# CHAPTER III
# EXPERIMENTAL

## 3.1 Materials

### 3.1.1 Solvent-based Ink Printed HDPE Plastic Containers

Plastic containers used for this research were all composed of high density polyethylene and printed with blue color solvent-based ink by the screen printing process. Prior to printing, the containers were flame-treated in order for the ink to adhere well to the surface. All the containers were treated and printed by SVB Drinking Water Company.

Plastic samples (approximately 8 mm x 40 mm) containing blue-colored printed ink were cut from the printed area of the plastic bottles.

### 3.1.2 Surfactant

The cationic surfactant, n-hexadecyltrimethylammonium bromide (CTAB), having 98% purity in the powder form, was supplied by the Fluka Company, Switzerland. It was used as received without further purification. The chemical structure and properties of the surfactant are as follows:

Chemical Structure: $C_{16}H_{33}{}^{+}N(CH_3)_3Br^{-}$

Molecular weight: 364.46 g/g-mole

Melting point: 100°C

Critical micelle concentration (CMC): 0.92 mM.

### 3.1.3 Abrasive Material

Small irregular shapes of ceramic pieces were used as the abrasive material in order to facilitate the detachment of loosened ink from the rigid plastic surfaces.

3.1.4 pH Adjusting Chemical

Sodium hydroxide with 98% purity was supplied by EKA Nobel Company, Sweden.

## 3.2 Experimental Procedures

3.2.1 Analysis before Deinking Process

The amount of ink present on each sample, before deinking, was determined by using an optical scanning method. The steps involved in the optical scanning process are shown in the Appendix A.

For optical scanning, each plastic sample was carefully positioned on the scanner and scanned at optimum conditions (standardized) using a HP LaserJet 4c scanner. In order to prevent the reflection from the white surface of the scanner cover, a black poster board was placed behind the sample during scanning. After scanning, an image file was imported into an Adobe PhotoShop program to quantify the amount of ink (pixels) present on the plastic surface.

3.2.2 Deinking

Each CTAB solution was prepared with distilled water at room temperature and stirred with a magnetic stirrer to produce a homogeneous solution. The surfactant solution was warmed up slightly to 40°C to speed up dissolution (since dissolution is slow in water at room temperature). The pH level of the surfactant solution was then adjusted by adding sodium hydroxide solution from a burette. All pH measurements were carried out using a

Benchtop pH/ISE meter Model 920A with Triode pH electrode Model 9157BN. After analyzing the samples (before deinking) by the optical scanning method, each sample was placed in 15 mL surfactant solution in a conical flask. The samples were then allowed to soak for either 2 hrs in the presence of 25 irregular-shaped ceramic pieces (abrasive material) or for various times in the absence of ceramic pieces. All samples were allowed to soak by standing the flasks in a temperature controlled water bath. After soaking, the flasks were shaked in the temperature controlled water bath at 200 oscillations per minute. After shaking, the samples were removed from the flasks, washed several times with distilled water and air-dried. Each experiment was repeated at least twice.

### 3.2.3 Analysis after Deinking Process

The extents of deinking of the samples were first evaluated visually. The deinked plastic samples were rescanned on the HP LaserJet scanner using the identical procedure and conditions as for the original samples. The amount of ink removed (%) was determined using the following relationship:

$$Ink\ removed\ (\%) = \frac{Pixels_{before} - Pixels_{after}}{Pixels_{before}} \times 100 \qquad (3.1)$$