THE RELATIONSHIP BETWEEN STRIPES IN PRINT AND WASH BOARDING

Printing on corrugated often results in the visibility of stripes that coincide with the flutes of the board. Mostly, the print is darker on top of the flutes than between the flutes. This phenomenon is most visible when printing a halftone directly on corrugated board. Figure 1 shows how the stripes in print can appear in a printed halftone area.

The industry has had many explanations and solutions for the problem. Some of the solutions really do work. However, the explanation as to why the solution works does not always stand-up against common sense and fundamental knowledge.

The problem

The target for corrugator output is to produce a flat surface, especially the outer liner, on which an image is printed. However, more often than not, the periodic wave form of the single face is visible in the outer liner. If the single face profile is visible in the double backer then this is referred to as "wash-boarding". We are talking here about a surface profile.

When printed on this board, dark stripes are often visible in halftone print. The industry commonly refers to wash-

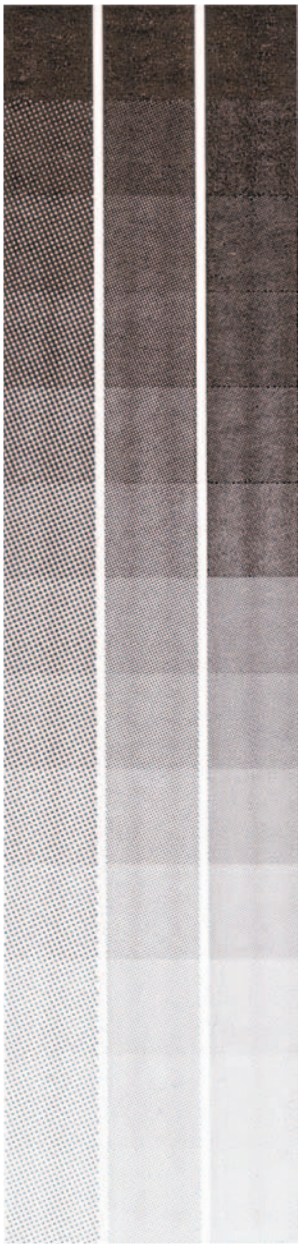

Figure 1: The 3 black bands are printed on 140 gsm White Top Kraft B-flute board. From left to right the screening of the bands is 12, 20 and 30 lines.cm. The printing plate was mounted on foam backing.

MR STREEFLAND HAS WORKED IN THE CORRUGATED INDUSTRY SINCE 1992. DURING THIS TIME, HE HAS BEEN TECHNOLOGY DEVELOPMENT MANAGER FOR SCA PACKAGING AS WELL AS TECHNICAL MANAGER AT STORK SCREENS. HE STARTED TECHNOLOGY COACHING BVBA IN FEBRUARY 2005.

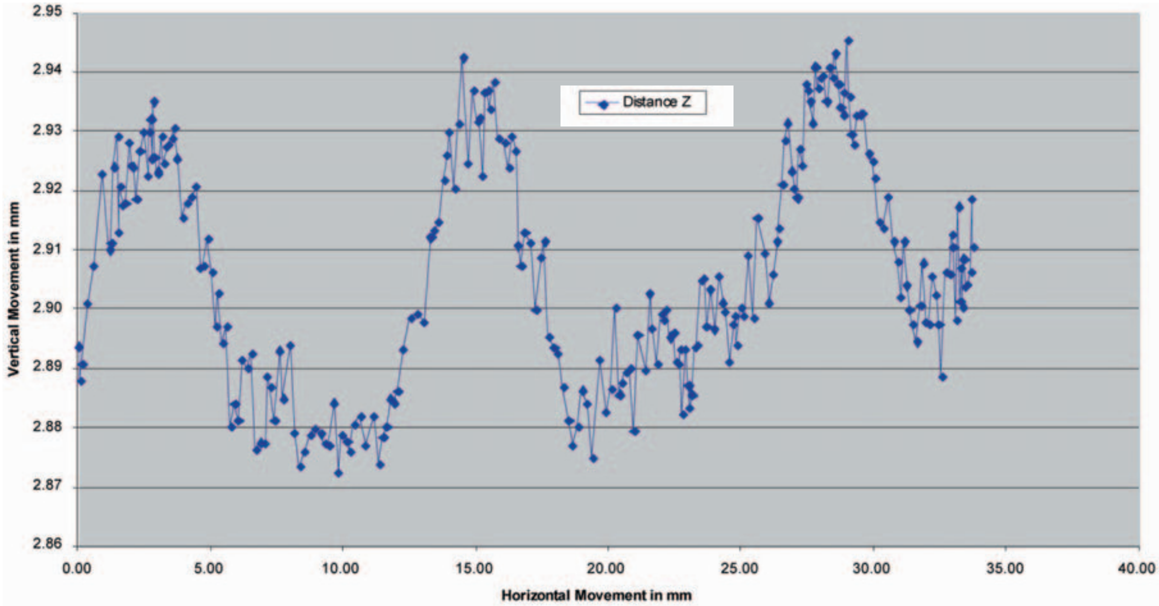

Figure 2: Surface profile of the board used to print the image of figure 1. The difference between minimum and maximum is 70 µm.

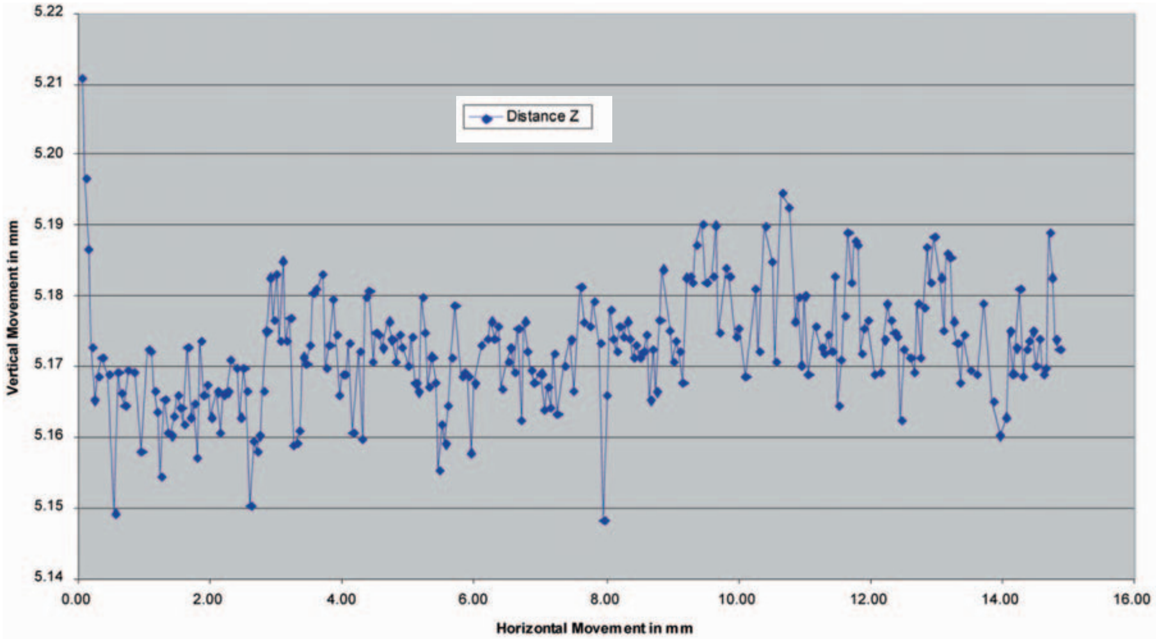

Figure 3: Surface profile a full tone area on a solid photopolymer printing plate. The difference between minimum and maximum is 50 µm.

boarding when this happens — however, these are simply stripes in print because we are not looking at the surface profile of the board.

I have often observed stripes in print when the board was perfectly flat. It is therefore important not to confuse the surface profile description of the board with the observation of "stripes" in print. Figure 2 shows the surface profile of the board on which the print of figure 1 was done. This is B flute board. The recorded surface profile does not show the same periodic curve as expected from the underlying B flute.

To give an indication of the surface profile magnitude of a polymer printing plate, the surface of the full tone area of a photopolymer printing plate was scanned. See figure 3. The difference in the minimum and the maximum value recorded for the polymer printing plate is similar to that of the scanned surface profile of the corrugated board. There is no sine wave visible in the surface profile of the plate.

Common solutions

The following are descriptions of some common and well-used solutions to reduce the stripes in print on corrugated board.

Backing material: A foam backing material between printing plate and plate cylinder is probably the most common solution to minimise stripes. It is unlikely that the combination of thin polymer material and the use of foam backing will result in deformation of the polymer material that follows the wash-boarding profile of the corrugated board. Assume that the polymer material is not deforming — how it might work in reality I will explain later. The use of backing material will have an effect on the colour to colour register. Un-equal impression pressure will result in a different stretching of the print of different colours in the print direction.

Finer fluting: EF-flute instead of B-flute. The use of smaller flutes is often proposed as a solution to reduce the visibility of stripes in print. However, this solution significantly increases the paper cost content of the board. It is claimed that an EF-flute compared to a B-flute of nearly the same total board thickness shows less stripes in print using a low basis weight outer liner. However, a liner and a fluting are added when making EF-double wall compared with B-flute board. The result is an increase of board weight and slower production speed on the corrugator. The board still needs to be dry at the end of the hot plate section but to make EF-doublewall board, double the amount of glue is used compared with B flute with a heavier outside liner. Increasing the basis weight of the outer liner on the B-flute board might also have the desired effect of reducing the visibility of the stripes, yet not affect the speed on the corrugator and still result in a lower basis weight board. Currently it is difficult to purchase or use White Top Kraft and/or White Top Test liner with a high basis weight (> 200gsm) for environmental reasons. But avoiding the use of heavy liners for environmental reasons does not stand-up if customers are supplied with over weight double wall board using low basis weight liners.

Coated paper instead of uncoated paper: This option also might result in a lower visibility of the stripes in printing. It probably has to do with the way the paper picks-up the ink from the printing plate (shearing of the ink) and that this is possible at lower impression pressure settings. Also, the use of a lower ink film thickness on the screen roll will help to reduce the visibility of the stripes.

The Theory

As indicated, it might not be the profile of the surface of the board that gives rise to printed stripes. If we take a closer look at the way dots are printed in a halftone area on top of the flutes and between the flutes (see figure 4 and 5) then it looks as if the same dots printed on top of the flutes show more spreading and filling of the ink than between the flutes.

This points towards the pressure between substrate and printing plate being greater on top of the flutes than between flutes. It would also explain why perfectly flat board can show stripes in print. The support of the flutes makes the board stiffer on top of the flutes than between the flutes. The severity of the stripes would probably better correlate with a force deformation profile of the board rather than the dimensional surface profile.

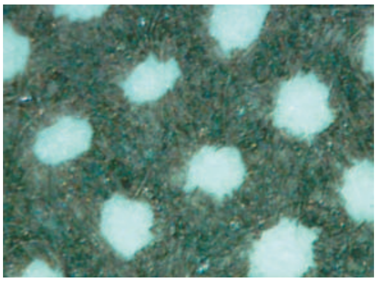

Figure 4. Image taken from sample of figure 1 in 50 per cent dot area, 30 lines/cm. Screen, on top of the flutes, at about 200 times magnification.

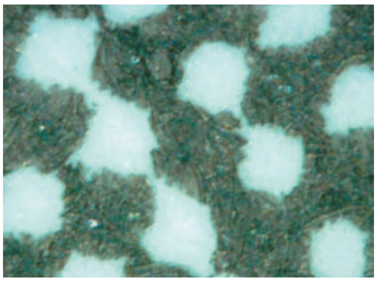

Figure 5. Image taken from sample of figure 1 in 50 per cent dot area, 30 lines/cm. Screen between the flutes, at about 200 times magnification.

The proposed theoretical model to measure the surface force profile of the board and correlate it with the stripes in print might allow for the proposal of a prediction module to determine how severe the stripes might be before printing the board. This proposed theoretical module would also explain why foam backing material and a finer flute have a positive impact on reducing stripes. The foam backing material simply reduces the maximum impression force on top of the flute tips so the pressure difference on top of the flutes and between the flutes is reduced — the plate is not deforming following the wash board profile. Finer flutes means that the force resistance differential between flutes and on top of flutes is reduced.

Conclusion

Characterising board and the amount of stripes in print that correlate with the flute profile of the board can probably be best done by making a surface profile where we measure "the local surface E-module" of the board on top of the flutes and between the flutes. Unfortunately, normal testing equipment is not sensitive enough to do this because we are talking about measuring low forces (<0.001N) and small displacements (< 25µm).

Wilbert Streefland can be contacted at: wilbert@tcbvba.be

Figure 6: The devise used for measuring the surface profile as shown in figure 2, 3 and 4 was developed, designed and built (including software) by Technology Coaching BVBA. Measuring resolution <4 µm