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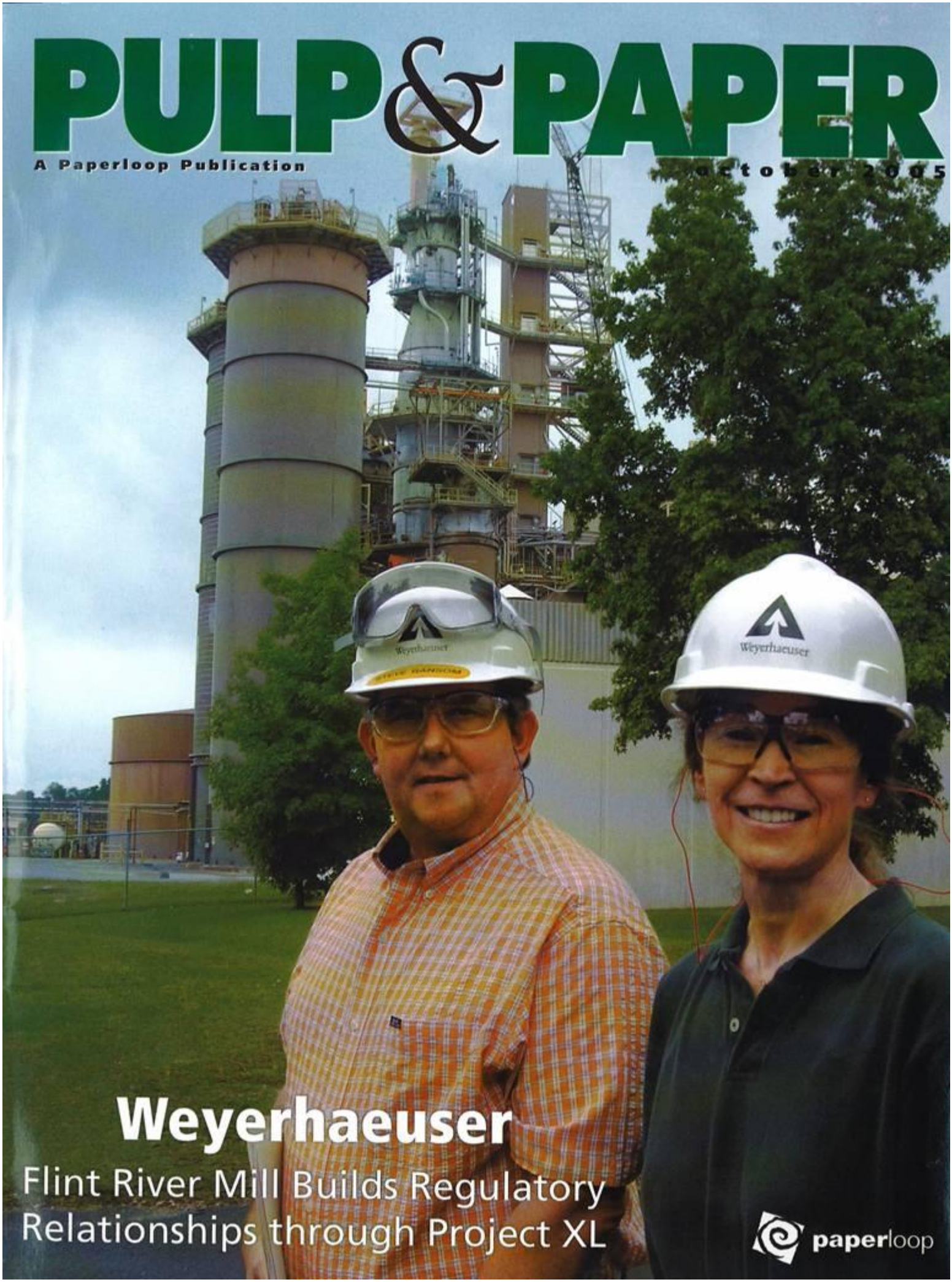

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An alternative to aggressive deinking strategies with associated lower yields, tailored enzymes "furnish" benefits like enhanced quality, production gains, and lower costs

Deinking Mills Dodge Financial Crunch with Customized Enzymes

By **JAMES G. TAUSCHE**

Managing costs at deinking mills has never been more challenging. Increased global demand for wastepaper, led by significant growth in Asia, has driven prices upward and created sporadic shortages of some grades. At the same time, wastepaper quality has drifted downward as plants have struggled to deal with inks and stickies that resist conventional treatments.

Given the high-cost furnish, aggressive deinking – with associated lower yields – can no longer meet the financial needs of deinking mills. As if that weren't enough, the real cost of virgin pulp has continued to fall over the years.

How can deinking mill managers compete in this kind of environment? Thanks to the increased ability to tailor enzyme blends to the particular attributes of a plant, managers now have the potential to deink much more effectively and drive total costs down. These tailored treatments offer a strategy to address the wastepaper and marketplace challenges of the future, especially as new raw materials are found or created and new application strategies are employed.

Traditional Options Not Paying Off

At the top of the list of production costs in a deinking plant is wastepaper, typically in excess of 70% of the raw material cost of most mills. Mills frequently pursue one of two paths to reduce this cost. One is to "buy" their way out of deinking problems by using cleaner, more expensive furnish. That's the high-cost path and, consequently, not a very attractive one.

The second path is to deink more aggressively. That's the lower-yield path. Since every mill has its own particular attributes, throwing everything but the kitchen sink at the problem usually causes as many problems as it solves. Enhanced deinking efficacy – effective ink removal with efficient retention of fibers – is an imperative.

Tailored Options for the Industry

Fortunately, there's another option: tailoring a blend of enzymes to the particular attributes of a mill. Historically, mill conditions were not always optimal. But enzymes have been performing under adverse conditions for millions of years. Hyperthermophilic organisms live in geysers and near volcanic vents on the ocean floor. Cryophilic microorganisms prey on dead whale carcasses in the ocean and thrive at cold temperatures. By studying these organisms, scientists have discovered enzymes that function well in high or low temperature, pH, pressure, and other extreme conditions – not unlike the conditions commonly found in industry.

Over the past 10 years, research has enabled the tailoring of enzyme attributes to the needs of a particular plant. In fact, large-capacity computers are now used to consider and test thousands of potential enzyme structures that might offer desired enzyme functions. It is from this collective work that enzymes have become an increasingly valuable raw material to the pulp and paper industry.

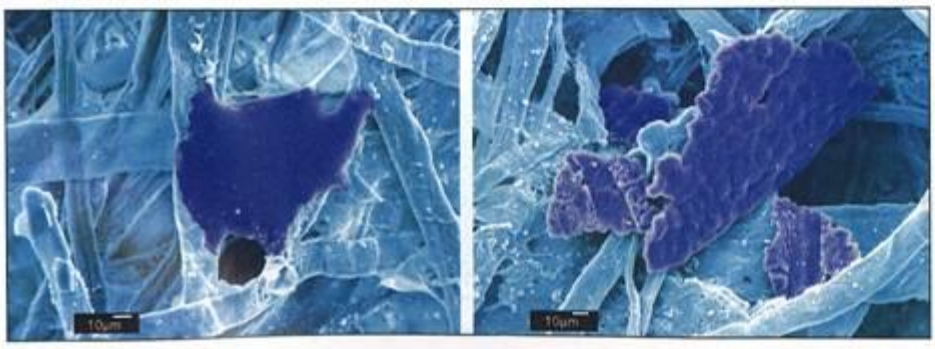
A New Approach to Enhance Deinking Efficiency

Enzyme varieties are much like fingerprints, each with its own characteristics. The function of the enzyme is called its mechanism. For example, cellulases act on cellulose, but the particular variety of cellulase determines what it does to the cellulose fiber. Enzymes also have specific attributes that govern their relative activity versus temperature, pH, kinetics, and other key factors. Consequently, a tailored approach is essential in order to obtain the greatest impact from the technology.

For the last 10 years, Enzymatic Deinking Technologies (EDT) has ➤

FIGURE 1.

Scanning electron microscope images of ink detachment of toner ink particles using conventional chemical deinking (left) versus enzymatic deinking (right)



been applying its patented Enzynk enzymatic deinking approach to mills in the Americas, Europe, and Asia. Each Enzynk treatment is a customized blend, tailored to the specific needs of each mill. The key input factors are the wastepaper being used or desired to be used, the deinking plant system, the key operating conditions, and the desired outcomes from the treatment. The supplier's up-front development process involves an audit of the deink plant in which the attributes of the current system are studied. This helps in understanding the current deinking efficacy and how the treatment needs to be directed.

The effect of improved ink detachment can be seen in Figure 1, which shows scanning electron micrographs of toner ink particles treated with a conventional chemical deinking approach as compared with EDT's enzymatic deinking process. Toner inks are essentially melted plastic that impregnate the sheet, forming large ink-fiber complexes. Normal pulping fails to destroy these "hairy particles," hampering both the removal and yield control across flotation, cleaning, and washing.

The enzymatic process detaches inks more effectively from fibers to facilitate their removal and close the gap between virgin and recycled quality. On the many other non-toner ink particles, different enzymatic mechanisms are in effect which help generate the brightness gains and dirt reductions across a variety of furnishes.

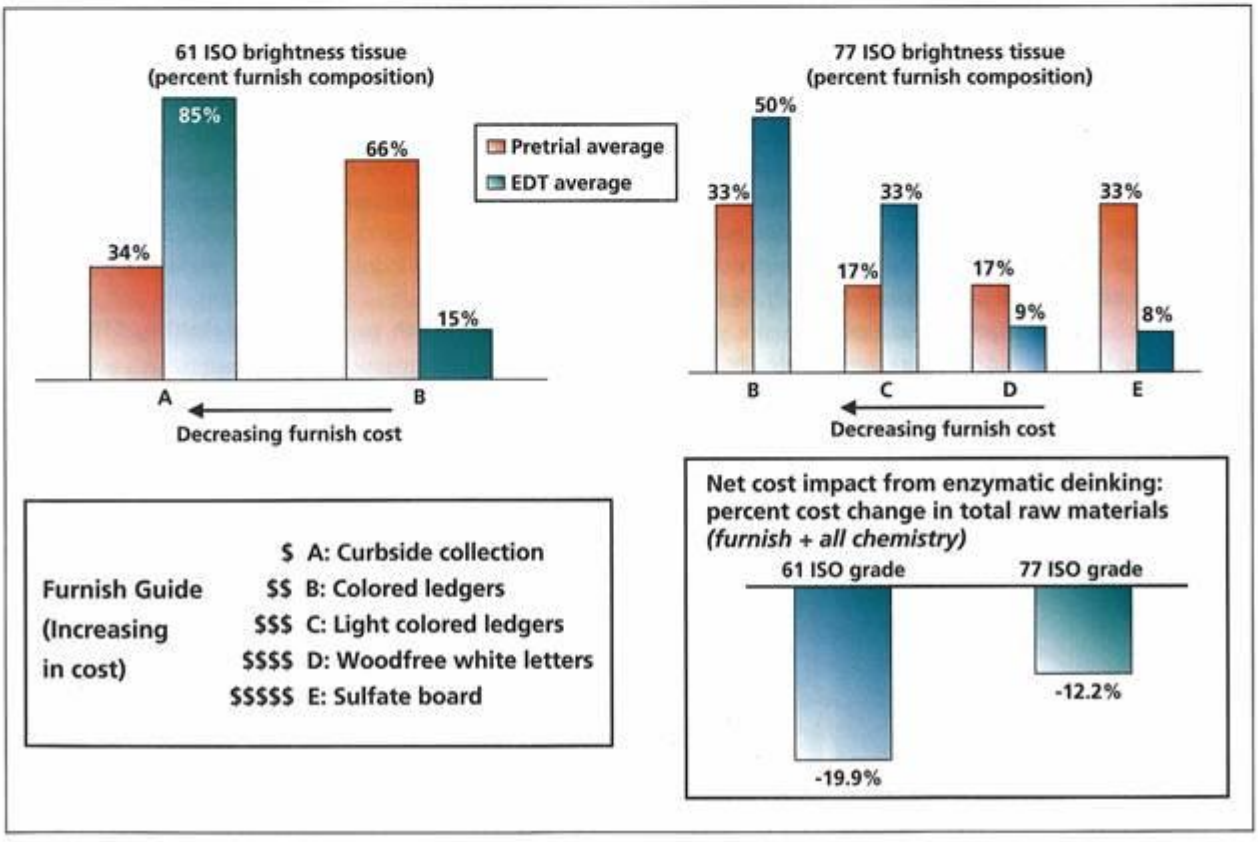
The tailored treatments are rather complex, consisting of multiple components that perform singular and synergistic functions. In nature, it is common to find a variety of enzymes that participate in a function. Even though each enzyme is specifically targeted, the objective function requires a combination of enzyme activities to accomplish the goal, working like an "enzyme team" in pursuit of an objective. EDT's treatments in the pulp and paper industry follow this strategy. Multiple component formulations help in efficiency and effectiveness of the desired goal and provide a better fit for the specific attributes of each mill.

Designing a Mill-Specific Savings Strategy

Treatments aim to maximize cleanliness and brightness and provide deinking mills with broad strategic options, ranging from quality enhancement to production gains to cost reductions. Many mills, most notably in freesheet printing and writing and recycled tissue production, find it straightforward to

FIGURE 2.

Net cost reduction in raw materials due to furnish degradation made possible with enzymatic deinking



leverage benefits from improved quality because of the variety of grades already produced at each mill.

Mills have also used the enzymatic deinking technology to upgrade their product mix. In some instances, mills have re-launched products around brighter and cleaner quality specifications.

Most mills leverage improved deinking efficacy to pursue cost reductions. While reductions in alternate chemistries or bleach are possible, it is typically more interesting to address the largest cost component in recycling: furnish. Mills producing a variety of brightness grades are already skilled at using various blends of furnishes to produce different final grades. Enhanced deinking efficacy enables mills to downgrade in furnish mix and cost while still attaining the same final quality. Since furnish represents well over half of the raw material cost of production, even slight decreases in furnish mix can represent significant savings.

Significant Bottom-Line Improvements

The stories of two mills illustrate how dramatically an "enzyme team" can affect both quality and cost. The first mill wanted to downgrade furnish (Figure 2). The mill produces a variety of final brightness grades and had experienced a worsening financial squeeze due to rising wastepaper costs and difficult market conditions.

Already set with good deinking equipment, the mill was looking for ideas to enhance ink detachment to foster improved removal. Mill management was pleased with initial trials that showed brighter and cleaner final pulps. The pre-enzyme furnish mix for several final brightness grades are shown with the new furnish mix possible with Enzynk. The mill achieved 12-20% net reductions in total raw material cost (furnish plus all chemicals) for its main grades. This success has enabled the mill to make dramatic improvements to its cash flow and perform well in the market.

Another mill wanted to reduce visible dirt and variations in brightness in its sheet. This is a single-loop deinking plant with cleaning, screening, flotation, disperging, washing, and reductive bleaching. The mill was using very expensive furnish, consisting mainly of solid bleached sulfate board and lightly printed materials. Many less expensive furnishes were available, but the mill was unable to use them and reach suitable quality.

Figures 3-5 show the improvements in dirt reduction and changes in brightness gain from Enzynk use at this mill. The treatment enabled the mill to produce a higher-quality and more consistent final sheet and use a lower-cost wastepaper mix. Improved ink detachment and the ensuing enhanced fiber selectivity across flotation and cleaning led to a 5% yield improvement.

In a related benefit, the yield improvement translated into a 30% reduction in sludge generation. This application has enabled the mill to save money while reaffirming its position in the market, and at the same time better support sales volumes and pricing pressures in a competitive environment. P&P

FIGURE 3.
TAPPI dirt reductions due to enzymatic deinking

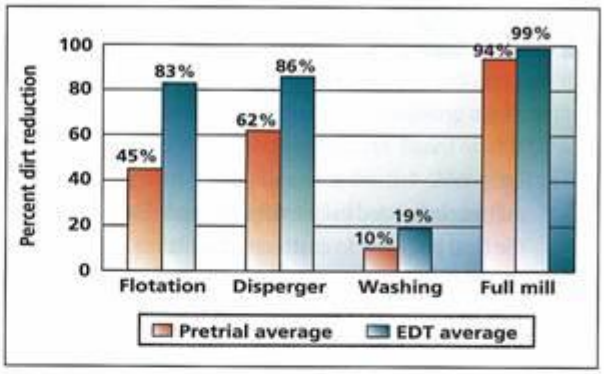


FIGURE 4.
Improvements in brightness gains due to enzymatic deinking

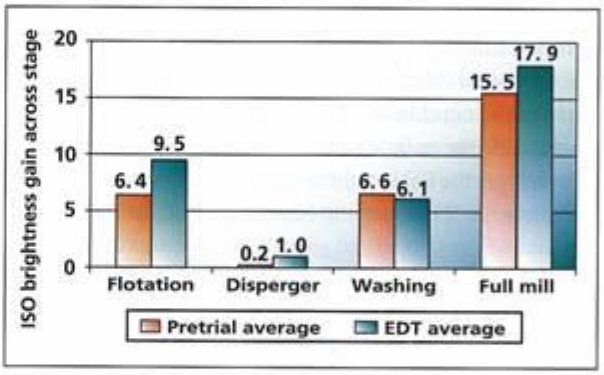
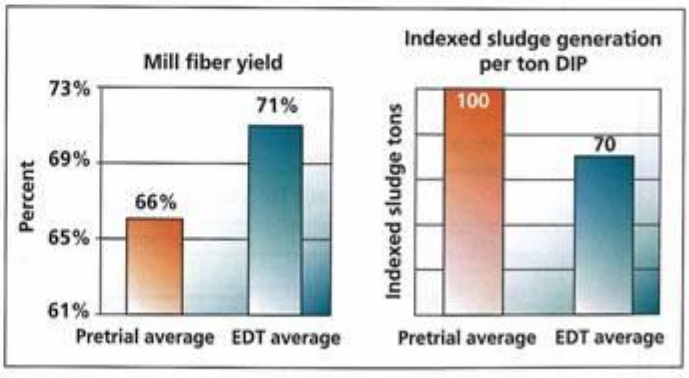


FIGURE 5.
Increased fiber yield effect due to enzymatic deinking



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