NOVEMBER 2009

ADVANCED ADHESIVES REPORT

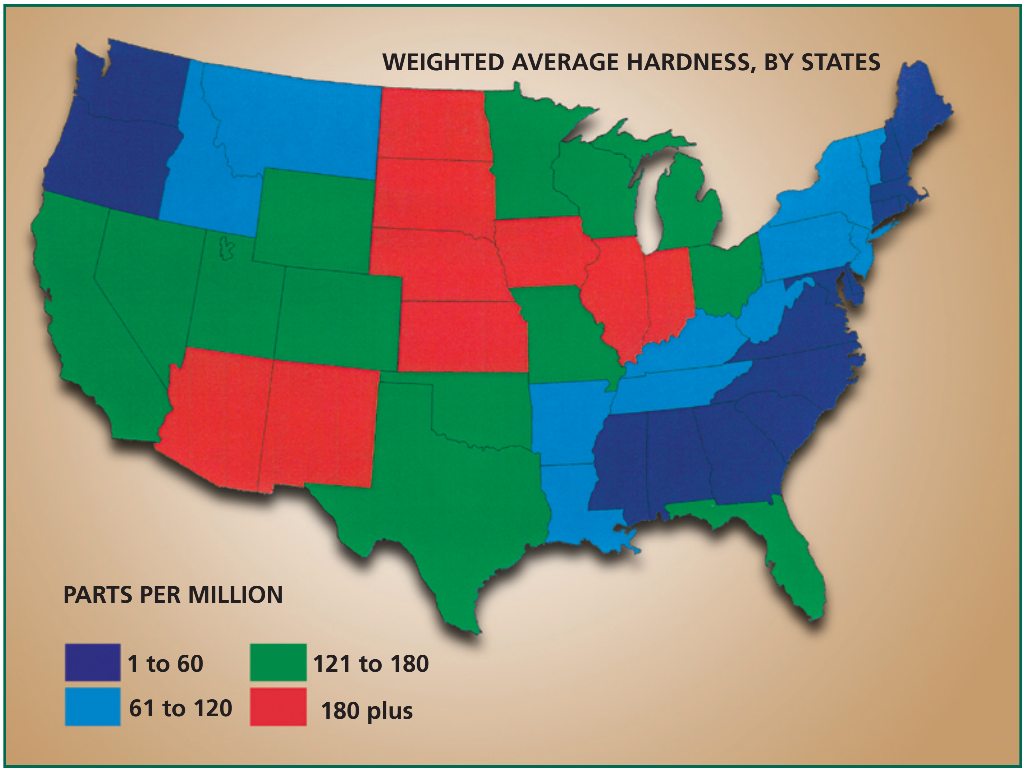
Your corrugating newsletter from Harper/Love Adhesives Corporation

Hard water? Easy fix.

By Bill Kahn

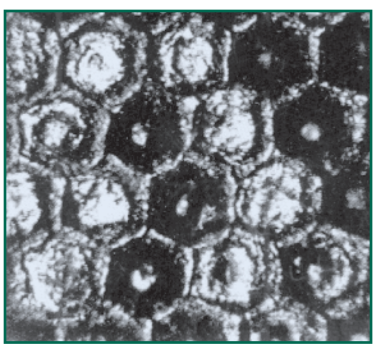
Hard water is an issue in many box plants across the country and can result in serious problems with adhesive transfer and application on the corrugator.

Hard water is high in dissolved minerals, both calcium and magnesium. As water moves through the soil and rock, it dissolves small amounts of these naturally occurring minerals and carries them into the ground water supply. Rainwater is acidic, due to the carbon dioxide picked up in the atmosphere. (Water and CO_2 make carbonic acid, a.k.a. acid rain.) This acid water dissolves the limestone, iron and other minerals in the soil. Water is an excellent solvent for calcium, magnesium and titanium, so if these minerals are present they will end up in your well or municipal water supply.



This map from a 1932 U.S. Geographical Survey shows the average water hardness of water supplied by public water supply systems across the U.S. The data is still pertinent because the makeup of the soil and mineral deposits has not changed significantly since the survey.

When hard water is used to make starch adhesive, these inorganic compounds will plate out or build up on the glue rolls and both clog the cells as well as create a milky-white haze on the surface of the roll. This clogging and buildup effectively reduces the usable volume of the cells and limits the amount of adhesive that the cells can carry and transfer to the medium.



Even if your city water is of minimal hardness you may have a water hardness issue if you use water from your in-plant treatment system to make adhesive. The chemicals used to treat wastewater, as well as the clay used to filter it, will increase the hardness of the treated water to a level that will be a problem in the adhesive because of its high pH. In an alkaline environment such as adhesive with a pH of 11.5, calcium carbonate readily comes out of solution and sticks to metal surfaces.

Minerals in the water are measured by parts per million (PPM) or by grains per gallon (GPG). We have found that water hardness in excess of 60 PPM (3.5GPG) will cause problems.

The solution is relatively simple. Our Calciban™ product is designed to be added to the adhesive and will serve to keep inorganic materials in suspension so they can be applied with the adhesive to the glue lines and not deposited on the glue roll. It only takes a few ounces of Calciban in each batch of starch to ensure you have no issues from water hardness.

Steam traps:

What's hot, what's not

by John Kohl

Energy costs are a large portion of the operating cost of a corrugated box plant. Even with the recent drop in oil prices, a plant must strive constantly to control energy usage and waste.

One of the best ways to reduce energy costs is to maintain and upgrade the steam system for the corrugator. This can be accomplished in many ways, including the installation of a high-pressure, high-temperature, condensate return system. These systems can pay for themselves in a short period of time and continue to save on energy costs in the long term. By returning the condensate to the boiler at a higher temperature than the ambient makeup water there is less energy consumed to heat the water back into steam and there are additional savings by eliminating the need to treat the makeup water with chemicals.

Steam supply and condensate return lines should be insulated to reduce heat loss due to radiation. A typical 4" diameter steam line supplying 150 psig steam, loses 850 MBTU per year per 100' of pipe. If a box plant has 250' of 4" supply and return lines uninsulated, the energy loss is substantial. Even small section of missing insulation will add up to additional energy costs. The annual cost of 250' of uninsulated steam lines can be calculated by:

Current cost of steam = $4.50/MBTU

250 ft x 850 MBtu/ yr per 100 ft = 2125 MBTU/yr

2125 MBtu x $4.50/MBtu = $9,562.00 per year

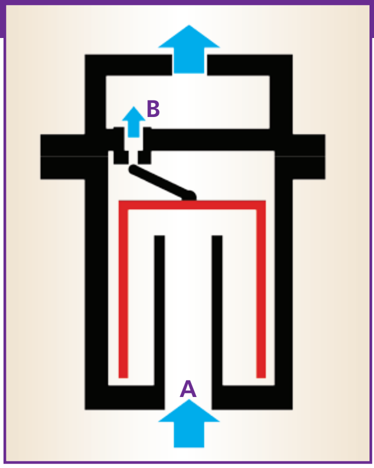
Steam traps are one of the most frequently overlooked opportunities for energy savings and corrugator efficiency in a box plant. If the traps are not functioning properly, steam may not remain in the vessel long enough to transfer its heat energy to the vessel, and subsequently to the liners. Condensate can act as an insulator inside a steam vessel. A trap that isn't cycling properly may leave the vessel waterlogged and cause a lack of heat transfer. This, in turn, may cause poor bonding and lower corrugator speeds.

There are three primary types of traps:

1. **Mechanical—inverted bucket or float**
2. **Temperature—bimetallic or thermostatic**
3. **Thermodynamic**

Mechanical traps

The inverted bucket trap is a mechanical trap that has been in use since the early 1900s. It is used on a large percentage of corrugator steam systems due to its efficiency and low maintenance needs. The bucket trap operates on the difference in density of steam and water (condensate). Steam entering the trap causes the bucket to float and closes the discharge valve at the top of the trap. As condensate fills the trap the weight of the bucket causes the bucket to sink and the valve opens, releasing the built up condensate. The bucket trap also has the ability to vent the air and CO_2 while under load. This type of trap is easy to check for proper function by listening to the sound of the bucket dropping after each cycle with a stethoscope or monitoring temperature change on the condensate pipe exiting the trap.



BUCKET TRAP
The most common type of steam trap is an inverted bucket trap. Steam and water enter at A. Initially the steam pushes up the inverted bucket (in red). When the trap fills with water, the inverted bucket will drop and the water will be blown out into a condensate line at B. The bucket then rises again and the hole at B closes. The cycle repeats itself.

In a float ball trap, rising condensate lifts the float, which opens a valve to release the condensate.

Both of these types of traps usually fail in the open position, allowing steam to flow through the system. The main drawback of this type of trap is that they do not vent air well when not under load. This causes the entire steam system to have a virtual air lock on startup, making it difficult for it to heat up until all the air is vented. Some plants open bypass drains and valves during startup to release the trapped air in the system, speeding up the heating of the vessels.

Thermostatic traps

There are two types of thermostatic traps, bimetallic and balanced pressure. Both operate and release condensate by using the difference in temperature between live steam and condensate.

A balanced-pressure trap uses an element filled with a liquid that expands when heated with condensate to close the valve and cools from the surrounding air to open the valve and release condensate.

The bimetallic trap uses a bimetal element operating the same way to perform the same function. Both of these traps are well suited for removing air from a steam system during startup, as they remain open when cold and close when up to temperature. The drawbacks of these traps are that they do not vent air and CO_2 well under load and they don't handle flash steam well.

Thermodynamic traps

Thermodynamic steam traps operate by changes in fluid dynamics as opposed to temperature change or the fluid level of condensate. The trap cycles by using the dynamic effect of the flash steam as it passes through the trap. As the hot condensate flows into the trap it drops in pressure and releases flash steam. The flash steam is rapidly expelled from the trap on the outlet side causing a reduced pressure that draws the disc closed. When the flash steam above the disc valve drops in temperature and condenses, it has a lower pressure than the inlet side where the condensate is at the pressure of the steam system. This higher pressure cause the cycle to repeat itself. The main limitation of these types of traps is that they do not function well in a system that does not have a large pressure differential across the supply side and condensate return side.

Proper functioning is critical

Whatever type of steam system your corrugator has, the traps must function properly to maintain vessel temperature and ensure proper heat transfer to the paper. Maintenance departments should have a planned PM schedule to check traps for proper function on a regular basis. The schedule should also include replacing or rebuilding worn traps before they fail and cause lower productivity or waste from poorly bonded board. The U.S. DOE recommends traps be checked monthly and replaced every 3 to 4 years.

A steam trap that has failed in the open position acts as a steam leak and results in wasted energy costs to a box plant. The lost energy cost can be calculated by using the volume of a steam leak multiplied by the cost of steam and the operating hours of the steam system. For a system operating at 150 psig the flow through a 1/8 orifice trap is 38 lbs per hour.

38 lbs/hr trap leak x 520 hr/mth x $10/1000 lbs steam

=38 x 520 x 10 = $197.60/month per trap

This costs doubles to $395 per month when the trap completely fails in the open position and vents 76 lbs of steam per hour into the return lines.

Don't forget to clean and replace the strainers in the steam lines frequently. They collect rust and sediment from the condensate and steam and are there to protect the traps. Inverted bucket traps are not as sensitive to dirt clogging as some of the newer, more sophisticated float or thermostatic types.

HOT TIP!

Preheating single face liners and flute tips helps supply heat energy to the glue line more efficiently.

By Bill Nikkel

Recently I worked with the Harper/Love R&D lab on a project to help us understand better how preheating the double face liner and the flute tips of the single face web contribute to heating the glue lines.

We used our laboratory double backer simulator and a hypodermic-style temperature sensor to measure the glue line temperatures, which were displayed on a digital readout.

To compare findings directly we looked at a double face liner and a medium with identical basis weights of 26 lbs/msf and assumed the following conditions:

- Typically the adhesive covers about 25% of the overall board area.
- When adhesive is applied to the flute tips of a 26 lb medium that means it has contact with 6.5 lbs of medium (25% of 26 lbs).
- When it contacts a 26 lb liner it will also contact 6.5 lbs of that liner (25% of 26 lbs).
- A typical double facer adhesive application of 1.25 lbs dry starch/msf, which at 25% solids amounts to 5 lbs of liquid adhesive/msf of board.
- The hot plate temperature of the simulator was kept at 300°F.
- Specific heat of paper averages 0.45 and specific heat of liquid starch mixture is 1.

The heat energy required to raise the temperature of an object can be calculated using the formula:

$Q = c*m*\Delta T$ where Q is the heat energy required, c is the specific heat, m is the mass and ΔT is the change in temperature required.

Increasing the temperature of the flute tips of a single face web with a 26 lb medium 10°F requires 0.45 x 6.5x10 = 29.25 BTU.

Increasing the temperature of the portion of the 26 lb double face liner which will be in contact with the adhesive (25% of the area) by 10°F, also requires 0.45 x 6.5 x 10 = 29.25 BTU.

Increasing the temperature of the 5 lbs of adhesive will require 1 x 5 x 10 = 50 BTU.

So, the heat energy available in either the flute tips or the contacting liner can raise the glue line temperature by almost 6°F (29.25 BTU versus 50 BTU)

Heating the flute tips by 10°F required only 29.25 BTU to be supplied by the preheater, but heating the contacting portion of the double face liner to be raised 10°F required the entire double face liner web to be heated 10°F and therefore required 0.45 x 26 x 10 or 117 BTU—four times more than supplied to the medium.

Conclusions

- When producing single wall board, operators should consider running with the flute tips of the single face web against the preheater drum to improve speeds (as long as they are still able to control warp) and continue to preheat the double face liner on its dedicated preheater.
- When producing double wall board, the lower single face web should be run with its liner side against the preheater and the flute tips of the upper single face web should be run against the upper preheater. The double face liner should of course still be heated on its dedicated preheater.
- In general, it makes sense to maximize preheating of all webs prior to their entry into the hot plate section to reduce the amount of heat required which subsequently has to be transmitted from the hot plates through the insulating liner in order to finalize setting the bond.

Machine manufacturers may also want to consider adding additional flute preheating equipment in the area of the glue machine to supply heat energy more efficiently to the glue line.

Leaders in the science
of making
good adhesives better™

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Use Calciban™ to keep your glue rolls clean and efficient

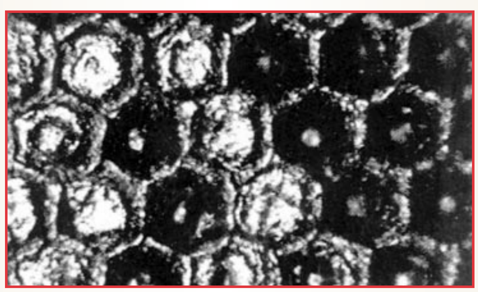
Calciban prevents calcium buildup that can cause adhesive transfer problems.

Inorganic compounds in your adhesive water can cause calcium buildup on your glue rolls. These deposits, which appear as a milky-white haze on the roll surface, clog cells and reduce the amount of adhesive the cells can carry. This creates a risk of bonding problems and increased waste.

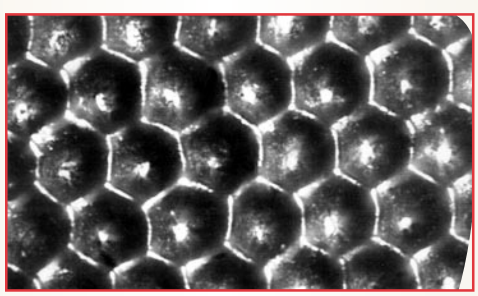
In also means lost productivity when you need to shut down for time-consuming cleaning operations.

Just 3 to 6 ounces of Calciban in a 300-gallon batch of adhesive can prevent this buildup and the problems it creates. It can be post-added to the batch, or to starch in a storage tank.

At an investment of only about $1 per batch, Calciban is low-cost insurance against the problems of calcium buildup.



The problem: *Inorganic compounds in adhesive mix water can clog cells in your glue transfer rolls.*



The solution: *Used regularly, Calciban keeps glue-roll cells clean and efficient, for proper adhesive transfer.*

Other uses for Calciban:

- **Add to cooling water in closed-loop systems**
- **Add to flexo wash water**
- **Add to boiler feed water**

To order, contact your local Harper/Love representative or call us toll free at 800-438-3066.