

Glue Application in Corrugators (Part 2)

Optimisation potential from the viewpoint of a metering roll manufacturer.

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This section deals with the various surface finishes and with new developments that offer further potential for the optimisation of glue application.

Existing glue roll types

In principle, we distinguish between two different surface finishes on glue rolls in the corrugated board industry. At first, one of the most frequently used, the line patterned type, and secondly the structured type (also called “sand-blasted” or “matt-finished”).



Structured (sand-blasted) surface and line-patterned surface

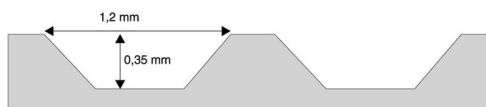
Structured or sand-blasted chrome rolls have a shorter lifetime and are cheaper to manufacture. Structured rolls have a considerably smaller, but largely undefined volume, while by comparison line-patterned glue rolls with standard line patterns between 7 and 10 lines/cm have an extremely high, but precisely defined volume. They are more expensive to buy, but have a considerably longer lifetime.

Development of finer line patterns

Because with conventional standard line patterns considerably more glue is often applied than is required for satisfactory bonding - despite the smallest mechanically possible gap setting - the question of using structured rolls constantly arises, despite the well-known disadvantages, as these transfer a much smaller quantity of glue to the surface.

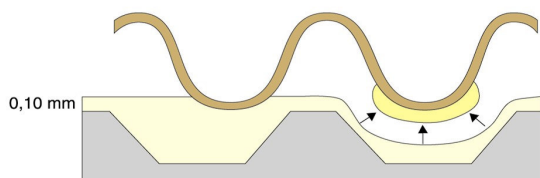
In order to utilise the advantages of a constant line pattern over a structured surface without applying more glue, finer line patterns are increasingly being used today. Continuing developments result in new line patterns, which are universally usable and bring further advantages.

Most standard line patterns today are between 7 and 10 lines/cm. With a conventional standard line pattern of 8 lines/cm, the surface therefore has more than 8 cells, evenly arranged next to each other, per running centimetre. This gives a cell aperture of 1.2 mm with a cell depth of 0.35 mm and a volume of around 120 cm³/m². This volume corresponds to a glue layer thickness of 0.12 mm.



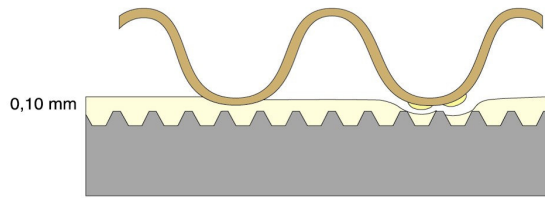
Line pattern 8 lines per centimetre

The proportion of an F-flute profile to the cell size is shown below. For simplification, a glue film of 0.1 mm has been assumed in the drawing. At least 30% of the cell volume must be added to the actual glue film on the roll surface. With a line pattern of 8 lines/cm and a volume of 120 cm³/m², this means an increase in the glue film of 0.036 mm.



Line pattern 8 lines/cm in proportion to the F-flute

A line pattern with 50 lines/cm and a volume of 35 cm³/m² gives a cell aperture of 0.18 mm with a depth of just 0.05 mm. The following illustration shows the changed proportion between the same F-flute profile and a finer line pattern.



Line pattern 50 lines/cm in proportion to the F-flute

Assuming that once again at least 30 % of the cell volume must be added to the actual glue film, an increase of just 0.012 mm results in the new situation.

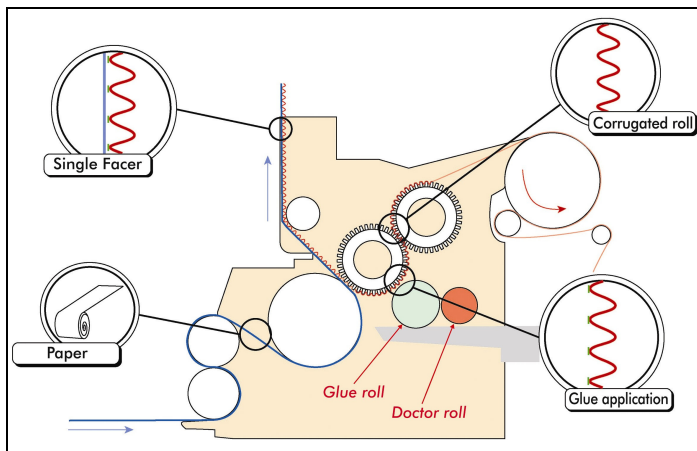
If we similarly compare an 8 lines/cm standard line pattern with a 50 lines/cm line pattern, a reduction in the useful total glue film of approx. 18% results, with a glue film of 0.1 mm in the gap.

Conclusion: A finer line pattern offers the potential to reduce the glue application by 10 - 20 % with the same glue gap setting! In addition, finer line patterns enable quality improvements and cost savings, for example drying times (energy saving), higher machine speeds without extra drying, and better printability of the corrugated board.

Single facer / glue applicator (laminator)

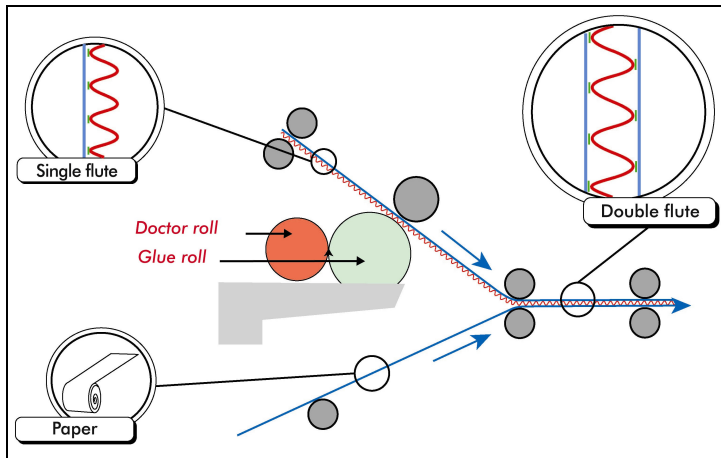
The metering situation in the single facer and the glue applicator is very different. With the single facer, the interval between the time of glue application and actual bonding is very short. In addition, a higher bonding pressure can generally be set, so that good bonding can be achieved with correspondingly less glue.

Whereas coarse rollers with 7 – 10 l/cm were used in the past, the combinations [30 l/cm, vol. 60 cm³/m² (A, B, C flute)] or [50 l/cm, vol. 35 cm³/m² (E, F, micro flute)] are now often successfully used.



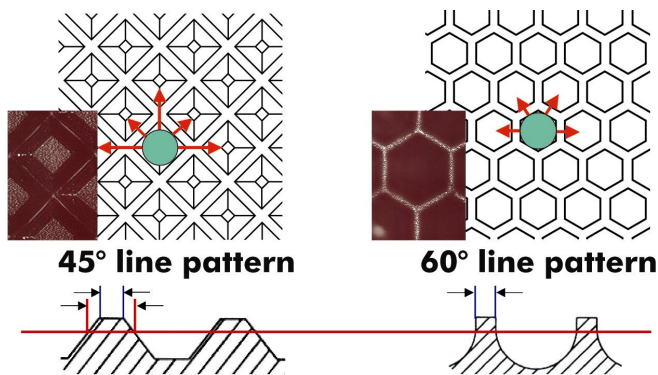
Single facer

In the glue applicator there is a relatively long interval between glue application and actual bonding. In this case the glue has more time to dry and to penetrate the paper. The pressure that can be used for bonding is also considerably less than with the single facer. Therefore, a higher volume is generally required in the glue applicator. Once again, changing from the coarse line pattern of 7 – 10 l/cm, predominantly used at present, with a volume of 120 – 130 cm³/m², to a 15 l/cm line pattern with a volume of 85 – 90 cm³/m² (in combination with a 30 or 50 line pattern on the single facer), represents a first step.



Double facer

Initially, the finer line patterns were produced in exactly the same way as the coarse line patterns, with a 45° angle. However, at present we mainly execute these with a 60° angle, as this angle brings clear advantages in cell arrangement and cell geometry. With the same line pattern, approx. 17% more cells are available in comparison with the 45° line pattern. As all cells are exactly the same distance apart, a more even glue distribution can be achieved.



Cell shape with 45° and 60° angle

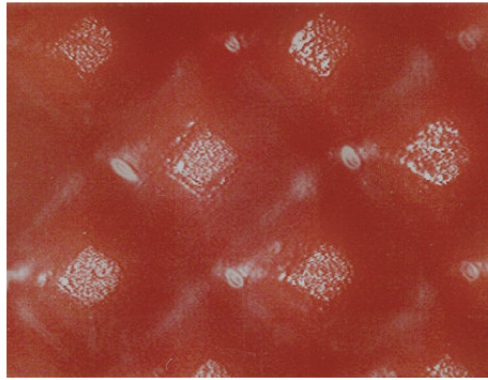
The dome shape of the cells with the 60° line pattern also brings a considerable advantage in respect of mechanical stress and wear, in comparison with the obtuse pyramid with the 45° angle. As the above illustration shows, with the 60° line pattern the cell apertures remain constant for much longer, due to the steeper edges in the upper area, and the transfer ratios are unchanged. With the obtuse pyramid, on the other hand, the web geometry expands very quickly with increasing mechanical stress, as a result of which the surface characteristics of the roll also change more quickly in reference to the glue application.

The finer line patterns with 60° angle are currently successfully used to improve individual glue application. In addition, our company also had the idea of further optimising the surface structure (line pattern) to develop an all-purpose glue roll that combines the previously mentioned advantages of finer line pattern (smaller volume) with additional solutions for other problems.

New development

From this idea, Apex developed the positive-reverse line pattern for glue application in corrugators.

In comparison with the closed cell structure of a conventional line pattern, the positive line pattern has an open cell structure. The designation reverse line pattern refers to the quasi inversion (positive) of a conventional line pattern: what previously constituted the base of a cup is now an upright nodal point in this line pattern. The webs become a network of channels.

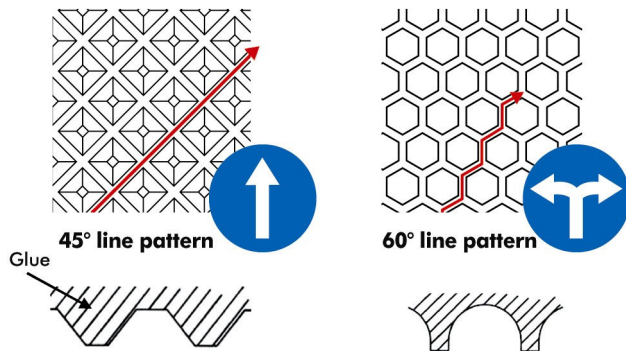


Positive-reverse 45° line pattern

The decisive advantage of the reverse line pattern is that, in addition to the glue film in the gap, a quasi sealed glue film is present and transported in a type of grid in the roll surface.

While closed cells constantly convey air to the glue, which can lead to problems due to air accumulation in the system, this phenomenon is excluded with the positive line pattern as the air moves freely in the channels and can escape.

Increasing machine speed is also generally associated with additional glue application in the gap, due to the build-up of hydraulic pressure in the gap and the problem of aquaplaning. Another phenomenon often occurring here is that more glue is applied in the centre than in the edge area. The positive line pattern can considerably reduce or equalise the build-up of hydraulic pressure. The result is a more consistent application quantity, irrespective of the speed range. Cleaning this surface structure is also considerably easier than with a closed cell shape. Experience with similar line patterns in the coating sector shows that, due to the straight channels with the 45° reverse line pattern, the dosing characteristics in the gap change, depending on viscosity. Against this background, Apex ultimately decided on the more difficult to produce 60° positive-reverse line pattern, as this combines all advantages of the open cell structure with the advantages of the 60° angle.

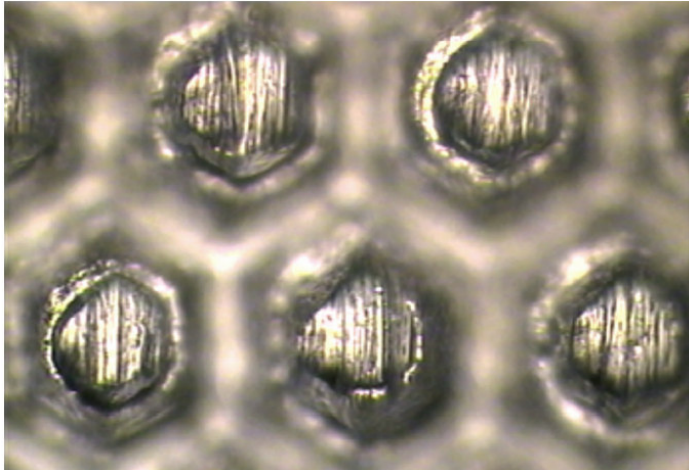


Comparison of 45° and 60° positive-reverse line pattern

In addition, the 60° positive-reverse line pattern has considerably more grip in the glue film than conventional fine line patterns, so that good glue conduction can be ensured even with a larger gap. This new type of line pattern is currently at the trial stage and is being tested in projects on a wide range of units used in the industry, with different glue constellations. The results are very promising.

The **expected advantages** are: No build-up of pressure in the gap and thus consistent application across the entire speed range and working width, no air entrainment, less or no squirting, better glue separation from the roll surface, easier cleaning and reduced soiling, less influence on good metering by mechanical stress, reduced glue application, as well as universal use in both single facers and in glue applicators for all flute types.

Naturally, all standard line patterns and processes can still be produced in all material combinations. However, the newly developed positive-reverse line pattern has been designed on the basis of the high quality material combination of a stainless steel surface for the glue roll and a doctor roll with a specially polished ceramic coating. The long-term goal must be to achieve a comparable precision in glue application during corrugated board manufacture to that already achieved when colour-printing corrugated board.



Positive-reverse 60° line pattern

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