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TECHNICAL PAPER

Enzymes: the new approach to minimizing fiber costs?

Enzymes, which are proteins that are not alive but are produced by living organisms, selectively catalyze specific chemical reactions. They govern our bodies and nature itself. Their use in modifying wood fibers offers exciting potential for recycled and virgin tissue makers.
A pioneer in this field looks at why enzymes are gaining so much interest.

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"The use of enzymes in papermaking has enormous potential," says Jim Tausche, CEO of US-based EDT. "Enzymes are still a bit of a mystery to the average papermaker, but this is changing quickly. It is important to realize there are thousands of enzymes available for industrial use and using them in papermaking applications is not a 'one-size-fits-all' proposition. Enzymes are a bit like keys: each opens a different door and you need the right ones to unlock the potential of your fibers in your mill process for the goals you seek."
Tausche, a co-founder of EDT, has more than 15 years of experience in this specialized area of applied science. Also known as Enzymatic Deinking Technologies, LLC, EDT was founded in 1994 to commercialize the research efforts of the late Karl-Erik Eriksson, Ph.D., a Swedish microbiologist and renowned expert in the field of enzymatic mechanisms involved in the modification of cellulose and lignin.
In its first decade, EDT worked largely on enzymatic treatments for the deinking of wastepaper (Enzynk®) and on extractives management of mechanical pulps (EnzOx®). Over recent years, the company's work broadened to include the use of enzymes in fiber modification to "clean" and "refine" fibers, allowing the simultaneous benefits of drainage and strength development. This new technology, Refinase®, offers value to all paper grades, including tissue.

TISSUE SECTOR GROWING WELL. "Today," says Tausche, "tissue is EDT's most vibrant sector as there are many values from Enzynk® and Refinase® which directly address the needs of tissue mills. Optically, Enzynk® can increase brightness by reducing dirt, control stickies, and help mills degrade furnish usage and cost while raising fiber yield. Wastepaper is by far the biggest cost item in a deinking process and improved deinking can have a huge impact on total manufacturing costs."
Particularly exciting is the use of Refinase® for enhanced fibrillation to improve strength, drainage, softness and bulk. Strength gains made possible with fiber modification enable mills to change the mix of wastepaper furnish or virgin fiber being used and consider adjustments to refining or other dry strength strategies. Just as wastepaper is the number one cost for recycled tissue, virgin pulp is the largest cost by far for premium tissue. Many of EDT's customers are leveraging the technology to pursue strategic shifts in fiber sourcing to ensure cheaper and more secure long-term supplies. A good example is the drive to maximize the use of Eucalyptus for softness, economic and environmental reasons.

CUSTOM ANALYSIS OF MILL SITUATION. EDT's expertise is built on being able to do in-depth analysis of the incoming raw material and customizing a treatment for each mill. For recycling, the analysis looks at fibers, inks, coatings and stickies, as well as the mill layout and equipment. Development is focused on the most desired benefits sought by each mill. For virgin pulp treatments, similar analysis is conducted to create the best enzyme treatment to fit the mill's process and goals. "We have a consultative and tailored strategy," explains Tausche. "We analyze each mill situation to create the most effective blend of enzymes to achieve the desired effect and then we partner with the mill to implement operational plans to capture that value."
Enzymes have a wide variety of mechanisms, kinetics, and affinities for temperature and pH. EDT works with hundreds of different enzyme mono-components in its "library." Based on this resource and the mill analysis work, EDT tailors

an enzyme mixture of up to a dozen ingredients which is then tested in the lab before being trialed in the mill. "Initially," says Tausche, "people think it seems far-fetched that you can add an enzyme mixture in the pulper and then six process hours later a surprising assortment of benefits materializes: the brightness rises three points, sheet tensiles jump 20%, drying energy drops by one quarter, and it becomes possible to run 5-10% faster. But, this is what we see in mill after mill."

ENZYMATIC FIBRILLATION WITHOUT REFINING. "Enzymatic refining" complements, and can even replace, mechanical refining. While research on the enzymatic mechanisms continues, Tausche describes what is believed to be happening with Refinase® is two fold. First, an enzymatic "cleaning" occurs similar to the use of enzymes in detergents for your clothing. Cleaned pulp fibers have more hydrogen bonding sites to enhance sheet strength. Second, enzymatic fibrillation occurs with the hydrolysis of thin strands of the outer fiber to create more physical linkages in the sheet while retaining the original length and structure of the fiber. This contrasts with mechanical refining which uses more aggressive action to fibrillate and even cut fibers.

MORE, BETTER, AND CHEAPER TONS. While the potential continues to be explored, it seems these enzyme technologies, when applied correctly, help address two critical issues facing tissue producers: fiber supply and energy costs. If enzymes can allow wider use of lower cost fiber raw material, this can open up entirely new sources of usable fiber, a critical raw material predicted to become even harder to find and more costly to use in coming years. At the same time, if fibrillation and strength can be achieved with less mechanical refining, then strength and softness can be attained while saving energy and avoiding unnecessary degradation of the fibers.
These enticing possibilities for tissue makers seem worth exploring to see what advantages can be gained to improve economic value. •