



# ADVANCED ADHESIVES REPORT

Your Corrugating Newsletter from HarperLove

## COLD WEATHER OPERATIONAL CHALLENGES

*A little preparation can prevent a lot of problems*

By Rex Woodville-Price

**Wintry weather can have a profound impact on our daily lives, so logically, box plants also have to deal with the effects of the cold. Let's look at some areas which are affected by winter and some of the steps we can take to minimize its negative impact.**

### ADHESIVE FORMULATION

Before the advent of modern adhesive mixing equipment, one of the most common changes a box plant did to compensate for cold weather was to run a winter adhesive formula. This was primarily to compensate for differences in incoming water temperature. The colder the incoming city water is, the greater the amount of steam energy that must be introduced to heat it. By its very nature, steam condenses back into water when it gives up its latent heat by evaporation. Colder water means more condensate is produced to dilute our formula.

To counteract this dilution, today's automatic starch kitchens use an ingenious strategy. When heating a volume of water to a preset temperature, the kitchen's control system does not add the complete amount required, it leaves out a small portion. After the water is heated, it is weighed again and water is added to complete the missing amount. This is generally shown as a finish water step in the recipe. This process ensures the same amount of water goes into each batch regardless of the temperature of the incoming water. During cold weather, the steam lines that feed the mixer might accumulate more condensate, so this feature will also compensate for that extra water.

### STEAM SYSTEM

Cold weather puts a greater demand on the entire steam system. Some plants still heat their building using the same boiler that supplies steam to the corrugator. Heat losses through uninsulated pipes and valves will be greater at lower ambient temperatures. Paper is another item affected by temperature. Paper that is stored outside will be colder and require more heat energy from the preheaters to bring it up to ideal bonding temperature.

Boiler makeup water coming from the municipal water supply will be colder, which will further tax the deaerator system. Ensure it is in good working order and pressurized to the correct setting so it can do its job properly. Sudden high steam demand increases the possibility of water carryover, a condition where water is pushed into the steam supply lines along with steam. Verify that the systems that control water level are properly adjusted. Monitor and record stack temperatures. A rise in flue temperatures is usually an indication of buildup in the tubes or leaks in the baffles. Either of these conditions will lower boiler efficiency. Plants using heavy fuel oil (bunker) that needs to be heated, should make sure tank temperature controls are in good working order. It is important that transfer lines are insulated and have sufficient trace heating.

### HUMIDITY

We tend to think that the major impact of winter is lower ambient temperatures, but since cold air holds less moisture, the relative humidity is also lower. Lower humidity can bring about problems with board drying too much and then causing cracked scores on the converting side. Running board off of the machine with higher moisture content will help combat this issue. It is helpful to check board moisture at the stacker and establish targets based on feedback from the converting operation. Board moisture content can be quantified using a moisture meter (of the type used for measuring moisture in wood) or by the weight loss method, using a scale and an oven. Adding extra penetrant to the adhesive will help drive some of the adhesive's moisture into the paper, which will help produce board with higher moisture content. This can be a useful tactic to help reduce score cracking.

### WET STRENGTH

Running MRA or WPA board presents additional challenges in cold weather. The single face bond is usually the most challenging to produce a moisture resistant bond. This is due in part because the single face web is more susceptible to temperature drops. Drafts from open windows, ventilators, or doors can cool the single face web while it is on the bridge. Thermosetting resins require a temperature above 125°F

## COLD WEATHER OPERATIONAL CHALLENGES (continued)

(52°C) to crosslink and cure. Once the temperature of the board drops below this minimum, the reaction stops irreversibly and will not start again, even if the temperature is raised.

Achieving adequate stack cure can be difficult in cold weather because drafts and lower ambient temperatures in the plant will cool the board. This is exacerbated by the low relative humidity during colder weather. Thermosetting resins cure best in hot and humid environments such as the inside of a stack of corrugated board when it comes off the stacker. Care should be taken to keep this moisture and heat energy in the stacks as long as possible to promote proper curing.

### ADHESIVE SYSTEM

Uninsulated adhesive transfer lines running against outside walls or the roof, have a potential for heat loss. This could deliver colder adhesive to the machine. During cold weather, positive pressure single facers can quickly cool the adhesive since they are now drawing colder air. Cold adhesive brings about several problems such as higher viscosity, increased consumption, lower penetration and lower machine speeds.



### WATER TREATMENT SYSTEM

Cold weather can also pose some problems for a plant's water treatment system. Some of the chemicals used as flocculants or coagulants are freeze sensitive and should not be allowed to freeze. Much as caustic soda will do; many chemicals also become more viscous as their temperature drops. This could alter delivery volumes, particularly when using timed feed rates, so addition amounts to the treatment tank should be monitored to guarantee accurate quantities.

The amount of time required to treat a batch can also be increased in cold weather because chemicals take longer

to pump in. Chemical reactions tend to occur more slowly at lower temperatures, so it is advisable to increase mix time slightly. One benefit to colder temperatures is that there is less bacterial growth and less airborne mold or yeasts.

### CHEMICALS

It is a good idea to check if any of the products used in the plant will be damaged if frozen. Read the label on the product or consult the SDS to be sure. Take care that those products which shouldn't be exposed to cold weather, be protected while in storage. Long weekends or holidays that entail a plant shutdown are of particular concern. Products can also freeze during transport; make sure that the transportation company is aware of which shipments are susceptible. Although we do not advertise it, most of our products are freeze-thaw stable.

### PEOPLE

It is fodder for jokes that someone was foolish enough to lick a frozen

flagpole and have their tongue stick to it. However, for someone less experienced with cold, grabbing a frozen handrail with bare hands is actually a plausible scenario and not at all amusing.

Don't overlook your people. New employees may have come from warmer climates and may not be familiar with severe cold. Hypothermia and frostbite may be foreign to them, or at the very least they may not recognize the onset symptoms. It may pay off, for the sake of safety to offer some sort training if you have any newcomers. The training should emphasize simple things like understanding that cold temperatures suppress thirst, so a conscious effort must be made to drink fluids in order to avoid dehydration.

Even if most of the work in a box plant takes place indoors, there are still some things that must be done outside, particularly by maintenance personnel. Fork and clamp truck operators often need to be outside. Extra care should be taken to ensure that docks, ramps and driveways do not present slipping hazards.

Winter does complicate corrugating operations, but a little thought and care can prevent most potential problems, and spring will be here before long.



# BONDING IN COLD WEATHER

By Lou Cuccia

## Colder ambient temperatures can have an impact on the bond.

- ▶ Adhesive temperature directly affects viscosity. For every 2°F change in temperature, adhesive viscosity will change by 10%. In winter, incoming air for positive pressure single facers can cool off the adhesive.
  - ✓ Monitor adhesive viscosity periodically. Remember to record the adhesive temperature. Consider that the adhesive which appears to be thick may merely be cold.
  - ✓ Ensure your TVC (temperature/viscosity control) system is in proper working condition. Check circulating pumps, water temperature (never over 130°F) and build up on coils. Verify that storage tank agitation comes on when the system is circulating warm water. If the TVC system has the option to cool the starch in hot weather make sure it is switched over to heat for the winter.
- ▶ High viscosity will increase application rate. If more adhesive is applied, it will require more heat energy to bond and dry.
  - ✓ Check board soaks with iodine for heavy or spotty glue lines due to incorrect application.
- ▶ The paper can be colder if it is stored outside or in an unheated warehouse.
  - ✓ Check paper temperature entering and exiting the single facer.
  - ✓ Check flute tip temperatures entering the double backer.
- ▶ Cold air drafts blowing into the plant from open doors or cold roll rooms can cool the paper. Unfortunately, this will usually cool one side more than the other which can create additional problems.
  - ✓ Check side to side paper temperatures.

# CAUSTIC SODA AND COLD WEATHER

By Rex Woodville-Price

Caustic soda is an essential and vital component of corrugating adhesive. Even though it is used in relatively small quantities, it has a big impact on the performance of the adhesive. Liquid caustic soda, perhaps more than any other chemical in the plant, is affected by cold temperatures. Particularly susceptible to cold temperatures, is the 50% variety commonly used in the US. Using and storing caustic soda in cold weather makes it particularly important to pay attention to the factors that can affect it.

As the temperature of 50% liquid caustic soda drops below 53°F (12°C), sodium hydroxide begins to drop out of solution and crystalize. When this phenomenon occurs, the denser precipitate will settle to the bottom of the tank. This will cause changes to the concentration level of the caustic and could bring about a rollercoaster effect in the gel temperature of the adhesive. Since only a small amount of caustic soda is used in a batch (typically about

one half of one percent), a small variation in quantity will have a significant impact.

The viscosity of liquid caustic soda is also affected by cold temperature. Although this causes fewer problems nowadays because most modern starch mixing equipment weighs the caustic soda before it is added, it can still cause problems for the caustic pumps. 50% caustic soda becomes difficult to pump

Automatic temperature control systems are recommended for bulk liquid caustic storage tanks in order to maintain a constant temperature above its “freezing point”. It is normally set between 85-90 degrees F (30-32°C).

This will prevent the sodium hydroxide from crystalizing and precipitating out; maintaining a constant concentration. It will also aid in keeping the viscosity at the proper range to avoid having any issues pumping it to the starch kitchen or the water treatment system. Electric heating elements in the form of tape (also known as trace heating) are commonly used to

keep pipelines carrying caustic soda from freezing. This tape is normally placed under the insulation to increase its effectiveness.

Paying attention to a few details and ensuring the equipment is in good operating condition can avoid a lot of problems when using liquid caustic soda during the colder months of the year.

### LIQUID CAUSTIC VISCOSITY

At 68°F (20°C), 50% liquid caustic has a viscosity of 115.0 centipoise.

At 86°F (30°C), 50% liquid caustic has a viscosity of 47.7 centipoise.

At 122°F (50°C), 50% liquid caustic has a viscosity of 16.3 centipoise.

around 60°F (15°C). As caustic flow rate slows down, it will take more time than programmed to deliver the required volume. Some mixing equipment may even time out and give an error message.

Though these problems can be insidious, they can be minimized if precautions are taken. Insulation on the caustic storage tank and pipelines will aid in maintaining appropriate temperature.

- CAUSTIC SODA AND COLD WEATHER BONDING
  - BONDING IN COLD WEATHER
  - COLD WEATHER OPERATIONAL CHALLENGES
- In this issue:*

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## 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 over-drying 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.*



*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.*