August 2005

ADVANCED ADHESIVES REPORT
Your corrugating newsletter from Harper/Love Adhesives Corporation

Just how reliable are your splicers?

By: Bill Kahn

Without a doubt, reliable splicer operation is key to running an efficient corrugator that produces flat, quality board. Each time a splicer does not fire properly, or doesn't fire at all, the corrugator must be shut down until the problem is corrected. Meanwhile, production time is lost and the probability of making scrap on startup is high.

Single Splicer

To examine reliability of a single splicer is fairly straightforward. If it fails 10 out of 100 attempts, then its reliability will be 90 percent. Conversely, if a splicer has a reliability factor of 90 percent, then it will miss a splice about 10 times for every 100 tries.

This simplistic picture of splicer reliability is true only when one splicer is of concern. When many splicers are involved, as on a corrugator, the impact of all splicers on the overall system reliability is of concern.

INDIVIDUAL SPLICER RELIABILITY	FAILURES PER 100 TRIES		
	1 WEB	3 WEBS	5 WEBS
100%	0	0	0
99%	1	3	5
98%	2	6	10
97%	3	9	15
96%	4	12	19
95%	5	15	23
90%	10	27	41
80%	20	49	67
70%	30	66	83

3 Splicers (singlewall)

When running singlewall, three splicers are operating independently from each other, but not simultaneously. If each splicer has a reliability of 90 percent, the resulting system reliability would not simply be 90 percent. Rather, the system reliability would be defined by a closed mode probability analysis:

$$P\ \text{system} = 1 - \prod (1 - P\ \text{component})$$

where,

P = Failure probability for system or component

$\prod$ = Product of component failure probabilities

A seemingly adequate splicer reliability of 98 percent may not be sufficient. Even this high reliability rate for individual splicers will result in 6 failures out of 100 on singlewall, and 10 out of 100 on doublewall.

For a three-splicer system, with each splicer having a 90 percent reliability (10 percent probability of failure), the system failure probability would be calculated as:

$$P\ \text{system} = 1-(1-.1)(1-.1)(1-.1) = 1-(.9)(.9)(.9) = 0.271$$

In other words, the system will probably fail in 27 splices out of every 100 splice attempts, yielding a system reliability of only 73 percent.

5 Splicers (doublewall)

For doublewall, the number of splicers involved increases to five. Calculations performed as above for five splicers of 90 percent reliability is only 59 percent. This means that 41 of every 100 splicer attempts will lead to the corrugator being shut down. The numbers are staggering.

The table at left gives system failure rates based on the number of splicers involved and the reliability of individual splicers, assuming each to be the same. Actual calculations can be done with your measured reliability data. This data helps to stress the importance of 100 percent splicer reliability.

W. J. McNown of Mead-Westvaco and K.L. Ferguson of Solvay Paperboard, contributors to a previously published article on this subject, are gratefully acknowledged.

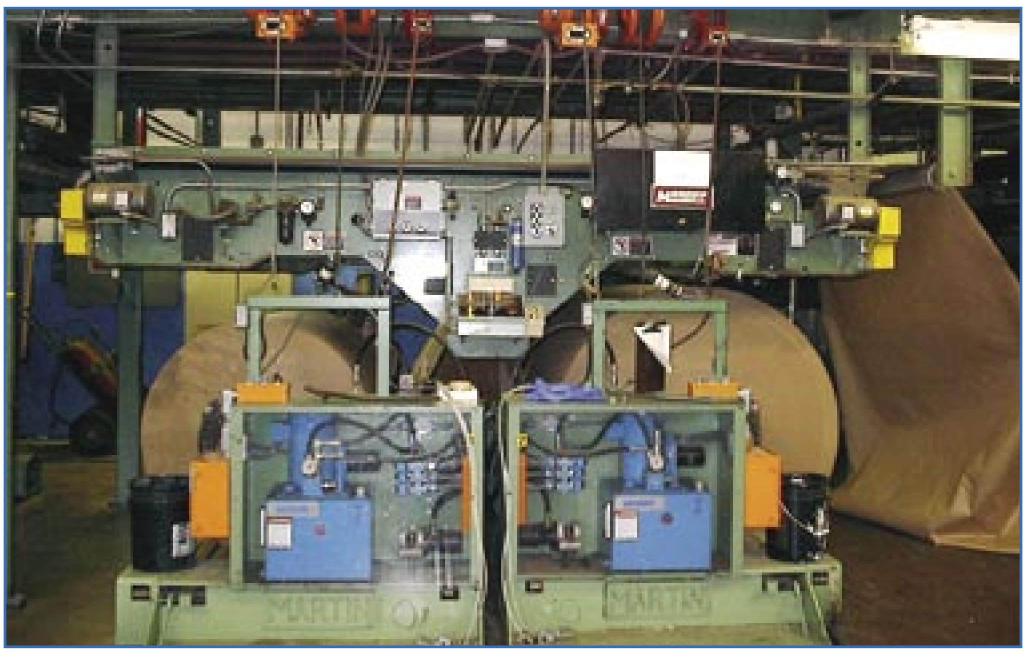
Simple checks for basic splicer problems

While most adjustments to a splicer should be left to personnel who have been extensively trained to do so, some problem conditions are fairly easy to detect and correct.

By Chris Polster

When running corrugators at high speeds, the condition of every component of the process becomes increasingly critical to dependable, consistent operations. Adhesive, paper, and machine conditions that are more forgiving at slower speeds all have a much greater effect on board quality and machine performance when pushing the upper limits of the speed range.

One factor that can have an enormous effect on machine uptime, board quality, and ultimately waste, is splicer dependability. The crew's ability to make successful splices consistently at high speed not only helps them reach production goals but also decreases the effects that machine speed changes have on warp profiles. If crews have to reduce machine speeds drastically to increase the chances of successful splicing, it will have a negative effect on production and also the ability to control warp on the machine. Missed splices also produce waste.



While most adjustments to a splicer should be left to personnel who have been extensively trained to do so, some problem conditions are fairly easy to detect and correct. If your operators start to see problems during splicing, check for these common causes.

1. Splicer rolls and roll stands out of parallel

If roll stands or rolls inside the splicer assembly are out of parallel, operators will often observe liners and medium wrinkling, the web going out of line during splicing or speed changes, and poor splicing efficiency. Trying to determine whether or not rolls or roll stands are out of parallel may seem a daunting task, but the condition is usually fairly easy to see. If a splicer roll or roll stand is out of parallel, in most cases, by watching the paper travel through the splicer, the operator can see the edge of the paper running offset to one side on or before the roll that is out of parallel. The operator simply lines up the edge of the paper on one side by eye to see if they all line up as the paper travels through the splicer. If the paper edge is running out of line on one of the rolls, it will most often do so on the roll that is out of parallel or on the preceding roll in the machine direction. If the issue is only visible on one roll stand and not the other, it is often the roll stand itself that is out of parallel.

2. Incorrect roll placement in a splicer

Many splicer manufacturers use a crowned roll for the contact roll in the splicer head. (This is the roll where splices are prepared and dual backed tape is applied before the splicer head is sent into the ready position.) These rolls are usually identified by an engraved strip on each edge of the roll. Sometimes, when rolls are taken out of a splicer for maintenance or mechanical problem, the crowned roll may be put into an idle roll or dancer roll position and an idle or dancer roll will be put into the contact roll position. This will lead to less than optimal splicer performance. This possibility can be checked by ensuring that the contact roll has the engraved edges.

3. Debris buildup on the splicer head assembly

Debris buildup on the splicer head assembly is one of the most frequently seen (and easiest to prevent) problems leading to poor splicer performance. This problem usually starts with too much lubricant applied to the worm screws of the splicer head assembly, which then becomes a magnet for paper dust and debris.

- Debris buildup on the *splice preparation* part of the splicer, or the part of the splicer around the splicer head when it is in the out position, can prevent the splicer from coming back to the out position correctly. The debris will be visible on the rail and worm screw that the head travels on in the area where the head comes to a stop in the out position. The buildup often prevents the splicer head from coming to a stop in a uniform manner. The splicer head is cocked out of parallel when the splice is prepared and indexed. This can lead to splices ripping out or paper wrinkling at the splice as the paper tries to right itself.

Just because a splicer is functional, it does not mean that the unit is performing at its best

- Debris buildup on the *splice ready* part of the splicer, or the part of the splicer around the splicer head when it is in the in position, can also lead to several splicing problems. Once again, build up on the screws and rail can cause the splicer head to not go into the ready position in a uniform manner. Also, debris and lube buildup on the splicer blocks and the inside of the head itself can act as a cushion when the splicer is fired, resulting in poor or uneven contact during the splice.

Crews can combat the problems caused by debris and lubricant buildup by wiping down these assemblies weekly as part of your regular PM program. It will also help to use a dry lubricant instead of oil or grease.

4. Buildup of adhesive-backed labels from mill rolls on rollers inside the splicer assembly

When a mill roll is running through a splicer, the adhesive tags placed on the roll by the mill will sometimes come off and adhere to an idler, dancer, or contact roller in the splicer assembly. The buildup of these tags on the splicer rollers will change both the diameter and finish on their surface. This can lead to paper walking back and forth as it travels through the splicer, poor contact during splicing, and even problems with warp. These labels should be removed during PM.

It is important to remember that just because a splicer is functional, it does not mean that the unit is performing at its best. For consistent success running high quality and high volume, your crews will have a far easier time doing so if all the components of the process are in optimal condition.

Technical questions and answers from the field

Is it normal Industry practice to increase starch application on the flute that is running on the top flute of the doublewall? One of our plants normally runs the starch gaps at .005" to .007" on the B flute. But when they run doublewall they have to increase the gap to .009" to .013" in order to get a good bond between flutes.

If you are increasing the B flute setting for DW, it indicates that you are lacking one of the two components, pressure or heat, needed to form a bond. Under normal running conditions, you should not have to increase starch settings. Often, an operator will increase the setting because the bond is marginal. This will only make the bond greener and now the operator has to slow down the machine in order for the heat to gel the larger amount of starch that is being applied. The right decision is to reduce the starch setting, which will take less energy to gel the starch and increase the speed of the machine. Another great tool for DW is a Jet Assist.

Which is more common: a single viscosity starch run at both stations; or dual viscosity with different viscosities at the SF and DB stations?

Dual viscosity systems are still being run on older finger machines. These dual systems are dual viscosity and dual gel point, due to the amount of heat that is generated at the nip. On newer fingerless machines, more plants are running single viscosity and single gel point systems very effectively.

What additives are being used successfully to enhance starch penetration on high performance liners?

Formulas have been adjusted over the years to address the dense fibers of high performance liners. They include increasing solids to 28 to 30 percent, increasing gel points to 145^0 to 148^0 F., and decreasing viscosity to 28 to 36 Stein-Hall seconds. These changes give a little more open time for penetration, green bond forming and strong dry bonds.

How does water float of medium affect starch bond in corrugated sheets?

A very fast water float will pull the water out of the starch prior to gelling and can leave a white glue line. We normally associate white glue lines with lack of heat, but an attribute of starch that affects bond is water holdout. The starch must have water present in order to properly gel and form a bond. If a low viscosity starch has lost its ability to hold the water on the glue line, while it is experiencing the swelling of the starch granules and bond formation, the water will be pulled into the medium and leave you with ungelled starch on the glue line. This will appear as a white glue line. Conversely, a very high water float will retard the penetration of the cooked starch and the result will be a brittle bond.

You are invited to e-mail your technical questions to: **experts@harperlove.com**

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In this issue:

Aquaseal Plus™ Outstanding performance. Superior wet strength.

This unique product combines water resistance and high performance in one easy-to-use liquid product.

- Reduces cost compared to using carrier starch for performance, plus resin for wet strength
- Stable viscosity
- Exceeds TAPPI 24-hour soak test
- Better bond quality
- Increased corrugator speeds on heavyweight grades
- Single, simple application
- Easy-to-use liquid for any manual or automatic mixing system
- Safe to use. FDA approved

For detailed technical information or a demonstration in your plant, contact your Harper/Love representative or call us toll free at 800-438-3066.