Key alkaline wet- and dry-end conversion program decisions: an overview

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The most effective chemical deposit control and felt conditioning and cleaning program can be chosen after evaluating retention program performance, the fillers employed, the type of size hydrolyzate formation (when cellulose-reactive size is used), and the type of pitch.

Background

In 1981, it was predicted that, by 1986, 25% of all U.S. printing and writing grades would be produced using alkaline size (cellulose reactive) and that, by 1991, 55% would be produced using alkaline size (*1*).

In November 1989, Stephen Walkden of Hercules Specialty Chemical Co. said that alkaline papermaking represents about 20% of overall U.S. paper production. Uncoated free sheet, an industry sector at the forefront of the alkaline sizing trend, will experience market growth from 26% in 1988 to 52% by 1993 (*2*).

The March 1990 issue of *Alkaline Paper Advocate* reported that of the 153 U.S. fine-paper mills it surveyed, about 45 are alkaline. Approximately 40 more mills will be converted—26 in 1990 (*3*).

Introduction

Short-term trials of alkaline systems can be misleading because one cannot see some unforgiving changes in one-, three-, or even seven-day trials.

The key wet- and dry-end machine system programs that must be examined carefully to achieve a smooth conversion are: retention, microbiological slime, boilouts, organic and inorganic chemical deposition control, and felt conditioning and cleaning.

Since both cellulose reactive sizes can form hydrolyzates, alkenyl succinic anhydride (ASA) or alkyl ketene dimer (AKD) use magnifies the importance of these five programs. More reactive AKD sizes now are available. If either size is poorly retained and allowed to recirculate, the hydrolyzate formed will cause deposition, holes, breaks, and picking problems.

Retention

Retention is the most important proprietary program in an alkaline conversion. An effective polymer program depends on proper wet-end chemistry, optimum fourdrinier drainage, and polymer feedpoint(s). The feedpoint(s) selected must allow good fines and size retention; if not, microbiological growth, deposition, boilout, and felt conditioning program costs will increase.

The major problems

Although runnability and sheet quality may be satisfactory during a short trial, when longer trials are run, filler and fines retention can become unsatisfactory and cause paper quality problems. It can become increasingly difficult to achieve and maintain the proper balance between retention and formation as trials are lengthened.

Different types of deposits can be observed in the deculator, headbox, and screens when retention problems occur. Depending upon the programs evaluated, the deposits vary in hardness (containing high amounts of precipitated calcium carbonate) and softness and can be tacky or sticky (containing size hydrolyzate or pitch, or both). Some microorganisms are usually entrapped in these deposits. Machine operation may need a major washup or boilout every 3–4 days.

Sheet holes, breaks, and defect problems are almost always assumed to be microbiological in origin. More pressure is put on the microbiological control and boilout programs. Some mills revert back to acid papermaking while evaluating their programs.

Troubleshooting

It is important to optimize first-pass retention, especially fines retention, to minimize sheet holes and defects. Optimize the fourdrinier drainage zone by using data from a drainage profiler. Compare the alkaline drainage profiles to the preconversion acid drainage profiles, then make adjustments to improve retention.

When ASA or AKD is used, size deposits must be well controlled. Both alkaline sizes, particularly ASA, are highly reactive and can hydrolyze quickly. Since these cationic, charged sizes can preferentially attach to fiber and fines, low first-pass retention causes a high percentage of ASA or AKD size to recirculate through the white water system. This re-

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sults in size hydrolyzate deposits throughout the thin stock or wet-end system, or both. Holes and sheet defects follow. Also, the loss of size with the fines (and recirculating fiber) results in low sheet sizing. Unfortunately, compensating by adding more ASA or AKD size often compounds the hydrolyzate deposit problem.

Solutions

From a retention point of view, successful conversion depends on optimizing retention and determining how additives affect retention, formation, drainage, and wet-end chemistry. With this knowledge, you can plan a successful conversion.

Optimizing retention. In an alkaline system, balancing, optimum retention vs. formation concerns is critical to control machine deposition and to provide optimum sizing efficiency. To ensure optimum retention:

- Target for as high a first-pass retention as possible (85–90%). The first-pass ash retention should also be as high as possible (55–60%).
- Minimize the amount of size added. For example, add no more than 2.0–2.5 lb/ton of ASA.

Determining the effects of additives. The effects of certain additives on retention, formation, and drainage can be determined using a Britt or dynamic handsheet mold jar. The principles and results of these tests are comparable.

Wet-end chemistry must be monitored. Examine all functional additives used, e.g., cationic starch, alum, precipitated calcium carbonate (PCC), ground calcium carbonate (GCC), extenders, and clay.

Alum chemistry in alkaline mills differs from that at acid mills. Alum is gelatinous, sticky, and hydrated in the typical alkaline papermaking pH conditions of 7.2–8.8 units. Although alum can be a contributor to machine deposition, hole, and runnability problems, a low dosage (3–5 lb/ton total) or a split feed arrangement can minimize these problems. For example, alum can be applied to the selectifier screen inlet while a high-molecular-weight anionic polymer is applied to the screen outlet. Dual polymer programs may also be effective when applying alum.

On-machine use of cationic starch increases internal strength, can help retain the alkaline size on the fibers, and assists with the control of wet press picking. However, unjustified use can provoke problems too:

- Cationic starch is not a good retention aid due to its low molecular weight and short chain.
- Cationic starch feed rates can influence the selection of a retention aid.
- Cationic starch has a strong affinity for fines rather than fibers. High fines loading may absorb too much starch and interfere with retention.
- Overfeeding of starch can seriously unbalance the chemistry of the alkaline system.

Small-particle-size fillers (e.g., clay, GCC, and PCC) have large surface areas and charges that can consume functional additives such as ASA, AKD, and polymer. If significant portions of polymer dosage are attracted to these filler particles, less polymer is available for neutralization and retention. Dispersants that are not present in fillers (e.g., PCC) can inhibit retention. Some mills will monitor the charge (zeta potential) of major slurried fillers that are added to the machine process system. One mill that uses slurried chalk (calcium carbonate) maintained a zeta potential close to the isoelectric point. A low-molecular-weight, highly charged cationic polymer was used to achieve an economical -7-mV (zeta potential) target.

The slurried chalk contains anionic dispersant, which predisposes it to a highly negative charge. Without the polymer control program, makedown of this chalk into a slurry form produced zeta potential variations of -20 mV to -25 mV. Wet-end stability upsets resulted (*4*).

Microbiological slime

To many people, microbiological control is the key alkaline conversion program. Wet-end total bacteria counts (TBC) can increase by factors of 10–100 or more when a mill converts to the alkaline process.

While not all total count bacteria form slime, TBC can be used as a relative gauge of the slime potential in a machine system.

The major problems

Stringers and beards formation. Filamentous fresh-water bacteria can make up over 30–50% of the deposit matrix. Iron bacteria (*Sphaerotilus*), sulfur bacteria (*Beggiatoa*), *Herpetosiphon* spp. (a filamentous, pigmenting bacteria), and other types of unidentifiable filamentous microorganisms comprise a significant portion of these deposits.

Such deposits often form on surfaces washed by white water or fresh warm water. Deposits occur most often when a fresh-water chlorination program is absent or marginal. These deposits can usually be removed via hosings, but once they are in the system, they remain until a system boilout occurs. Stringers and beards growth can be more prolific during the cool seasons of spring and fall, after heavy rainfalls and runoffs, and when surface water supplies are pulled from low-level rivers, lakes, and ponds.

Mucoid and gelatinous slime. Mucoid and gelatinous slime deposits can be seen on white water chest walls and at the wet-end machine area. Often, these slimy masses contain predominantly unicellular microorganisms and a few filamentous organisms. But, sometimes the deposits are a heavy mixture of both unicellular and filamentous biology. The slime may be pigmented, showing an orange to pink coloration.

Stagnant deposits. Stagnant deposits are usually found in areas with high levels of fillers. They cling to splash, mist zones, and low-turbulence areas of the paper machine or press section. Typical areas include the foils, tray surfaces, fourdrinier frame, and press section shower structures. Unicellular microorganisms or filamentous bacteria, or both, are found in these deposits. If rotten or putrefactive odor is identified, facultative or anaerobic bacteria are probably present. Again, pigmented slime may be present with these deposits.

I. Microscopic examination survey

Deposit location: foil box
Machine headbox pH: 7.6

Furnish pulp components
- Coated broke
- Bleached softwood kraft
- Bleached hardwood kraft

Key system additives
- Alum
- Starch
- TiO_2
- Calcium carbonate
- Talc
- AKD size

Microscopic microbiological analysis
Color: Off-white
Consistency: Sludge-like
Odor: Chemical/putrid
Percent biological: 55%
- 45% Bacterial types:
  - Motile and nonmotile organisms
  - Large filamentous slime masses
  - Filamentous bacteria resembling *Herpetosiphon* and the sulfur bacterium *Beggiatoa*
- 10% Miscellaneous:
  - Nematodes (worms)
  - Protozoans and protozoan cysts

Troubleshooting

TBC profiling alone can be terribly misleading. Often, the TBC cannot be correlated to microbiology-related runnability and product quality problems. One must monitor the TBC and note if the slime-forming unicellular microbe levels are increasing. The TBC can remain the same as slime increases.

It is also critical to monitor filamentous biology. Filamentous bacteria are usually found on shower nozzles, squirts, foil sections, in headboxes, and on or around fresh-water lines and valves. TBC monitoring, via the TAPPI Plate Count Method, does not detect these types of filamentous microorganisms:

- Iron bacteria (*Sphaerotilus*)
- Sulfur bacteria (*Beggiatoa*)
- *Herpetosiphon*.

These organisms—along with algae, diatoms, protozoans, or nematodes—usually originate in the fresh and raw water supply. Since the routine TBC plating method does not culture these microorganisms, deposits should be examined under a microscope. For example, **Table I** shows an analysis of an alkaline, fine paper, wet-end machine deposit. This deposit is primarily "beards and stringers" and originated because of poor fresh-water microbiological control.

Slime detection (coupon containing) boxes should be placed at strategic points in a mill system. Good locations include bypass runs off the headbox, trays, clear or cloudy legs, and the white water chest. The coupons are removed and replaced at timed intervals. Then the number of days these coupons have been in service is recorded. Pictures of the coupons may be taken. The deposition is weighed and examined microscopically for microorganisms, fiber, and relative chemical content. Organic and inorganic chemical analyses also are performed to fully characterize the type of deposition. When the wet-end TBC is in a "low or acceptable range" (i.e., 1,000,000–2,000,000/mL) and no microbiological problems are apparent, a deposit or biofouling monitoring unit can help evaluate and identify nonbiological problems and their source(s).

Solutions

Fresh water. Acidic process environments help control potential beards and stringer biology. However, alkaline pH is a more favorable environment for the growth of fresh-water filamentous microbiology. Therefore, it becomes even more important to establish a fresh-water biological control program. An oxidizing biocide such as chlorine or hypochlorite is preferred. When these biocides are used, we recommend:

- The free-chlorine residual range be at least 0.3–0.5 ppm at the machine.
- The pH of the fresh water supply be maintained at 7.2–7.5.

A chlorine controller, which can also monitor pH and conductivity, is recommended to maintain the targeted free-residual range. The stability and consistency of free-chlorine residual control will reduce deposit and slime control costs and guard against corrosion, bleaching colors, fabric degradation, and other concerns.

Stock and white water system. The majority of alkaline slime control conversion programs use only conventional or both conventional and oxidizing biocides. An oxidizing biocide is rarely used alone. Our data on 103 U.S. fine-paper machines indicates the following types of biocide programs: 53 conventional only, 43 combination conventional and oxidizer, 14 hypochlorite or chlorine, 29 chlorine dioxide, 5 hypochlorite or chlorine only, 1 no biocide, and 1 unknown.

Deciding which program to use involves many factors. Consider:

- The problems associated with using oxidizers: handling, bleaching of colors or shade problems, fabric life deterioration, and corrosion.
- If ASA or AKD is used, the need to use an oxidizing biocide as part of the total slime and deposit control program can increase. ASA users experience this need almost twice as often as AKD users.
- TBC-conscious mills will prefer oxidizing biocide because of its immediate "kill."
- An oxidizing biocide also can function as a chemical deposit control agent. Starch and size hydrolyzate-related deposits or picking and stickies problems may lessen when an oxidizing biocide such as chlorine dioxide is part of the machine slime and deposit control program.

Additive and coating preservation. When a mill is converted to alkaline, it may want to target for even higher filler and ash production. Therefore, all additives and the coating microbiology must be well controlled. Additives include starch (especially that which is used to catonize or emulsify ASA size), ASA or AKD size, clay, and carbonates. Any purchased filler or additive slurry material that is delivered should be screened for microorganisms. Preservative or biocide addition to coating and these additives often represents a very small portion of the total slime control program costs. Also, housekeeping and boilout practices in these areas must be maintained.

Since fresh water is used to makedown most additives, maintaining a satisfactory microbiological control program for this source is important. Filamentous microorganisms and unicellular deposit-forming bacteria that originate from fresh water can cause problems. Check filters, rotameters, chest interface (air/water) areas, and associated piping.

Boilouts

If most or all of the following conditions exist, boilouts become the key program:

- The retention swings or is not well controlled, and the mill desires high ash and opacity product specifications.
- More than 5–6 lb/ton of alum is used.
- Filamentous fresh-water microorganisms are a chronic or persistent problem.
- Slime and deposit control programs do not exist or are marginal.
- ASA or AKD is used and hydrolyzate deposition and related problems, such as picking, are evident.
- Machine water closure and recycling is ≤ 6000–7000 gal/ton.
- The machine runs at least 350 days/year with few or no grade or color changes involving serious washups or housekeeping activity.

The major problems

Sheet hole, breaks, and defects continue to be a difficult and unsolvable problem. Papermakers sometimes approach this problem by increasing the frequency of system boilouts. This approach is moderately successful but requires machine downtime.

Troubleshooting

Alkaline machine systems typically run dirty. This deposition demands effective boilouts of the machine and additive systems at regular intervals.

When selecting a boilout program:

1. Inspect the system for the location and quantity of deposits.
2. Identify the deposits and categorize as:

   Microbiological deposits.

   Organic deposits. Determine types and amounts of extractables such as pitch, coating latex, or size hydrolyzate.

   Inorganic deposits. Determine types and amounts such as calcium carbonate, clay, talc, titanium dioxide, aluminum hydroxide, or silica/sand.
3. Develop the appropriate program for the application:

   An alkaline boilout will effectively destroy most microorganisms and converts aluminum and soluble calcium ions to relatively soluble hydroxides.

   An acid boilout will effectively remove the calcium carbonate filler and hardness-related salts deposits.

   Is a solvent involved? Solvents help solubilize organic and synthetic material such as pitch, styrene butadiene rubber latex (SBR), wax, etc.

   Is a chelant or sequestrant necessary? Chelants "tie-up" metal ions, making them stable and water-soluble complexes. Chelants can help remove inorganic scale from equipment.

   Are surfactants or dispersants included in the formulation? They are designed to promote uniform and maximum separation of extremely fine solid particles. Surfactants and dispersants also wet out the particles and equipment surfaces to promote boilout solution penetration.
4. Monitor boilout performance before and after inspection. Monitor specific trouble spots in the inspection. Take pictures and save them for future reference.

Solutions

The pretrial boilout must involve the wet-end and back-system areas, along with associated recycle lines. Acid process deposits that remain will be softened with the alkaline furnish. In this case, residual acid deposits can slough-off and create serious runnability and sheet quality problems.

An effective boilout program requires that the mill monitor four elements:

- Time. Schedule at least 2–4 hours for a boilout.
- Temperature. If alkaline, 130–140°F (higher ranges can hurt fabrics), if acid, ambient to moderate (e.g., 100–110°F) temperatures.
- Concentration. Alkaline boilout to pH 12.0, acid boilout at pH 3.0.
- Proper component selection. Add chelants, solvents, and surfactants when needed.

Boilout solution analyses should be conducted before, during, and just when the boilout will be terminated. Specific tests are conducted to determine if the boilout has been continuously removing and solubilizing deposit matrixes that contain metal cation complexes such as calcium, aluminum, iron, and magnesium. pH and temperature goals must be

II. Combinations of chemical deposits

Analysis	*Sources*
Organic extractable analysis	
Polyvinyl acetates	Coatings, adhesives
Styrene butadiene resins	Coatings, adhesives
Fatty esters or their acids or salts	Wood pitch, defoamer
Ethylene bistearamide	Defoamer
ASA or AKD hydrolyzate	Cellulose reactive (alkaline) size
Latex binders	Coatings, adhesives
Resin acids or their salts	Wood pitch, size
Inorganic ash analysis	
Aluminum/aluminum hydroxide	Alum, clay
Silicon/silica	Sand, defoamer, talc
Titanium dioxide	Titanium dioxide (i.e., for opacity)
Talc	Talc (i.e., for pitch control)
Calcium carbonate	PCC, GCC, coating
Clay	Clay filler, coating

III. Chemical analysis summary

	Mill A	*Mill B*
Deposit location	Foils	Manifold
Wet-end/headbox pH	7.2	7.8
Size	AKD	ASA
Organic analysis		
Methylene chloride extractables, %	27.4[a]	22.9[b]
Major extractables	Fatty acids Wax/ polyethylene	Organic acids Organic acid salts Organic esters
Minor extractables	Fatty acid salts Fatty esters	N/A
Inorganic analysis		
Ash, %		
Total	27.4	11.1
Aluminum, as Al_2O_3	2	14
Calcium, as CaO	43	41
Silicon, as SiO_2	14	17
Titanium, as TiO_2	41	
Phosphorus, as P_2O_5	...	8
Sulfur, as SO_3	...	3
Iron, as Fe_2O_3	...	1
Magnesium, as MgO	...	16
Carbonate spot test	+	+

[a]AKD or AKD decomposition products are present in the extractables. [b]Acid anhydride (indicative of ASA) is a major methylene chloride extractables component.

achieved and maintained. In the case of alkaline boilouts, alkalinity and chelant residuals must also be monitored to determine whether they have dissipated or remained at levels that form soluble metal complexes with calcium, barium, aluminum, iron, manganese, and magnesium. Chelants can effectively dissolve inorganic scales.

Because the machine deposit components can change, boilout selection must vary. For example, where the deposit layers are primarily calcium carbonate, and with or without size hydrolyzate, an acid boilout is best. An alkaline boilout is best if the predominant deposit components are microorganisms, starch, pitch (fatty esters, fatty acids, or abietic acids), aluminum hydroxide, and nonhydrolyzate ASA or AKD. With this in mind, mill practice should switch boilout types. Many mills today practice sequential boilouts; they conduct monthly caustic boilouts and quarterly acid boilouts.

A periodic boilout program should be established for the ASA emulsification system, too. A hypochlorite bleach flush may be warranted in additive systems such as size press or coating.

Chemical depositions

The major problems

Because of the slippery nature of deposits formed during alkaline conversion, deposition is sometimes thought to be microbiological slime. Further screening and consideration can help detect this problem. Though microbial populations are often part of any deposit, chemical factors may be responsible for deposition.

Little "troublesome" deposition builds up during short 2–7-day trials. As runs begin to exceed two weeks, however, chemical deposits are noted in these areas: headbox, couch, additive system, slice, press, saveall, flatboxes, felts, cleaners, wire, Uhle boxes, and screens.

These deposits can yield a variety of profiles; some of the component combinations are listed in **Table II**. Chemical analyses of some troublesome alkaline, fine paper, wet-end deposits are shown in **Table III**. Organic extractables are the significant deposit binding materials.

Troubleshooting

Wood pitch. Encapsulated wood pitch (e.g., resin acids and salts, fatty acids and salts, and esters) is liberated during the stock preparation fiber refining process. Wood pitch can be tackier at alkaline pHs. Pitch may be less likely to "set" on fiber when the levels of alum or cationic promoter are absent or reduced. A pitch problem can cause sheet spots and dirt specification problems. Pitch deposits can appear in the stuff or headbox, or deposits occur on fourdrinier drainage ele-

IV. Felt press section chemical deposit analysis summary

	Mill A	*Mill B*	*Mill C*
Deposit location	Uhle box	Uhle box	Uhle box
Wet-end/headbox pH	8.0	7.6	7.5
Size	N/A	AKD	AKD
Organic analysis			
Methylene chloride extractables, %	15.1	3.4	54.2
Major extractables	PVACs SBRs	PVACs SBRs	PVACs Fatty esters Wax and polyethylene Organic acids
Minor extractables	Secondary amide Organic esters	Fatty esters Secondary amide	Organic acid salts
Inorganic analysis			
Ash, %			
Total	38.7	55.4	28.2
Calcium, as CaO	53	34	62
Titanium, as TiO_2	13	32	28
Aluminum, as Al_2O_3	2	14	3
Silicon, as SiO_2	18	19	5
Magnesium, as MgO	13	. . .	1
Iron, as Fe_2O_3	1	. . .	. . .
Phosphorus, as P_2O_5	. . .	1	1

ments, pump impellers, consistency regulators, Uhle box covers, and dryer fabrics. Pitch is a significant problem if the deposits contain ≥ 5% extractables or fatty esters or if fatty acids (or their corresponding salts) are the major component(s).

White pitch. Alkaline coated fine paper machines often experience problems with white pitch. White pitch is a grayish deposit composed of inorganic filler (e.g., calcium carbonate, titanium dioxide, or clay), latexes, other coating components (e.g., PVACs and SBRs), and sometimes natural organic resin pitch. These components, especially the fillers and latex, often enter the system via the coated broke.

Press picking. Before startup, the mill should consider cleaning all rolls. Even with hard granite rolls, acidic deposits such as rosin size can become sticky under the new alkaline-pH conditions.

General wet-end deposition. General wet-end deposition is a common problem with many alkaline machines. This deposition is a mixture of fibers, fines, microorganisms, fillers, starch, and stickies such as size hydrolyzate.

V. Felt filling contaminant solubility

Acid solubles	*Alkaline solubles*	*Solvent solubles*	*Insolubles*
Aluminum hydroxide	Aluminum hydroxide	Rosin size (acid and salt forms)	Clay
Calcium carbonate	Biological slime	Alkaline size	Talc
Acid cure	Lignin	Fatty and abietic acids and salts	Titanium dioxide
Wet strength	Starch	Esters	Silica
	Rosin size (acid forms)	Secondary amide	Pulp fibers
	Alkaline size	Latex	
	Fatty and abietic acids	Wet strength resins	
	Esters	Asphalt	
	Neutral cure wet strength	Polyethylene	
	Dry strength additives	Oil	
	Hemicellulose	Grease	
	Glue	Wax	

Solutions

Retention is a key factor in controlling chemical deposition. Deposition on the machine is directly related to the retention of wood pitch and white pitch colloidal particles. Also, as with ASA or AKD size, low first-pass retention causes cycle-up of fines. When these tacky contaminants and fines concentrate in the headbox loop, deposition, runnability, and product quality problems are promoted.

Wood pitch. Deposition potential in the machine wet-end system will increase when poor first-pass and colloidal retention occurs, and encapsulated pitch is liberated at the refiners. The pitch liberated during refining results in a high potential for free-pitch content in the stock. Many pitch components are tacky and prone to agglomerate at wet-end temperatures (110–125°F). The mill must optimize the wet-end chemistry and retention programs to keep the unretained pitch content to a minimum. Proprietary pitch control programs can augment this approach.

White pitch. Successful proprietary programs have been developed which use coated broke deposit control agents and pitch stabilizers. It is essential to retain wood pitch and latex portion depositing components in a discrete form before they can agglomerate. Research indicates that less deposition occurs when pitch particles are maintained in a colloidal state until they can be retained. Retained colloidal particles are much more stable to shear than large aggregates. Charged functional additives, such as alum or retention aids, also have great impact on the results of the proprietary programs.

Press picking. A mill should investigate impact-related areas of the papermaking operation. For example, make sure acid broke or white water that contains rosin size does not mix into the alkaline process. Decrease the sheet moisture levels that enter the press section. Try to increase wet sheet strength by increasing refining, decreasing filler loading, adding more cationic starch, or increasing softwood levels. Change to a harder-surface press roll.

Some mills have successfully installed a shower or water doctor over the roll. Applying small amounts of a combination wetting and cleaning agent has eliminated chemical deposition. Alum applications in the shower water source also have been successful.

General wet-end deposition. A deposit control application must be designed to control the major types of chemical deposition. Proprietary programs can be designed to meet these goals.

Since retention is important and alkaline is "less forgiving" than the acid process, the chemical program(s) used must be well justified. Some deposit control or dispersing-type agents can interfere with sizing and retention. To eliminate these concerns, laboratory sizing (e.g., handsheet) and retention studies should be performed before applying these chemicals to the stock or wet-end areas of the machine system.

Felt conditioning and cleaning

Ideally, felts last a specified length of time. They should be replaced after a "normal" run during a scheduled machine shutdown. A felt's condition has a significant impact on production.

The major problems

Felt and roll areas are filled with contaminants which cause uneven sheet moisture profiles and picking problems. Increased drying costs or decreased production, or both, result.

Alum, deposit control agents, or cationic promoter may be used to help reduce machine pitch and hydrolyzate deposition and runnability problems. The pitch deposition potential decreases at the wet end. The deposit and picking problems may shift to the press section because the melting point of the aluminum-salt pitch forms has increased. Also, the particle size of aluminum-salt pitch forms is fairly large and, therefore, may worsen the picking problem. Fillers and size hydrolyzate also may be involved with the deposit and contribute to the picking problem.

Troubleshooting

Alkaline fine-paper grades can encounter contaminants, some of which are associated with cellulose-reactive size hydrolyzate. Some of the felt contaminants are fillers such as calcium carbonate, a mixture of clays, and titanium dioxide. These fillers can be associated with starch, natural pitch, latex, fibers, fines, and possibly polymeric retention aids.

Table IV lists the analytical data from troublesome press section (Uhle box) deposits found in coated alkaline fine-paper mills. Coating components (e.g., PVACs, SBRs, and wax and polyethylene), size hydrolyzate, and pitch form the sticky binder that attracts and holds other debris. Fillers contribute to the deposit bulk and consistency.

In the nip of a press, water is pressed from the wet web and transferred into the felt. This water contains materials that can cause felt filling. As the contaminants accumulate in the felt structure, several physical and chemical mechanisms can cause precipitation and contaminants binding on the felt binder. As a result, the felt is easily compacted, its void volume is reduced, and its ability to accept water is diminished (*5*).

Even though a high percentage of felt contaminants can be retained by the sheet, contaminants are sometimes picked off the sheet when it contacts the felts in the press section. These contaminants are usually in a flocculated form and are bound together by pitch, hydrolyzed size, or to some degree by the polymer used to increase first-pass retention. The particle size of these contaminants are too large to be removed through the press-felt fabric. The felt either fills up or the contaminants flake off. Contaminants can build on the press rolls, dryer fabric and cans, or calender rolls, or they can redeposit on the sheet and cause picking, spots, holes, etc.

Methods that measure the relative filling rates of felts include Uhle box vacuum, Huyck-Smyth porosity readings, machine speeds, and the ScanPro® moisture meter. The Scan-Pro can also be used to troubleshoot profile problems and monitor operational strategy (*6*). Scan-Pro is a registered trademark of Lorentzen & Wettre USA, Inc.

Felt showering, Uhle box operation, doctor blade life, and press roll quality are mechanical considerations that, when optimized, will ensure the most effective press section and felt conditioning operation (*6*).

Solutions

High first-pass retention is a key factor in preventing synthetic size from circulating in the system and hydrolyzing. High first-pass retention also keeps cellulose reactive size usage down. Keep records of roll changes and consult with roll manufacturers to obtain correct roll compounds and grinding specifications. Properly condition and clean felts to keep size and other deposits out.

After addressing mechanical and operational factors, a press section audit may reveal that a chemical conditioning program will improve overall operations and product quality. A chemical conditioning program will stabilize contaminants so they do not precipitate or bind to the fiber and are contained in the water removed at the nip, Uhle box, or wringer press. This will reduce picking of the sheet.

When designing a chemical conditioning program, choose the chemical based on the contaminants and characteristics of each felt (*5*). **Table V** shows which of these major filling components can be extracted by various media (*6*).

The chemical program will use pH and solvency mechanisms to control and retard the filling rate in felts. An optimum felt conditioning program uses both mechanical and chemical means to keep modern synthetic felts open (*6*).

Many mills develop and implement their press section performance strategies based upon operational experience, felt life, etc. They deviate from this strategy when a change in pulp characteristics, excessive felt filling, or other operational factors cause the press section to become a production bottleneck (*6*).

Summary

At this time, we have identified 53 U.S. fine-paper mills and 103 machines running part or full-time alkaline grades. Therefore, we estimate that 33–36% of all U.S. fine-paper mills use alkaline production.

The paper industry has been seeking partnership suppliers using teamwork as the basis for mutual problem solving and profit improvement during and after the alkaline conversion.

There are several guidelines to consider when planning total slime and deposit control programs for the alkaline conversion. Retention is the primary program; it has a direct impact on every other area discussed in this paper.

The alkaline environment can support filamentous and general bacterial slime problems. Filamentous fresh-water organisms, which cause stringers and beards, prefer an alkaline environment. An oxidizing biocide may be necessary in the slime and deposit control program.

Boilout type and scheduling are critical factors—even more so when retention and slime and deposit control programs are marginal or ineffective. Alternating between acid and alkaline boilouts is usually effective.

The need for proprietary chemical deposit control agents is a function of retention, size hydrolyzate, pitch and white pitch, and filler types.

The press section is a common area for deposition. Check and control the machine wet-end chemistry; the wet end and press section do not operate independently. Filled felts and deposits in this area lead to quality problems such as sheet holes and spots, breaks, and crushing.

New standards of machine cleanliness and program success criteria must be established for the alkaline process. They can be quite different from acid process machine criteria. □

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