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Techniques to minimize twist warp

Scope

This purpose of this TIP is to establish definitions of twist warp, and help understand the causes of warp, and twist warp. Quality demands, and production efficiency in press/finishing are ever increasing. Greater efforts must be placed upon the consistent production of flat combined board through a fuller understanding of causes of liner or singleface web tension whether it be within the liner or equipment itself.

Safety precautions

Observe all corrugator safety rules.

What is twist warp?

Twist warp, often called diagonal warp, is a combination of cross directional (CD) and machine directional (MD) warp.

What causes warp?

Studies conducted by the Corrugated Industries Development Corporation (CID) found that warp is caused by non-uniform changes in the dimensions of the components of the corrugated structure, particularly the liners.

Cross direction (CD) machine warp is caused by nonuniform CD changes, primarily due to differences between the two liners. The predominant force is shrinkage and/or expansion of the liners due to moisture content changes which is a paper property called hygroexpansivity. This means that as paper picks up moisture (hygro), it will grow in size (expansive). Conversely, as paper loses moisture, it shrinks in size. As corrugated board is produced, several sheets of paper are used, often with different moisture contents. This means that once these sheets are combined, they may expand and/or shrink by varying amounts. The mechanical forces created in the combined board structure may result in warp. The degree of shrinkage and expansion is much greater in the cross direction than it is in the machine direction of paper.

Machine direction warp is caused by nonuniform MD changes or directional forces between the two liners prior to being combined. The predominant force is web tension. If the top liner (singlefacer web) tension is much higher than the bottom liner (doubleback liner) tension end-to-end up warp will occur. This occurs because the top liner was stretched more than the bottom liner when the bond was made. It then will spring back when the combined board is cut by the knife and its pent up tension is relieved. Conversely, if the bottom liner's tension is much higher than the top liner's tension, end-to-end down warp will occur.

What causes a sheet to twist?

One of the major causes of twist warp is uneven tension levels in any of the webs occurring during the production of corrugated board. Uneven tension can be caused by a poorly wound or out-of-round roll of liner; any misalignment of equipment (rollstand, splicer, preheater stack, glue machine, bridge guide, doublebacker hot plates); or out-of-level equipment, preheater wrap arms, idler rolls or double backer belt faults. It has been found that liners

with extreme fiber orientation angles (polar angles) to each other can cause varying levels of twist warp. The degree of twist warp has been observed to increase as the polar angle difference between the liner increases. Recent studies have shown that twist warp levels increase with increasing moisture content of the combined board.

How to minimize incidents of twist warp

Equipment: Look for any consistent looseness or a slack edge on one side of the liner or singleface web. Measure the liner/singleface web temperature side-to-side for uneven heat transfer levels with an infrared pyrometer. Experience has shown that a slack edge or a temperature difference side-to-side of over 10°F indicates an equipment level or an alignment problem.

All equipment must be leveled to the ground plane to within a recommended level of 0.006 in. (0.15 mm) per running foot. Example: an 87-in. (2489.2-mm) wide corrugator would yield a (7.3 feet × 0.006 in.) ± 0.043 in. [(2225 mm × 0.152) ± 1.09 mm] specification and a 98-in. wide corrugator would have ± 0.049 in. (1.25 mm) specification applied to the level. This specification level of roll stand core chucks, splicers preheater drums, wrap idler rolls (front and rear position) fixed idler rolls, glue machine, bridge guide, bridge guide idler rolls, and doublebacker entry idler roll, hot plates. Tools needed: a 6-in. (152.4-mm) or 12-in. (304.8-mm) machinist level or an optical/laser transit.

All equipment must be aligned to within a recommended level of ± 0.063 in. (1.60 mm). Tools needed: a 100-ft steel tape measure or an optical/laser transit.

Be aware that your equipment can be easily knocked out of level or alignment by a clamp truck, a roll of liner or medium striking the equipment or a heavy load of single face festoons striking the bridge guide. Pay attention and react accordingly.

Paper: Work with the liner suppliers and request a decrease in fiber orientation (polar angle) angles. When high polar angle liners are encountered, the plant should run the board as flat as possible targeting a board moisture content of 6.5 - 8.0%. A second option is to run two like position (front, middle, back) rolls off of the paper machine on the single facer and the glue machine. This technique matches or balances the tensional forces of each liner by bringing the polar angles in to the same orientation. In extreme cases it may be necessary to run the single face liner “flipped” or with the “finished or print side” to the glue line to match the tension forces with the double face liner.

Current heightened mill awareness of high fiber orientation angles (polar angles) has greatly reduced incidents of twist warp being caused by liners.

The practice of monitoring uniform tension levels side-to-side will minimize incidents of twist warp in your plant.

Keywords

Warping, Corrugated boards, Twisting

Additional information

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