Deinking of ONP with Cellulolytic Enzymes and Synthetic Collecter in Alkaline pH

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ABSTRACT

This paper presents an overview of ONP deinking efficiency with cellulolytic enzymes and synthetic collecter in alkaline pH. Deinking is a series of unit operations designed to detach ink from cellulose fibers and separate the dispersed ink from the pulp slurry. Deinking chemicals are process aids that enable expensive mill equipment used in these unit operations to operate more efficiently – often much more efficiently. We propose the blended deinking agent with cellulolutic enzymes and synthetic collecter in deinking pulp of conventional alkaline method. The deinking efficiency of old news print in alkaline pH was enhanced with enzyme treatments. The brightness of deinked pulp was increased with less residual ink particles and yield of enzymatic deinked pulp was improved compared to the deinked pulp of conventional alkaline method.

Key words: *Deinking, commercial cellulolytic enzymes, neutral pH, surfactant, brightness, mechanical strengths.*

1. INTRODUCTION

Deinking is a series of unit operations designed to detach ink from cellulose fibers and separate the dispersed ink from the pulp slurry. Unit operations designed to promote ink detachment from cellulose fibers include pulping, kneading, and dispersion. Deinking is necessary to achieve minimum brightness values required for printing and writing grade papers. Deinking chemicals are process aids that enable expensive mill equipment used in these unit operations to operate more efficiently – often much more efficiently. The conventional deinking method should need much of chemical agents, such as sodium hydroxide, sodium carbonate, hydrogen peroxide and surfactants. Many approaches have been suggested to solve the problems encountered by traditional deinking techniques(mutje et al, 1997; Qien et al, 2005).

Biodeinking is proposed as an alternative since it was known that enzymatic deinking is beneficial to decrease the usages of chemicals and water compared to conventional alkaline methods (Eom et al., 1991; Plasid et al., 1993; Jeffries et al., 1994; Bajpai et al.,1999;). The magnetic deinking method has shown potential for separation of toner particles from fibers based on magnetic contained in toners from laser printers and copiers (Pinder, 1996; Marchessault et al.,1997). The combined technology of enzymatic and magnetic deinking was compared to the conventional enzyme/flotation process (Gubitz et al., 1998).

More recently, alkaline actives cellulolytic enzymes were used for deinking of waste papers(Sreenath et al, 1996; Santosh et al, 2003; Eom et al, 2004).

Therefore, this paper proposes the blended deinking agent with cellulolutic enzymes and synthetic collecter in deinking pulp of conventional alkaline method and investigated deinking efficiency of ONP with blended deinking agents in alkaline pH.

2. Materials and methods

2.1 Materials

2.1.1 waste paper

Old news print(ONP) was torm into small pieces by hand.

2.1.2 Enzyme

Cellulolytic enzyme is producted by N-company. Enzymes activities were measured using the carboxymethylcellulose (CMCase), Filter paper (FPase)

2.1.3 Blending deinking agents

As chemical deinking agents, alcoholic surfactant (Eo/Po) and Soap, was used. Blending conditions was indicated in Table 1. Eo/Po surfactant was made from Eo(22 mole) and PO(22 mole) in stearly alcohol(C18%-

98%) base. Soap type deinking agent made from unsaturated fatty acid Soap.

Table 1 Blending deinking agents

	Enzyme	Agent
A	**20%**	**Eo/Po 80%**
B	**20%**	**Eo/Po 70%, Soap 10%**
Blank	**20%**	**Water 80%**
Control	**Free**	**Eo/Po 100%**

2.2 Experiment

2.2.1 Enzyme assay

For determination of carboxymethylcellulase activity (CMCase), soluble carboxymethyl cellulose (Sigma.Ltd.) was prepared by suspending 1g of CMC in 100mL of 50mM glycine-sodium hydroxide buffer (pH9.5), or tris (hydroxymethyl) aminoethane-hydrochloric acid buffer (pH7.0), and stirring the suspension until completely dissolved.

CMCase activity was measured in the reaction mixture containing 0.1mL of CMC in buffer and 10mL of blending deinking agents was incubated at 30℃ for 60 min. The reaction was stopped by adding 3mL DNS color reagent to estimate reducing sugars.

Filter paper culture enzyme activity was measured in buffer at each pH. Filter paper activity(Fpase) was measured in the reaction mixture containing a piece of filter paper(10mg, 1×1.2 cm, Whatman No. 1) in 1.5mL buffer, and 10mL of blending deinking agent was incubated at 50℃ for 30 min.

Except using birch xylan(Sigma. Ltd) as the substrate, xylanase assays were indentical to CMCase assay.

One unit(IU) of each enzyme activity was defined as the amount of protein which produced 1.0μ mole of reducing sugar, expressed as glucose, per min. Protein was determined by the Lowly Method with bovine serum albumin(Sigma. Ltd.) as a standard.

2.2.2 Deinking

The waste paper(20g ONP) was transferred to disintegrator and with warm water to achieve 4% consistency and 50℃, and disintegrated for 10 min.(3000 revolutions in the canadian standard disintegrator).

A batch of 4% pulp suspension was transferred to the enzymatic reactor which was subsequently heated 50℃ in a water bath. The pH was adjusted to 9.5 with 0.5% NaOH and 0.7% Na_2SiO_3. A series of treatments was performed using various amount of enzyme, and allowed reacting for 30 min. during the reaction time, the pulp was mixed properly and pulp suspension transferred into the flotation cell.

The flotation was performed in a 3.7L(fig.1) Laboratory flotation cell at a consistency of 1%. The standard conditions used for flotation were pH9.5, temperature 50℃. The pulp suspension was stirred at 300rpm for 10 min. with an air flow of 3L/min. The floated ink removed to reject cell.

The pulp freeness was determined according to TAPPI Method T227. Handsheets of the pulp samples were made with a standard TAPPI handsheet mold according to TAPPI Method T205. The brightness of the pulp was measured according to TAPPI Method T452.

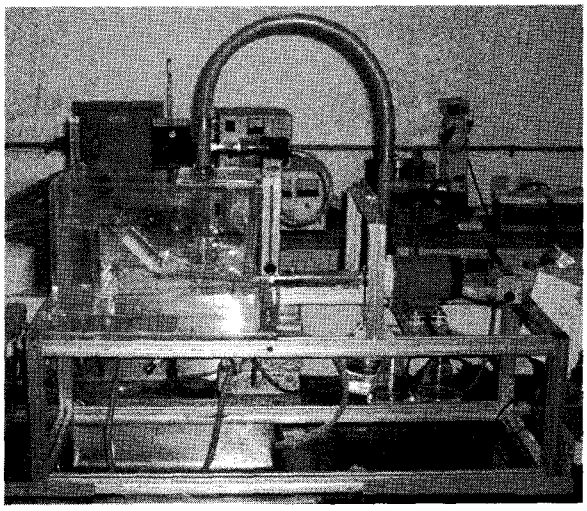

Fig.1 Laboratory flotation cell

3. Results and discussion

3.1 Enzyme activity of blended deinking agents

Fig.2 is shown enzyme activity of blended deinking agents is not less than crude enzyme activity. Also enzyme activity of pH 9.5 is not less than enzyme activity of pH 7. It means that blended cellulolytic enzymes is still useful in alkaline deinking

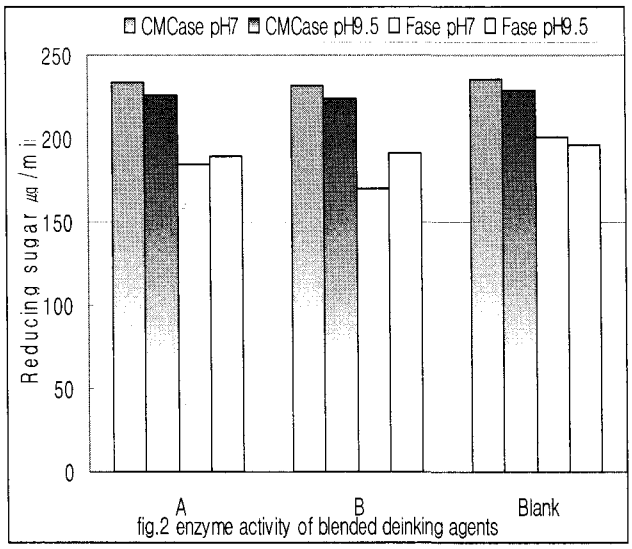

fig.2 enzyme activity of blended deinking agents

3.2 Deinking

3.3.1 Brightness of ONP in flotation(%)

Before and after Brightness of ONP in flotation and delta- brightness are shown fig. 3. Brightness of blending type are much higher than the conventional deinking method(control). It suggest blending cellulolytic enzymes activity is efficient in alkaline pH.

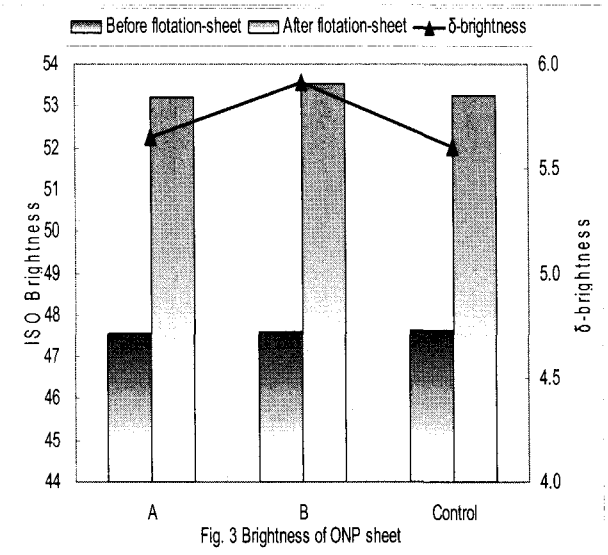

Fig. 3 Brightness of ONP sheet

3.3.2 Yield of ONP in flotation(%)

Fig.4 views yield of ONP after flotation. Yield of blending type are much higher than the conventional deinking method.

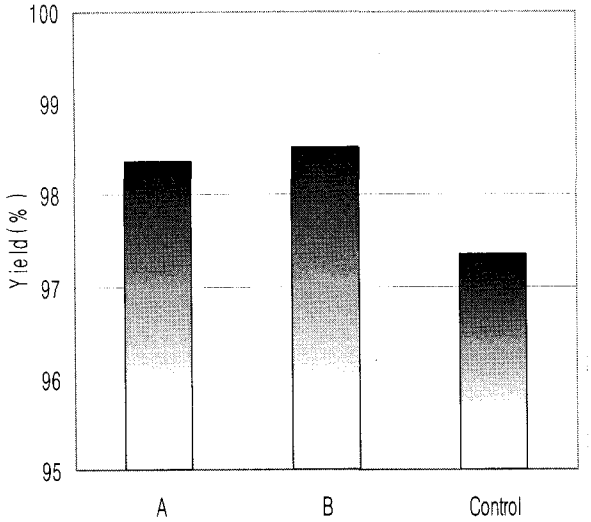

Fig. 4 Yield of ONP after flotation(%)

4. Conclusion

We can summaries the results of this work as fellow,

1. cellulolytic enzymes of Blended deinking agnets have useful enzyme activity in alkaline deinking
2. Brightness of blending type are much higher than the conventional deinking method.
3. Yield of blending type are much higher than the conventional deinking method.

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