February 2005

ADVANCED ADHESIVES REPORT
Your corrugating newsletter from Harper/Love Adhesives Corporation

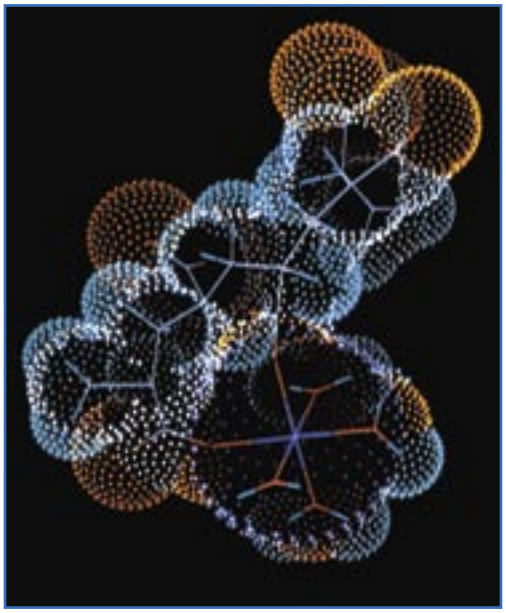
Nanotechnology in Corrugating Adhesives

Nanotechnology may be a current buzzword in industry but it is not new to the papermaking and corrugated industries.

By John Kohl

Nanotechnology in corrugating adhesive is the use of submicron size chemicals and additives to improve the overall characteristics of an adhesive. It is a big word for an extremely small unit of measure. The actual size of nanoparticles has a range from a few atoms across up to 0.1μm or 100nm. An object that is 100 nanometers across is only 1/1000th the diameter of a human hair.

Nanotechnology was put forward theoretically in 1959 by Nobel Laureate Richard Feynman who gave a famous speech called: "There's plenty of room at the bottom." Research in the use of nanomaterials is now a $6 billion to $7 billion per year industry. More than 150 companies worldwide have been founded since 1990 with a focus on nanotechnology. These companies will have an estimated economic impact of $1 trillion in 15 years.



Computer image simulates nanotechnology in Aquaseal Plus™ (©2005 BASF Corporation)

Nanotechnology may be a current buzzword in industry but it is not new to the papermaking and corrugated industries. It is currently used to increase paper machine production by increasing the web dryness and decreasing steam demand through the use of silica and cationic starches. These same principles have been used for years in the corrugating industry with the use of carrier starch. When a carrier starch, whether pearl or modified, is cooked it releases its subcomponents that are only 10 to 20 nanometers in size. Ketone resins, used in corrugating adhesives for years to provide wet strength, are also on the nano scale of only 5 to10 nm.

In recent years Harper/Love has invested the bulk of its R&D effort using nanotechnology to develop liquid products that are specifically engineered for the corrugating process. These products work in conjunction with the existing starch-based adhesive to improve its affinity to paper on the nano scale. This ongoing research has led us to develop new products that reduce warp and washboarding and reduce the amount of energy used to complete the bonding process in the double backer.

By holding a large percentage of the water in the adhesive on the glue line where it's needed for starch gelatinization, there is less water absorbed into the medium and liner. With the water remaining in the glue line and on the surface of the substrates, it is easier and faster to remove with the available heat of the corrugator. The additives have been engineered to allow only the key bonding chemicals to penetrate the papers and increase the bond strength. This increased dewatering of the adhesive also allows the corrugator to run at a higher speed, since the double-back bond is dried sooner and consumes less heat energy (steam).

As our understanding of the bonding process between the starch and the cellulose fibers of the paper grows, we will be able to develop better additives. Nanoengineered materials, chemicals, and composites that have a specific affinity to the paper are currently being developed. These new additives will help improve corrugator efficiency, reduce waste, and improve overall bond quality in the near future. As machine speeds and energy costs increase, the science of nanotechnology will drive the next industrial revolution in corrugating.

John Kohl is technical director for Harper/Love Adhesives Corporation. He has more then twenty years of experience in the corrugating industry

Score line cracking: Causes and cures

As you would expect, the predominant reason for cracked score lines is that when there is less moisture in the air, board dries out faster.

By Chris Polster and Bill Nikkel

In recent years, score line cracking has become increasingly troublesome in the corrugated converting industry. The problem is prevalent during periods of low humidity and can become quite an issue in drier areas. As you would expect, the predominant reason for cracked score lines is when there is less moisture in the air, board dries out faster.

Some reasons for the recent increase in score line cracking:

- Increased use of recycled fiber in the paper making process, leading to denser paper with a lower stretch-to-break property.
- Introduction of high-performance liners, which are also denser papers.
- Increased demand for laminated products using preprinted labels (which are predominantly short-fiber papers with a low stretch-to-break property).
- Corrugators designed for high speed operation with additional heating devices can transfer too much heat at lower speeds.

What can we do about this problem?

- Minimize preheater wraps on liners and medium so a minimal amount of moisture is removed from them.
- Use as much return (salvage) steam as possible at the medium showers.
- Wrap liners so moisture is driven to the glue lines and will subsequently be locked into the combined board.
- Run the flute tips of the single face web against the preheater. This helps achieve good bonding with less heat energy transfer from the hot plates, displacing less moisture from the board.
- Maintain high running speeds. This reduces the dwell time of the single face web on the bridge to conserve the heat energy available in the web. This also requires less heat energy from the hot plates, displacing less moisture from the combined board.
- Process blanks coming off the corrugator as early as practical and process labeled blanks soon after the laminating operation. While the moisture in stacked blanks changes slowly (except for the top and bottom blanks and the exposed board edges), extended delays in processing (one or more days) will result in undesirable moisture losses.

Other important measures to combat score line cracking:

- Use suitable scoring profiles and minimize scoring head run-out.
- Use correct scoring rule pressure in the die cutting operation by using correct score rule height relative to cutting rule height.
- Monitor the condition of anvil covers to reduce the amount of pressure needed to score and die cut properly.

Caution: Increasing the adhesive application and thus the amount of moisture in the combined board is not a good idea. It is not only wasteful but also creates other problems such as warp, washboarding, etc.

Water chillers for the corrugator: Is their value worth the cost?

When you add downtime, loss of production, waste created, and man-hours lost, it is usually much cheaper to install a water chiller and eliminate the problems.

By Wayne Porell

When visiting plants I often hear comments such as, "Why do my single-face fingers and the back of the starch pan keep gelling from the starch even though I have a gel temperature of 152°? We need to shut down the machine every four hours to clean the fingers and the starch pan." Or, "Why does my positive-pressure single facer get so dirty so quick from starch gelling in the starch pan?"

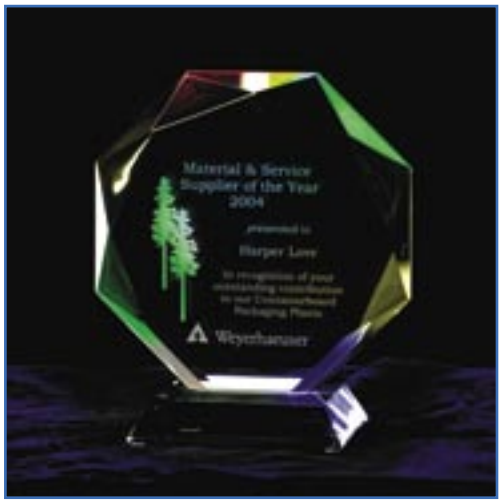
The answer to these questions is that the water going through the water jacket (splash apron) that sits between the starch pan and in front of the bottom corrugator roll simply isn't cold enough. Using a chiller will solve the problem.

Most water supplies, whether from city, town or well, are generally between 50°F to 80°F depending on the season and the average ambient temperature where the plant is located. Plants that feed their water jackets directly from the main water supply can waste as much as 1,000,000 gallons of water a year per single facer because the water enters the water jacket and then goes down the drain. This can be very costly when you figure how much it costs for water and how much it costs to treat the water before it can be released to the city sewer.

It is also very costly to shut down the corrugator for cleaning. When you add downtime, loss of production, waste created, and man-hours lost, it is usually much cheaper to install a water chiller and eliminate the problems.

Water chillers need to keep the water at a temperature of at least 47°F to create condensation on the outside of the water jackets; 42°F is better. If condensate is not present on the outside of the water jacket, starch builds up and sticks to the water jacket and gels. In the course of a few hours it steadily builds up on the fingers and the back of the starch pan. This can lead to dry streaks on the single face side of the sheet. The temperature in the back of the starch pan can reach up to 160°F to 180°F or higher thus gelling the starch. A water jacket is designed so any of the starch that comes in contact with it will run back into the starch pan. That is why condensate must be present on the outside of the water jacket. It is also designed to help keep the back of the starch pan cool so the starch temperature doesn't rise to gel point.

A chiller needs to supply at least four gallons of water per minute to feed two single facers at one time, keep the water cool enough to create condensate, and allow the water jacket to do the job it is designed to do. The chiller should be located close to the corrugator, but be in an area that is well ventilated so the compressor doesn't overheat. The supply lines and the return lines need to be insulated so the condensate doesn't drip on the floor and create a safety hazard.



Harper/Love receives supplier award from Weyerhaeuser

Weyerhaeuser recently named Harper/Love Adhesives Corporation Material and Service Supplier of the Year for 2004.

According to Weyerhaeuser, Harper/Love earned the award by bringing value through audits and assessments, involvement and support of Weyerhaeuser's education process, assistance with quality audits for key Weyerhaeuser suppliers, and assistance with improvement programs.

Harper/Love General Manager Bill Kahn comments, "We work hard to contribute to our customers' success beyond the products we supply. We are grateful for this recognition and will continue to earn it every day."

Leaders in the science
of making
good adhesives better™

Harper/Love Adhesives Corporation
11101 Westlake Drive
P.O. Box 410408
Charlotte, NC 28241-0408
800-438-3066 • www.harperlove.com
e-mail: salestech@harperlove.com

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In this issue:

- Nanotechnology in corrugating
- Score cracking: causes and cures
- Water chillers: worth their cost?

XM-5 PENETRANT

XM-5 Penetrant is a conditioning agent which facilitates adhesive release into paper substrates. By reducing surface tension, XM-5 Penetrant assists the liquid phase of starch adhesive to migrate rapidly into the paper substrates to be bonded. This third generation penetrant was developed to penetrate and assist bonding of liners coated with synthetic polymers. The chemical composition of XM-5 also allows it to penetrate even the most difficult to bond substrates, including preprinted liners with a varnish overcoat.

XM-5 also helps retain moisture in the sheet to prevent overdrying and reduce the risk of score line cracking.

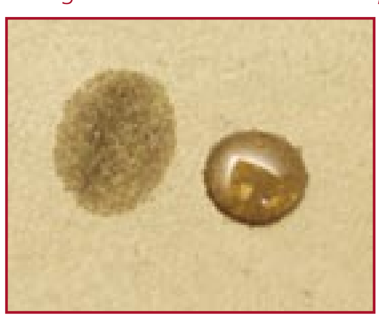
Benefits

- Enhanced starch adhesive penetration potential
- Helps reduce score line cracking
- Helps sheet retain moisture
- Low foaming action
- Consistent performance
- Easy to use

Features

- Very effective surface tension reduction
- Precise quality control
- Convenient drum or bucket containers are available

Our laboratory uses an electronic timer to measure penetration of liquids through various substrates. This sample combination stopped the timer at one second.



Plain water bead on right was applied first. At the time of the photograph, it had been sitting on the paper surface for several minutes. The spot on the left shows where water with XM-5 penetrant absorbed instantly.