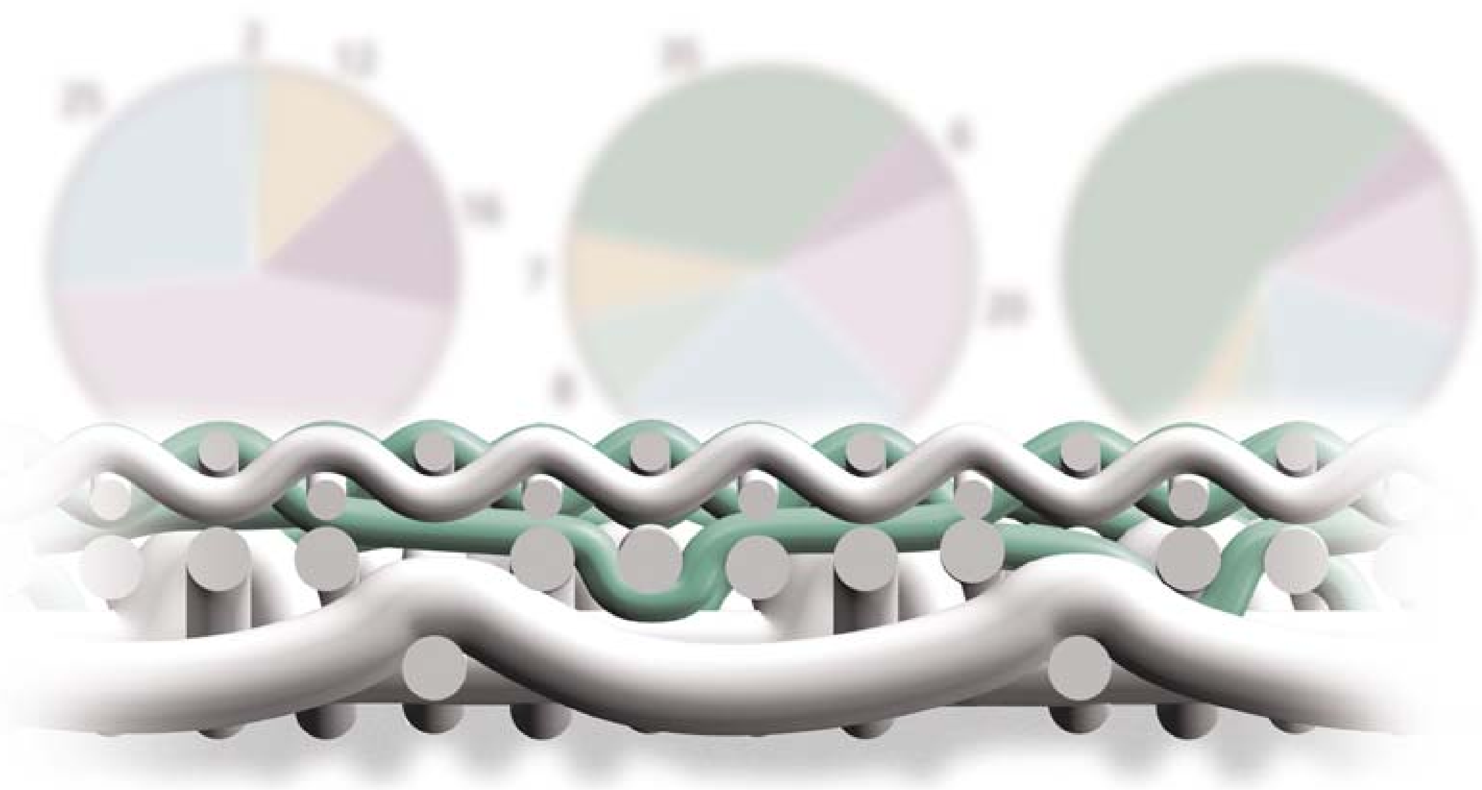
Forming Section | All Paper Grades



Press Release

Structurally bound Forming Fabrics (SSB Fabrics)

Chris Kershaw, Vice President Corporate Marketing, Heimbach UK Ltd., chris.kershaw@heimbach.com

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Paper industry trends

The Paper Industry, like any other, has seen considerable evolution in recent years.
Key issues for any paper-maker today would, of course, include the following:

- emphasis on / improvement of paper quality
- increased use of the printing process on all paper grades
- rising use of re-cycled fibre in furnishes in most paper grades
- more fillers in the sheet
- lower basis weights
- faster speeds
- new and wider former configurations
- continually increasing machine widths

Certainly, the use of re-cycled fibre is growing continously across almost all paper grades (Fig.1). The main impact of this has been a reduction in fibre lengths, and a much more variable stock quality. Newsprint above all others has embraced this change. Those grades that have always used re-cycled fibre have invariably increased the percentage employed, although at an understandably slower rate.

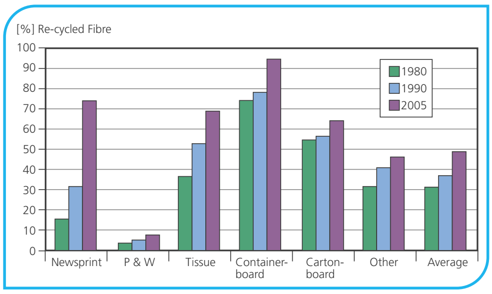

Fig.1 Increased usage of re-cycled fibre in all grades

In addition to the grades, where filler use has been well established at a high level for quite a while, fillers are now in widespread use across almost all paper grades. Even in the production of SC papers filler usage has been increased by 30% compared to the 80's (Fig.2).

Basis weights are continually being pushed lower (Fig.3) across the spectrum of paper grades.

Standard for news is now down from 48 g/m^2 to 42 g/m^2, with some products even as low as the 36-40 g/m^2 range.

On pilot machine facilities, speeds now exceed 2000 m/min, and we already have the first paper machines exceeding 11 metres in width.

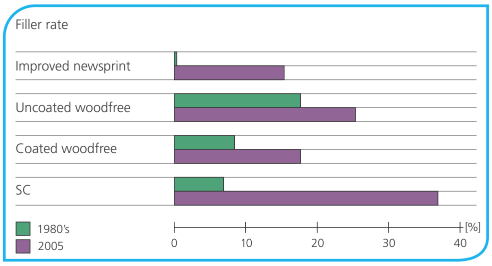

Fig.2 Increased usage of filler

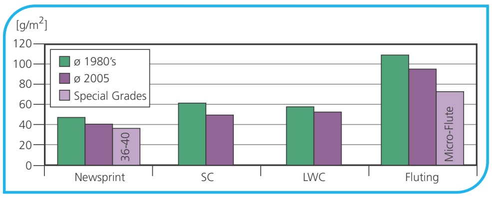

Fig.3 Reduction in basis weight

Development of forming fabrics

Clearly, these developments have become the design drivers for those forming fabric manufacturers ready to respond to some very specific issues (Fig.4). Today's forming fabrics are required to fulfil frequently conflicting demands if they are to respond to the changes documented here.

Paper makers expect high life potential in addition to a fine paper side and high fibre support must still allow effective dewatering.

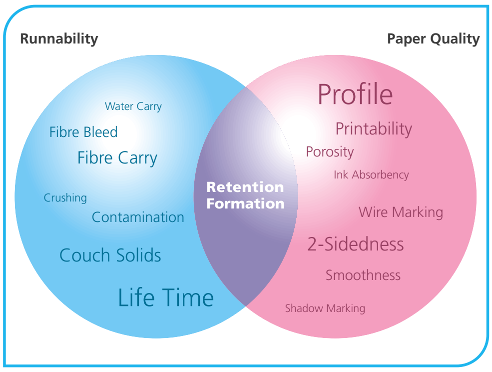

Fig.4 Forming fabric design drivers

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At the same time paper makers expect as well, that none of these properties will compromise dimensional stability – not even at speeds of up to 2000 m/min, as will be the case on new former configurations.

Probably the most important forming fabric property in responding to these technical challenges is Fibre Support. Forming fabric designers as well as papermakers consider it to be a critical factor, which needs to be taken into account with a high priority. Fibre support is usuallly measured by the Fibre Support Index (FSI), which is an industry standard developed by Dr. Robert Beran (Fig.5).

Industry standard developed by Dr. Robert Beran

$$FSI = \frac{2}{3} \times (a \times Nm + 2 \times b \times Nc) \times 2.54$$

Nm = Paper side MD mesh / cm
Nc = Paper side CMD mesh / cm
a, b = Beran constants, dependent on weave

Fig.5 Fibre Support Index (FSI)

Dr. Beran arrived at two main conclusions: Fibres could only be supported by yarns on the surface of the forming fabric, or where a crossover point occurred between machine direction (MD) and cross machine direction (CMD) yarns. Secondly, he stated that cross machine direction support of the fabric was twice as effective as machine direction support, which makes sense when we think of predominantly MD fibre orientation within the jet.

These principles were used to determine constant factors for different weave patterns. A formula was then developed taking into account paper side MD and CMD yarn counts to allow the FSI to be calculated. This index is recognised across the paper industry.

Higher fibre support leads to higher mechanical retention and, through reduced consumption of retention aids, to improved sheet formation (Fig.6). It also reduces fibre carry and improves sheet release, resulting in better runnability and higher production (Fig.7).

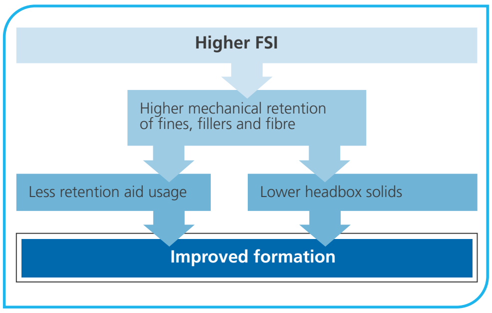

Fig.6 Benefits of increased Fibre Support Index (FSI)

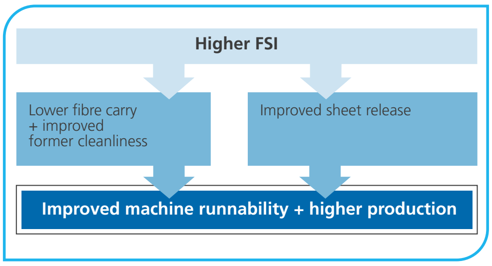

Fig.7 Benefits of increased Fibre Support Index (FSI)

A look at the continuous development of FSI's in forming fabrics over the last 40 years shows a steady upward trend. Single layer fabrics during the Sixties had an FSI of no more than around 80. This value increased in double layer fabrics to approximtely 130 during the Seventies, to 150 during the Eighties, and finally to 190 in SSB fabrics in the late Nineties. At present FSI values of 200 and over can already be achieved. The 220 mark is bound to be reached within the next 2-3 years.

As their response to the demand for a higher FSI and improvement of other key parameters, manufacturers of forming fabrics have developed, in the late 1990's, the SSB concept. "SSB" stands for "Sheet Supporting Binder". These designs have a binding yarn, which contributes to formation in cross machine direction as well. Forming fabrics of that generation, such as PRIMOBOND from Heimbach Group (Fig.8), consist of two, separate, warp structures. These are linked together by pairs of fine intrinsic binder (SSB) yarns, creating a single structure by alternating between the paper and the machine side structures.

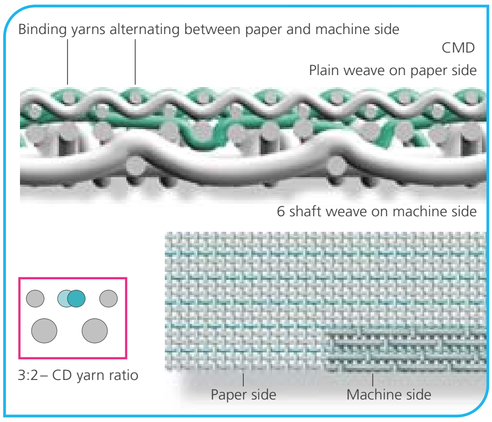

Fig.8 Modern SSB fabric construction (PRIMOBOND from Heimbach)

Thus the top, or paperside layer, can provide the highest possible fibre support, whilst the bottom, or machineside layer is constructed for high wear resistance.

SSB designs now exist for all paper grades, from tissue through publication papers to packaging and board. Their acceptance within the industry is clear. In the mid 90's, these products did not exist, and the European paper industry had principally settled with traditional double or triple layer designs.

By 2003 a significant change had occurred, with already over 35% of all forming fabrics delivered into Europe being of SSB design. Our forecast for 2007 shows that this trend will continue to grow to over 50% of all products consumed by

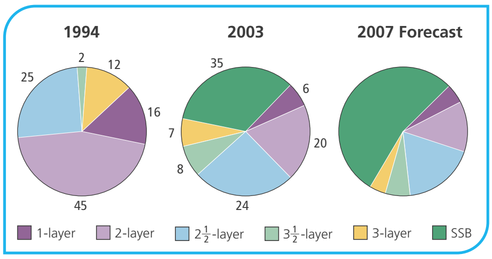

Fig.9 European forming fabric industry product split [%]

European papermakers (Fig.9). This is more of a revolution, than an evolution.
Of course, there are many different SSB constructions now available, and it is worthwhile looking at the different options. Most SSB designs are woven on standard 20 harness loom technology, and are developments from the standard triple layer designs which were traditionally woven on 20 harnesses as well.

Some SSBs are now woven on 24 harnesses (e.g. SSB forming fabrics from Heimbach Group), and it can be argued that this gives greater flexibility

Shafts, Loom	Shafts, Fabric	2	3	4	5	6	7	8
24	Paper side	●	●	●		●		
	Machine side	●	●	●		●		
20	Paper side	●		●	●			
	Machine side	●		●	●			
16	Paper side	●		●				●
	Machine side	●		●				●

● possible; blank: impossible

Fig.10 Weave options in SSB design

(Fig.10) with more weaving options, in much the same way that the move from 7 to 8 shaft double layers offered more options and benefits.

On the paper side, most designs have a 2 shaft, or plain weave pattern for optimum fibre retention and minimum sheet marking. In some cases, however, a 3 shaft construction is used, typically for the production of packaging grades (e.g. PRIMOBOND.HD), as well as in the tissue industry (e.g. PRIMOBOND.T).

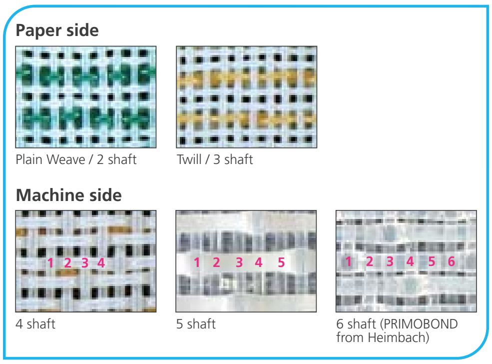

Fig.11 Weave options, paper and machine side

At the same time, SSB designs offer great flexibility on the machine side providing high wear resistance, with usually anything from 4 to 5 to 6 shaft

or more constructions being available (Fig.11).
All SSBs, whatever the weaving construction, are available in various cross machine direction (CMD) ratios, with the three predominant designs being 1:1, 2:1 and 3:2 (Fig.12, schematic diagrams only).

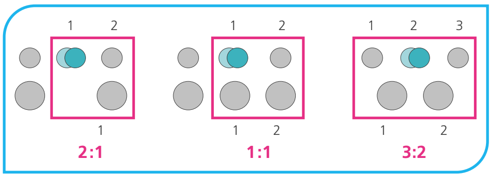

Fig.12 CD yarn ratio with SSB design (schematic)

The term CMD ratio describes the ratio of paper-side and machine-side cross direction yarns.
Each of these variations is designed for different objectives. As a general rule, the 2:1 ratio is a 20 harness product, and was amongst the first SSB concepts.

Developments existing in the 3:2 ratio offer a significant increase in yarn, or wear volume and cross machine direction stiffness, without the loss of fibre support on the paper side. This ratio tends to be used predominantly in 24 harness designs (e.g. SSBs from Heimbach). The 1:1 CMD yarn ratio is available in all SSB constructions and is generally aimed at high-speed applications due to the reduction in caliper and void volume.

If we measure SSB designs against more conventional or standard double and triple layer designs, for any key parameters, the SSB gives superior performance. The values for fibre support, frame length, wear volume, cross dimensional stability and number of drainage holes are significantly improved (Fig.13).

Practical examples

A 24 shaft SSB design from Heimbach replaced a conventional 8 shaft double layer on a hybrid former producing newsprint at 1400 m/min. Retention polymer addition could be reduced from 4000 l/min to 2800 l/min due to the higher FSI. 2-Sigma profile improved from 1.0 to 0.7, and the

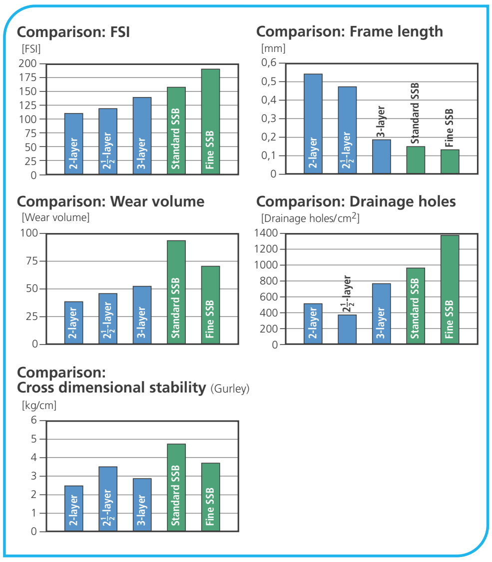

Fig.13 Comparison forming fabric designs

drive load of the forming section, previously in the range of 900-1000A, reduced to around 850-900A. At the same time, sheet porosity improved, which would positively influence printability. Overall, clear evidence of quantifiable gains when moving from double layer to SSB forming fabrics.

A Gapformer producing Fluting from 100% waste paper ran a packaging quality SSB instead of its traditional 2 1/2 layer qualitiy. A record life was obtained due to the much higher wear volume in SSB structure. Running time was increased from 90 to 120 days. At the same time retention aid consumption dropped by 30% with immediate, quantifiable savings for the mill. This was due to an increase in the fibre support properties of the SSB design.

Even moving from one SSB design to another can have a significant impact upon machine performance. An Optiformer producing LWC changed from a 20 shed, 1:1 ratio SSB to a 24 shed forming fabric from Heimbach with 3:2 ratio. This led to clear gains in formation, porosity and planarity, due to a slower drainage allowing all 5 loadable blades to be employed, as opposed to 3 previously. In addition, the lifetime achieved with the latter design was a record for this application.

Conclusion

In conclusion, we would suggest that developments will certainly not stop at their present position, and estimate that we will quickly move on to even finer structures (> 80 "S" count), higher FSI's (over 200 – like the ultrafine PRIMOBOND.XF with FSI > 215), and further weave pattern developments. Some of these steps will also certainly require new yarn materials to be effective. The speed of change can only continue to accelerate, and forming fabric suppliers are ready to meet the challenge.

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