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ADVANCED ADHESIVES REPORT

Your corrugating newsletter from Harper/Love Adhesives Corporation

Coping with cold

By Rex Woodville-Price

Wintry weather can significantly affect your operational routines. A little preparation will keep you running smoothly.

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 assures 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.

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

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 (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.

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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 MSDS 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.

Personnel

Don't overlook your people. New employees may have come from warmer climates and may not be familiar with severe cold. It may pay off, for the sake of safety to offer some sort training for newcomers. The training should emphasize simple things like understanding hypothermia and frostbite. They should know that cold temperatures suppress thirst, so a conscious effort must be made to drink fluids in order to avoid dehydration. Cold objects should not be handled with bare hands.

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.

Caustic soda really hates winter

The fifty percent concentration we use in the U.S. is particularly susceptible to colder temperatures

By Rex Woodville-Price

Liquid caustic soda, perhaps more than any other chemical in the plant, is adversely affected by cold temperatures. The 50 percent variety commonly used in the U. S. is particularly susceptible. Using and storing caustic soda in cold weather makes it important to pay attention to the factors that can affect it.

As the temperature of 50 percent liquid caustic soda drops below 53°F (12°C), sodium hydroxide begins to drop out of solution and crystallize. When this occurs, the denser precipitate will settle to the bottom of the tank. Since most caustic storage tanks draw from the bottom, the pump will soon pull this liquid with the higher concentration, which contains the settled crystals. Even if this worst-case scenario doesn't occur, when a new order of caustic is inevitably added it will agitate the crystals at the bottom of the tank. They will go back into solution and result in higher concentration.

These scenarios, to whatever severity that they may occur, 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.

Liquid caustic soda precipitation points

50 percent caustic soda solution precipitates at 53°F (12°C)

30 percent caustic soda solution precipitates at 34°F (1°C)

24 percent caustic soda solution precipitates at -2°F (-19°C)

Liquid caustic viscosity

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 percent caustic soda becomes difficult to pump 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 error messages.

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

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

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

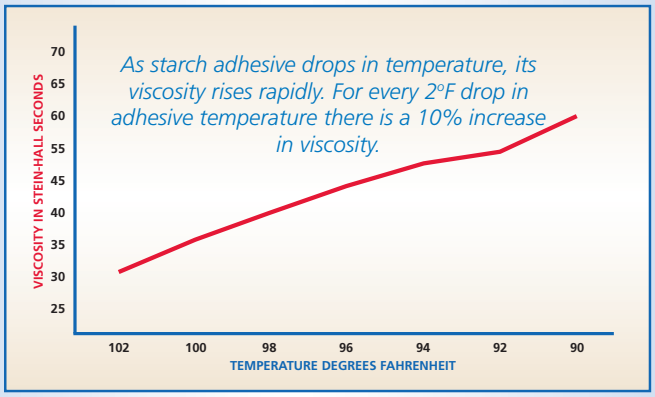
Though these problems can be serious, they can be minimized if precautions are taken. Insulation on the caustic storage tank and pipelines will aid in maintaining appropriate temperature. Automatic temperature control systems are recommended for bulk liquid caustic storage tanks in order to maintain a constant temperature above its freezing point. It is normally set between 85°F to 90°F (30°C to 32°C). Ideally, there will be an agitator to help keep the solution homogeneous.

These controls will prevent the sodium hydroxide from crystallizing and precipitating out, thereby 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.

In Europe, it is common to use more dilute forms of liquid caustic (30 percent is typical). There are some advantages to this because the freezing point (minimum temperature of stable solubility) of more dilute caustic is much lower. More dilute caustic requires larger volumes to achieve the same gel point, so it less susceptible to minute changes in addition rate. Lower concentrations of caustic solution are also marginally safer than their more concentrated equivalents. A possible disadvantage to using these more dilute versions is that as larger volumes are required, larger storage tanks may be needed. Also, transporting larger volumes could increase transportation costs, since we are in essence paying to haul water.

Bonding in cold weather

Adhesive temperature directly affects viscosity, which directly affects the quality of the bond. Here are some things you can do to compensate for cold-weather changes.



By Lou Cuccia

1. Adhesive viscosity, finished batch temperature and gel point should be checked and recorded for every batch made in a manual system, and at least twice per shift on an automatic system. Adjust formula for finished batch temperature if needed.
2. Check adhesive viscosity, temperature and gel point at the machine twice per shift.
3. Check viscosity and temperature at the storage tanks twice per shift.
4. Always take a related temperature with every viscosity measurement.
5. Always preheat your viscosity cup.
6. Check your TVC (temperature/viscosity control) system to assure proper working condition. Check circulating pumps, water temperature and build up on coils. Adjust temperature, never over 130°F, and circulation time if needed. 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.
7. Check board soaks for heavy or spotty glue lines due to poor application rate and transfer.
8. Check side-to-side paper temperatures due to cold air drafts, open doors or wrap arm parallel issues.
9. Check paper temperature entering and exiting the single facer and hot plate section.
10. Check flute tip temperatures entering the double backer. Temperatures should be at least 10°F over gel point.
11. Check heated vessels and trap temperatures for condensate buildup.
12. Check temperature and agitator on caustic holding tank. Be sure all pipes are insulated and heat tape is added where appropriate. This also applies to the piping from the caustic holding tank to the starch platform. Remember, 50 percent caustic will freeze and separate at 50°F.

Leaders in the science
of making
good adhesives better™

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