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Cross direction warp in corrugated board

Scope

Why cross direction warp in corrugated board occurs and how to correct it.

Safety precautions

Correct use of cutting gloves, knives when cutting samples for soak testing.

Content

What is cross directional warp?

In cross directional warp the line of curvature (warp) moves across the corrugator. Another way of saying this is that the line of curvature is parallel to the flutes (Fig. 1).

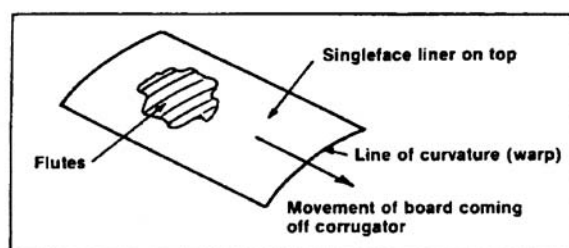


Fig. 1 Cross directional warp.

What causes cross directional warp?

Cross directional warp occurs because of two interacting realities.

The first reality has to do with the nature of paper. Paper is hygroexpansive. This means that as paper picks up moisture (hygro), it will grow in size (expansive). As paper loses moisture, it shrinks in size. If we start with a piece of paper at 7% moisture, which is about what we expect for paper exposed to normal room air, and expose that piece of paper to 90% humidity, the paper will get wetter and bigger. Now if we dry the paper back to 7%, it will shrink to a size that is smaller than it was originally.

The second reality is that corrugated board consists of several sheets of paper, held together by an adhesive that is originally applied to the paper with water as approximately 70% of its mass. Unless you are very lucky, these sheets of paper will not have exactly the same moisture contents when they are combined in the corrugator. Yet after

the different sheets are combined into board and after the board is exposed to a given humidity, all of the sheets will come to the same moisture equilibrium.

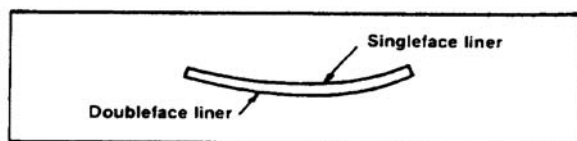


Fig. 2 Normal/up warp.



Fig. 3 Reverse/down warp.

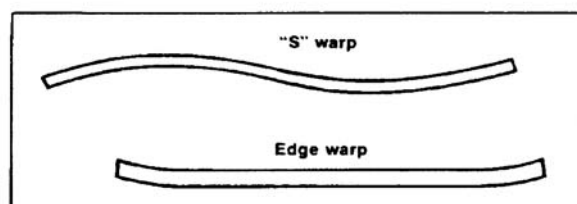


Fig. 4 Combination warps.

All sheets may have started at different moistures, moistures percentages, also can be exposed to varying degrees of moisture loss in preheating or preconditioning, are wetted with adhesive, have heat applied at different times to the surface of the combined board, yet they end up at the same moisture in the stacks. This means that they may expand and/or shrink by different amounts. The mechanical forces created in the board structure result in warp.

The degree of shrinkage and expansion is much greater in the cross direction of paper than it is in the machine direction of paper.

Studies conducted by the Corrugated Industries Development Corporation (CID) have found that the moisture content differences between the two liners are the most significant causes of warp. The moisture content of the medium, unless it exceeds 10 to 12%, is neutral in causing warp.

Note: Currently many mills are producing medium with average moisture content in the 9 to 10 % range, while liners are in the 7 to 8% range.

What are the varieties of cross directional warp?

There are two basic types: up warp, also known as normal warp as shown in Fig. 2, and down warp, also known as reverse warp as shown in Fig. 3. There are combinations of cross direction warp, such as shown in Fig. 4.

How does up warp occur?

When the singleface web and doubleface liner are combined in the hot plate section, they are both flat. If the singleface liner is wetter than the doubleface liner when the board is combined, the two will come to the same moisture content in storage. The singleface liner will dry and shrink. The forces created by this shrinkage will pull the edges of the board up. The doublefacer liner will increase its moisture content and expand; the expansion forces will push the edges of the board up (see Fig. 5).