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EMULSIFICATION FOR LATEX PRODUCTION: ROTOR STATORS, STATIC MIXERS, NANOCOMPOSITES AND FUTURE DIRECTIONS

U. El-Jaby[1], M. Cunningham[1], T. McKenna[1], E. Bourgeat-Lamie[2]

[1]*Department of Chemical Engineering, Queen's University, Canada*

[2]*Laboratoire de Chimie et Procédés de Polymérisation – UMR 5265, Villeurbanne, France*

Traditionally a large majority of sticky, adhesive or film-forming products are made via suspension or conventional emulsion polymerisation. However, miniemulsion polymerisation is growing in popularity in the field of process development because of the ease with which one can incorporate a wide range of organic and inorganic materials into the final product, and directly emulsify dispersions with solids contents of up to 50 or even 60 volume per cent.

Miniemulsion droplets, with diameters typically on the order of 100 – 500 nm, are created by mechanically dispersing an organic phase in an aqueous medium. The key components contributing to the stability of the miniemulsion droplets are the surfactant and the co-stabiliser, and in free radical processes either water or oil-soluble initiator can be used. Various homogenization devices can be used, with the most common at the laboratory scale being ultrasonic probes. However, one of the limiting factors in the acceptance of miniemulsion polymerisation as a commercialisible technique was that in early laboratory studies ultrasonication was the only method considered for the generation of polymerisable droplets

We have shown that rotor stator mixers and in-line, or static mixers are promising alternatives. In addition to demonstrating the feasibility of these techniques, an investigation of the evolution of the particle size distribution during polymerisation revealed that controlled coalescence can occur for reasons that are difficult to identify.

A Sulzer SMX7 static mixer was then successfully used as homogenization device for the miniemulsification and miniemulsion polymerization of a mixture of monomers (MMA/BuA 50/50 wt%). Finally, the same homogenization system was used to disperse silica-loaded monomer, and the resulting dispersions had narrow enough DSD that they could be used to synthesise silica/polyacryalte nanocomposites. It was found that droplet size is dependent on the silica content, and increases with increasing the silica concentration. It was also shown that there is a relationship between droplet size and the viscosity of dispersed phase. The majority of droplets were nucleated upon polymerization when less than 15% silica was used. However, when the silica content exceeded 15%, Np/Nd increased to value much higher than 1 indicating the occurrence of homogeneous nucleation.