FLOTATION SAVE-ALL CELL OPERATIONS

ERIC S. REBARBER

EFFECTIVE REMOVAL OF FINES AND FILLERS FROM THE WHITE WATER, USING A FLOTATION SAVE-ALL CELL, ENHANCES THE PAPERMAKING OPERATION.

FOR PAPERMAKERS, THE CHIEF GOAL IS TO OPTIMIZE machine runnability and sheet quality. One essential papermaking tool is an efficient flotation save-all cell, hidden in the sub-basement or in the attic (the fourth level up). When working properly, the cell removes fines, fillers, and additive residuals from the white water.

The cleaner white water reduces plugging of nozzles and valves by "cloudy" shower water and dilution water. Over time, cleaner white water also minimizes variability and potential upsets in the headbox fines content. The overall result is better fiber utilization and fewer deposits to blotch the sheet.

For all of these good things to happen, it is important to understand the practical mechanics and chemistry involved in operating an efficient flotation save-all cell. This article will discuss proper set-up of the flotation save-all cell, and how to monitor the inputs, such as the addition of air and polymer.

DESIGN OVERVIEW

The flotation save-all cell removes fiber from the white water in three steps. First, the fibers are concentrated by flocculating the fines with a high molecular weight polymer. Then, the flocs are floated to the surface by well-distributed, rising air bubbles. Finally, the flocs are mechanically skimmed away while the fiber-free water flows out the stand pipes. The key is to balance the building of net-like fiber flocs and the addition of air to carry these flocs to the cell surface.

The cell is simply a shallow open tank with three separate sections:

1) the inlet chamber, where the feed flow of white water is baffled to minimize turbulence throughout the cell;

2) the floating pool, separated from the inlet chamber by the barrier wall, where fiber flocs will continuously float toward the surface throughout the pool; and,

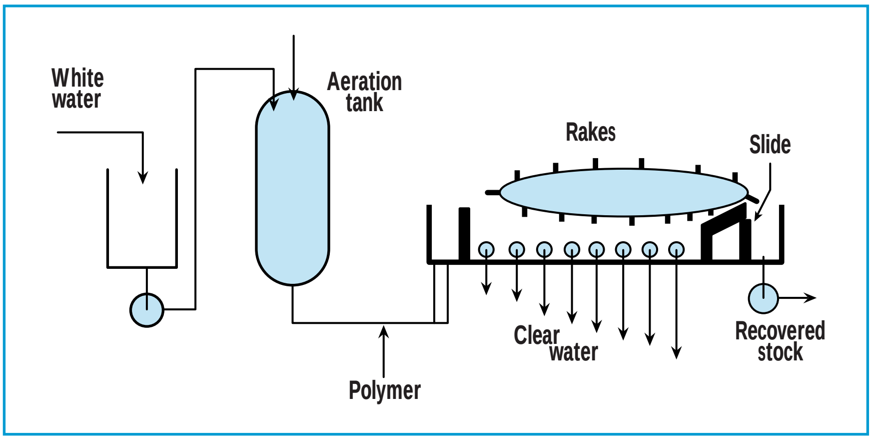
3) the recovered stock chamber, to where fiber and filler flocs are skimmed for reuse.

A typical, older configuration of a flotation save-all system found in mills today is depicted in **Figure 1.** The source of the white water is usually the seal pit tank, with the clear filtrate from the cell returning right back where it came from (the seal pit). Usually removed a few feet and a couple of partition walls from the cell feed pump, not a very efficient design. The system usually includes an aeration tank to assure proper mixing and distribution of the air bubbles into the white water stream. The rakes or paddles of the cell may be one entire unit or two separate arrangements: one set for the floating pool, and one set exclusively for the ramp (slide) leading to the recovered-stock chamber.

Newer, state-of-the-art save-alls in many mills have slightly different designs. For example, the clear water standpipes may be replaced with a flume that runs the clear water from the bottom end of the floating pool, under the recovered stock-chamber and into a separate tank. Or, thin baffles may be run a few inches under the surface of the water and along the full length of the floating pool to help promote floc seeding and building, and to guide them to the surface.

CONTROLS FOR THE FLOWS

Inlet Guides. The guides on the inlet pipes entering the cell from the bottom function as baffles in front of the inlet valves. These guides can be adjusted to balance the incoming flow. The flow should be equally distributed throughout and across the cell inlet chamber without any harsh flow disrupting the surface. If the incoming flow is bubbling up through the surface, then these guides need to be adjusted to baffle this turbulent flow.



1. Flotation Save-all System

Barrier Wall. The barrier wall guides the flow of the water from the inlet chamber and directs it smoothly towards the surface. The wall can be adjusted up or down to help "fling" much of the fiber directly to the surface while the clearer water flows over the wall and down into the pond. This adjustment depends on the level in the cell. Not much more than an inch or two should separate the top of the wall and the water surface.

Standpipes. The standpipes do much more than just guide the cleared water away. Properly set the standpipes will govern the overall performance of the cell. The first job of the standpipes is to control the level in the pond. The level of the pond should be at 3/4 of the way up the slide (under the paddles) . Raising or lowering of the standpipes will raise or lower the level of the pond. If the control of the level goes beyond the capability of the standpipes, i.e. pond is overflowing, then the feed valves of the cell should be closed to reduce the white water flow.

The individual standpipes must be set at different heights to control the outgoing water flow along the length of the cell. Early in the cell (close to the inlet guides after the barrier wall) the flocs are starting to migrate towards the surface and the water is still somewhat cloudy with fines. Consequently, the first few standpipes should be set higher than the later standpipes. As the water approaches the end of the cell, it should be increasingly cleaner. The last standpipe (closest to the end paddles) should be the lowest set standpipe. This allows for a higher flow rate to help the fiber blanket continue to move towards the end paddles.

CONTROLLING THE FLOCS

Air. Air should be added to the stream of white water coming from the seal pit going to the cell. Air should also be added where it will be uniformly mixed into the water before the air reaches the polymer addition point. A tap with a pipe that enters well into the middle of the stockline (like a quill) before a few elbows in the stock pipeline should assure good mixing. If air is added at the inlet of the seal pit pump for supposedly better mixing, then the air has a tendency to bubble-up back into the seal pit tank and run the pump dry (No flow!).

The air flow is determined by the performance of the cell. The air line should have a control valve and a working rotometer. For continuous operation and control, a needle valve is recommended for better air flow control. This valve should be located at the cell for easier access and better cell operation. This allows the operator to see the effect on the cell immediately after making a change.

Polymer. A high molecular weight polymer should be used as a flocculating agent. The higher the molecular weight, the larger the polymer, the greater the potential for larger flocs. A simple settling jars study can be used to screen several different polymers. A wide range of cationic and anionic polymers should be compared for the fastest settling rate and the lowest supernatant turbidity (ppm). Cationic polyacrylamide is recommended as a flocculating agent. This specific type of polymer has proven very effective for most papermaking conditions because fines and filler are highly anionic.

The polymer addition rate is usually between 1 to 5 ppm as received (100% active), and should be diluted to about 0.5%. Good dilution will help the polymer mix quickly. The polymer must be well-mixed into the white water flow of the cell, but away from any shear that can break down the length of the polymer. This length is what creates the sturdy net-like flocs. Therefore, the polymer needs to be added close to the cell inlet. The polymer flocculates by attaching loosely on to the fines while leaving long loops and tails to bridge to other fibers. If the polymer is added any earlier in the system, it will completely adsorb on to the fiber surface, reducing the surface area available for flocculation of fines and fillers.

Paddles and blowers. As the flocculated fibers concentrate at the surface of the cell pond, ideally the flocs form a blanket of stock of about 1 inch thick. This blanket must be promptly removed to the stock chute at end of the cell, or the fibers will eventually sink. The paddles should cut down into the fiber blanket and gently drag the cut out portion of the blanket into the stock chute.

Most cells have two sets of paddles. One set, the pond paddles, covers most of the length of the pond. A second set, the slide paddles, transfers the blanket over the inclined slide into the stock chute. Since these paddles break a lot, most mills replace the main bank of paddles with blowers. These are generally high-intensity blowers, the type used for industrial space heaters.

The pond paddles, or blowers, are supposed to gently help push the blanket towards the paddles at end of the cell. The speed of the paddles can be controlled to balance the rate of flotation (blanket depth) with fiber removal. In other words, the blanket must be removed fast enough to open up more area for more fiber mat to be created. The blowers should be angled so that the air is hitting the blanket almost tangentially. If the angle is too steep, the air will disrupt the blanket and promote sinking.

The slide paddles should only cut down just below the blanket, to allow the clear water to flow under the paddles and back into the pond. The paddles should not seal tightly against the surface of the stainless slide because then the paddles would be pushing clear water into the stock chute. A little bit of carryover water, however, helps keep the stock chute clear of fibers. If the rubber strips of the slide paddles are replaced, make sure they are not too long, or the paddles will seal against the slide.

COORDINATING THE FLOWS AND THE FLOCS

As the individual fibers travel the length of the cell, they slowly unite into floc-nets with the help of the polymer and quickly rise to the surface. If the flocs are too big or too heavy they will tend to settle out before they can reach the paddles at the surface of the pool. More air will be needed to lift larger flocs when compared to smaller, lighter flocs. Too much air, however, will create enough upward velocity and shear to break apart the floc structure.

The consistency, usually measured in parts per million (ppm), exiting from each standpipe should be monitored closely. If the middle or later standpipes have a higher ppm than the earlier ones, then settling is occurring. This means that the flocs are too heavy for the amount of air being added, and the balance of air and polymer must be adjusted. If all of the standpipes give similar but high ppm, then either too much air or not enough polymer is being added.

The maximum amount of air and polymer that can be added are limited by the consistency in the incoming white water, and by the dimensions of the flotation save-all cell. If floc shearing occurs and the addition of more polymer neither strengthens the floc nor keeps it from settling, then the input water flow to the cell must be reduced. This lowers the fiber and chemical loads on the cell, but allows slightly more time for the seal-pit white water to reach equilibrium at the targeted lower consistency.

For continuous operation of the flotation save-all system, interlocking the polymer feed pump and the air flow to the seal-pit pump is recommended. Be careful during start-ups or whenever the cell pond is not full. Once the feed pump is interlocked, the polymer should not be started into the cell until it is completely filled with whitewater, or more preferably, fresh water. When the cell is not full, starting of the polymer will cause the flocculating fibers to concentrate, gather and settle. The floc level must reach the paddles in order for the paddles to be able to push the fiber blanket into the stock chute.

Also, a dedicated makedown system is an imperative for continuous operation. Side-by-side papermachines can share a makedown system, but should have their own feed pump and spare. The makedown tank should be relatively small and have good mixing to ensure good polymer extension while minimizing potential bacteria problems. Only warm water should be used because cold water, especially during winter, can cause the polymer to agglomerate into gel clumps that do not disperse evenly into the makedown solution. Papermakers should beware of trying to build a polymer makedown system in-house. Let the polymer-supplier supply the equipment as well, or pay it off through a polymer up-charge. Paying for the more reliable equipment will save "big bucks" in paper machine sheet breaks and downtime.

PUTTING IT ALL TOGETHER

For the flotation save-all cell to work effectively, the addition of polymer and air must be coordinated with the mechanical adjustments of the cell. The cell must be monitored closely during an optimization trial. Make careful adjustments early on to assure that the blanket forms quickly and that the fibers do not settle. If they settle considerably, then the cell may have to be emptied and refilled with fresh water before restarting. Be patient, though, because once the blanket is lost it will take some time to rebuild.

Most older, typical flotation save-all cells can achieve efficiencies of over 85% (on a fiber basis). Some of the newer designs produce close to perfectly clear water with 99% efficiency. In general, the efficiency of the cell only needs to be as high as necessary to eliminate problems in machine runnability or sheet quality. TJ

Rebarber is an applications manager at Eka Chemicals, Akzo Nobel, Inc., 2211 Newmarket Parkway, Suite 106, Marietta, GA 30067