CHAPTER 5

CONCLUSION AND SUGGESTIONS

We investigated the dependence of charge-to-mass ratio (q/m) of the two-component developer on the shaking time, the toner concentration, the carrier size, and the carrier core and coating material, in terms of the small-sized polyester toner and the large-sized styrene/acrylate toner. Consequently, we have analyzed the print qualities as image density, background density, tone reproduction, resolution, and dot gain by the above-mentioned parameters of developers. Finally, we acquire the relationship of the toners q/m, the parameters, and the print qualities.

Conclusion

The physical and chemical sequential order of parameters affecting the developer charge and its relation to the print quality are the toner size, the carrier size, the toner resin, the carrier core and coating material, the toner concentration, and the shaking time of the developer. The toner size is directly related to the print quality, that is, the small cyan toner increase the solid density, enhance the continuous- and half-tone reproduction, and improve the resolution or sharpness. Either the small carrier size (carrier D) or the large toner size (red toner) increases the latitude of toner concentration, which produces high print density without background density. The polarity of charge depends on a position in the triboelectric series; and the value of charge is determined by the work function difference between the toner resin and the carrier coating polymer (carrier B, E, F or K). The toner q/m value is also determined by the toner coverage on a carrier or the toner concentration, that is, the toner q/m is lower when the toner concentration is higher, which is more affected by the large carrier size (carrier A), or by the small toner size (cyan toner). Too low a T/C values, gives the higher toner charge, which gives a print with too low density. Likewise, a very high T/C induces a very low toner charge and the consequent background density becomes very high. The latitude of T/C or the optimum range of T/C found on the print, which is corresponding to the optimum range of q/m of around 15 - 20 μC/g for the red toner, and 15 - 25 μC/g for the cyan toner. We found that the toners with the q/m values lower than 10 μC/g produce very higher background density than 0.4, and the toner q/m values higher than 30 μC/g produce lower print density than 1. In addition, we found that the limit of toner coverage on a carrier (A, B, C or D) corresponding to the maximum toner conentration is higher than 100%. The maximum coverage percentage of the large red toner and the small cyan toner is about 140% and 160%, respectively.

Therefore, the optimum range of q/m determined by the toner and the carrier materials, which is controlled by the latitude of toner concentrations is affected by the paticle size of carrier and toner. To control the small toner size, the carrier size should be reduced to maintain a wider latitude of toner concentration, which gives an appropriate range of toner charge for producing a high print quality in the electrophotographic printing.

Suggestions

There are other parameters affecting the developer charge which should be investigated further, such as the shaking intensity and frequency, other coating polymers, and other toner resins. We found that all of them affected the toner q/m significantly. We can tailored make the particular developer by considering the work function or the triboelectric series of the toner resins and the carrier coating materials.

In the present research, we used the only fresh toner and carrier which differs from the commercially two-component developer because the carrier is repeatedly used (countless uses), and the fresh toner is refill. The latitude of T/C and q/m of the present work would be varied during copying leading to the inconsistent print quality. For this reason, the next experiment should be designed to conform to the requirements of a commercially viable machine. Furthermore, it would be useful to measure the charge distribution of developer by an E-SPART analyzer, in order to study in greater detail of the relation between the image quality and the developer charge. In this thesis, we are not able to study the mechanism of the electrostatic charge of the two-component developer, so it would be better off for the next researcher to perform a more detailed charge model, similar to Figure 2-17.