Chapter 4

Conclusion

4.1 Summary

The styrene-acrylate latexes with particle size in the range of 0.40 to 0.60 μm was prepared by a one-stage emulsion polymerization technique. The experiments were carried out by varying the percentage of chain transfer agent to study the effects on the molecular weight distribution. As the percentage of chain transfer agent was increased, the molecular weight of copolymer decreased.

The latexes produced were then used in the second part of the study on emulsion-aggregation process to produce the raw toner. The usage of different amount of polyaluminium chloride (PAC) at the aggregation stage was used to control the particle size distribution. The results showed there was an increase in size over the increase of the amount PAC used. Overall, the fusing of the particles at the coalescence stage was quite good with particles of spherical shapes.

The pH of the aggregation was an important factor in emulsion-aggregation process and the optimum pH for the aggregation to occur was found to be in the range of pH 2.5 to pH 3.0 because the PAC required a slightly acidic ambient to be effective. However, at pH about 1 which was very acidic, many fine non aggregate particles of size about 4 μm were formed.

The aggregation duration was less significant in controlling the particle size distribution as compared to the pH. The aggregation is normally considered to depend on

the collision frequency between particles and the collision efficiency which determines whether having collided they remain aggregated. The collision frequency between particles was very much depending on the aggregation pH that destabilizes the latex and allows aggregation to occur.

Coalescences pH was just as important as the aggregation pH. Once the aggregates of the correct size had been stabilized by adjusting the pH to near neutral at about pH 6-7, the temperature was raised to well above T_g so that the aggregates internally coalesced to give essentially spherical or "potato" shaped smooth particles. If the coalescence pH was too low, the particles would keep growing in size. On the other hand, if the coalescences temperature was too high, there could be many coarse particles formed and resulted in lower yield of toner.

The coalescence temperature above 95°C was well above the copolymer Tg so that the aggregates can internally coalesce to give spherical and "potato" shaped particles which were permanently bounded particles comprised of resin, pigment and wax. Lower coalescence temperature will result the additives such as wax, CCA and pigment not bounded permanently to the copolymer resin and loose out and coalescence stage will be incomplete.

The latex contained the anionic surfactant, Dowfax 2A1, and thus with the addition of the cationic surfactant, benzylkonium chloride with opposite charge, the aggregation could be accomplished with shorter duration for the same desired particle sizes.

The wax content used could be varied from different manufacturers. Thus, from the study of wax content, we can note an obvious observation where about 1% of the total

wax added into the system was washed out without properly incorporated into the toner particles.

The use of latexes made of with different percentage of chain transfer agent could be used to control the average molecular weight, the melt flow index as well as the glass transition temperature are important parameter in the fixing properties of the toner.

Overall, the properties of the final finished toner prepared for both the batches have quite similar properties with the OEM finished toner. In terms of fusing, the finished toners also appeared to have relatively good fusing compared to the OEMs although the sharpness index is not as low as the OEMs.

4.2 Suggestions for future works

The chemically produced toner (CPT) has very wide market now as to compare to conventional toner as the CPT has many advantages over the conventional pulverized toner especially on the printing quality and the toner consumptions. Thus, there are many interesting areas which can be used for future investigations.

1. The styrene-acrylate resin raw toner can be further improved in all aspects especially the molecular weight can be pushed up higher and melt flow index can reduce lower to improve the storage life of the toners.
2. Study on other cheaper monomers in order to reduce cost.
3. The replacement of styrene-acrylate copolymer resin with palm oil based polyester resin in the emulsion-aggregation process because polyester is made of palm oil base which is more environmental friendly than the monomers that are petroleum based chemical.

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