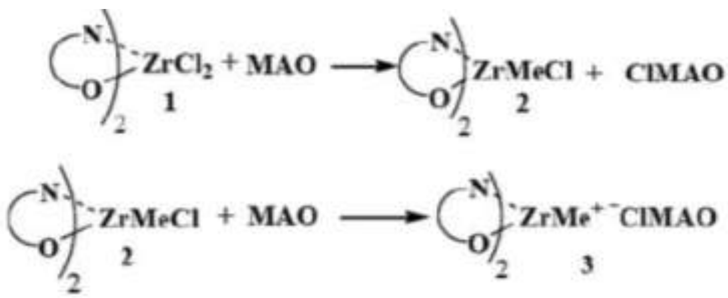

Figure 2: Structure of the material used

MAO with methylene bound to form pores but are distributed symmetrically over the surface of the polymers through polymerization(Yang et al., 2018). The structure of the methylene with MAO shows stability at medium temperature. MathWorks simulator is required for demonstrating the experimental work as well(Ahsan Bashir and McKenna, 2018).

Performance Analysis and Result

The results based on stability with metallocene catalyst with polypropylene begin with the initial temperature of 25^0C(Jungllnget al., 1995). The result in terms of stability is given within table 1

Table 1: Metallocene catalyst with MAO and Methylene

Run	T(^{0}C)	MMA(mL)	Co-Catalyst	Mn(g/Mol)	Mw(g/Mol)	S(%)
1	25	10	MAO	100.5	130.2	98
2	30	10	MAO	111	129.63	90
3	35	15	MAO	125.3	128.56	85
4	40	15	MAO	120.25	128.23	82
5	45	20	Methylene	118.236	130.23	80
6	50	20	MAO	-	-	-
7	55	20	MAO	-	-	-
8	60	25	Methylene	-	-	-
9	65	25	MAO	-	-	-
10	70	25	MAO	-	-	-
11	75	30	Methylene	100.5	130.2	99

'S' indicates the stability factor which is expressed in percentage(Zhong et al., 2019). The stability at temperature at 25^0C and 75^0C is best in range of 98%(Azimfaret al., 2018).

The result in terms of stability factors achieved with varying temperature with MAO and propylene is given in figure 3

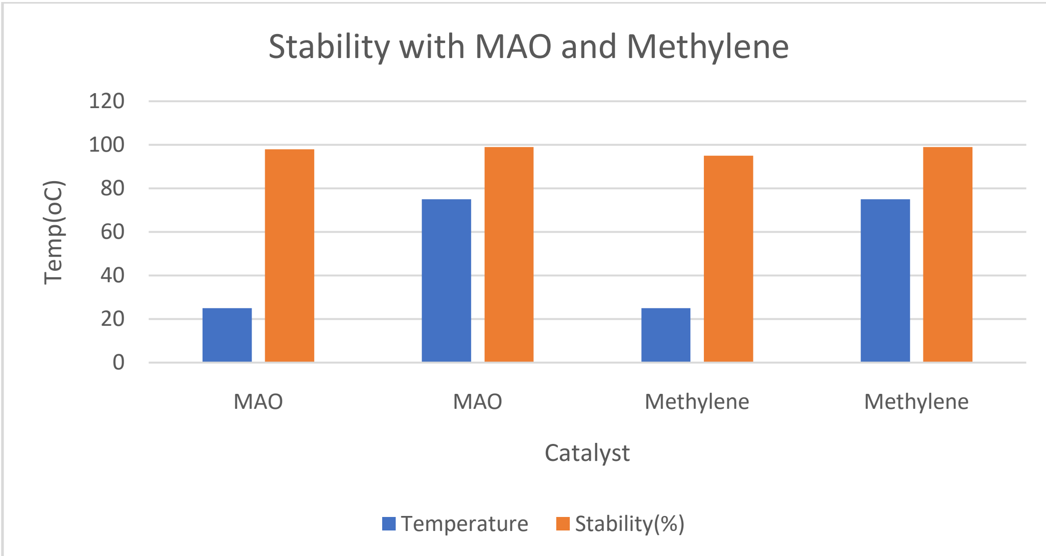

Figure 3: Result in terms of temperature and stability

As the temperature increased beyond 75, molecule structure of the formed polymers will be disturbed causing asymmetrical structure of polymers. The result obtained through MAO and polypropylene at different temperatures reducing molecular weight is given in figure 4

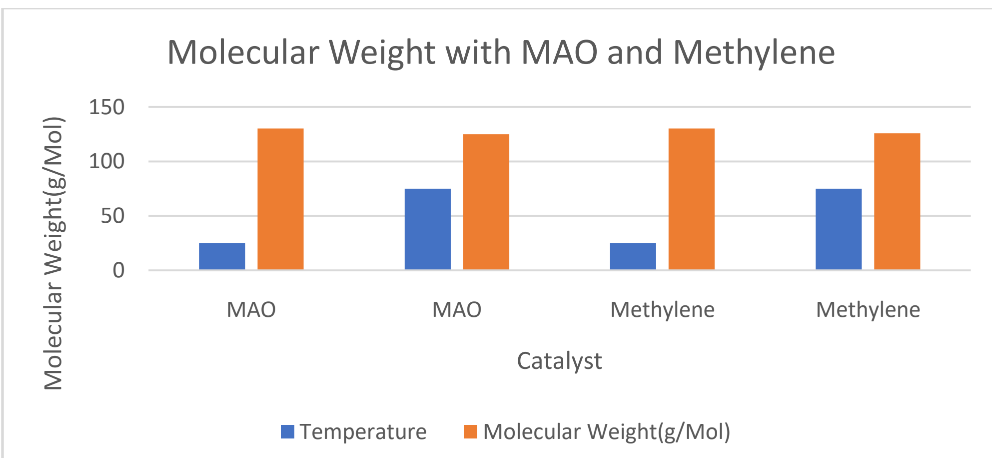

Figure 4: Molecular weight(g/Mol) with varying temperature

CONCLUSION

The metaheuristic approach is followed to express the stability of polymers with metallocene catalyst. The temperature range for the evaluation purpose is taken to be 25^0C to 75^0C. at higher values of temperature, asymmetrical molecule structure is formed that is unstable in nature. The electrons within the formed polymers will get extra energy and that energy causes structural breakdown. At 25^0C, stable molecular structure is achieved both with MAO and polypropylene. Highest stability is observed with methylene at 75^0C that causes uniform distribution of catalyst over the surface of formed polymers.

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