

Sizing up recycling: Better paper through chemistry?

New ground is being broken in the area of functional chemical additives that enhance the properties of recycled paper

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Although governments and consumers are still trying to come to grips with a definition of "recycling," according to a research scientist, it is clear that the use of recycled fiber in the pulp and paper industry is on the upswing. Recycling itself is not new—mills have been recycling broke for a long time. But new ground is being broken, for instance, in the understanding and application of functional chemical additives that give recycled paper a "property boost" to help keep it on a par with paper made from virgin fibers.

Studies are showing that "better recycled paper through chemistry" is increasingly possible. At the 75th Annual Meeting of the CPPA Technical Session, a session on recycling provided some information that (a) dispels some myths and (b) underscores the reality that recycled fibers can be and have been sized.

Margaret J. Molnar, regional manager of marketing development for Buckman Laboratories of Canada, said work over the past 2–3 years can help to dispel "myths we have been tagged with at the beginning of our deinking operations that now all of us are deeply immersed and involved in."

Eight product categories evaluated

Specifically, Molnar was referring to the effect of repulping aids on deinking processes. In studies, 17 products and product combinations were evaluated on numerous types of secondary fibers. These repulping and deinking products were categorized as:

- Caustic
- Neutral foaming
- Alkaline foaming
- Foaming solvent
- Emulsifiable solvents
- Fatty-acid based
- Solvent

- Low-foaming surfactant solvent.

Her presentation was entitled "The effect of repulping aids on deinking processes, part 1." Molnar, who co-authored the paper with Lowell F. Lott of Buckman Laboratories International in Memphis, TN, emphasized that, prior to any deinking process, fiber preparation in the pulper is important so that fiber contaminant separation and final trash removal will be accomplished by mechanical means. Time, consistency, pH, temperature, and process water quality affect fiber preparation, and all five variables are key in fiber preparation. "None should be overlooked for anyone considering setting up a system of deinking," Molnar stressed.

Four ways to monitor the potentials for fiber cleaning during repulping, Molnar said, are to measure the freeness, pulp brightness, dirt counts, and hand sheet filtrate turbidity or solids. A fifth method is to count the nonsoluble, nonfibrous particles using a hemocytometer and microscope at 400X. This method of counting the stickies as repulping progresses provides a way of tracking fibers and trash separation. The method is relatively simple and very effective, Molnar said.

Consistency in repulping is important as a small change in consistency releases more fiber-bound trash that can be washed away or floated away. The difference between 5% and 7% consistency could mean 28% more fiber furnish available. "High-consistency repulping produces dramatic results," she said.

The effect of time is that longer times at higher consistency will lead to excessive ink dispersion and gray stock, she said. Another factor, the pH of process water surrounding the fibers in the repulper, also has a beneficial effect on the release of the contaminants. Studies on wax-coated linerboard showed that wax particles in the coating are not solubilized or modified with caustics. The fiber swelling and interfiber abrasion enhanced with caustic causes the release of these light, hydrophobic contaminants. Early wax release from the fibers in the repulper reduces pulping time and improves the performance of reverse-flow cleaning, she noted.

Myths about deinking

Some of the myths surrounding deinking that Molnar addressed are that "laser can't be deinked, calcium has to be

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present, sodium silicates are really, really necessary, and clay is always necessary."

In studies using furnish with UV-coated packaging mixed with old newspapers and old magazines, average furnish losses using representative products from the eight product categories evaluated showed that average furnish losses are slightly lower for the washing flotation sequence because those chemicals that produce foam or froth have been washed away, she said.

Ash removal in washing, flotation, or combination processes was studied for coated food board and laser-xerographic office papers. These fiber sources are dissimilar with respect to the location of the ash component. Regardless of the ash location in the fiber, the washing process was most effective for the ash removal. "Most products, including caustic, are ineffective for ash removal," Molnar said. "Ash content has no bearing on ink removal during the flotation processes. Additional clay or other inorganophiles may in some cases be detrimental to the deinking process itself," Molnar said.

The impact of deinking chemicals on fiber strength has been viewed with concern by groups unfamiliar with the history of the deinking processes, especially with the extent of deinking fibers worldwide, Molnar said. Evaluations of deinked newsprint processed with a neutral foaming type product indicate that the age of the newsprint and the method of storage may have a greater negative effect on the dry strength than the deinking chemicals, she noted.

The importance of being washed

Sizing problems underscore the importance of a good wash, Molnar said. "If chemicals are there, they will adsorb onto the fiber and be more of a detriment because they act as desizing agents." Furthermore, foaming and untrained air can present problems owing to excessive furnish losses in flotation during thickening, foam persistence during washing, excessive defoamer use in deinking processes, and the surface foams in the effluents.

"The myths that are out there are starting to be dispelled by the fact that there are mechanical and chemical means to help alleviate these problems," Molnar said. "A wide range of effective chemistries exist to enhance the mechanics of fiber cleaning."

Sizing agents are a widely used chemical additive whose place in recycled fiber was discussed by Betty M. Moyers, a research scientist with Hercules, Inc., in Wilmington, DE. Her presentation was entitled "Sizing chemistry in recycled fiber."

"Recycled fibers can be and have been sized," Moyers said. Three areas to look at in order to effectively size recycled paper are fines and fillers, surfactants coming in, and system charge.

Fines consume a tremendous amount more size than regular fibers so they need to be contained or eliminated from the system, she said. Two ways to do so are to reduce refining, by not putting recycled furnish in directly with the regular pulp system, and to increase the reject level. New research such as enzyme refining that's much less stringent on the pulp and new types of refiners are enhancing the ability to make paper with a minimum number of fines possible, Moyers said.

Go for the maximum

The answer to the question, "How to make recycling economically feasible?" is to "go for the maximum retention possible," she said. It's important to look at the whole balance of the system. "Chemicals cost a lot of money, so you have to make a further decision whether cost in losing a little more fiber might actually save you money when you're talking about a board grade that requires a tremendous water holdout and strength additives, versus what you're going to pay for chemicals."

Surfactants can come from such sources as coated additives, postconsumer materials, glues, oils, and adhesives. "With the coating additives, this is a critical area. In this and other postconsumer waste applications, it may require some compositional changes, particularly since they are now coming back into the paper system and they weren't there before," Moyers said. Reformulating adhesives and eliminating stickie problems are keys to effectiveness, she said.

Certain compounds, such as highly oxygenated polyglycol components, are extremely detrimental to sizing and must be eliminated from the system to accomplish good end-use paper, she said. In postconsumer waste, the composition of glues and adhesives can have a dramatic effect on the sizability of the pulp that's coming back in. Animal-based and starch glues are more compatible with the paper system, she said.

Impact of surfactants

The chemistry of deinking surfactants will have an impact on sizing, she said. Two commonly used classes of these are fatty acids and polyalkene oxides. When doing studies to determine the most effective deinking chemical that can be put into a particular system, also consider what kind of paper is going to be made and what kind of properties it must have. If it has to be sized, study the effect those surfactants will have on sizing.

"You will double your sizing costs if you choose a surfactant that isn't well washed out and has a negative impact," she said. The primary means of preventing these problems are to eliminate them from the system via washing and eliminate them from the postconsumer applications by reformulations.

Another area in effective sizing is to consider how cationic or anionic one's system is. "Both recycled fiber and mill-coated broke can have an extremely high charge associated with it. When you're putting these in your system, you're going to create a charge imbalance that has to be adjusted for," Moyers said. Uniform sourcing, getting material from the same place each time, or knowing what each supplier is providing if several sources are used, will help in maintaining control of the charge.

Sizing has been used effectively in several recycled fiber systems, Moyers said. For example, newsprint is an area that is introducing sizing, due to market reasons, recycling, and the move toward specialty grades. The growth in recycled fibers is being accompanied by the development of procedures for eliminating or coping with sizing interferences. □