ABSTRACT

This project studied the full process of producing Chemically Produced Toner (CPT) used in laser printer. Latex particles of 0.40 to 0.60 μm were prepared by semi-continuous emulsion polymerization process. A series of latexes was made from the copolymerization of styrene, butyl acrylate and acrylic acid monomers in the presence of surfactants Dowfax 2A1 (anionic) and Ipegal 897 (non-ionic) surfactants with potassium persulphate as the initiator. The addition of different percentage of chain transfer agent (CTA), 1-dodecanethiol was used to control the molecular weight distribution. As the percentage of CTA was increased, the molecular weight and glass transition temperature decreased while the melt flow index increased. The latexes were then used in the emulsion-aggregation (EA) process to produce raw toner by incorporating pigment, wax, charge control agent and other additives. The EA process experiments were carried out using the latexes of different percentage of CTA from 1.0% to 2.2% and also on latexes of 1.0% and 1.4% CTA blended in different ratio. A few parameters of the EA process were varied to study their variation in the molecular weight distribution, the particle size distribution (PSD), sharpness index, melt flow index, relative dielectric constant, dissipation factor, tribocharge, glass transition temperature (T_g), wax melting temperature (T_p), wax content and the fusing properties of the raw toner. Additive blending is the final stage of chemically produced toner (CPT) process, by incorporating mainly the silica such as RY200L2 and SS50F to improve the flowability properties of the toner before proceeding to the test print and performance test. The results obtained were used to compare with the Original Equipment Manufacturer (OEM) and other market toners from other manufacturers. Overall, the other after market and OEM toner showed the PSD of

the average particle diameter by mass (D50) in the range of 5.5 to 8.0 μm, sharpness index in the range less than 15.0, T_g in the range 52-57℃, the wax content is less than 8%, tribocharge in the range of -30.0 to -16.0 μC/g, melt flow index in the range of 10-30 g/10min, M_w in the range of 2.00 to 9.00 $\times$ 10^4 g/mol, M_n in the range of 1.00 to 3.00 $\times$ 10^4 g/mol, M_p in range of 2.00 to 5.00 $\times$ 10^4 g/mol, polydispersity in the range of 1.5 to 3.0, the flowabilty in the range of 4 to 6 mm disc size and the apparent density in the range of 0.30 to 0.50 g/m. Results from all the experiments that were carried out, the two batches of the finished toners at the final stage managed to obtain PSD of D50 in the range of 5.56 to 6.04 μm with sharpness index of 10.18 to 12.30, the tribocharge in the range of -20.0 to -17.0 μC/g, melt flow index in the range of 20.0 to 25.0 g/10min, flowability at 5 mm, apparent density at 0.33 g/m, T_g at 55.0℃, wax content 5.8 to 6.5%, M_w in the range of 4.50 to 5.50 $\times$ 10^4 g/mol, M_n in the range of 1.80 $\times$ 10^4 g/mol,, Mp in the range of 2.80 $\times$ 10^4 g/mol, and the polydispersity in the range of 2.5 to 3.0. These toners were able to product good printing effect after 1 cycle of printing test done.

ABSTRAK

Zarah lateks dengan saiz di antara 0.40 hingga 0.60 μm disediakan dengan proses pengemulsian. Satu siri lateks yang mengandungi monomer stirena, butil akrilat dan acid akrilik dipolimerasikan oleh surfaktan ionik Dowfax 2A1 dan surfaktan bukan ionik, Ipegal 897 dengan potassium persulfat sebagai agen permulaan. Penambahan 1-dodecanethiol, agen pengawalan rantai dalam peratusan yang berlainan ke dalam reaksi untuk mengkaji kesannya terhadap taburan jisim molekul. Apabila, peratusan 1-docecanethiol meningkat, taburan jisim molekul and suhu peralihan kaca menurun dan *melt flow index* meningkat. Emulsi latex kemudian akan digunakan dalam proses *emulsion-aggregation (EA)* untuk menghasilkan toner mentah dengan mengabungkan pigmen, lilin, agen pengawalan cas and bahan tambahan lain-lain. Experimen proses EA dijalankan menggunakan emulsi latex yang berlainan peratusan 1-dodecanethiol (CTA) dari 1.0% sehingga 2.2% dan juga atas emulsi latex campuran 1.0% and 1.4% CTA dalam nisbah yang berlainan. Beberapa parameter dalam proses EA diubah untuk mengkaji perbezaan dalam taburan berat molekul, taburan saiz zarah (PSD), index ketajaman, *melt flow index*, *relative dielectric constant, dissipation factor*, *tribocharge*, suhu peralihan kaca (T_g), suhu perleburan lilin (T_m), kandungan lilin dan ciri-ciri *fusing* toner mentah. Pergabungan bahan tambahan lain adalah peringkat terakhir untuk memproses *chemically produced toner* (CPT) dengan mengabungkan terutamanya silica seperti RY200L2 dan SS50F untuk membaiki ciri pengaliran toner sebelum membuat ujian pencetakan dan ujian performa. Keputusan yang diterima digunakan untuk dibandingkan dengan *Original Equipment Manufacturer* (OEM) dan toner dari pengeluar

lain. Keseluruhan, pengeluar dan OEM toner menunjukkan taburan saiz zarah dalam purata diameter zarah (D50) di dalam linkungan 5.5 ke 8.0 μm, index ketajaman dalam lingkungan kurang dari 15.0, T_g dalam lingkungan 52-57℃, kandungan lilin kurang dari 8%, *tribocharge* dalam lingkungan -30.0 ke -16.0 μC/g, *melt flow index* dalam lingkungan 10-30 g/10min, M_w dalam lingkungan 2.00 ke 9.00 × 10^4 g/mol, M_n dalam lingkungan 1.00 ke 3.00 × 10^4 g/mol, M_p dalam lingkungan 2.00 ke 5.00 × 10^4 g/mol, *polydispersity* dalam lingkungan 1.5 ke 3.0, *flowabilty* dalam lingkungan 4 ke 6 mm saiz disk dan *apparent density* dalam lingkungan 0.30 to 0.50 g/m^3. Daripada keputusan dari semua experiment yang dijalankan, dua sampel toner pada peringkat akhir dapat mencapai taburan saiz zarah (D50) dalam lingkungan 5.56 ke 6.04 μm dengan index ketajaman 10.18 ke 12.30, *tribocharge* dalam lingkungan -20.0 to -17.0 μC/g, *melt flow index* dalam lingkungan 20.0 ke 25.0 g/10min, *flowability* pada 5 mm, *apparent density* pada 0.33 g/m^3, T_g pada 55.0℃, kandungan lilin dalam lingkungan 5.8 ke 6.5%, M_w dalam lingkungan 4.50 ke 5.50 × 10^4 g/mol, M_n dalam lingkungan 1.80 × 10^4 g/mol, M_p dalam lingkungan 2.80 × 10^4 g/mol, dan *polydispersity* dalam lingkungan 2.5 to 3.0. Toners ini dapat menghasilkan kesan cetakan yang baik selepas 1 pusingan ujian cetakan dijalankan.