CHAPTER 1

INTRODUCTION

The first electrophotographic image was born by Chester Carlson in 1938. Then, in 1944, Carlson and Battelle Momorial Institute had a collaboration to investigate the experiments with his process. In 1946, the Haloid Company (the present Xerox Corporation) was granted a license to develop electrophotography. Afterwards, in mid-1948, the US Army Signal Corps supported a research for both Battelle and Xerox, aiming to apply this process to military photographic areas. Finally, in 1950, the first commercial electrophotographic machine was produced by Xerox Corporation, which was called "xerography". It was a hand-operated copying system. In 1960, the Xerox 914, which was the first automatic office copier at six copies per minute, appeared on the market. In 1969, 3M Company produced a Color-in-Color copier, which used electrophotography to form a mask that controlled the migration of colorants. In 1970, IBM produced a copier that used the reusable organic photoreceptor. In 1973, Xerox introduced the 6500 Color Copier followed by the 1005 model. After that, in 1978, Canon released Canon T machine. In 1988, Eastman Kodak emitted the ColorEdge copier that used a flexible photoreceptor belt. In 1988, Xerox presented its DocuTech 600 dpi laser printer, which had a speed of 135 pages per minute. At the same time, Kodak announced its 1392 Lionheart 300 dpi, a PostScript-based electronic printer that was used for short-run printing and on-demand publishing market.[1]

Nowadays, the printing market is changed from long run printing to short run one because of the advances in technologies. All technologies, which relate to the printing, are focused on the digital data. Therefore, the printing press should be supported by the relative technologies. The analog conventional printing press is gradually replaced by a digital, fully automatic printing press. The electrophotographic printing, which is one of alternative systems, has gained more market share than other systems, and it is the second rank of market niche as offset printing the first rank as shown in Table 1-1.[2] The eletrophotography is the underlying technology in copiers and printers. This technology uses a drum charged with a high voltage and an image source by a laser or an LED.[3] The electrophotography is suitable for printing in this globalized decade because it has a high speed, and high quality through a good digital performance. However, it has three serious disadvantages: charge voltage decay, unclear and not completely understandable toner chemistry, and the volatile organic compound of isopar in a liquid toner system.

Table 1-1 The forecast of various printing systems by 2006

Printing systems	Market niche by 2006, % in
Wet and dry offset	49
Toner-based processes	35
Other ink processes	8
Ink-jet processes	7
Other processes	1

Note that the above market niche is based on price and performance

From the previous examples and the above table show the evolution and the advance of electrophotography. The development is not focused on only machine but also materials such as toner and carrier. Particularly, the toner is the important factor that controls the print quality in electrophotography.

In a high quality electrophotographic printing, toner must be moved in a controllable manner through the printing engine so that it ends up in the desired place on the paper. As toner is electrostatically charged particles, therefore, toner charging properties are the important factors that control the print quality. A charge control agent or charge agent, CCA, is added to control the magnitude and polarity of toner charge. The charge-to-mass ratio of the toner particles, q/m, depends on various factors such as the ratio of toner to carrier (T/C) in the developer, kind, concentration and distribution state of CCA, toner resin and developing mechanism. The molecular structure of CCA consists of two parts, an acceptor site and a donor site, for electron transfers. Electronical configuration of each atom and types of functional groups control the CCA characteristics. CCA concentration also affects chemical and/or electrical properties of the toner. This research investigates the relation of CCA distribution on printing quality, which derives from different functional groups, and developing mechanisms of these toners. The CCA distribution effect on print qualities in terms of dot gain percentage and density of electrophotographic print-out are critical for acquiring the suitable charging characteristics of CCA.

1.1 Objectives

This research has two objectives. First, the elucidation of the CCA distribution on polymer binder and its function to toner charging. Second, the elucidation of the effects of CCA distribution on print quality.

The research is expected to acquire the suitable CCA characteristics, which control the charge properties of the toner, in order to obtain high quality electrophotographic print-outs.

1.2 Scope of the Current Research

The scope of the research is to look at various factors: effects of the carrier and CCA dependencies. The amount and type, and toner shape including various charging mechanisms also give effect to the toner charge. As for the carrier dependency, the rotation-charging mechanism was used to give charges to the toner. For the other dependencies, the toner charges were individually produced by rotation-charging mechanism, printing-charging mechanism, and hand shaking charging mechanism. Furthermore, the toners were evaluated for the print quality in terms of the solid density, the background density, and the dot gain percentages with a test form by printing with an LED printer for the printing-charging mechanism.

1.3 Content of the Thesis

Chapter two deals with the overview of the theoretical considerations and literature reviews. In Chapter 3, the experimental, explains in details about the materials, the apparatus, and the procedure of this research. Chapter 4 presents the results and discussion of the carrier dependency, the CCA dependency, the charging mechanism, the toner shape dependency, the comparison of q/m values between E-SPART analyzer and blow off measurement, and the print evaluation. Finally, Chapter 5, concludes the result and gives some possible suggestions. From the results, it is found that (1) the carrier sizes affect the toner charge in a two-

component system; (2) the addition of CCA stimulates the toner charge to reach the saturation within a short time; (3) the CCA types and its amount give the effect to the toner charge and the quality of the printed images; (4) the charging mechanisms affect the toner charge, however, they depend on the CCAs.