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A method to control the polystyrene runaway reaction

The preferred method to produce polystyrene (PS) is the mass process. It consists of a series of reactors followed by a devolatilization unit to remove the unreacted styrene. The first reactor is called prepolymerizer. It is a boiling continuous stirred tank reactor (CSTR). It is the largest volume in these series, has the highest styrene contents, the highest amount of initiator, and the highest rate of polymerization. When the rate of heat generation inside the prepolymerizer exceeds the heat of removal, the runaway of reaction will occur. Because the exothermic nature of polystyrene, the net heat gain can lead to a self-acceleration reaction, where the temperature and pressure increase uncontrollably until the rupture disc will occur. The need of retardant to kill the runaway reaction is very important. Different inhibitors were tested in a two-liter glass jacket reactor at different conditions. Para Benzoquinone (pBQ) and Nitroso Di Phenyl Amine (NDPA) show a good performance to stop the polymerization from a few minutes to several hours. It was found surprisingly that the retardant works even better with high conversion. Their effectiveness depends strongly on the temperature, time of addition and concentration. The higher the temperature, the fast the formation of radicals, the retardant will not be able to stop the polymerization reaction. The drawback of using the retardants is a yellow color which is producing of off-specification material and the contamination of the process. The duration to clear the product cannot be determined in the laboratory.

Biography

Ibrahim Maafa has completed his PhD in Chemical Engineering at 2016 from University of Waterloo and MASc in Chemical Engineering at 2006 from University of Waterloo. He did his BS in Chemical Engineering from KSU in 1998. He was working as a process engineer in SABIC R&T for more than 10 years. Currently, he is an assistant professor in Chemical Engineering, Jazan University since 2016. He has more than 20 years of experience in the polymer synthesis and simulation and modeling. He interests in free radical and coordination polymerization, polymer degradation, catalysis.

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