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Role of Different Chemicals in De-Inking

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Abstract – This is mainly because neutral de-inking has great potential to lower chemical usage and cost, to reduce water treatment cost, to improve product quality and paper machine run ability. Mills will beneRt from switching from alkaline to neutral Sotation de-inking. Since no caustic or silicate is added in the pulper, Rbres are not yellowed or darkened. As a result, bleaching chemicals such as peroxide may not be required. Enzymatic de-inking represents a new approach to modern paper-recycling mills. Extensive research has been conducted to use enzymes to improve de-inking efRciency. The enzymes used included primarily cellulases, hemicellulases, amylase, lipase or resinase. Commercial application of enzymes to the Sotation de-inking of waste papers showed enhanced ink removal efRciency. Neutral pH de-inking further beneRts the use of enzymes since it can improve ink detachment from the Rbres and repulsing efRciency. Since most enzymes work at acidic pH and lower temperature, enzyme manufacturers have to develop thermophiles and alkaline-stable enzymes to lower usage and enhance their effectiveness.

Keywords: De-Inking, Chemical, Approach, Paper-Recycling, Mills, Application, Removal, Improve, Lower Temperature, Manufacturers, Develop, Effectiveness, etc.

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INTRODUCTION

The de-inking process involves detaching the ink from the cellulose fibers and then separating the dispersed ink particles from the pulp slurry by flotation. The principal chemicals involved in this process are sodium hydroxide, hydrogen peroxide, sodium silicate, chelating agents, surfactants, and collector chemicals. Not all furnishes require all of these chemicals invariably. Every furnish will require careful optimization (Bhardwaj *et. al.,* 1997). The amount of each chemicals to be added is dependent on the furnish, the water and the presence of other chemicals. Each chemical should be custom optimized for maximum performance. The objective of the present study is to examine the effects of different chemicals in flotation de-inking and to search for more environmentally favoured substitutes (Borchardt, 1993). The de-inking chemistry and the physicochemical interactions among air bubbles, fibers, fines, fillers and ink particles are very complex.

The Rrst Sotation de-inking patent was Rled by Hines in 1933. However, it was not until 1952 that the Rrst commercial Sotation de-inking system was installed at a paper mill in the USA, and the Rrst European installation was at a tissue mill in Greece in 1959. Up to 1970, the growth of Sotation de-inking technology was relatively slow. However, in the past 20 years, the market has grown extremely rapidly (Borchardt and Matalamki, 1994). The worldwide Sotation capacity for de-inking of wastepaper's has increased from 0.2 million tons in 1965 to about 25 million tons in 1995. De-inking is a separation process to remove inks and other non Rbrous contaminants from waste papers. Different types of units are required to separate inks from Rbres, and this mainly includes washing, Sotation, cleaning and screening. The selection and operation of these units are based on the types of waste papers and the requirements of the Rnished de-inked pulp. Wastepaper is commonly grouped into Rve categories, which include mixed paper, old newspapers, old corrugated containers; pulp substitutes and high grade de-inked (Carmichael, 1990). Wastepaper classi Rcation and the Rnished products obtained from different kinds of waste papers. De-inking is a two-stage process which involves dislodging the ink and nonRbrous contaminants from the Rbre surface and removing them by washing, Sotation, cleaning and screening. Common contaminants include ink, staples, paper clips, sand, plastics and stickiest. The most important and widely used de-inking process to date is the froth Sotation process (Colodette et. al., 1990). This process removes the widest range of ink particles from waste papers. Flotation alone or in combination with other processes can remove almost all types of ink particles and other contaminants from the slurry of wastepaper.

REVIEW OF LITERATURE:

Additionally, the use of waste paper is a better utilization of the waste product and can provide source of income to the poor. Recycled fiber has been an important source of paper making fiber in the last 100 years. About 30% of global frber consumption is derived from waste paper (Corson, 1980).

Paper is more than an industrial and commercial commodity. It is easily the cultural barometer of a nation, and effective growth and rising welfare of a nation cannot be achieved without a rise in the consumption of all kinds of cultural and industrial qualities of paper. Besides, paper being essential for liquidation of illiteracy, it is the most essential means of communicating thoughts of the peoples of the world and of developing better understanding between them. Process of modern democracy itself will be seriously hampered if paper is not available in sufficient quantities or without paper what would be there to safeguard human rights, the right to education, the right to culture, and the right of information. Paper has yet another important function, namely, as a packaging material par excellence. Packaging and wrapping are an index of standard of living (Datt and Sundaram, 1997). It is an established fact that for any increase in national income, there is more than proportionate increase in paper consumption.

Extraction of surfactants from natural sources: In the present investigation, natural products showing surfactant properties were extracted from three plants, Acacia intsia, Sap Indus trifoliatus and Sida rhombi folia. The extraction procedure was common for all the three plants. Weighed out 100 gm. each of dried bark powder of Acacia intsia, powdered fruit wall of sap Indus trifoliatus and dried aerial parts of Sida rhombi folia. They were extracted separately with methanol in Sox let apparatus, cooled, filtered and then fractionated with water: butanol mixture (Deng and Abazeri, 1998). The butanol fraction was collected and evaporated in a water bath, and finally oven dried at 40C.

Pulping: Chemicals were added to 870ml de-ionized water at 50- 55 following order; 0.4% DTPA, 1.5 % NaOH (10% solution), 2.5 % sodium silicate, 0.25% surfactant and 1.0% H_2O_2 (I0% solution). Immediately after adding the peroxide the pulping liquor was poured over the waste paper in the pulper. The contents were then pulped for 30 minutes. The exit pH was controlled by adjusting the level of NaOH to give a pH of 9.5 to 10.2. The percentages given for the chemicals are on oven-dried (0.0) fiber and represent a typical formula.

Flotation: During flotation the re-pulped stock was diluted to 1.0% pulp consistency, and a constant pH of 8.5 was maintained using IN H_2SO_4 Flotation was carried out for 10 minutes in the 5 lit. Capacity froth flotation unit with bristles attachment. The inky foam was constantly removed and collected in a catch pan by manual skimming.

Buchner funnel pulp pads and hand sheets were prepared to evaluate the brightness of the pulp at the pulper and the de-inked stocks. From each sample hand sheets were made according to TAPPI standard method T218 om- 91. The most common measurement for performance of de-inking is pulp pad brightness. The ISO brightness of all samples was determined according to TAPPI method T 452 OM - 87 using Technidyne.

DE-INKING CHEMICALS

Sodium hydroxide: Sodium hydroxide was used to adjust the pH of the pulp to the alkaline region and to saponify or hydrolyze the ink resins. At pH 9.5-11.0, the pH conventionally used for re-pulping, the fibers would take up some water and become more flexible. The primary effect of caustic is to increase the swelling of cellulose fibers. During saponification ink pigment is released by the breakdown of ink binder. Sodium hydroxide addition during re-pulping of thermo mechanical pulp (TMP) increases the level of fiber swelling. The addition rate of sodium hydroxide during pulping is usually presented as a percentage on 0.0. Fiber (Dick, R.H., and Andrews, D.H (1965). It is to be noted that the amount of NaOH added is the amount required to reach a given pll, and not a given dose on fiber. The effect of alkalinity on the brightness after pulping and flotation de-inking is given in Table 1 and illustrated. The brightness of the pulper was found to increase with the pH up to 10.2. Above a pH of 10.2, the 'brightness decreased. The increase in brightness at the pulping stage without ink removal is due to the bleaching effect (Doraiswamy *et. al.,* 1996). This agrees with an earlier report of Ferguson. With increasing pH at the pulping stage an improvement in final brightness was observed after flotation. As alkali concentration increases, an increase in de-inking effectiveness is also observed (Dorris and Page, 1997). The absorption of hydroxide ions increases the electrostatic repulsion between fibers and ink particles.

Table 3.1 Effect of pulping alkalinity on brightness

pH	Brightness % ISO		
	Pulper	Post floatation pH 8.5	Post floatation pH 5.5
8.6	47.0	56.5	58.4
9.0	47.1	57.0	58.7
9.4	48.0	58.1	59.2
9.8	49.0	59.0	60.0
10.2	49.2	59.6	60.8
10.6	44.5	58.8	59.6

Pulper condition		Flotation condition	
DTPA	– 0.4%	Consistency	– 1.0%
Na_2SiO_3	– 2.5%	pH	– 8.5
Surfactant	– 0.25%	Duration	– 10 minutes
H_2O_2	– 1.0%		
Consistency	–12.0 %		
Temperature	– 55°C		
Duration	– 30 minutes		

CONCLUSION:

Flotation de-inking is a complex separation process of inks and other contaminants from Rbres. Due to economic reasons and strict environmental regulations, new materials used by paper manufacturers and new printing technologies, paper mills require environmentally benign de-inking technologies which can easily Rt into the current de-inking system without extra capital investment. In recent years, great progress has been made in Sotation de-inking technologies with respect to Sotation cell design, utilization of new surfactants and the understanding of de-inking chemistry. Commercial application of enzymes to the Sotation de-inking of waste papers showed enhanced ink removal efRciency. Neutral pH de-inking further beneRts the use of enzymes since it can improve ink detachment from the Rbres and repulsing efRciency. Since most enzymes work at acidic pH and lower temperature, enzyme manufacturers have to develop thermophiles and alkaline-stable enzymes to lower usage and enhance their effectiveness.

- The present investigation has helped to gain a fundamental understanding of what is occurring in de-inking process.
- De-inking process requires careful balancing of physical and chemical conditions to produce the most effective ink removal and brightening of the de-inked fiber.
- Production of good quality de-inked pulp can be achieved by flotation de-inking.
- Under optimized conditions around 60% brightness could be obtained by flotation de-inking and a further gain of nearly 4 to 5 % by an additional bleaching stage.
- The total rejects could be limited to around 5% under the experimental conditions.
- Sodium alginate and surfactants isolated from natural products could make the process environmentally favorable.

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