CHAPTER 5

CONCLUSION

The preparation of uniform poly(styrene-co-methyl methacrylate) microspheres are successfully accomplished using the SPG emulsification technique. Monodisperse St-MMA copolymer microspheres with an average particle size from 7-14 μm were obtained, employing the SPG pore size of 1.42 μm by precisely controlled nitrogen pressure. The effect of crosslinking agent showed that the amount of EGDMA was required to give a crosslinked network in particles. However, the use of EGDMA with co-additive, hexadecane caused phase separation and various morphologies of the resulting particles such as the non-spherical particles. Increasing the crosslinking density enhanced the degree of phase separation.

The use of different additive types resulted in different droplets and particles, and size distribution. The particle size decreased when changing the additive from long-chain alkane, HD, to long-chain alcohols, 1-hexadecanol, and to long-chain ester, methyl palmitate (MP) and bees wax (BW), respectively. The influence of additives on this effect was due to the interfacial tension between disperse phase (monomer and additive), and aqueous phase that depended on the functional group and the alkyl chain length. The additives containing the ester group, such as, methyl palmitate and bees wax are able to yield a smaller particle size and higher droplets stability because of the hydrogen bonding and the long-chain alkyl part of molecules. The systematic elucidation of morphologies in St-MMA, St-n-BMA, and St-2-EHMA copolymer particles by the effect of additives demonstrates that the compatibility between hydrophobic additives and monomer may provide various morphologies of particles.

The mixed additive by varying the composition of additives was studied on preparation of St-MMA copolymer particles. The results revealed that the particles of different morphologies were obtained. The formation of particle phase separation was effected by the dominance of one additive to the other. The selection of suitable additive fraction and type can provide the spherical particles.

The initiator type on the preparation of St-MMA copolymer revealed that BPO produces microspheric particles with the narrow molecular weight distribution due to

the slow decomposition rate, in which a less amount of secondary nucleation took place compared with that by ADVN. However, BPO and ADVN initiators can be used for the preparation of narrow particle size distribution. AIBN is an exceptional initiator since the emulsion polymerization is so dominant instead of suspension polymerization.

The different compositions of styrene and MMA in the feed reveal that the particles size becomes smaller when the mixture contains a large amount of MMA. Depending on the compatibility, the use of methyl palmitate as a co-additive favors the MMA fraction than does that of styrene. On the other hand, the morphology of particles reveals the spherical shape for all compositions of the copolymer when methyl palmitate was used. However, the tendency of secondary nucleation increased when the amount of styrene increased. To suppress the secondary nucleation, $NaNO_2$ was used instead of hydroquinone in the preparation of PMMA homopolymer, and it resulted in the lower secondary particles.

Lower glass transition temperature copolymer was obtained. The addition of low Tg monomer of alkyl methacrylate monomer, n-BMA and 2-EHMA were successful by met this purpose. The Tg of synthesized copolymers was in a good agreement with the calculated values based on Fox's equation.

The results of this study would help develop further work concerning the synthesis of monodisperse copolymers particles incorporating charge control agent for the dry toner application. The investigations to control the particle morphology and the selection of suitable additives are of great interest for applications in the other fields.