Leaders in the science
of making
good adhesives better™

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ADVANCED ADHESIVES REPORT

Your corrugating newsletter from Harper/Love Adhesives Corporation

Combat rising corn prices with low-solids adhesives

Polymer technology gets the job done with less corn, lower cost

By John Kohl

The price of industrial cornstarch, and the cost of corrugating adhesive made from it, continue to rise. In the coming year, the increase will be dramatic compared to past increases. This is due to the low crop forecasts, the large volume of corn being sold to China, and the ever-increasing volume committed for the production of ethanol. Current corn prices are at $6.65 per bushel vs. $3.65 a year ago. This is an increase of 82 percent that will be passed on to the starch users.

For many years, box plants were accustomed to paying $0.11 to $0.15 per pound of starch. After the ethanol mandate, the price has been climbing roughly 10 percent every year. Some plants will be purchasing pearl starch for as much as $0.27 a pound in 2012.

High solids: the way we were

The original Stein Hall adhesives of 40 years ago were in the 25 percent solids range due to the lack of mixing and shearing capacity of the old two tank systems. As the industry evolved, the introduction of high shear mixers, with higher horsepower motors, allowed for higher solids without the high viscosities associated with the older systems. These high shear mixers became the norm and the solids were pushed into the 29 to 32 percent range. It was thought that higher solids adhesive with less water was ideal for high speed corrugators, since there was less water that needed evaporation from the glue line in a very small window of time. Corrugating starch adhesive formulas have thus remained in the 28 to 32 percent solids range for the last 20 years and when we talked about lower solids, we were referring to the old 25 to 26 percent range.

Low solids: new technology, new opportunity

Today, low solids usually means somewhere around 23 percent. The savings to a plant based on adhesive batch cost with solids reduced to this level is dramatic. With the use of the LSP liquid additive developed by Harper/Love to improve the bond speed and strength of lower-solids corrugating adhesive, a box plant can realize substantial savings, while improving run ability, with reduced energy cost and adhesive consumption.

The savings are significant

ADHESIVE COST COMPARISON
(based on corn at $0.20 per pound)

	Higher solids	Reduced solids
Cornstarch	770 lbs	575 lbs
Water	1870 lbs	1915 lbs
Percent solids	29%	23%

Reduced solids savings	**$39**
Batches per day	**20**
Savings per month	**$17,160**
Savings per year	**$205,920**

Application rates as low as 1.3 pounds. per MSF (C flute equivalent) have been achieved at speeds of 1200 FPM, with excellent pin values, using adhesive solids as low as 22 percent. This low application rate adds up to a saving of 0.7 pounds per MSF of starch from the 2.0 pounds per MSF that the plant started at. For a plant that produces 1 billion square feet per year and purchases starch for $0.20 per pound, this adds up to savings of $140,000.

Keep in mind that these savings are based on the 2011 starch price of $0.20 per pound, which will likely be in the $0.25 range for 2012. This represents a 25 percent increase in cost and savings for the reduced solids adhesive and a possible $175,000 savings.

Plant managers should also look at savings based on cost per MSF produced as opposed to just batch cost. Ultimately, it is not the total cost of the batch that matters, but what it costs to bond a thousand square feet of board (MSF). To determine this we first calculate the application rate in dry pounds per MSF.

Application Rate 2.0 lbs/MSF x $0.20 = $0.40/MSF

2.0 lbs/MSF x $0.25 = $0.50/MSF

Adhesive cost of $0.50 per MSF may not seem like much, but when calculated over a plant's entire production of 80 to 100 MMSF per month; the number becomes huge, in the range of $40,000 to $50,000. If solids reduction can help a plant reduce this controllable cost even a few tenths of a percent, the savings can add significantly to the bottom line.

Considerations of water and temperature and their effects on bonding paper

By Rex Woodville-Price

It is no secret that, with the increase in corn prices, we have seen a tendency for plants to react by lowering the solids contents of their adhesives. These lower-solids adhesives, when bolstered by the proper additive, have achieved very good results. This is a paradigm shift, and contrary to what we have always thought to be fact.

Lower-solids adhesives, by definition, have more water. It was once believed that this water was detrimental to running good quality board but we have recently discovered that this is not the case. Even if we look at adhesives that are at opposite ends of the practical range, we are still only talking about less than 10 percent difference in solids. So let's determine how much more water we are actually dealing with. If we take an adhesive with a solids content of 29 percent, which by most standards would be considered a high solids adhesive, and compared it to a 21 percent solids adhesive (again, which most would agree is a low-solids adhesive) that is a difference of only 8 percent, which of course would be made up by water.

Extra water can be a good thing

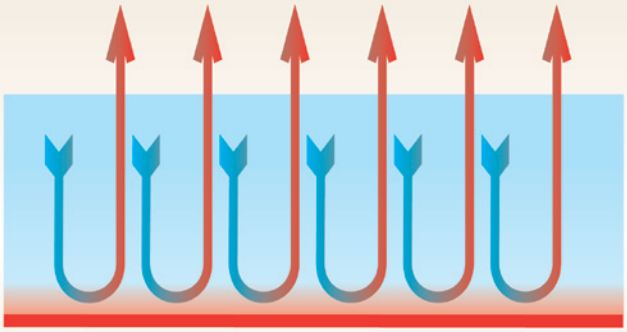
This little extra water can actually have a beneficial effect on some board combinations, particularly when we are dealing with highly recycled and absorbent substrates. The additional water in the adhesive assures there is enough water present for proper gelatinization of the starch. Another case is when we have a very dense paper (typical of high performance or high ring crush liners). These papers transfer heat more quickly and can overheat the adhesive to the point where it causes a shallow, superficial bond and in more severe cases even crystallizes the bond. It is now believed that sometimes, adhesive application is helping to control localized temperatures at the bond site. The increased water content of these lower-solids adhesives may be helping to minimize this effect and would, at the very least, minimize the financial impact of this slightly greater rate of application.

When I visit our clients in Europe, and see the trend to run lower temperatures on the machine in an effort to save fuel, I notice an additional side effect: It is now possible to achieve an acceptable bond using less adhesive when running under these conditions. The explanation for this phenomenon can also be traced to the role of the water in the adhesive. Since there is a lower temperature at the bond site, less adhesive is theoretically needed, because the water required for proper gelatinization is not driven off.

As a caveat, production of heavy agricultural boxes (such as our banana box clients in Latin America) which require high resistance to humidity and are run using adhesives with resin, still need slightly higher solids and application rates to achieve adequate moisture resistance.

Mechanics of water migration in paper

Which way does water move in paper in relation to heat? This question has important implications for how we wrap the paper on the preheater drum. When paper is heated over the surface of a preheater, the water contained in it will evaporate and move through the porous sheet. The remaining moisture in the paper will migrate toward the heated surface (and therefore drier side) as it seeks to regain equilibrium. This movement of water toward the heated side will continue until all of the water in the paper is evaporated. Sometimes, when running slowly, we can actually see this moisture rising from the paper as it goes over the preheater.



Moisture in paper moves first toward the heat. As it becomes vapor, it escapes away from the heat, through the porous paper.

Thermodynamics dictates that the side of the paper that we heat will be hotter than the other side. It also stipulates that the thicker the paper, the slower it will heat up (more thermal mass) and the greater the difference in temperature from the heated side to the unheated side.

All this points to an advantage in wrapping paper so we heat the side we are going to bond, particularly with heavier papers. Since it takes time to heat the paper, this will help us heat the paper more quickly when trying to run at high speed. This also allows us to achieve the desired temperature with less heat input and therefore with less drying of the paper.

If paper is allowed to dry completely it will not bond as well; some degree of moisture in paper is required to form a good bond. Since water boils at 212°F (100°C), we want to avoid heating paper over that temperature, as it will boil off all the water. So we see why proper heat management is important to bring the paper to the correct temperature at the surface we are going to bond, using the least amount of energy, in the least amount of time while retaining the desired moisture content.

Harper/Love trade-show exhibit showcases strength and versatility of corrugated board

Unique booth attracts attention and admiration at ACCCSA convention in Ecuador

Harper/Love Adhesives made a strong showing at the 31st Annual Convention of the Association of the Corrugators of the Caribbean, Central and South America (ACCCSA) held September 19 through 21, 2011, at the Hilton Colon Guayaquil Exhibit Hall in Guayaquil, Ecuador. With a show team of ten and a one-of-a-kind booth, the company was well represented at the three-day supplier exhibit, which included nearly one hundred companies who supply the ACCCSA member plants.

The 20-foot exhibit was designed and built for Harper/Love in Ecuador. Except for some supporting structure and graphics, the booth was made entirely from corrugated board. It featured four columns and two arches faced with open-face C-flute single face on the visible surface.

The fully functional chairs, table, and lectern were made 100 percent from corrugated board. They were constructed of C-flute single wall board and faced with C-flute single face. The chairs and the table were quite sturdy and received many compliments from the attendees who tried them. Most were surprised that something made from corrugated board would be strong enough to hold the weight of an adult without wobbling. Harper/Love products were employed in the corrugated board used in the exhibit.

The booth graphics featured the flags of many of the countries within the ACCCSA territory in which Harper/Love does business. There was also a representation of the monument located on the Guayas riverfront, which is source of great pride for the host city of Guayaquil.

This was the fourth time the ACCCSA convention has been held in Ecuador, but the first time in Guayaquil. Earlier Ecuadorian conventions were held in Quito. At the 1993 Convention in Quito Harper/Love's owner, Katherine Harper, was presented an award for her work in helping establish the organization in 1980, as well as Harper/Love's ongoing involvement in supporting the growth of the

The convention was well attended. The Harper/Love team noted it was particularly pleasing to meet the corrugator crews from local plants, including the men and women who ran the board used to make the company's exhibit.