Deinking in bubble column and airlift reactors: Influence of wastewater of Merox unit as pulping liquor

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A B S T R A C T

Deinking efficiency of recycled fibers was investigated in bubble column reactor (BCR) and in internal loop airlift reactor (ALR). The brightness and intensity of ink spot of deinked fibers were reported as deinking efficiencies. A four-step process involving pulping, washing, flotation, and secondary washing was used. Employing ALR instead of BCR resulted in an increase of 1–4% in brightness, and a decrease of 3–14% in number of ink spot. Subsequently, in separate experiment the wastewater obtained from a Merox unit was used in pulping step instead of sodium hydroxide solution as pulping liquor. Compared to sodium hydroxide, industrial wastewater rendered more brightness gain. Comparison of both experiments suggests that using industrial wastewater in the pulping step and ALR in flotation step gives satisfactory results for industrial applications, yields a quality product with reduced capital investment and operation costs while considerably preserving the environment.

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1. Introduction

The deinking of fibers is an important stage in wastepaper recycling. Flotation deinking is one of the principal deinking systems adopted by the paper industry (Economides et al., 1998; Julian Saint Amand, 1999; Theander and Pugh, 2004; Zhu et al., 2005; Beneventi et al., 2006; Cho et al., 2009). Prior to flotation step, pulping is carried out where the ink is initially detached from the fibers. The detachment of the printing ink from the fibers of the disintegrated recycled pulp needs a combination of chemical and mechanical conditions (Borchardt, 1993; van de Ven et al., 2001). Due to the influence of the surface active chemicals (e.g. NaOH, H₂O₂, and chelating agent) and the mechanical shear forces in the pulper, ink particles of different sizes are released to the aqueous phase. The brightness of recovered paper is about 40–45% ISO after pulping (Lassus, 2000). Flotation, the most common method used, provides a high yield of fibers, i.e. a low amount of rejects, and less effort to purify the white water produced. It is a selective separation method using the different surface properties of particles. Air is introduced into a diluted fiber suspension of low consistency. Consistency defined as the mass in grams of oven-dry fiber in 100 g of pulp–water mixture. The water-repelling ink particles attach to the air bubbles and rise to the surface. The hydrophilic fibers remain in the water phase. The froth that contains the ink particles can be removed mechanically, by overflow (McKinney, 1995; Renner, 2000). Flotation deinking is usually more effective in removing large particles (10–100 μm) from newsprints (Julian Saint Amand, 1999; Johansson et al., 2000; Theander and Pugh, 2004). Many researchers described the factors that affect flotation deinking. They recommended optimum values of consistency 0.5–2%, temperature 40–55 °C, pH 8–11, water hardness 110–130 ppm Ca²⁺, sodium hydroxide 0.25–1.0%, hydrogen peroxide 0.5–1.0%, and soap 0.25–1.0 wt% based on dry newspaper (Borchardt, 1993; McKinney, 1995; Economides et al., 1998; van de Ven et al., 2001; Lassus, 2000).

Some conventional mechanical flotation devices used in the deinking of wastepaper are simple stirred tank reactors with air bubbles sparged continuously into the recycled pulp slurry. In the recent past, the use of column flotation as an effective technology for the deinking of wastepaper has been suggested. Column flotation is a novel technology being introduced into the mineral processing industry since it offers significant cost and process advantages over conventional flotation cells. Among the benefits of column flotation are a

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