

Back to School on Adhesives

by Tom Clarke

In the April 2002 issue of *Paperwise* we looked at trouble shooting corrugating starch adhesives in a basic way. Viscosity and gel point were discussed from the ingredients perspective. In this edition of *Paperwise* we will examine the adhesive system from the perspective of producing and maintaining adhesive based on a sound recipe.

Adhesive Mixing Systems

Presently in North America, adhesive preparation equipment ranges from older, two tank "Pratt/Ringwood" type low shear set-up to the modern high shear systems that can yield batches as large as 540 gallons or as small as 100 gallons. There are generally two storage tanks of varying capacities. In some cases, there may be a third storage tank for waterproof formulas, although dosing systems are slowly replacing this storage tank. Regardless of the equipment's age, all are effective in making good quality adhesive when well maintained and calibrated.

All corrugator adhesive suppliers strive to provide quality products and recipes for the preparation of stable corrugating adhesive. If viscosity and gel point variations become persistent, there are steps that can be taken to troubleshoot the problem before a wholesale formula change is needed. Here are some pointers:

For Older Mixing Systems

1. *Verify that the mixing blades have been maintained regularly.* There should be six blades – three on each side of the mid-line of the shaft and evenly spaced.

The pitch of the blades should be 12 to 15 degrees and each set of three should have the pitch arranged opposite to the other set across the mid-line of the shaft. Proper blade pitch promotes good top-to-bottom agitation of the adhesive.

Observe the adhesive flow of a batch during preparation. The motion should be across the top of the mass curling downward at the mid-line of the mixing tank, then across the bottom and rising at each end wall of the mixer. Often, when replacements are installed, the pitch of the blades is

altered or they are all set in the same direction. Surprisingly, there have been instances where one or two blades are left off because the motor is stalling out. In that situation, replacing the motor with a higher horsepower drive would be the best solution.

2. *Verify that the shear time for the carrier is consistent, particularly in single tank setups.* For two tank systems, the drop rate or pump over rate for the carrier must be constant or final batch viscosity variations can result.

In Automatic Systems

1. *Periodically check that the shearing mechanism is tight on the shaft and not able to slip during high shear action.* The maintenance department can include this routine as part of the starch kitchen preventative maintenance program.

2. *Verify that the feed from the borax and caustic storage is flowing freely.* Both borax and caustic solutions can crystallize and obstruct the feed system flow causing insufficient quantities in your adhesive formulation. This is important because too slow or too fast a delivery of caustic can change the rheology of the batch and the final viscosity.

3. *Calibrate the load cells on a regular basis.*

For all Systems

1. *Keep good records of batch preparation –including final viscosity, measured gel point and final batch temperature.* The batch should finish as close to 100°F as possible. In automated systems, viscosity and batch temperature are stored in a computer log. Gel point should still be routinely checked.

2. *Check the weighing and measuring systems.*

3. *Check the delivery and return pumps for cavitation or worn vanes.*

4. *Check air pumps for leaks and worn parts.*

5. *Walk the piping system to and from the corrugator looking for sharp turns or other restrictions.* Look at the outlet valve position to the glue pans. Is it partially closed? Why? Anything but full open causes turbulence and increases shearing of the carrier.

6. *Check for starch deposits.* Depending on the practicality of your piping arrangement, find a convenient horizontal section and unscrew it or cut it out. You may be surprised to find that a three-inch pipe has an effective diameter of one inch or less because gelled starch has deposited in the

pipe and constricted flow. This situation can cause back pressure at the pumps, poor circulation and viscosity changes in the pan.

Note: Every starch adhesive has a carrier! It is the cooked portion that suspends the raw starch. When people say, “I don’t use any carrier”, they really mean that the cooked portion is ‘pearl starch’ and not one of the specialty modified carrier starches that are available on the market.

Temperature

We previously mentioned the importance of batch-to-batch temperature consistency. Remember the rise or fall rule of viscosity: a 2°F change in temperature will cause a 10% change in viscosity.

- Make sure the other temperature control systems (TVC system, agitation timers, single face water jackets, etc.) are functioning properly and are calibrated at least twice a year. Maintain records.
- Viscosity should never be recorded without the accompanying temperature at which it was measured.
- Are the pan temperatures running above 110°F? Find ways of reducing the temperature such as water jackets or baffles (is there cold water circulating through them?), better adhesive flow through the pans, or reduce TVC temperature in storage. If these methods are not effective, modify the formula to give you what the original equipment manufacturer (OEM) recommends as viscosity at the corrugator. Remember, it is what the flute tip picks up that is important, not what viscosity you have in the storage tank.

Glue Application

It is costly to replace glue roll – metering roll mechanisms. Yet, many plants neglect housekeeping and preventative maintenance of the single item that directly controls quantity and quality of glue application. Simple TIR checks, including checking the smoothness and parallel motion in metering roll-glue roll gap changes, and the removal and cleaning of the doctor blade on the metering roll, can have tremendous effects on bonding quality and warp of corrugated board. Simply replacing worn or nicked blades will add months or years to the glue mechanism’s life.

In single facers, a build up of adhesive on the glue roll outside the paper width can transfer to the lower corrugating roll and force the pressure roll away from the single face web enough to cause blistering, loose edges, and

shallow bonding. As little as a 0.0015-inch build-up can cause this effect on lightweight board combinations.

Dried starch adhesive on the doctor blade will cause striations (streaks) in the metering roll affecting the amount and uniformity of adhesive transfer to the flute tips. A piece of semi-gelled adhesive caught on the doctor blade can track as much as three inches across a portion of the metering roll, wiping off the starch on the glue roll and causing unbonded areas (or blisters) in the single face web.

When glue gaps are changed, always go past the intended setting and then return to it. This reduces the possibility that the metering roll may move out of parallel to the glue roll. Examine the toothed rail on which the mechanism slides for debris and clogs and clean routinely. Check for carriage looseness in the rails.

Change the doctor blade on the metering roll regularly. It can be nicked, gouged or split at anytime. This will cause film thickness variations and over time damage the metering roll. A doctor blade installed too tightly or out of parallel to the metering roll can distort (bow) that roll and cause variable glue application as a result.

The Last Word

There are several more do’s and don’ts related to the maintenance of a consistent and effective viscosity at the glue pan of the corrugator. The relationship of viscosity and gel point to the overall rheology of the adhesive can be explored too. Adhesive starch solids as calculated from the formula and ‘tank drop’ consumption can be used to verify the accounting method of determining adhesive consumption. All the above will be reviewed in a future article.

If you would like more information on corrugator adhesives or other technical topics, contact your Smurfit-Stone Sales Manager or call us toll free at 1-877-785-7835 or e-mail us at paperwise@smurfit.com