Towards New Generation of Forming Medium

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ABSTRACT

The objective is loud and clean in respect of reducing drag load by which the mechanical stability of the fabric and reduction in the power requirement without sacrificing the sheet support has been achieved. Furthermore, the newer design try to create a configuration in which higher number of fillings can be used to present higher volume of material at the machine side to take care of the wear and tear of the fabric for a better life. While the trials of the design in question has proved beyond doubts about the higher life expectency of the fabrics, few more trials may strengthen its potentiality in regard to sheet quality of international standard.

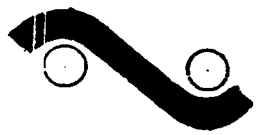
INTRODUCTION

Since the day the first paper maker dipped his mould in the vat, he is looking for better runnability, life and blemishfree paper from a forming medium to the extent it could contribute. In addition to the above, with change of social and economic scenario, the expectation from a forming medium has extended further in the form of saving of energy, paper making fibres and chemicals. The paper machine manufacturing companies also playing their role in devising various formers and faster machines to extend optimum benefits to the paper makers. As far as paper making raw material is concerned, a great change has been noticed during the last quarter of the Century. Perhaps no where in the world the raw material mix as was used 25 years ago is been used today which is either due to non-availability of the so called "long fibre" material or due to environmental reasons.

All the aforesaid changes has put the clothing industry in a complex situation. The clothing industry also has risen to the occasion to accept the challenge in which it has changed the forming medium from metallic wire to synthetic wire cloth which is probably the single development that has changed the economics of paper making.

The early type of synthetic forming fabric was 2 & 3-shed single layer (Fig. 1 & 2). When they were

Fig.-1



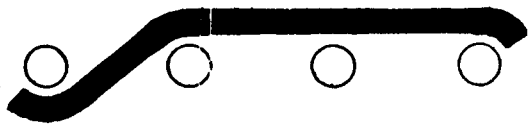
2-shed plain weave

Fig.-2

3-shed single layer

Swil Limited,
27-A, Camac Street
Calcutta - 700 016

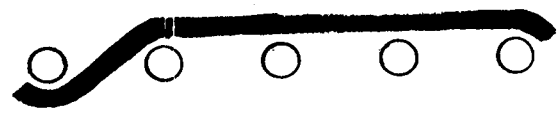
Fig.-3



4-shed single layer

introduced the synthetic wires operated on Fourdriniers designated for metal wires. The immediate problems faced was elongation, CD narrowing and the general lack of cloth rigidity. It was observed that the stretching of the wire was caused by straightening of the crimps in MD Strands. Reducing the amount of crimps improved stability. So, 4-shed (Fig. 3) and the 5-shed designs were introduced, because going from three to four shed weaving reduces the number of CD crimps by 25% and going to 5-shed, the reduction was 40%. The design modification brought other advantages as well. Reduced crimps increased the void fraction of the wire, which in turn allowed a denser strand packing without losing permeability. Increased strand number in turn increased wire stability and also provided more sheet support & wear potential.

Fig.-4

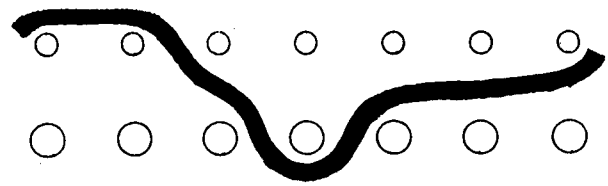


5-shed single layer

Upto 1970s Single layer forming fabric was widely used. But in the meantime, paper industry was also developed considerably. More wider and faster paper machine were introduced single layer fabric cannot be used at all or only with difficulty becuase of the large size and requirements on wire stability of such machines.

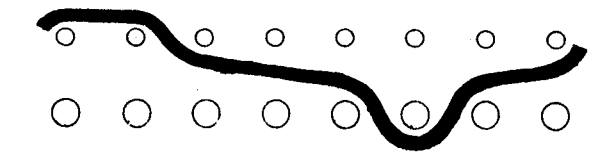
So double layer fabric was introduced in late 1970s to solve the problems faced with single layer. The main drawback of single layer fabric was elongation and stability. One obvious way to reduce stretch is to increase the amount of MD-oriented material per unit width. This was achieved by applying double layer weave design, a technique that was well known from the manufacturer of dryer screen. Here, a warp density exceeding 100% of the width of cloth can be applied maintaining the openness as the warps are separated by a double layer of wefts or CD strands. The thickness and thus even the CD stiffness of the double layer wire was higher than that of single layer. Though double layer wires were primarily introduced for reason of stability, it was discovered later that they possessed potential for improved sheet forming efficiency, retention and drainage. The main advantage of double layer design is that the double set of wefts allow the knuckle patterns of the two sides to be designed independently. Thus, the top side is optimised for fibre support, retention and sheet smoothness, the lower side for wear resistance and low drive force. The reason for higher fibre and fines retention is that the initial drainage rate is slowed by the high flow drag caused by the large number of strands and curved channels through the structure. The thickness and large strand density ensure mechanical stability and stiffness, important for runnability. The double layer wire is a rather complex

Fig.-5



7-shed double layer

Fig.-6



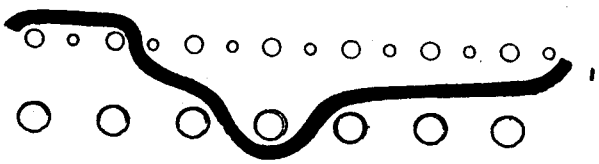
8-shed double layer

structure. The number or practical designs of single layer wires are very limited, whereas the possible double layer designs are almost endless. The mostly used double layers are of seven Fig.-5 or 8-shed (Fig.-6) design.

The double layer fabric reign supreme until middle of 1980s. Then came the two and half layer design or X-weave. The original concept was introduced by a North American Company in 1984 and quickly set new standard for paper making quality. In X-weave, extra weft yarns were added in the cross machine direction on the paper making surface to give increased fibre support. The number of bottom weft yarns were half than that of top weft yarns. So the structure was much opened up to give increased drainage capacity. Also the more opened structure allowed the use of large diameter yarns on the machine side for better wear potential. The X-weave was available mainly in 7-shed (Fig.-7) and 8-shed (Fig.-8) weave design.

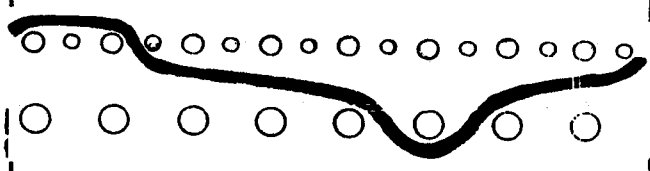
It was observed that though double layer & X-weave could cover almost all type of paper machines, the running time could not be increased specially on machines where abrasive condition persists. It was also observed that going to higher shed design gave longer float in bottom surface which ultimately allowed more material for abrasion. So 14 Shed and 16-Shed double layer and X-weave designs were introduced (Fig.-9 shows 16-Shed double layer & Fig. 10 shows 16-Shed X-weave). These weaves created long "Floats" of cross machine direction yarns on the machines side which protected the machine direction yarns from premature wear. The top surface of these designs were same as corresponding 7-shed or 8 shed design. So running time was increased considerably keeping the paper making quality same as 7-shed or 8 shed.

Fig.-7

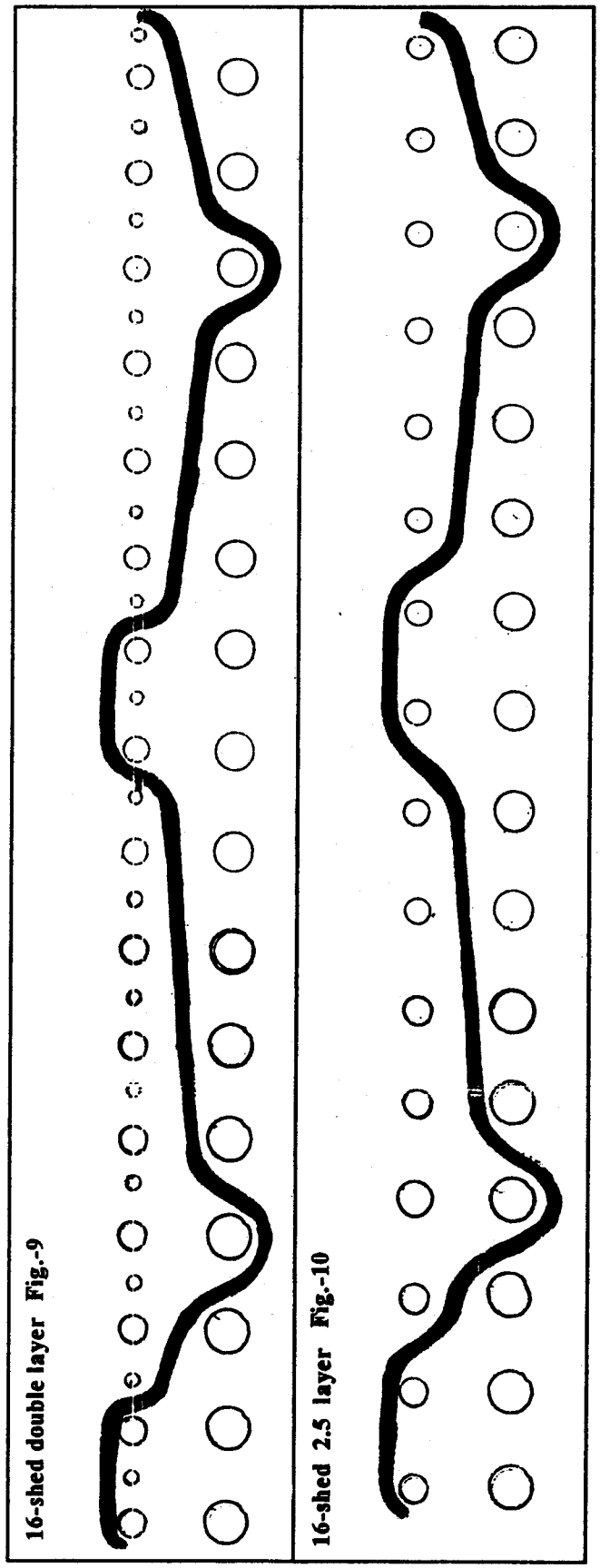


7-shed x weave {2.5 layer}

Fig.-8



8-shed x weave {2.5 layer}



16-shed double layer Fig.-9

16-shed 2.5 layer Fig.-10

Though wire marking of 14-shed or 16-shed was slightly higher than that of 7-shed or 8-shed designs, these designs were used on paper machines where a little more wire marking was not a problem. These designs proved to be very successful on Fourdrinier and multi-wire board machine, kraft liner, liner board with considerable improvements in fabric life and runnability.

These are the conventional designs which are commonly used today in almost all type of paper machines. The present need of the paper Industry is to increase running time of the forming fabric without sacrificing paper making quality. In order to achieve this continuous development is going on to make it possible to present more material (by increasing diameter and number of weft yarns) at the bottom surface to take care of abrasion and ultimately offer more running time without disturbing other characteristics of the fabric. This factor can not be achieved in conventional multi-layer fabric as with increase in diameter and count of bottom weft wire, the air permeability through the fabric reduces and the rate of drainage will be poor which will directly affect the paper making characteristics and runnability of the paper machine. The 14-shed & 16-shed designs though give more running time but these designs can not be used on fine quality writing-printing paper, tissue paper machines as its wire marking is more than 7-shed or 8-shed designs.

Recently a new multi-layer design fabric has been used in one of the Indian paper mills which can effectively solve the shortcomings of conventional weave designs. The new designs has the possibility to insert higher diameter and higher number of weft threads in the bottom surface of the fabric without sacrificing the permeability, fibre support and other basic requirements of paper making. This design proved to be very successful in not only Fourdrinier paper machines but also in twin-wire high speed machines. The following comparison between conventional design and new design clearly shows its advantages :-

The tables 1 and 2 show how successfully the

TABLE-1

		8-SHED D/L	NEW DESIGN
01.	WARP DIA (MM)	0.20	0.20
02.	WARP COUNT /CM	56	56
03.	TOP WEFT DIA	0.22	0.22
04.	TOP WEFT COUNT /CM	18	21
05.	BOTTOM WEFT DIA	0.30	0.35
06.	BOTTOM WEFT COUNT/CM	18	21
07.	T- COUNT	92	98
08.	PERMEABILITY CFM	386	423
09.	FSI	88.9	92.7
10.	DRAINAGE INDEX	15.44	18.33

TABLE : 2

		16-SHED	NEW DESIGN
01.	WARP DIA (MM)	0.25	0.25
02.	WARP COUNT /CM	36	36
03.	TOP WEFT DIA	0.30	0.30
04.	TOP WEFT COUNT /CM	15	16.5
05.	BOTTOM WEFT DIA	0.40	0.40
06.	BOTTOM WEFT COUNT/CM	15	16.5
07.	T- COUNT	66	69
08.	PERMEABILITY CFM	460	460
09.	FSI	60.3	64.5
10.	DRAINAGE INDEX	14	15.6

new design overcomes the limitations of conventional designs. The main problem of conventional designs, as described earlier is the weft count can not be increased without sacrificing permeability. But with the new design weft count is increased by. 10% to 15% keeping the permeability same. This unique feature of the new design leads to series of other advantages also-

1> More weft yarns per unit in the top. surface of the fabric offers better fibre support (as reflected in better fibre support index value), better formation of paper sheet, better paper sheet transfer from wire part to press part and smooth runnability.

2> More weft yarns per unit in the bottom surface offers more material for abrasion which gives more running time. Also its bottom weft "Floats" are longer than conventional designs, which further offers more material for abrasion and protects the machine direction yarns from premature wear. For these reasons considerably higher fabric life is achieved with the New Designs & this leads to higher production and less down time.

3> Since the T-Count is higher, the fabric is more rigid and dimensionally stable which enables it to run very successfully in more wider & high speed paper machines.

4> With higher Drainage Index the fabric provides uniform and smooth drainage of water from the paper pulp and this leads to less drage load for de-watering in paper machine.

The data collected from paper machine running with the new design also confirms its edge over other designs.

From Table : 3 The unique feature of the new design is clearly established. With higher retention, less power consumption and higher production, the new design fabric is going to give meaningful support to the paper making industry by improving productivity, reducing down time and above all improving profitability. The objective is loud and clear in respect of reducing drag load by which the mechanical stability of the fabric and reduction in the power requirement without sacrificing the sheet support has been achieved. Furthermore, the newer design try to create a configuration in which higher number of fillings can be used to present higher volume of material at the machine side to take care of the wear and tear of the fabric for a better life. While the trials of the design in question has proved beyond doubts about the higher life expectancy of the fabrics, few more trials may strengthen its potentiality in regard to sheet quality of international standard.

Apart from the designs which are described, there are few more designs which are used special application. These designs are :-

1.5 Layer - For Higher GSM Kraft Paper, Liner Board etc.

Three Storied - For finer paper & high speed machines where stability, drainage are more important.

Triple Layer - Latest development in forming is Triple Layer which is the most sophisticated weave and is unique for finer tissue and where wire marking and retention are important criteria. This fabric has two separate fabric layers top and bottom connected with a binder stand (stitch). As a result there are two sets of warp yarns and two sets of

TABLE-3

		CONVENTIONAL DESIGN	NEW DESIGN
01.	G.S.M.	48	48
02.	M/C. SPEED	500	525
03.	HEAD BOX CONSISTENCY	0.76	0.76
04.	TRAY WATER CONSISTENCY	0.31	0.24
05.	COUCH LOAD	270 AMP.	250 AMP.
06.	FORWARD DRIVE ROLL LOAD	360 AMP.	290 AMP.
07.	RETENTION	60.25%	68.4%
08.	TOTAL PRODUCTION (TONS)	13,000	16,288

weft yarns. In general, the top layer is finer with plain weave and the bottom layer is coarser with 3-shed, 4-shed or 5-shed design. Advantage of triple layer designs are better formation and sheet quality due to the fine top layer, improved retention of fines and fillers, increased stability, improved wear resistance due to the coarser bottom layer. The triple layer fabric is still not very popular in this sub-continent and used selectively only probably because of its high cost and is not tested fully on high abrasive machine conditions.

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