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Investigation of gelatin and sodium alginate as gelling agents for emulsion gel polymerization of styrene under reduced temperature

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Throughout the years scientists have investigated different polymerization methods to reduce the required temperature of the polymerization. As a result, emulsion gel polymerization was discovered. This method got attention due to its advantages such as an eco-friendly process, lower consumption of energy, higher yields, ability to provide high molar mass polymers, and the ability to scale up to the industrial level. The general objective was to check the ability of gelatin and sodium alginate as candidates for gelling agents in emulsion gel polymerization of styrene at room temperature. Apart from the general objective, the optimal amounts of gelatin and sodium alginate for emulsion gel polymerization were investigated. The surface morphology of the resultant polymer composite was investigated using a scanning electron microscope (SEM). Four components were used in this polymerization. Styrene was chosen as the monomer and AIBN was the initiator. Cetyltrimethylammonium bromide (CTAB) was used as the surfactant to form an emulsion. Gelatin and sodium alginate were investigated as gelling agents. Calcium chloride was used as a cross-linking agent for sodium alginate samples. The mixture of styrene, AIBN, and gelling agent (gelatin or sodium alginate with calcium chloride) was shaken with a vortex mixer (60s). Then Aqueous solution of CTAB was added and vortexed (60s). Then the samples were kept in a dark for 24 h and then ventilated for another 24 h. Finally, the samples were dried in a desiccator for 24 h. The resultant polymer was extracted to toluene and precipitated in distilled water. Weight conversions were used to determine the optimal gelling agent weight for the polymerization. For gelatin, the optimal gelling agent weight was 0.05 g/ml of styrene and the sample showed an 88.9% polymerization conversion. Sodium alginate's optimal weight was 0.1 g/ml of styrene. The optimal weight ratio between sodium alginate and calcium chloride was found to be 1:2. Sodium alginate resulted an 89.2% of polymerization conversion under the optimum conditions. According to SEM images the Polystyrene/Gelatin composite consisted of a smoother surface with very small pores. Polystyrene/Sodium alginate composite showed box-shaped polystyrene particles. Through this research, we were able to successfully polymerize styrene at room temperature using new gelling agents of gelatin and sodium alginate. As the recommendations for this study, several optimizations and new pathways can be investigated. Such as investigation of the polymerization rate for both sodium alginate and gelatin. Other gelling agents can also be investigated using the emulsion gel technique.

Keywords: Emulsion gel polymerization, Gelatin, Low-temperature polymerization, Polystyrene, Sodium alginate

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