Enzymatic Deinking- A Bright Solution With a Bright Future

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ABSTRACT

The increasing cost of wastepaper is challenging recyclers to dig deeper into the wastepaper stream to remain competitive. This paper presents the results of an industrial-scale investigation exploring the benefits of enzyme-enhanced deinking by reducing the chemicals with maintaining the required brightness. The results showed decrease in residual ink count with maintaining the more or less same brightness with reduction in deinking chemicals.

Key words: Enzyme Cocktail, Celluase, Amylase

Introduction

Producing recycled paper is a different story than virgin paper. After we have thrown our old newspapers and cardboard boxes in the recycle bin, they are bundled together in big bales and sent off to the paper mill. At the mill, the paper is dissolved by mixing it with water and chemicals and then chopped into small pieces. To remove bits of plastic and globs of glue, the pulp is heated and sieved in a mechanical screening process. Although the paper has now turned into a gray porridge-like mass, it still contains ink from printed material and glue residues from envelopes and so on. In the deinking process the pulp is washed with large amounts of surfactants. " Enzymes like the Cellulase and the amylase help loosen the ink from the paper fibers, and as a result mills can reduce the amount of harsh chemicals they use" (2)

In the spirit of continuous improvement relative to quality, environmental safety, and profitability, there has been increasing interest over the past several years by producers of recycled newsprint/magazine to eliminate or reduce the use of sodium hydroxide in the repulping process. From an environmental perspective, the use of sodium hydroxide leads to an effluent load. While the impetus to reduce or eliminate sodium hydroxide may have emerged in the Paper manufacture as a way to reduce environmental impact [1], one of the most obvious reasons to consider caustic-free repulping is chemical cost reduction.

Reducing sodium hydroxide from the repulper eliminates alkaline darkening. Subsequently, if alkaline darkening becomes a non-issue, then the use of hydrogen peroxide, sodium silicate, and chelants may also be eliminated or reduced in the repuler. Thus, with the elimination of sodium hydroxide comes the potential for other chemical cost savings.

Ink removal remains a major technical obstacle to greater use of recycled paper. Many of the conventional deinking processes require large quantities of chemicals, resulting in high wastewater treatment costs to meet environmental regulations. Deinking processes are also substantial sources of solid and liquid waste. Disposal is a problem, and deinking plants would benefit from more effective and less polluting processes. Enzymes seem to be a novel solution to these problems.

Concept of Enzymatic Deinking:

Biotechnology has the potential to increase the quality and supply of feedstocks for pulp and paper, reduce manufacturing costs, and create novel high-value products. Novel enzyme technologies can reduce environmental problems and alter fiber properties. Because the pulp and paper industry is capital-intensive with facilities specific to the tasks (3), new technology must either reduce expenses or fit easily into the existing process design. Pulp and Paper companies are reluctant to build or expand plants when the overall industry has enough capacity to satisfy market demands (3). Nevertheless, the industry has embraced enzymes for use in the paper-making process.

Enzyme Cocktail is designed to be effective, yet gentle on fibers and efficient in enhancing liberation of ink from the fiber surface. Deinking involves dislodging ink particles from fiber surfaces and then separating the

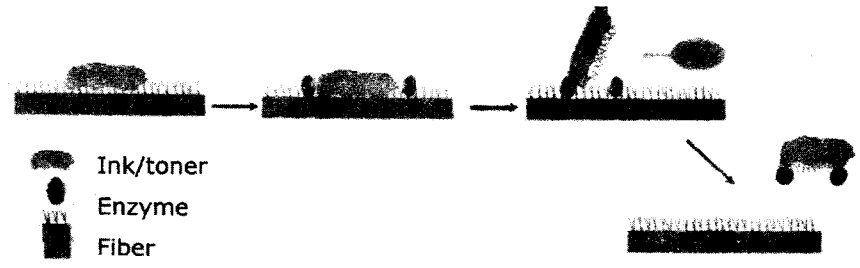

Figure 1: Schematic diagram showing mechanism of Enzymes (Cellulase) on fiber

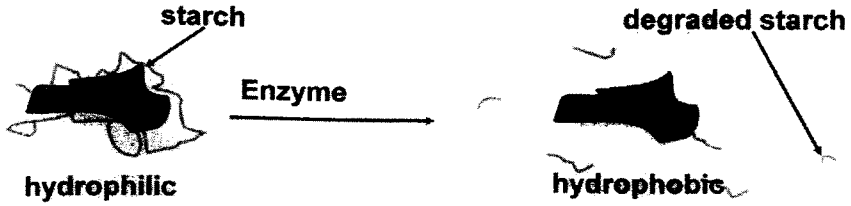

Figure 2: Schematic diagram showing mechanism of enzymes (Amylase) on starch content in the raw material.

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dispersed ink from the fiber suspension by washing or flotation. **Enzyme Cocktail** approaches involve either attacking the ink or fiber surfaces. Lipases and esterases degrade vegetable-oil based inks. Pectinases, hemicellulases, cellulases, and ligninolytic enzymes alter the fiber surface or bonds in the vicinity of the ink particles, thereby freeing ink for removal by flotation.

Case Study:

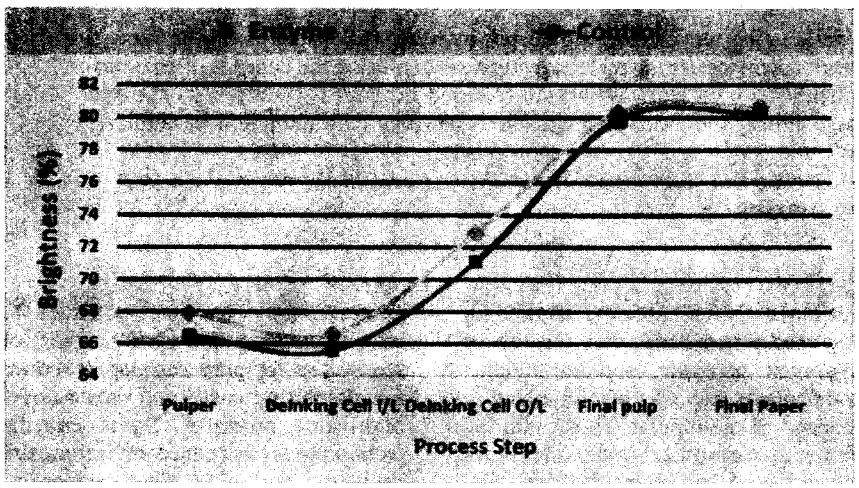

Figure 3: This trial is made on CBS=25%, Multi grade=25% and Records=50% and shows the typical effect of Enzyme cocktail on brightnes.

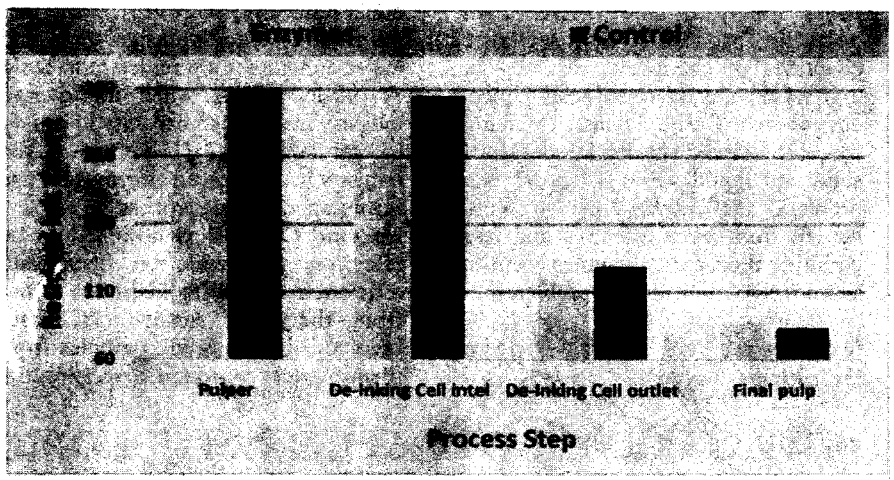

Figure 4: Significant reduction in Residual Ink count following the addition of Enzyme cocktail at various process steps.

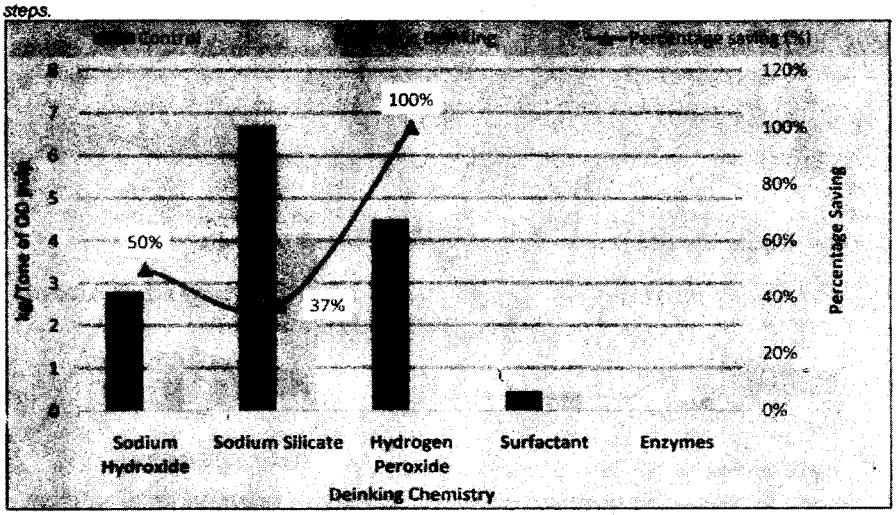

Figure 5: Cost benefit by using Enzyme cocktail.

Enzyme cocktail used in high density pulping in the Pulper (old newsprint, MOW, CBS, etc.) at around 10-12% OD consistency along with a non-lonic surfactant. Applying **Enzyme cocktail** during the process dramatically increases the liberation of ink particles from the paper surface which are further separated in froth floatation process, resulting in whiter and brighter paper products.

An Indian Mill, where **Enzyme cocktail** (activity 500 ECU/g & 6.7 KNU/g) was applied at 280 grams per dry ton of multi grade furnish like CBS, MOW and ONP, produced the data presented in figure 3, 4 and 5. The pulp is used to prepare writing and printing grade. **Enzyme cocktail** is able to reduce the residual ink count, increase brightness and give cost benefit by almost 50% saving in sodium hydroxide, 37% saving in sodium silicate and complete elimination of hydrogen peroxide.

Advantages of Enzymatic Deinking

Enzymatically deinked pulp possess super physical properties, higher brightness, and lower residual ink compared to chemically deinked recycled pulps. Enzymatic deinking works at neutral or slight alkaline environment which reduces overall chemical requirement and minimize yellowing of reclaimed paper after alkaline deinking. Reduced chemical usage means lower waste treatment cost and reduced environment impacts.

Results & discussion:

The enzymatic deinking trial was run using following conditions Enzyme was dosed in Pulper at the consistency of around 15%, Pulper temperature 45-50° C, residence time of around 25-30 minutes and Pulper pH of 8-8.5.

The goal in this case was to improve dirt removal efficiency over that commonly achieved with a traditional alkaline approach, without causing any adverse effects. In addition to reduce the chemical consumption in the Pulper.

Reference:

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