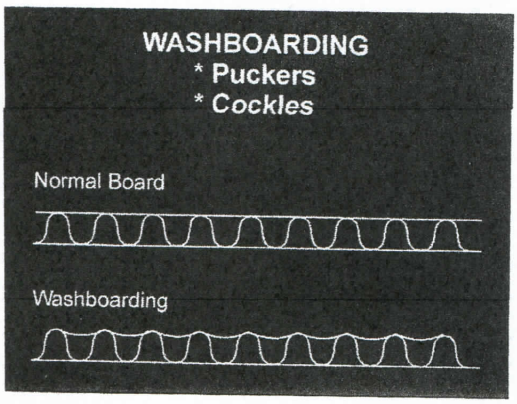
HOW TO SOLVE WASHBOARDING ADHESIVE PROBLEMS MAKING CORRUGATED BOARD

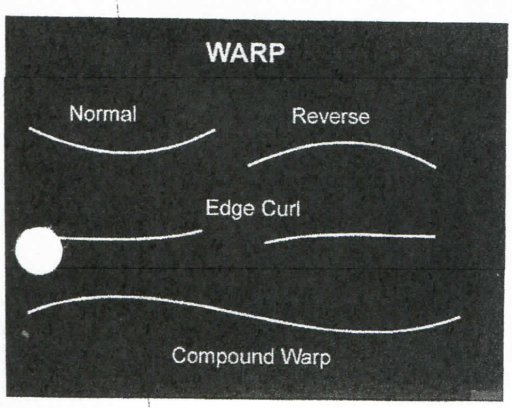
Corrugated board presents a constant challenge as a printing substrate. Eliminating adhesive-induced irregularities can improve printability.

From a printing point of view, a flat substrate will allow better printability than a substrate with irregularities. This basic fact is true for newspaper, wide web, folding carton stock, and corrugated board. In the case of corrugated board, its architecture and manufacturing process provides numerous opportunities for irregularities. Consequently, it presents a constant challenge for use as a printing substrate.

Let's briefly examine corrugated board irregularities which will have a negative impact on printability:

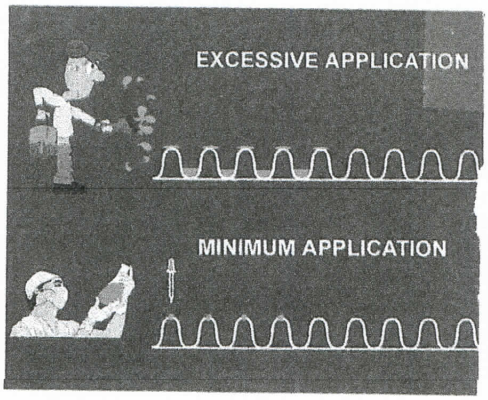
- Washboarding – Puckers, Cockles
- Warp





Both washboarding and warp cause printing problems because the inked printing plate cannot complete a continuous impression on these irregular sheets. Where do these irregularities come from, or better yet, how can these problems be avoided? This article will focus on the problems of warp and washboarding as a function of starch-based corrugating adhesive application. Improper handling of starch adhesive is very often the cause of corrugated board printing irregularities. The elimination of adhesive induced irregularities will be discussed as follows:

- Mechanical control of adhesive application
- Roller total indicated runout (TIR)



Starch-Based Adhesives

Starch-based corrugating adhesive is mostly water. Unlike synthetic closure adhesives based on polyvinyl acetate, most starch adhesive formulations cannot be enriched beyond 30% solids, due to the nature of the starch component. Today's higher shear starch kitchens appear capable of suspending adhesives up to 35% solids, but this is still far less than the percent solids of a synthetic adhesive, which range from 40 – 60%. The relative low cost of starch adhesive ingredients and the affinity

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ADHESIVE

that soluble starch has for paper components make it a natural choice for use as an adhesive. Starch adhesive works great for manufacturing corrugated board, and in a perfect world it is applied only to the flute tips in minimum quantities. Problems in the form of board irregularities begin to show up when the adhesive is applied in a sloppy manner. The problems stem not so much from adhesive volume, but application variation. The water content or percent moisture of liner and medium stock are carefully monitored and controlled by paper mills during the manufacturing process. When starch adhesive is applied in a haphazard manner, the moisture balance of the corrugated board is no longer consistent; consequently, surface texture changes begin to occur. To prevent these problems, an operator must understand and control starch adhesive application.

Controlling Adhesive Application

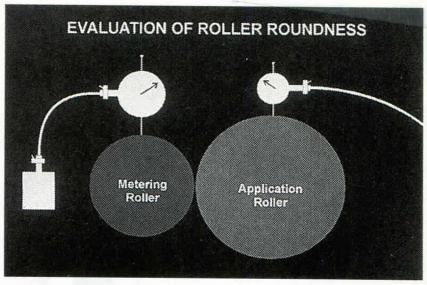
As stated earlier, the bonding process of corrugated board involves an aqueous starch-based adhesive. Essentially, the tips of the fluted medium are brought into contact with the adhesive which is presented on a glue applicator roller. Once the adhesive is applied, the medium is joined to the single face liner at the nip formed between the lower corrugating roll and the pressure roll. The enormous heat and pressure of the nip force energy to pass through the bonding zone.

The setting process is accomplished by merely evaporating the water content of the adhesive after complete gelatinization. Actually, this is no easy task when the following is considered.

Adhesive Percent Solids 30%
Application Rate
2.5 dry lbs/MSF (12.25 grams/m^2)
Water To Evaporate
5.83 lbs/MSF (28.58 grams/m^2)

As machine speeds increase, the available heat and dwell time at the nip is reduced, and as a consequence, the moisture content of the sheet will magnify. Naturally, preheater wrapping techniques come into play to help rebalance the sheet moisture. This is part of the art of corrugated board manufacturing.

In the case of the double backer side of the sheet – which is normally the print surface – the bonding process proceeds as described for the single facer, but without the available pressure to force heat through the bonding zone. Since the flutes are already formed, using significant pressure to force heat through the double backer bond would crush the board. To compensate for this and to ensure bond formation, the continuous sheet is pulled through the hot plate section, which is often up to 40 feet long. Light downward pressure is exerted by either ballast rollers or any one of a number of new devices. The objective is to set the adhesive and then evaporate the moisture. Since the hot plates are engineered to deliver a constant heat level across their width, and the ballast roller assembly provides constant downward pressure, it becomes imperative that the source of moisture, the starch-based adhesive, be applied in a consistent manner.



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Application Dynamics

When discussing starch adhesive application dynamics, there are two methods of application: machine direction and cross machine direction.

MECHANICAL CONTROL OF STARCH ADHESIVE APPLICATION

Action List

- Obtain and preserve accurate mechanical manuals for all gluing machines.
- Obtain and assign proper toolage to mechanics and operators.
- Using the manuals, train the mechanics and operators in proper gluing machine set up.
- Replace scraper and wiper blades on a regular schedule.
- Evaluate roller roundness and gap parallel on a regular schedule.
- Replace worn application and metering rollers.
- Keep a log of adhesive application system analysis data using appropriate forms.

Regardless, the alignment of the applicator roller and metering roller is important, as is the total indicated runout (TIR) of the rollers.

In principle, the adhesive applicator roller is bathed in a constant supply of starch-based corrugating adhesive. When the roller turns during board manufacture, adhesive is picked up by the roll texture and is metered to a film thickness by the metering roll. In a perfect world, both rolls run true, and adhesive would be picked up and metered accurately and efficiently. In the real world, however, the rollers become worn and knocked out of balance through wear and tear. Notice how the application rate can change with very small changes in roll roundness. In addition to roll wear, if the journals become bent in any way, adhesive application becomes very difficult to control. No amount of operator skill can overcome such a problem, especially when the metering roll also becomes worn or bent.

Problems with bent or worn glue metering and applicator rollers can show up as moisture imbalances in the machine direction. Board run with out-of-tune application systems is typically manufactured with *too* much glue. The excessive adhesive results in warp and washboarding.

Extreme care should be exercised by operators to avoid machine conditions which result in paper stock wrapped around corrugation rollers. Due to their width and the force of the corrugation process, wrapups which result in bent glue rolls are a far too frequent event. To manufacture a precision printing substrate, precise adhesive application is a must. Visual inspection of an idling glue roller often shows an appearance which pulses on a regular basis. That is definitely a sign that the roller should be

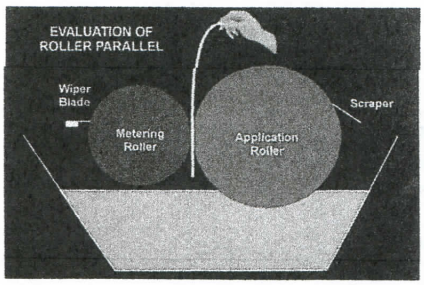
thoroughly inspected.

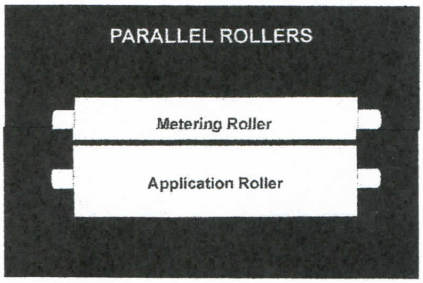
In regard to roll roundness, an evaluation should be conducted monthly, whereby a check is made on each 24 inches or 60 centimeters of the roll in question. Using a micrometer fitted with an adjustable neck and a magnetic base, a study can be made on roll roundness. When variations of ±0.005 inches or ±0.127 mm begin to appear, it is time to consider having the roller reconditioned. When rolls are to be reconditioned, be certain that the procedure is done in pairs – that both the applicator roller and the metering roller are reconditioned as a set. This will ensure that the rollers remain matched.

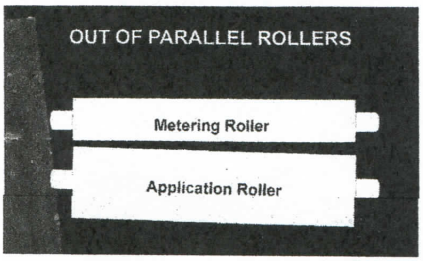
Parallel Rollers

Now that adhesive variations in the machine direction have been discussed, what about variations in the cross machine direction? These problems are typically due to adhesive and metering rollers which are out-of-parallel. When the glue gap is set by the operator, it is often assumed that the clearance is constant across the width. This is *sometimes* true.

Judging whether the rollers are parallel is an easy evaluation for the operator. Using feeler gauges of appropriate width, the consistency of the gap should be assessed on each shift with appropriate adjustment made on the spot. Machines requiring constant readjustment may have additional wear points that need to be addressed. By training the machine operators to maintain this critical aspect of adhesive application dynamics, *excessive deposition of moisture can be avoided.*







Conclusion

Regardless of the type or age of a corrugator or the country it is located in, a flat printable sheet will be consistently produced by strict adherence to the basics of machine maintenance. Worn machinery parts including adhesive and metering rollers will be the source of many fine printing problems until programs address these issues.

Improper or incomplete operator training results in a wasted resource, one that is capable of sharing the knowledge with others, while solving adhesive application problems on a regular basis.