CHAPTER 3

EXPERIMENTAL

3.1 Materials

3.1.1 Two types of toners : KT-16a (made by crushing method) and N-O9S (made by polymerized method)

3.1.2 Five types of carriers : F-200 (ferrite carrier) and TSV-200 (steel carrier) with different currents (17, 31, 76, and 182 μA), which correspond to the thickness of the oxide layer

3.2 Apparatus

3.2.1 Rolling type of toner charger : MS1 Minishaker, IKA-Works, Inc., USA.

3.2.2 Blow-off tribo measurement unit (home made) comprising two important units:

3.2.2.1 Electrometer : 617 Programmable electrometer, KEITHLEY, Ohio, USA.

3.2.2.2 Vacuum cleaner : VC-Z11L 160, TOSHIBA, Japan

3.2.3 E-SPART analyzer : EST-1, Hosokawa Micron Corporation, Japan

3.2.4 Printer for testing toner : 6ex, Oki Electronics (Singapore) Pte. Limited, Singapore

3.2.5 Electronic balance : AEX-120G Analytical balance, Shimadsu Corporation, Japan

3.2.6 Densitometer : RD 915, Macbeth Corporation, USA.

3.2.7 Scanning electron microscope : JSM 6400, JEO, Japan

3.2.8 Image analyzer : LUZEX F, PM 10-AD, Olympus, Nireco Corp., Japan

3.3 Procedure

3.3.1 Developer preparation

The developers (toners and carriers), prepared by Tomoegawa Paper Co., Ltd. in Japan, are different in component, concentration (wt%), and shape. They are shown in the following table :

Table 3-1 : Developers with different compositions and contents

Developer name		Concentration (wt%)
Toner	Carrier	
KT-16a	F-200	1, 2, 3, 5, 7, 10
KT-16a	TSV-200 (17μA)	1, 2, 3, 5, 7, 10
KT-16a	TSV-200 (31μA)	5
KT-16a	TSV-200 (76μA)	5
KT-16a	TSV-200 (182μA)	5
N-O9S	F-200	5
N-O9S	TSV-200 (17μA)	5

3.3.2 Measurement of charging properties of the rotating roller mechanism

3.3.2.1 Toner charge dependence on toner concentration (wt%)

a. The toner (KT-16a) and carrier (F-200) were mixed together with 1, 2, 3, 5, 7, and 10 wt% of the toner in a rotating roller (a glass cell, 24 mm in diameter) at rotating speeds of 600, 800, or 1000 rpm. The rotating roller was stopped after 30, 60, 120, 240, 360, and 720 seconds of mixing in order to measure the charge-to-mass ratio (q/m) by a blow off measurement unit that was connected to an electrometer and

a vacuum cleaner. The developer was poured carefully to nearly the same weight into a cage of a blow off measurement unit, which had a metal mesh size of 25 micrometers on the bottom, to make a uniform layer of mixture. The cage with the mixture was weighed by an electronic balance. The toner was blown off through the screen mesh for 10 seconds, and the q value was read from the electrometer. The cage with the mixture was weighed again to determine the weight of the toner alone. Then, the toner charge-to-mass ratio (q/m) was calculated and recorded.

b. The toner (KT-16a) and carrier (TSV-200 (17 μA)) mixed under the same conditions and the same measurements, as mentioned in Subsection "a", were taken for calculating the charge-to-mass ratio (q/m).

3.3.2.2 Toner charge dependence on mixing force

The developers in Table 3-2 experimented the same measurements, as mentioned in Section 3.3.2.1, were then taken for calculating the charge-to-mass ratio (q/m).

Table 3-2 : Developers for measuring the toner charge dependence on mixing force

Developer		Toner Concentration (wt%)	Rotation Speed (rpm)
Toner	Carrier		
KT-16a	F-200	3	400, 600, 800, 1000, 1200, 1400
KT-16a	TSV-200 (17μA)	3	400, 600, 800, 1000, 1200, 1400
N-09S	F-200	5	400, 600, 800, 1000, 1200, 1400
N-09S	TSV-200 (17μA)	5	400, 600, 800, 1000, 1200, 1400

3.3.2.3 Toner charge dependence on surface layer

The developers from Table 3-3 prepared for the same measurements in the subsequent experiments, as mentioned in Section 3.3.2.1. The charge-to-mass ratio (q/m) was then calculated.

Table 3-3 : Developers for measuring the toner charge dependence on surface layer

Developer		Toner Concentration (wt%)	Rotation Speed (rpm)
Toner	Carrier		
KT-16a	TSV-200 (31 μA)	5	600
KT-16a	TSV-200 (76 μA)	5	600
KT-16a	TSV-200 (182 μA)	5	600

3.3.3 Evaluation of print quality

3.3.3.1 Toner charge-to-mass ratio (q/m) in a real machine

The toners namely, KT-16a and N-O9S, were selected to measure the q/m ratio in a real printer, which is a developing unit of OKI 400 micro line CL Printer. First, the toner was poured into a developing unit of the printer. Next, the photoconductor (PC) was exposed at different percentages of 40, 60, and 100% on PC drum. Then, the q/m ratio was measured by a blow off technique at three positions, before transferring to PC, on PC, and after transferring to PC, for each percentage of exposure.

3.3.3.2 Printing experiment

The toner was poured into a developing unit of the OKI 400 micro line CL Printer. Two types of plain paper sheets, one for the KT-16a toner and the other for the N-O9S toner, were printed with a test form, which was produced by the fifth Aldus Pagemaker program. Thirty plain paper sheets, fifteen plain paper sheets for each type of the toners, were printed. Each sheet consisted of "A to Z" characters, different percent halftones of 20, 40, 60, and 100, and the lines with a size of 0.5 points. The print-outs were measured for solid density, density at 60% halftone, density at 40% halftone, and background density. The densities were measured by a reflection densitometer, which was calibrated with black and white tiles; and the background density was measured by a null density mode of the reflection

densitometer, which was calibrated to be zero on paper surface. The "a, f, g, B, C, E, 1, 2, and 3" characters and the lines (0.5 points) were measured in term of edge sharpness and edge raggedness by an image analyzer.

3.3.4 Morphology of toners and carriers

The toner, KT-16a (0.6 g), and the carriers, TSV-200 (19.4 g) and F-200 (19.4 g), were mixed to the total weight of 3 wt% at the rotating speeds of 1200 and 1400 rpm until 720 seconds, respectively. The mixture was analyzed for the morphology in term of the particle surface and particle shape by an SEM technique. For the coverage of the toner on the carrier surface, the same toner and F-200 carrier were prepared to the total weight of 1, 2, 3, 5, 7, and 10 wt% at the rotating speed of 800 rpm for 720 seconds. These developers were then taken photomicrographically by an SEM.