



frontline focus

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Bleaching 101: The Basics

by Wayne Bucher, WB Consulting

Bleaching is the process of making pulp white to improve printing properties and its ability to absorb liquids. Bleaching also attacks some contaminants to reduce stray dark colored particles in the final sheet of paper.

Bleaching processes add significantly to the total cost of making pulp. Also, the environmental impact of bleaching has the close attention of the government. Paper properties besides whiteness and/or brightness are affected by bleaching. So bleaching needs to be optimized and managed well. Ignoring the bleaching process leads to higher operating costs, maintenance surprises like corrosion failures, and regulatory problems. Small projects that improve the bleaching system help avoid major environmental expenses.

Fiber and lignin – the building blocks of paper
Papermaking fibers mostly come from wood, which is about half fibers and half dark-colored lignin - the glue that holds the fibers together. Removing lignin by cooking brightens the pulp. Bleaching then removes much of the remaining lignin. In the case of recycled fibers and mechanical pulp (made using primarily mechanical means with little or no chemical additives), bleaching brightens the lignin that remains in the fiber.

Chemicals used for bleaching fall into two major chemical categories—oxidative and reductive. Oxidation removes lignin. Reductive chemicals are for brightening. Alkali is also used to remove oxidized lignin. The box on the next page lists the main chemicals and their symbols.

Frequently mills use enzymes in bleaching. Enzymes are chemicals made from fermented microorganisms and are environmentally friendly. Their complex structures are unique in attacking organic structures in the fiber. Enzymes can be very

cost effective. An example of enzyme use is controlling pitch in mechanical pulps.

The Towers of Bleaching

Most pulp bleaching systems use combinations of chemicals. The equipment is arranged in stages. Each stage starts with chemical mixing, then goes into a tower to provide retention time (measured in minutes or hours), and ends with a washer.

For chemical reactions to work, certain conditions must be met. These include the temperature, how much chemical is used, and the pH. The pH is a measure of the acid or base (alkaline) concentration. Adding sulfuric acid (H_2SO_4) lowers the pH. Adding sodium hydroxide (NaOH or "caustic") raise the pH. See the left side of the Frontline Focus masthead above to see the tower stages between the woodpile and the papermachine.



What is pulp consistency?

Pulp is usually moved through the various processes as a water slurry. The percent of dry fiber in this slurry is called **consistency**.

$$\text{Pulp consistency} = \frac{\text{dry fiber weight}}{\text{wet weight of the sample}} \times 100\%$$

Measuring pulp consistency is necessary for correct dosage rate control of bleaching chemicals and it's also an important internal accounting function. The impact of this key issue on overall process control is often overlooked.

Mixing it up

Mixing chemicals with pulp is a critical step. Uniform mixing of gases with pulp requires more effort and attention than mixing of liquids with pulp. The reaction time is limited by the volume available after mixing (i.e. the tower size) and before the next process, pulp washing. Steam is usually added if the temperature must be raised to speed the reaction. Filtrates are recycled to conserve both heat energy and residual chemicals.

The stages of bleaching

The main work horse of bleaching is usually acidic chlorine dioxide (ClO_2), referred to as a D stage. Sulfuric acid may added to help lower the pH. Acids and ClO_2 can be very corrosive so leaks and fumes must be controlled. The first D stage is always followed by an extraction (E) stage. This hot, high pH stage uses caustic to dissolve the lignin attacked, but not removed, in the prior stage. This darkens the pulp as more lignin is exposed.



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Bleaching 101 (continued)

Almost all modern stages operate continuously at about 10%-12% consistency (medium consistency).

After cooking, washing and screening the brown fiber, a typical bleaching sequence consists of four stages: O-D-EOP-D. Oxygen delignification (O) is used to further reduce the lignin content by 20%-70%. Then ClO_2 is used in two stages with an E stage in between. Often this E stage has oxygen and/or hydrogen peroxide added, hence the name "EOP". This increases lignin removal and adds brightening between the two ClO_2 (D) stages.

Mechanical pulps are usually bleached with an alkaline peroxide stage, a reductive stage, or both. Fiber brightening is usually the main goal rather than lignin removal. Some recovered fiber operations have similar bleaching processes to brighten the fiber and any remaining ink or contaminants. Recycling's raw material must be controlled and matched with the bleaching process to provide stable brightness and final pulp properties.

Talking bleaching

Typical fiber quality parameters are **brightness**, a speck or **dirt count** measurement (parts per million), and some aspect of the pulp fiber's **strength**.

Viscosity is a common fiber strength test for virgin fiber. This test involves dissolving a small amount of fiber into its individual chemical strands. A liquid viscosity test tells a lot about final paper properties.

As the fiber is bleached, some of the organic material is dissolved in the effluent. The loss of weight is expressed as a **yield loss**.

Residuals are unconsumed chemicals at the end of the chemical reaction. They are a waste product and can often interfere with downstream process reactions. In some cases they will cause the brightness to reduce, rather than continue to improve.

Trace amounts of dissolved metal ions can be a serious bleaching challenge. Some sequences use special chemical additives called **chelants** to capture and contain these metal atoms. Because metal ion contents in the wood and water vary a lot from place-to-place, or even season-to-season, chelant optimization must be tailored to the specific situation.

OXIDATIVE

- Chlorine (C)
- Chlorine dioxide (D)
- Oxygen (O)
- Ozone (Z)
- Hypochlorite (H)
- Hydrogen peroxide (P)

REDUCTIVE

- Hydrosulfite (Y), usually sodium based
- FAS (formamidine sulfonic acid)

Environmental challenges

Increased environmental regulation has caused changes to pulp bleaching. Elemental chlorine and hypochlorite are heavily regulated by most countries and permitted now only in certain applications. Air emissions are also regulated, usually from D stages.



Gene Canavan

At Times I Wonder...

I wonder why our local community seems so successful? It's growing at a rapid rate. Shopping complexes and a jillion new homes are under construction. The Chamber of Commerce just built a new building for themselves. The old downtown area is being updated and renovated. Our school system is well regarded. Hmmm...

I think a big part of the answer is people like you and me getting involved in community affairs. Few of these folks are "professional" politicians. They're just working people trying to make a difference.

In my paper industry career, I've known many papermakers that personified these characteristics. They put their money (time and energy) where their mouth was. One was on the local school board. Another was a county commissioner. A third was mayor of his small town. None of these folks were professional politicians. Most had completed high school and then entered the work force. All of them wanted to make their community a better place and found a way to take action.

I encourage you to take a personal inventory of your abilities and see where you can become active in your local community. Perhaps in politics or serving with the library, YMCA, or Scouting. Our local community has a volunteer committee that plans the 4th of July activities. And of course there are the United Way and the many organizations that benefit from that effort. Ask your local industrial relations manager which organizations your company supports and consider lending your talents to them. If you have a good experience, to share please let me know and we'll write about it.

I wish you success at work, at home and in your community. Get involved!

The volume and quality of **effluent**—water borrowed from and returned to the environment—are significant issues for bleaching operations. Both environmental pressures and demand for fresh water from growing populations will continue to drive changes in bleaching. Reducing the amount of water discharged affects the bleaching chemistry because of trace chemical elements that come in, primarily with the wood.

Operating parameters should be optimized for each mill's unique situation, including chemical cost, equipment limitations, and regulations. Not only will this reduce operating costs, unique fiber and paper properties can be tailor-made, creating loyal customers. **FF**

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Uptime

The Brain Drain

by William F. Hauserman

*"Knowledge is better than blind practice."
Chinese Proverb*

If you are a senior operator or maintenance technician expecting to retire in the next several years then this article is definitely for you. But, if you are a more junior employee with a number of years left in your company, don't stop reading. This article is just as valuable for you.

A recent Industry Week magazine article recently reported on a U.S. Census Bureau projection. Every day this year, and likely in the next several years, 7,918 people will celebrate their 60th birthday. That works out to 2.89 million folks a year getting ready to retire. If you are a member of this baby boom retirement migration, congratulations and thank you for all you have contributed in your work life.

But it also means that when you walk out the door, walking out with you are years of irreplaceable troubleshooting knowledge and experience. That knowledge and experience is a valuable asset for your company and for those moving up to take your place

So what can be done to prevent the brain drain and prepare the organization for the future? How should paper companies take advantage of all that cumulative knowledge and experience and skills? What's the best way to extend your troubleshooting expertise? A couple of ways come to mind.

The Good Book

If you are one of the future retirees, I bet you have a pocket notebook you have carried during the years you have worked at your mill. Or perhaps it's a log-book or notes in your locker. In those records are problem histories, machine notes, facts about how grades or prod-

ucts run and a whole host of troubleshooting information that covers the types of problems you've seen. In it will be critical things like what you did to correct a problem, different solutions you tried, problem fixes that didn't work, who was involved in the problem solving effort - and much, much more. That's valuable information that needs to be passed on to the next generation of papermakers and maintenance techs.

Pass It On

But how do you do that? Probably the simplest means is to hand over your notes, providing they are in a readable format. But what about what is stored in your human computer, in your gray matter? Maybe you



sit down with other folks and talk them through what you know. That's useful, but you likely have more accumulated knowledge and experience than could be explained in a lifetime.

A better way is to enter what you know into your company's knowledge management system, knowledge repository, machine or product history files, CMMS files or other knowledge management systems. That takes a coordinated effort, but it's worth it for those that follow you. The ability to access problem history files, for example, at any time of the day to discover what was

done to solve the problem - and, equally important, what problem fixes were tried but discarded - is the difference between world class organizations and everyone else. If your organization has not created a method of storing and accessing this vital papermaking knowledge - your knowledge legacy - they should!

The Knowledge Legacy

Knowledge empowers people to greatness and gives them a sense of purpose, just like it did for you. You can help stop the brain drain by giving back to your company your wisdom, knowledge and experience if you are about to retire. If you are moving up in your company, pick

the brains of these experts. Inquire about how this valuable troubleshooting data is being captured and stored and how it can be accessed and retrieved to help you solve problems quicker and cheaper and fix them right to prevent recurrence.

Knowledge is better than blind practice. The more we can extend troubleshooting expertise through knowledge management, the more we can extend the future, increase productivity, quality

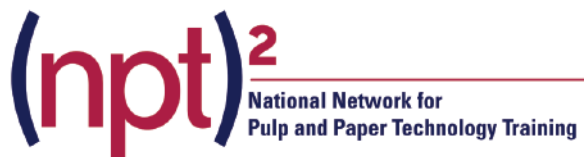
and customer service, decrease costs and in the long run, enhance job security. And a healthy company better protects your retiree health and pension benefits, right? **FF**

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Famous Quotes

"You want to have consistent and uniform muscle development across all of your muscles? It can't be done. It's just a fact of life. You just have to accept inconsistent muscle development as an unalterable condition of weight training"

-Response to Arthur Jones, who solved the "unsolvable" problem by inventing Nautilus.



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Downtime

Bike racer has the need for speed

by Jan Bottiglieri, TAPPI

With his crew at the mill or cruising the hills, for Robert Lawrence, life is a team sport. At work, Lawrence is crew leader on the #2 Paper Machine at SP Newsprint in Dublin, Georgia. In his downtime, he spends hours each week riding and racing his bike. "People ask me how I find the time," he said. "The way I see it, I had three options: fast cars, fast women, or fast bicycles. I chose the bicycles, because if anybody got hurt, it wouldn't be anybody but me!"

Lawrence started as a runner, but an injury sidelined him about three years ago, at age 46. That's when he started cycling with friends. "After spending 31 years working on concrete in the paper mill, it's one thing that I can do and not have any pains.

"I like competition," he continues. "Bike racing allows me to show my level of fitness against other guys my age, and it's just fun. It still reminds me of when I was a kid; there's a lot of freedom to it."

Pulling together

During a race, a bike team uses a technique called drafting to increase performance. The lead riders break the wind barrier, allowing the riders in back to be drawn along in the draft, which saves their energy. (NASCAR drivers use the same technique to save fuel.)

"The more people you have in front of you, the more your heart rate drops," Lawrence explains. "On average, if you've got three or four people riding ahead of you, your heart rate

will drop by 30%. That's 30% less energy that you put out, because the guys in front are doing the work. When you go out front and lead, you really have to work—but everyone behind you benefits."

It's the same in the mill, says Lawrence. "It takes a lot of people working together to achieve success. On a paper machine, every person must fulfill his or her responsibilities to make the paper safely, efficiently, and fast. I know—I work with some of the best papermakers in the business." The idea of drafting even extends to attitude, says Lawrence; when a team works well together, people are drawn along, and they want to be a part of it.

Safety is a focus for both his mill team and his cycling team. "When you're cycling, there are certain rules to follow to keep from causing someone else to fall or stumble. You need to train together to develop a fluid motion. For a machine crew to accomplish the same thing, they need to work together, too."



Lawrence (kneeling) with his #2 PM crew.

Last year, Lawrence and two of his cycling buddies tackled the Dahlonega Three-Gap 50 in the north Georgia mountains. "That first climb was five miles straight up of hairpin turns. When we got to the top—and believe me, I was not at the front!—there were people hollering, just like you'd imagine at the Tour de France. The real rush was coming down; those first couple of turns, I was really shaking! But then you get into the flow of it, and it's quite a rush. This year, we're planning on doing the Six Gap (100 miles)."



Lawrence (center, above and in orange at right) with his cycling buddies.

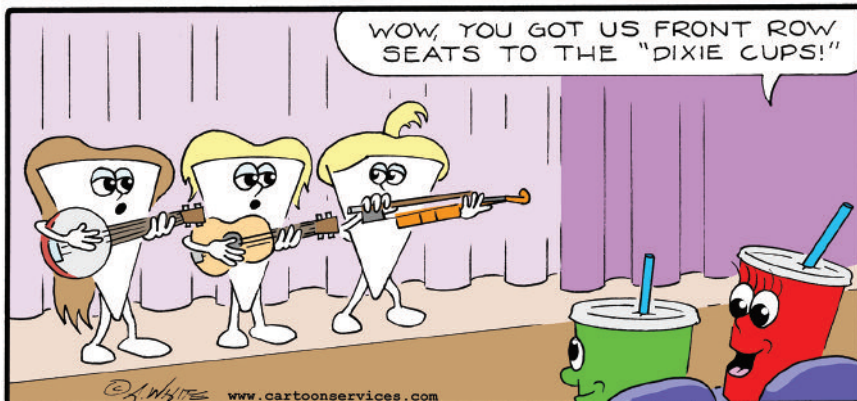


Lawrence's love of speed started in 1975, when he joined his first crew at Bowater's mill in Catawba, South Carolina. "The mill had an opening on Old Blue, which at one time was the fastest paper machine in the world," he recalls.

Lawrence is always quick to credit the people around him—his family, his crew at the mill, and one special mentor: industry veteran Omega Rodgers. "I loved to listen to him talk about his papermaking adventures. Omega had the personality to bring people together and find the best in them," Lawrence says.

"I'll always stay active and try to take care of myself, for my family and for work, too," he concludes. "I have a great place to work, and a bunch of great people to work with. I always want to be an asset to the company, not a liability. By staying fit, I can still do that." **FF**

Questions or comments on this story can be emailed to : jbottiglieri@tappi.org



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Mechanical Roll Engineering Services – Ensuring Reliable Roll Operation

Many North American mills run older, or even obsolete, paper machines. Harsh market conditions have forced some of these North American companies to shut down. So... is having the latest and greatest technology a requirement for survival? No!

However, you **are** expected to be more competitive in terms of machine speeds, reliability and production efficiency. Metso Paper offers tailored Mechanical Roll Engineering Services. This includes scheduled roll maintenance as well as reconditioning and modernization of rolls. Here are two typical examples of how you can solve roll related process problems, **without** expensive section rebuilds.

EdgeBlow™

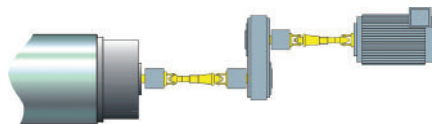
To ensure good sheet threading and runnability, the suction pick-up roll on a paper or board machine must hold the sheet firmly all the way to the trimmed sheet edge, while the sheet is transferred to the press section and the edge trims are cleanly separated to the pulper. Possible problems with the sheet or trim handling are normally seen as web breaks due to edge trims "trying" to follow the pick-up felt to the press, or as a sheet drop-off from the pick-up felt. As a patented Metso Paper product for suction pick-up rolls, the EdgeBlow optimizes the sheet transferring and edge trim separating processes.

Weyerhaeuser in Plymouth, NC, USA was experiencing chronic trim separation problems, difficult threading and lengthy lost production times on their NC1 linerboard machine, until they enlisted the help of Metso Paper in Aiken, South Carolina. By modernizing their existing pick-up roll with EdgeBlow, the mill has eliminated the edge following and web drop-off problems that plagued them consistently.

"The trim was not separating and the edge was dropping off on the machine drive side," explains **John Lewis**, former NC1 Production Superintendent, describing the threading problems before installing EdgeBlow. "We had lots of breaks there." Weyerhaeuser made a quick decision to install EdgeBlow and, in response, the Metso Paper roll service center in Aiken made a quick delivery, within a tight sixteen-day schedule. The effect on NC1 runnability has been dramatic. "There was a night and day improvement," states Lewis. "We are very happy with the retrofit. It is the best relatively small investment of money that we have ever spent on the machine." Over eighty suction pickup rolls have been modernized with the EdgeBlow system worldwide.

Triple Race Bearing modification with a dual standard bearing drive

The MeadWestvaco mill in Charleston, SC, faced a chronic bearing reliability problem common to many papermakers who use original Beloit-designed CC (controlled crown) rolls. The drive-side bearing of all LX 389-model CC Rolls is a triple race design. After a successful retrofit to a Metso-supplied dual standard bearing design in December 2005, the mill has seen much lower vibration levels and has more faith in long-term roll



Drive lay-out after upgrade, no changes due to roll modernization

performance according to **David Babson**, Maintenance Supervisor. "We could not get one of the triple race bearings to run for more than one year," says Babson.



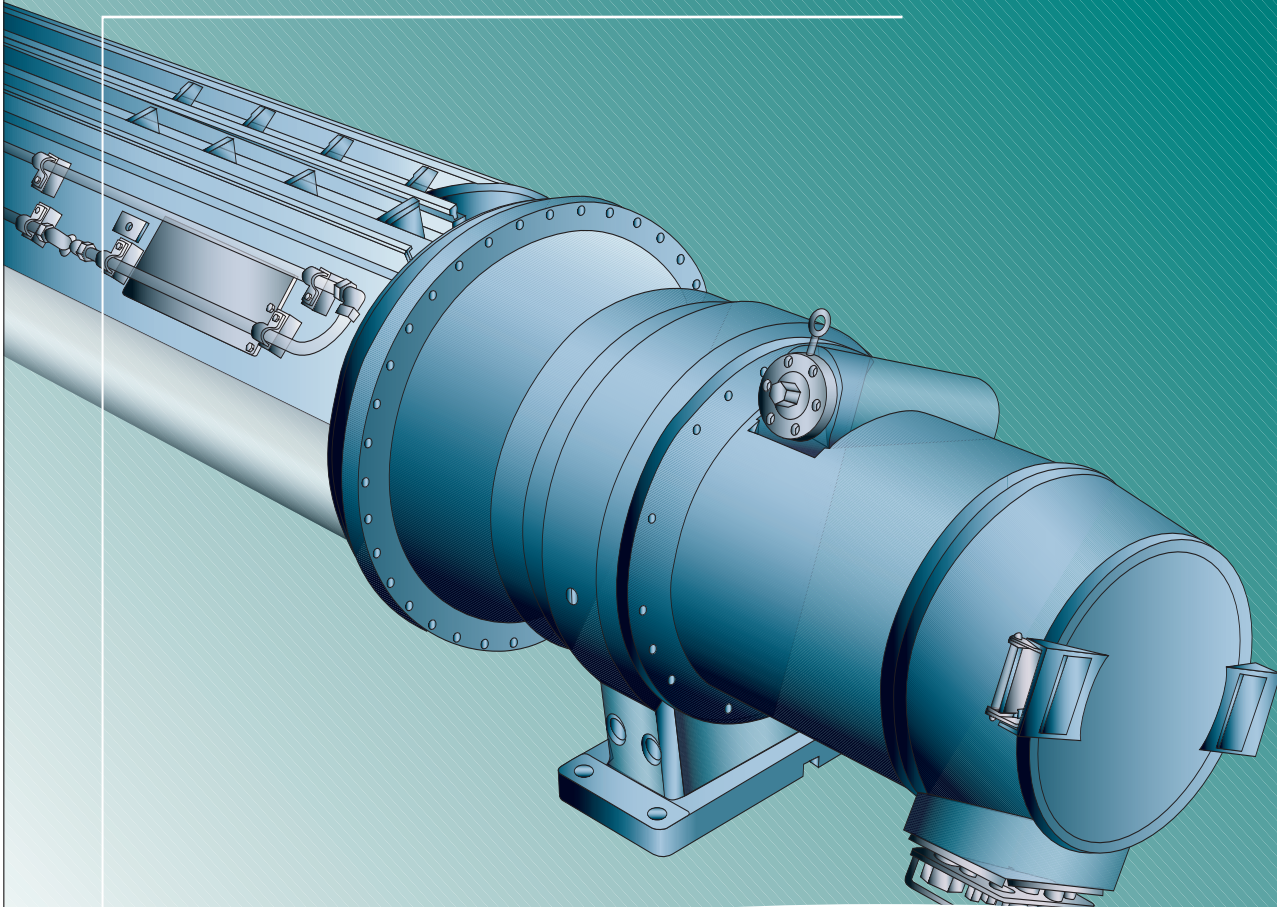
Like many mills, the Charleston mill found that the cost of replacing the bearing was getting much too high since they are no longer standard production line items and are considered to be a special order. Delivery times for the obsolete equipment can be very long. By evaluating the high cost of the triple bearing replacement, expensive wrecks and unplanned downtime, they calculated the return on investment for the Metso Paper solution to be very attractive. Babson reports that the installation was very easy. "The design is simple and easy to work with. The drive center line remained the same and that is important because we do not have a lot of room on the machine drive side," he says. The roll's initial performance looks promising. "The roll is running great and the vibration levels are down considerably. The vibration monitoring people could not be any happier," states Babson.

Conclusion

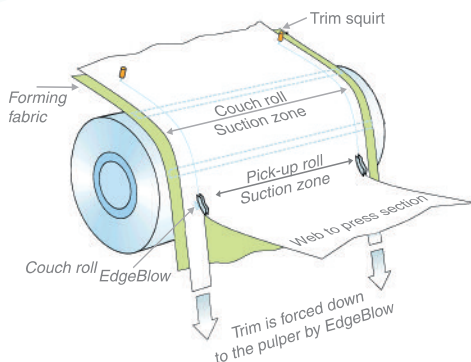
The above are just two examples of how Metso Paper has helped mills solve their troubling process issues. Metso is committed to the future of fiber and paper, and is the true frontrunner and OEM presence in the industry.

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Metso EdgeBlow™ Pick-Up Roll Modernization



www.metsopaper.com



An EdgeBlow modernization significantly improves the efficiency of paper machine pick-up rolls. The modernization contributes to more uniform web edge pick-up from the forming fabric. EdgeBlow also keeps trim from travelling with the paper web into the press section. An EdgeBlow modernization reduces the number of press section breaks caused by trim and tattered web edges.

Technical advantages

- Adjustable edge blow air volumes on the drive side and tending side
- Clear separation between web and trim
- Cleaner felt and cleaner suction holes on the pick-up roll shell at the edges of the web
- Trim will not follow the felt

Benefits

- Fewer web breaks in the press section
- Improved web edges (less tatter)
- Reduced need to clean the roll shell

By the way, the EdgeBlow modernization can be done for any make of pick-up roll.

*To add value to your papermaking,
contact paper.service@metso.com.*

