ADVANCED ADHESIVES REPORT

JANUARY 2001

Your corrugating adhesives newsletter from Harper/Love Adhesives Corporation

Finding your way in Miniflute World

The keys to success are precision equipment, disciplined maintenance, and careful starch management.

By Peter Snyder

The market for miniflute board is growing dramatically at about 12 percent to 15 percent per year. Small wonder: its great strength, combined with a smooth printable surface that competes with folding carton stock, make it attractive for marketers seeking both protection for their products and high-impact selling graphics in the same package.

Compared to running B and C flutes, the technical challenges of miniflute production are daunting. The higher volume of smaller flutes requires changes in virtually every aspect of the corrugating operation. There is less wiggle room, less margin for error.

The corrugator

In Miniflute World, there is no room for out-of-spec or worn-out machinery with sloppy tolerances. Adhesive application systems need to be equal to – or better – than OEM tolerances to deliver consistent, high-speed application of smaller quantities of adhesive.

It is not uncommon, for example, to find OEM minimum glue settings of 0.006" and Total Indicated Runout (TIR) of 0.002" on adhesive applicator rolls and/or metering rolls. If both rolls have a TIR of 0.002", the potential variation in the amount of adhesive on the glue roll is 0.004". We often discover TIR variations in excess of 0.004", even on fairly new equipment. These conditions will not allow operators to meter back the adhesive to a level that will allow high-speed production of flat board.

Miniflute in a nutshell

- Make sure your glue application system meets or exceeds OEM specs. It's possible to make and install rollers with TIR less than 0.0005". That should be your goal.
- Use a powerful high-shear mixing system for consistent, stable adhesive.
- Use minimum adhesive.
- Adhesive solids should be in the range of 28 percent to 30 percent.
- Adhesive viscosity should run 20 to 28 Stein-Hall seconds; 9 to 14 Love Cup seconds.

It is possible to manufacture and install application system rollers that have tolerances of 0.0005" (that's ten-thousandths; note the additional zero after the decimal point). This should be a goal of any corrugator interested in producing high-quality miniflute board.

Adhesive mixing

Powerful high-shear mixing equipment has a dramatic impact on adhesive quality, consistency, and the reduction in batch time. Among its key benefits is the elusive property of constant viscosity. With high-shear machinery, most starch adhesive formulations can now be compounded down to the base viscosity very quickly, eliminating the phenomenon of false viscosity. This means that once the adhesive is prepared and pumped over into storage, there will be no dramatic breakdown or loss in viscosity as the adhesive is used. This makes high-shear mixing a valuable tool for miniflute success.

And now, the sticky stuff

Since starch adhesive is water based, it makes sense to apply as little as possible and to compound the adhesive with the highest practical percentage of total solids. Most corrugating plants are running with formula containing 26 percent to 29 percent solids. Successful miniflute production will require solids percentages at the upper end of this range.

Dissolved solids – carrier starch and liquid adhesive products included in the formula – should also be relatively higher than commonly used for larger flute board combinations. A standard starch adhesive formula will have a dissolved starch/total water ratio of about 0.046 (200# carrier/4336# water). Miniflutes will need a ratio of 0.057 to 0.092. The purpose of this higher ratio is to ensure sufficient moisture is held on the glue line to fully gelatinize the adhesive, even at the reduced application levels required by miniflute board. This must be controlled with care, because a very high level of dissolved solids can retain too much water, which in turn could create warp problems.

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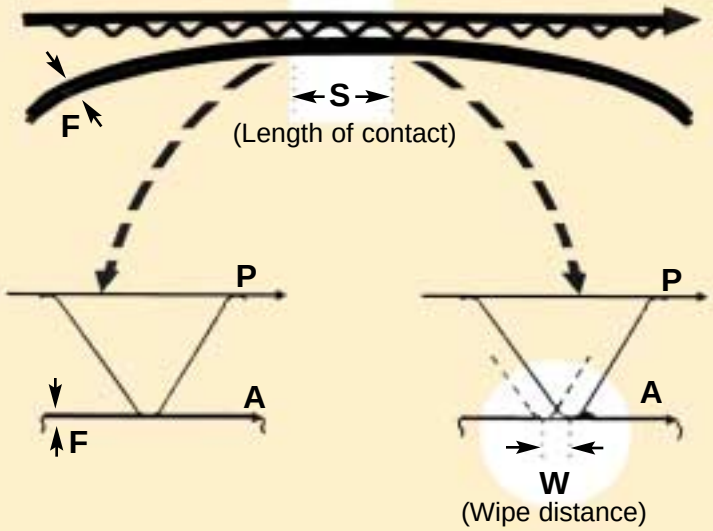
(Miniflutes, continued)

Finally, running viscosity has to be relatively low. The most successful miniflute operations have found that a high-solids adhesive (28 percent to 30 percent solids) run at a viscosity approaching that of water does an outstanding job.

Anthony Coleman's tips for successful miniflute operation

Technical Representative Anthony Coleman works out of the Charlotte office.

- **Heat, gaps, and parallel** must be maintained carefully. Make sure your operators have a heat gun and a set of feeler gauges.
- **Liner temperature entering** the machine should be between 190° F and 210° F. With the machine running, check operator side, middle, and drive side. If there is more than 15° difference, your wrap arms are probably out of parallel. Make sure the roll is shafted tightly and you have good tension. If you have adjustable roll stands, put them in the center position.
- **Check tension across the roll** when the machine is running. If you do it while the machine is down, you won't be able to detect wear in the wrap-arm mechanism. Equal tension across the web means equal heat transfer.
- **Wrap the singlefacer liner** to drive moisture to the glue line. Remember, moisture travels *toward* the hotter side.
- **When machine speed changes**, you'll need to change the amount of wrap, to control liner temperature. Less wrap at lower speeds; more wrap at higher speeds.
- **Use medium conditioners at high speeds.** More steam at higher speeds.
- **Too much heat on the double backer** will gel the starch prematurely, releasing moisture and causing blisters in the center where the moisture is trapped. Use "Backward is Better" reverse heat technique, or just turn off the heat in the first hot plate section.
- **Watch your ballast rolls.** They can cause hot plate deflection greater than the actual caliper of miniflutes, creating bonding problems.
- **Run a high-solids, low-viscosity adhesive** with a gel point of 146° F to 148° F, and a viscosity of 20 to 28 Stein-Hall or 9 to 14 Love Cup. High solids minimize water at the flute tips.
- **Miniflutes use more starch.** Make sure your system has a high-capacity pump and supply lines. If you have an open loop system with a standard check valve, you may need to install an adjustable pressure check valve.
- **If starch tends to push out** the front of the pan, install a dam.



A = Glue roll speed
P = Paper speed
If A/P - 96%
If A/P = 94%

W=S-SA/P
Assume S=1" W=1"-A/P
W=1"-.96 = .040"
W=1"-.94 = .060

Changing ratio by 2% changes wipe by 50%

Board and paper testing

Quality measurements eliminate guesswork

Send us your board and paper samples. We'll send you information you can use to monitor your operation and keep board-making variables under control.

Many corrugators use our board and paper testing services for ongoing quality control. They routinely send us samples; we perform specified tests and keep the results in a data base that over time demonstrates trends and helps establish benchmarks for quality board production. We also have the capability to investigate problems and recommend solutions. These services are available to any corrugator, without cost.

Board tests

- **Caliper:** Measure board thickness
- **Pin adhesion** (dry or wet): Measure the force required to separate corrugated board between the flute tips of the corrugated medium and its linerboard facings.
- **ECT:** Edgewise compressive strength determines the strength parallel to the flutes of a short column of combined corrugated board. This test predicts the compressive strength of the shipping container.
- **24-hour soak:** Small samples of combined corrugated board are soaked for 24-hours to evaluate the strength of the wet strength adhesive.
- **Glue line width:** The width of the glue lines as found on the liner are measured to give an indication of the amount of adhesive applied.

Glue roll speed ratio: little things mean a lot

Small changes in glue roll speed ratio can have large effects on wipe distance, the size of the glue bead, and the resulting adhesive add-on.

By Bill Nikkel

On most glue machines and finger-type single facers, flute tips make contact and wipe the glue roll surface for some distance, rather than make line contact. To make sure the adhesive ends up centered on the flute tip, the flute tip should move a little faster than the glue roll surface to create this wiping motion.

The size of the bead formed at the leading edge of a flute depends on thickness of the glue film and the wipe distance.

The greater the contact distance and the lower the speed ratio, the greater will be the size of the bead and the more adhesive will end up on the flute tip.

In the diagram (left), wipe distance W = S-SR.

S= Contact distance between flute tip and glue roll surface.

R= Glue roll speed ratio (glue roll surface speed/flute tip speed).

F= Glue film thickness.

Small changes in the speed ratio have large effects on the wipe distance W, and thus on the size of the bead and the resulting adhesive add-on.

For example, assuming a contact distance of 1 inch:

With a ratio of 96%, W would be 1-(1x .96) = 0.040".

With a ratio lowered to 94%, W would increase to 1- (1x 0.94) = 0.060".

A 2% change in the speed ratio creates a 50% increase in wipe distance, resulting in a significant increase in adhesive add-on.

There's more. For the whole story, ask your Harper/Love representative for the Technical Information Bulletin, "*How do glue roll speed ratios and the contact distance between flute tip and glue roll surface affect adhesive add-on for smooth and engraved glue rolls?*"

- **FEFCO #9** test: Samples of corrugated board are suspended in water with a weight attached. The time until failure is measured. This tests the wet strength bond in the "Z" or "shear" direction.
- **Linke test and MBI wet shear test:** Also measure wet strength in the shear direction.

Abby Bridgeman and Amanda Putnam check the results of a 24-hour soak test.

Dry pin adhesion test

FEFCO #9 test

Paper tests

- **Porosity:** This test measures the time for a specified volume of air to pass through a test specimen. Porosity measurements often can predict glueability and/or printability issues.
- **Cobb:** This test measures the amount of water absorbed by paper in a specified time. This helps define characteristics such as sizing, porosity, and absorptivity.
- **Water Drop:** This test measures the amount of time for a drop to absorb into paper. Various liquids are utilized such as water, caustic, lactic acid, and penetrant to predict issues with the substrate.
- **Moisture:** Paper samples are weighed, oven-dried, and weighed again to determine the percentage of moisture present in the original sample.
- **Basis Weight:** Utilizing the linear measurement of the area and weighing the mass, the grammage, or basis weight is calculated.

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IN THIS ISSUE:

Aquaseal™ W-150 wet-strength resin

Aquaseal W-150 is our "workhorse" liquid thermosetting resin. It features less than 1 percent free formaldehyde and offers excellent pot life and low batch shock properties. Excellent water-resistant glue line protection.

Uses

- Wet-strength corrugated board production
- Improve overall board quality for finishing

Operational benefits

- Exceeds TAPPI 24-hour soak tests
- Convenient liquid form
- Safe and easy to use
- Compatible with automatic starch kitchens
- Distinctive red color provides visual assurance of use
- No resins shock to the adhesive
- Low free formaldehyde: complies with OSHA regulations

Use 100 pounds per 700-gallon batch

Available in 55-gallon drums, 275-gallon totes

The Go-to Guys: forty-one and counting.

Since 1993, when we had just two technical service representatives in the field, we have made a concentrated effort to build the largest and best sales and technical service team in the industry. Today, we offer the expertise of sales representatives in thirteen territories throughout the Americas, and a large pool of technical talent who work wherever there is a need.

Corrugating operations are rich in technical challenges. Your customers' wants and needs are a moving target. We work with organic materials that change continuously. Equipment wears, fails, and develops gremlins. Turnover creates ongoing training and educational needs.

We've built this team to provide broad and deep technical resources for the industry. Our guys know every product specialty from miniflutes to triple wall, preprint to wet strength. They know corrugating, adhesive, and converting equipment inside out. They've maintained machinery, managed people, met production and budget objectives, and satisfied customers. They've walked in your shoes.

Whatever your problems and opportunities, we would welcome an opportunity to contribute to your success. Please don't hesitate to call.