ABSTRACT

Synthesis of water based polymer nanocomposite has raised increasing interest in the field of material science. Variety of inorganic nano materials such as clays, quantum dots, metals, silica, titania, alumina, zirconia, iron oxides etc. are being used as a filler materials in polymers matrix such as polymethyl methacrylate, polystyrene, polyvinyl chloride, styrene–butadiene and so on to improve the property profile of polymer nanocomposite. Also, it is very important to study the compatibility of the inorganic material with the polymer and its dispersion in polymer matrix as nanometer size inorganic particles have a strong tendency for agglomeration because of their high surface energy. Further, the problems like uniform dispersion of nanofiller in polymer matrix, stability of colloidal suspension and improvement in properties of nanocomposite using water-based suspensions can be effectively resolved using ultrasound assisted in-situ emulsion polymerization method than conventional in-situ emulsion polymerization. The objectives of this work is to (1) study the effect of operating variables such as acoustic intensity, temperature, initiator, surfactant and monomer concentration, on conversion of monomer and polymerization rate in ultrasound assisted semibatch emulsion polymerization, (2) synthesis and characterization of polymer nanocomposite using ultrasound assisted in-situ semibatch emulsion polymerization method at different loading of inorganic nanoparticles and its effect on different properties of polymer nanocomposite such as mechanical properties, anticorrosive properties, thermal stability etc. Further, the property profile of polymer nanocomposite synthesized using conventional and ultrasound assisted in-situ semibatch emulsion polymerization method is compared.

This thesis reports the preparation of PMMA/CaCO₃, PANI/CaCO₃ (PAC) nanocomposite using conventional and ultrasound assisted in-situ semibatch emulsion polymerization in presence of CaCO₃ nanoparticles. Also, an attempt to synthesize exfoliated structure of P(MMA-co-St)/O-MMT nanocomposite by ultrasound assisted in-situ semibatch emulsion copolymerization in the presence of modified MMT clay has been made. Further, the combined influence of ultrasound and initiator has been investigated for semibatch emulsion polymerization of methyl methacrylate (MMA) and emulsion copolymerization of MMA and styrene in the semibatch reactor. The effect of acoustic intensity, reaction temperature, initiator, monomer and surfactant concentration on the monomer conversion, particle size and on polymerization rate
has been investigated. In this work it has been clearly established that PMMA/CaCO₃, PAC and P(MMA-co-St)/O-MMT nanocomposites has been successfully synthesized using ultrasound assisted semibatch emulsion polymerization in the presence of an initiator. It has been found that ultrasound assisted *in-situ* semibatch emulsion polymerization improves the dispersion of modified nanofiller in polymer matrix than conventional *in-situ* semibatch emulsion polymerization. Further, the ultrasound based method is effective to increase the loadings of nanofiller such as CaCO₃ and MMT clay in the composites, which improves the properties of polymer nanocomposite thermal stability, mechanical properties, anticorrosion properties etc of PMMA/CaCO₃, PAC as well as P(MMA-co-St)/O-MMT nanocomposites. It has been also found that ultrasound assisted *in-situ* semibatch emulsion polymerization has been successfully used for the synthesis of the exfoliated structure P(MMA-co-St)/O-MMT nanocomposite in lesser time (1 h) with improved polymerization rate, colloidal stability and the dispersion of MMT in polymer latex. Finally, PMMA and P(MMA-co-St) nanoparticles were successfully synthesized in reactor operated in a semibatch manner by emulsion polymerization of methyl methacrylate and copolymerization of methyl methacrylate and styrene using high intensity ultrasound, respectively. It has been found that the overall conversion and polymerization rate increases with an increase in acoustic intensity, reaction temperature, initiator, surfactant and monomer concentration in both the cases. The obtained particle size of polymer is in the range of 50 nm due to ultrasonic irradiations.