AUGUST 2012

ADVANCED ADHESIVES REPORT

Your corrugating newsletter from Harper/Love Adhesives Corporation

Better bonds make better board

Start by understanding the different time-temperature-pressure demands of the single facer and the double backer

by Rex Woodville-Price

The ultimate job of corrugating adhesive is to create a proper bond in the board being produced. This is achieved by a combination of time, temperature, and pressure. These three factors combine differently on the single facer than they do on the double backer.

The single facer

When making single face web at the single facer, even at moderate speeds the papers don't spend much time inside the machine, so there's not a lot of time, but there is plenty of temperature and pressure.

Less time: Time is the commodity in short supply. The bond has to occur in a fraction of a second because the time from when the adhesive is applied to medium and the moment the single face web is released from the nip and rushed up the bridge is very short; at higher speeds, the papers make contact for as little as 3 milliseconds.

Higher temperatures: Once the medium enters the corrugating labyrinth it has full contact with heated metal on both sides. Then, as it travels around to the nip point between the lower corrugating roll and the pressure roll, it is held against that roll by either vacuum or positive pressure (or metal fingers in older machines). This means that we can apply enough heat to the paper just before the bond. The medium was also preheated by other steam vessels on its way to the single facer and the liner is preheated by several steam vessels (peanut rolls for example) and has contact with the heated pressure roll inside the nip.

Greater pressure: On the single facer we can apply almost unlimited pressure; a pressure-roll type single facer can generate enough pressure to literally cut both papers. Newer single facer technology replaces the pressure roll with a belt. The belt exerts less pressure at the nip but because the belt has contact with a portion of the roll (as opposed to the single point nip created by the pressure roll), the pressure is applied for a longer period of time.

The ability to make the bond with plenty of pressure and heat places fewer demands on the adhesive; because of this we are able to run adhesive formulations with lower solids and a higher gel temp.

On the single facer, the time from when the adhesive is applied to medium and the moment the single face web is released from the nip and rushed up the bridge is very short; at higher speeds, the papers make contact for as little as 3 milliseconds.

The double backer

At the double backer we are limited by the amount of pressure and heat we can apply, so we have to make up for it with time.

Pressure limitations: The amount of pressure (or down-force) available here is limited by the crush resistance of the board. Based on average Flat Crush Test results, we know we are limited to about 30 PSI, maybe even less with lighter mediums. Consequently, if we were to apply any more down-force we would crush the board and destroy its mechanical integrity, particularly its ECT value. This is in marked contrast with the single facers' almost unlimited ability to apply pressure.

Temperature limitations: At the double backer, we are able to heat the board only from one side since the hotplates touch only the double face liner. When running double wall board, heat transfer is further hindered by the need to transfer thermal energy through several layers of paper and air, which are both fairly good insulators. One of the most challenging bonds in the corrugating world, the bond between the webs on double wall, must receive all its heat from the hotplates, at the same time the bottom web is competing for this heat and acting as an insulating barrier to heat transfer.

Next page, please

More time compensates: Given these temperature and pressure constraints, machine manufacturers compensate by making the double backer longer and allowing the board to spend more time being heated while being firmly held together. In the typical modern corrugator, the heating and traction sections have a combined length of about 70 feet. At a run speed of 750 fpm, this translates to about 5.6 seconds of transit time with the bond held under pressure. While this is several orders of magnitude greater than the few milliseconds it spent on the single facer at the same speed, it is still only a few seconds. Most corrugators are speed limited at the double backer, especially on double wall board.

These limitations place higher demands on the adhesive, so in our quest to increase machine speeds we often employ an adhesive with a lower gel temperature and tend to use slightly more solids.

A good bond is at least as strong as the paper

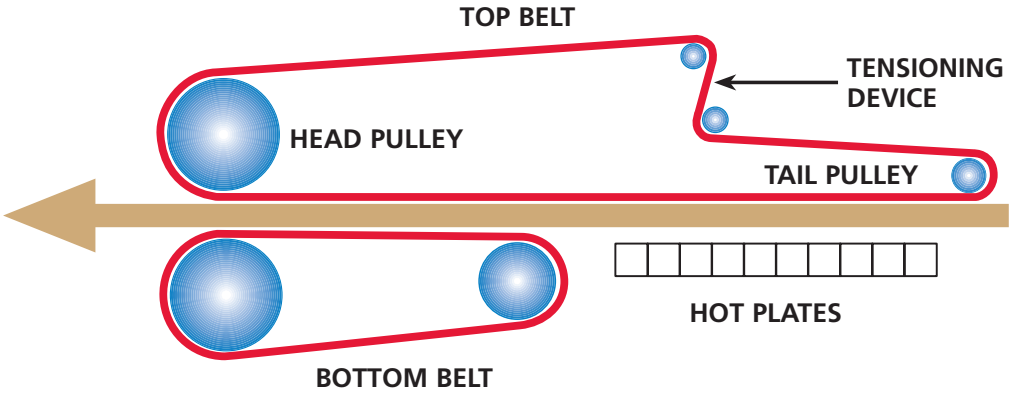
In a typical box, paper is by far the most expensive raw material, accounting for more than 80 percent of the cost. Adhesive, on the other hand, represents only a small percentage of the total cost, so it makes good economic sense to maximize the potential of the most costly resource.

With this in mind, we strive to create a bond that is as strong as the paper itself. We want the adhesive-paper interface to be stronger than the internal forces holding the paper fibers together. Whether we are achieving this or not can usually be determined by that classic test, done at every stacker around the world; pulling the board apart and checking for fiber tear.

Top corrugator belt tension: Too tight? Too bad!

Excessive tension is the enemy of glue-line consistency

by Wayne Porell



To achieve a consistent glue line across the web on the double face side, you need to have good pressure and solid contact across the web.

Whether you use ballast rolls or a version of shoes to apply pressure, you need to make sure the top belt is not under too much tension. When it is too tight, the belt can't relax and conform to the plates as deflection increases with speed. The belt will actually hold up the ballast rolls or shoes, causing an air gap between the plates and the bottom liner–creating an inconsistent glue line.

Trials performed with a tight belt showed glue lines that varied as much as .070" from the center of the web to the edges. We also observed a temperature variation of as much as 60° F from the center to the edges. By loosening the belt, we picked up an additional 20° F to 50° F at the glue line, and more consistent glue line measurements.

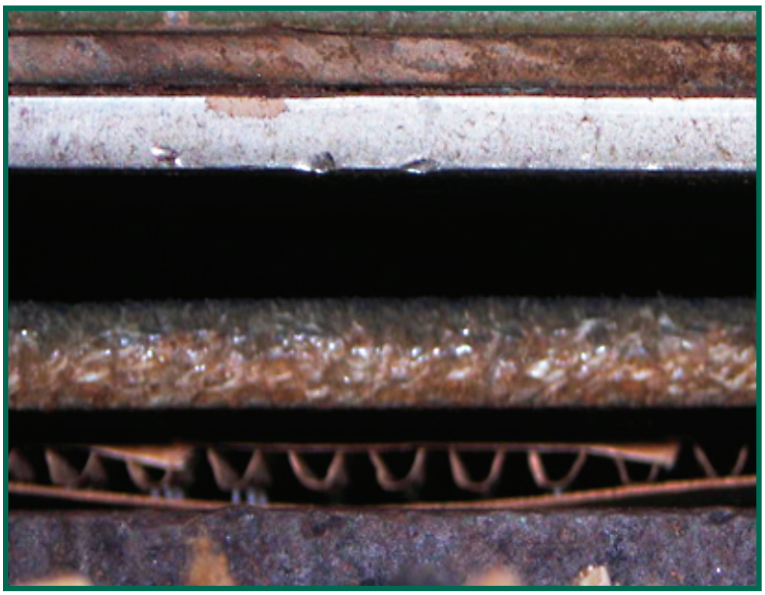
There is no magic number for belt tension; each machine is different.* To determine the right setting for your machine, measure glue line width in the center and the edges, and check the glue line with temperature strips. When you get consistent results across the web, your tension is correct. Make your adjustments in small steps and let the belt run for 2 hours to 4 hours to settle in before taking new measurements.

Another benefit of running the belt under less tension is reduced strain and wear on the bearings. Worn bearings will give you tracking problems. As you make your tension adjustments, take time to check for bearings that are already worn. A belt under proper tension, running on good bearings, will track better.

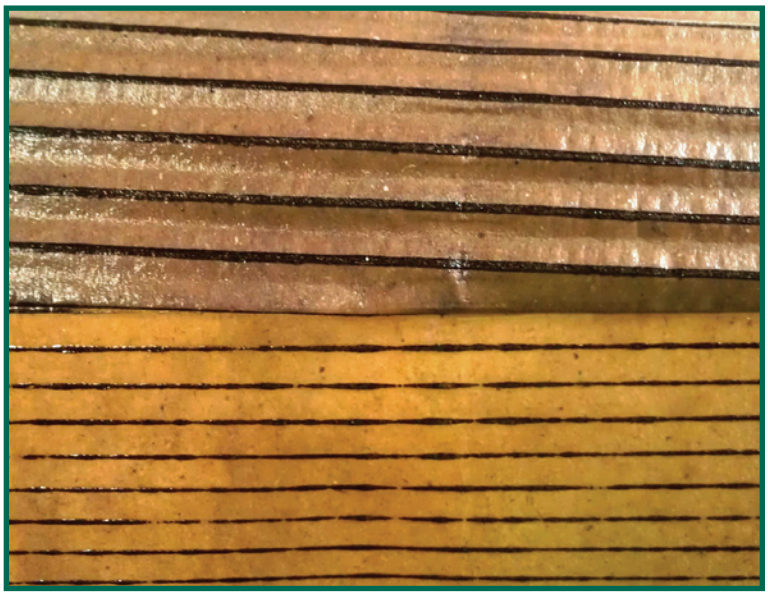
**I've found that with hydraulic tension adjusters, 600 psi to 700 psi works well on some machines.*

Evaluating glue line transfer

Glue line width is a reliable indicator of sufficient adhesive transfer from the medium to the liner



Here the board is pulling apart at the double backer; the bond is irretrievably lost.



Wider glue lines on the medium than on the liner indicates poor adhesive transfer.

by Rick Deardorff and Rex Woodville-Price

One requirement for a good bond on the double backer is to have enough adhesive in the right place. At least an 80 percent transfer is necessary for an optimum bond (if the glue line on the medium measures 0.075" the glue line on the liner should be at least 0.060").

Here are some of the factors that can affect the transfer and performance of adhesive on the double backer.

- **Application rate:** We need to have enough adhesive to make the bond. Since the adhesive is applied to the medium first, some of it could be absorbed, reducing the amount available for transfer.
- **Accuracy of application:** The adhesive should be centered symmetrically on the flute tip. If the adhesive is applied to the side of the flute tip it will not fully contact the liner and transfer will be incomplete. Incorrect glue roll speeds are generally the culprit and should be checked regularly.
- **Papers:** The combination of a medium that is too absorbent and a hard-to-penetrate liner can reduce adhesive transfer.
- **Web temperature:** In extreme cases, if glue line temperatures are too high going into the double backer, the adhesive will gelatinize partially before it reaches the liner and fail to bond properly once in the double backer.
- **Down force:** Enough pressure (down-force) is needed to hold the board together throughout its travel along the double backer. The liners and mediums need to be held together without disturbance while the bond is made.
- **Mechanical issues:** Any mechanical issues with the hold-down devices that diminish down force can have an impact on board quality.
  a. Spring loaded systems rely on spring compression to exert pressure and therefore should be adjusted properly to ensure proper height.
  b. Machines with moving side rails need to have these rails fixed and immobile while the machine is running (hydraulically, mechanically or pneumatically). Otherwise the hold-down devices could lift them as they push on the board and decrease their effectiveness. This of course does not apply to gravity systems such as ballast rolls or weighted plates.
  c. The rails where these systems are mounted need to be level and at an even height from hot plates. The hotplates themselves need to be level and not move.
  d. Any pneumatics should be in proper operating condition and without leaks. It is possible for cylinders to have internal leaks and move under load.
- **Belt tension:** Even if the hold-down devices are in proper working order, a too-tight belt will not allow them to work properly since it is trying to lift them. A good rule of thumb is to run the least amount of belt tension possible without causing belt tracking issues.

Bear in mind that these factors are interrelated; they often work in combination with each other and the solution to a problem may involve more than one cause.

Leaders in the science of making good adhesives better™

Harper/Love Adhesives Corporation
11101 Westlake Drive
P.O. Box 410408
Charlotte, NC 28241-0408
800-438-3066 • www.harperlove.com
e-mail: salestech@harperlove.com

In this issue:

- ***Better bonds***
- ***Adhesive transfer***
- ***Belt tension***