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ADVANCED ADHESIVES REPORT

Your corrugating newsletter from Harper/Love Adhesives Corporation

Why **WAX** is on the wane

Lack of recyclability and cost of disposal make wax coatings increasingly unattractive

By Bill Kahn

Historically, petroleum-based wax coatings for corrugated packaging have provided an excellent vehicle to withstand the rigors of getting perishable foods to market. This task varies from delivering iced poultry for restaurants or bodegas to shipping produce and protein to supermarkets all across the country. Wax coating enables corrugated containers to handle hydro-cooling, top-icing, slush ice injection, and high-humidity storage.

The three most common methods of wax applications are curtain coating, wax impregnating of medium and/or liners, and cascading where the finished boxes, on edge, travel under a series of weirs where cascades of molten wax flow over their entire surfaces. Waxed containers provided an excellent replacement for wire-bound boxes previously used to ship produce.

Today, however, environmentally unfriendly waxed containers have become an increasingly costly burden on grocers and consumers.

Cost of disposal

There is an increased cost to dispose of waxed containers, which are not recyclable because the wax coatings do not dissolve in water and cause problems in the repulping process. When even a small amount of wax enters the paper mill systems it can cause spotting on the new paperboard. In extreme cases it can cause the paper to become slippery and slip off the wound paper reels in a telescoping manner. Nonwaxed corrugated containers are recyclable and repulpable.

Waxed containers must be segregated from the nonwaxed OCC (Old Corrugated Containers) and then hauled to the landfill for disposal. It is costly to segregate the material and the disposal costs exceed \$100 per ton. This is even more expensive on the coasts where solid-waste disposal is growing more costly.

Major users lead the way

In 2005 a number of major end users (Wal-Mart, Albertsons, Publix) launched initiatives to eliminate waxed corrugated packaging and to require environmentally sustainable packaging solutions. An estimated 1,500,000 tons of waxed corrugated is not recycled annually. As large supermarket chains can cut back on the waxed corrugated they receive, their waste segregation labor cost and waste disposal costs will shrink. Also, if waxed corrugated is replaced by recyclable corrugated the revenue for selling it will increase. It is estimated that approximately 5 percent of the OCC generated by a supermarket is contaminated by wax and not recyclable.

Not surprisingly the leverage of these major users has created a flurry of activity in the area of wax-alternative coatings, which are recyclable and repulpable. The corrugated industry developed a testing protocol and recyclability standard in 2005 that allows these alternatives to be tested and certified. By 2009 there were more than 20 coatings that had passed the certification testing of the FBA (Fibre Box Association). Ongoing initiatives such as the Wal-Mart Packaging Scorecard will continue to drive suppliers to look for environmentally sustainable solutions without compromising package quality.



Products that have passed the AF&PA/FBA recyclability protocol and filed required paperwork with the FBA are authorized to carry the Corrugated Recycles Logo indicating certified wax alternatives.

When wax gets in the way, what are the alternatives?

Making the transition from wax coatings to more eco-friendly solutions

By John Kohl

Early in its evolution, the corrugated packaging industry adopted coatings both to enhance appearance and improve function. The packaging of frozen foods and refrigerated foods, for example, called for a substrate that would repel water and maintain its integrity while in storage or transit. Petroleum-based paraffin wax was readily available and low in cost. It was easy to apply on the corrugator (impregnating the paper) or to the finished box (curtain coated or cascaded). The wax not only provided a very good moisture barrier but when application was heavy enough it would provide a complete vapor barrier that would increase the shelf life of the food products packaged inside.

Waxed papers don't recycle

The push for sustainability and higher recyclability of corrugated boxes in the past 15 years has created a conundrum for makers and users of waxed boxes. More than 78 percent of corrugated boxes are currently recycled to make new boxes but boxes containing wax cannot be recycled. Any wax that gets into the pulp is considered a contaminate that gums up the paper machines and degrades paper quality. Wax will cause discolored splotches and a slippery surface that can cause paper winding issues at the mill and lower slide angle (less friction) on the finished box. There currently is no economical method to remove the wax from the fibers in the repulping process, which means wax-coated boxes are either incinerated or discarded in a landfill.

Exploring alternative coatings

There are about a dozen different companies developing synthetic-based wax-alternative coatings that are 100 percent recyclable. These include acrylics, SBRs (styrene butadiene rubber emulsions), and even PET (polyethylene terephthalate) from reclaimed plastic milk jugs. Being made of plastics, latex, acrylics, or a combination, these chemicals are all very hydrophobic when applied to liners and medium and provide an excellent barrier for water or to reduce moisture vapor transmission rate (MVTR).

The coatings are usually applied to the liners and medium off line (not on the corrugator) with a rod coater as opposed to the simple blade coaters. This is due to difficulties with maintaining even coat weight across and through the web with blade coaters, and the drying time for the coatings on the corrugator. Some of the coatings are even being added to the fibers during the paper making process or applied on a size press on the paper machine at the mill. Depending on the water resistance level needed, and the type of coating used, the coat weight may vary. It is sometimes necessary to add a second layer of coating (double bump) for the extreme water resistance applications (top ice boxes). There

is also work being done to use a clay coating as a base coat to fill paper surface inconsistencies to achieve a good moisture barrier with a single coat of the replacement coating.

All of these wax-replacement coatings have one thing in common: they break down and release their bond to the fibers during the repulping process to allow 85 percent or more of the fibers in the corrugated box to be reclaimed based on the FBA's Voluntary Standard for Repulping and Recycling Corrugated Fiberboard Treated to Improve Its Performance in the Presence of Water and Water Vapor.

Bonding challenges

These replacement coatings have had some major drawbacks that have kept them from being widely accepted by the box makers and end users/customers. It has taken a number of years to develop a solution to each of the challenges in using these coatings. The first and most difficult



challenge was the bonding of the liner and medium on the corrugator. Since the paper fibers were coated with chemistry that repelled water vigorously, the ability to make a strong bond as was previously seen in a waxed box, was very difficult. The traditional paraffin wax is thermal plastic and is very easy to bond through when hot. The new coatings encapsulate the cellulose fibers completely and the starch adhesive cannot make a conventional cellulose-to-cellulose bond, even with the use of penetrants and modified carrier starches. After years of research and development, Harper/Love has developed an additive that helps the normal pearl starch-based corrugating adhesive make an excellent strong bond to the coating. This has allowed corrugators to increase running speeds for wax replacement coated liners and medium from as low as 200 fpm to well over 700 fpm.

The glue lap or manufacturer's joint adhesive has also been a problem for some coating users. Since most cold-set PVA type adhesives are water based, there have been bonding issues here as well. Some coating users have resorted to high-end hot-melts or reformulated cold-sets. The cold-set adhesive manufacturers have been developing newer formulations that offer better adhesion to these coatings.

Printing issues

Most flexo inks used in corrugating today are water-based saturation type. This means that they dry by losing their water into the substrate rapidly. In some cases the outside surface of the box has a heavy coating of very water repellent chemistry on which the flexo inks cannot dry fast enough. Recently, ink manufacturers have developed new

flexo inks that overcome this issue and allow good quality print jobs at near normal press speeds.

Current coating technology makes wax obsolete

While there still remain some challenges to replacing all of the wax used in corrugated boxes, the last few years have shown significant breakthroughs in coating, bonding, and printing. As with anything new, acceptance of newer coatings as a replacement for wax, which has been around for generations, has been gradual. The technology has arrived; it is now up to the end users to trust the technology and reap the benefits of a fully recyclable product.

Water resistant boxes for fresh produce and meat must withstand hydro-cooling, top icing, slush ice injection and high humidity storage. Modern wax alternative coatings serve these functional requirements without problems associated with wax coatings.



Bonding wax-replacement coatings

High-tech coatings require high-tech adhesives

By Rex Woodville-Price

As the push against wax became more prevalent, box plants started using new papers with wax-alternative coatings. It quickly became apparent that it was going to be a challenge to get them to bond. Several things were tried to bond these papers on the corrugator, with varying degrees of success.

The basic problem is that these coatings are designed to make the board resistant to water. Since typical corrugating adhesives are about 75 percent water, getting adhesive into the board goes against the very design purpose of these coatings. After extensive testing in our research and development laboratories, it became evident that if we were going to be able to bond these papers, the majority of the bond was going to have to be to the coating itself.

New papers behave differently

On the machine, these papers react differently to heat than do conventional papers. This heat comes not only from preheaters and preconditioners, but also from the corrugating process itself. The way they transfer heat is different; so is the way moisture moves through them.

Some users observed that these coatings behave like plastics and therefore should not be heated too much; others had different experiences. It was necessary to separate anecdotal observations and get only measurable parameters. Machine settings were crucial to successfully running these papers, while maintaining optimum quality and production efficiency.

Adhesive formulation was another area where paradigms had to be dealt with. Special attention had to be paid to solids content, viscosity, adhesive temperature and gel point.

Harper/Love develops bonding solutions

There has been a great deal of development and testing in the Harper/Love Research Lab to resolve these bonding issues. The bonding challenge is unique, as we must bond to the coating by specific adhesion rather than attempt to penetrate through the coating. Our chemists have successfully developed several new products, which are compatible with the new coatings and are able to bond the material successfully as well as provide very high levels of wet strength. These additives designed for wax-replacement technology are currently in use in a large number of plants across North America. They support totally the concept of environmentally sustainable packaging solutions.

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Harper/Love Adhesives Corporation

Leaders in the science
of making
good adhesives better™



HARPER/LOVE WRM ADHESIVE

PERFORMANCE ENHANCER FOR COATED SUBSTRATES

WRM* ADHESIVE is a unique product in our line of high-performance liquid products. It features a blend of proprietary ingredients specifically developed to improve bonding and water resistance on all grades of wax-replacement coated substrates.

- Corrugator speed advantages on all grades of coated paper, including heavyweights
- Improves bond quality, resulting in increased pin adhesion and fiber tear
- Convenient liquid, ready to use
- Well suited for automated additions
- Distinctive pink color for easy recognition
- Near neutral pH
- Improved water holdout
- Use with any wet-strength resin system
- Highly compatible with all normal adhesive ingredients
- Contains no hazardous ingredients
- FDA approved
- 100 percent recyclable and repulpable

* Wax Replacement Medium