Manufacture of Big Size Paper Machines in the Country

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1.0 Introduction

As far as we know, the biggest size of paper machine manufactured in India is of 4.1 metres wire width and 3.6 metres width on reel. Part of this was imported from overseas collaborators. Smaller machines of less than 3 metres wire width have been completely manufactured and supplied by indigenous manufacturers, with, of course, a few imported components.

The biggest size of machine in operation in India since the last seven years, completely supplied by overseas manufacturers, is a machine of

Wire width	=240", i. e. 6.1 metres
Width at Reel	=approx. 5.5 metres
Operating speed	=600 metres/ minute
Production	=over 200 tonnes / 24 hrs

The demand for Paper in the country is growing very fast and it has been foreseen by the government that the present production of the so called cultural Papers, including writing and printing papers, will have to be increased considerably. One way of meeting this demand, to some extent, is to increase production by renovating and speeding up the existing paper machines. Bulk of the demand would however, have to be met by installing altogether new plants for these kinds of papers.

To plan the above it is necessary to determine the optimum size of paper machines which can be considered to represent the best techno-economical compromise. India cannot be considered as an under-developed country as far as the paper industry is concerned. As I have already said, we are having a machine of 6 metres wire width, which is being operated for several years now at as high a speed as approximately 600 metres/minute turning out more than 200 tonnes per day of writing and printing papers.

Therefore in developing countries like ours, where the sources of supply for traditional raw materials like bamboo are getting depleted at a very fast rate and where transportation of raw materials over long distances presents considerable difficulties, it is necessary to give a very careful consideration to these aspects in determining the optimum size of the paper machine for Indian conditions.

It is of course known that besides constraints on raw materials as mentioned above, there would be several other factors, namely, availability of finance etc., which have to be taken into consideration while deciding upon the width of the paper machine from case to case.

The main theme for discussion at this IPPTA Semeinar is

"Manufacture of Pulp and Paper Making equipment in India."

This Seminar, therefore, where most of the paper makers and the Indian as well as foreign paper machinery manufacturers have got together, affords excellent opportunity for a detailed and meaningful discussion of the various issues involved.

I have therefore taken this opportunity to highlight a few points which determine the optimum and economic size of the paper machine for the production of writing and printing papers in particular. The observations made by me have been based on the various studies conducted by our Collaborators, Messrs J. M. Voith, and the data compiled by them over the years from the large number of paper machines supplied by them.

2.0 What will be the optimum size of paper machine in General and in Particular for writing and printing papers.

Before we answer this question satisfactorily, we have to see the trend of modern technology which has already been tried and established. Bearing this in mind, it can be said that the paper machines for various papers have been de-

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signed and are running satisfactorily for the following speeds :

Writing & Printing Papers (wood containing & wood free)	750- 800 m/min
Newsprint	850- 950 m/min
Soft Tissue	1200-1500 m/min
Light Craft Paper	750- 850 m/min
Kraft liner	500- 600 m/min
Board (made on Cylinder Mould)	200- 250 m/min
Board (made on Fourdrinier Machine)	300- 350 m/min

Based on the aforesaid working speed ranges, the production rates for the various kinds of papers, calculated on the basis of per metre width on Reel, will be as follows :

Writing & Printing Papers of 60 g/m²	45–60 t/24 hrs
Newsprint	55–60 t/24 hrs
Soft Tissue	20–25 t/24 hrs
Light Kraft Paper of 40 g/m²	42–45 t/24 hrs
Sack Papers of 80 g/m²	68–70 t/24 hrs
Kraft Liner of 200 g/m²	150 t/24 hrs
Board (made on Cylinder Mould)	50–60 t/24 hrs
Board (made on Fourdrinier Machine)	70–80 t/24 hrs

2.1 Building Costs

Graph No. 1 shows the curves of various paper machine volume requirements in relation to their width. Here the volume of the paper machine hall from Headbox upto Reel, with the required space for storage of few rolls, has been considered.

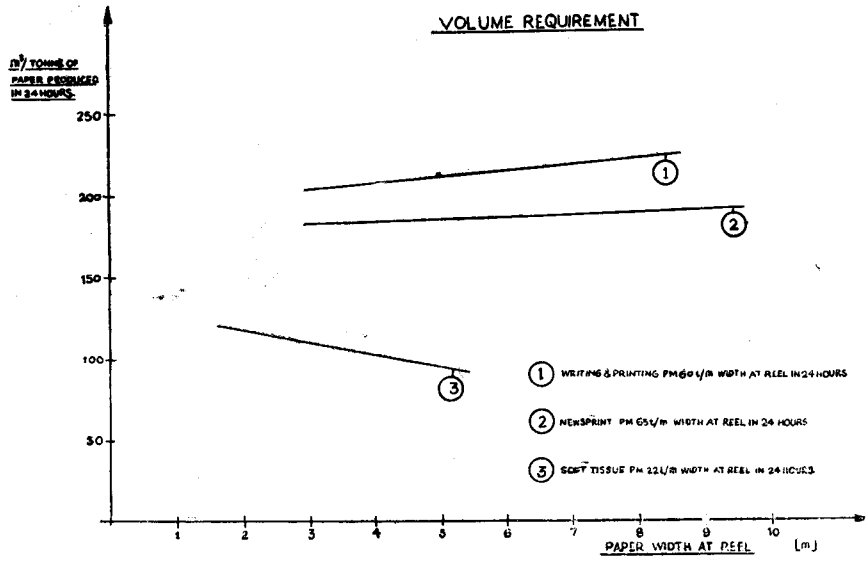

Fig. 1

All the curves clearly indicate that for all kinds of papers with Dryer Sections of traditional drying cylinders, the volume requirement in cubic metres per tonne of manufactured paper in 24 hours goes up as the width of the machine increases. This means that the building costs of all kinds of paper machines go up with the width of the machine.

However, it will be seen from curve No. 3 that in the case of soft tissue machines, the volume requirement per tonne of manufactured paper in 24 hours gets reduced as the width increases. This is because of the fact that for soft tissue machines there is only one of MG Cylinder, and for a higher production only an increase in the diameter of the cylinder is required and, therefore, for higher production the total volume requirement goes lower.

From this analysis it is clear that for all kinds of papers including writing and printing, except soft tissues, the width of the paper machine should be kept as small as possible.

2.2 Investment Costs

Let us now analyse the investment costs for paper machines of various wire widths which can meet the aforesaid accepted technological trends.

To compare the investment costs a graph No. 2 has been drawn showing per tonne of paper produced in 24 hours versus the width of the paper machine in metres at reel. As the newsprint paper machine cost is the lowest, this has been taken as the base for reference purposes, as 100.

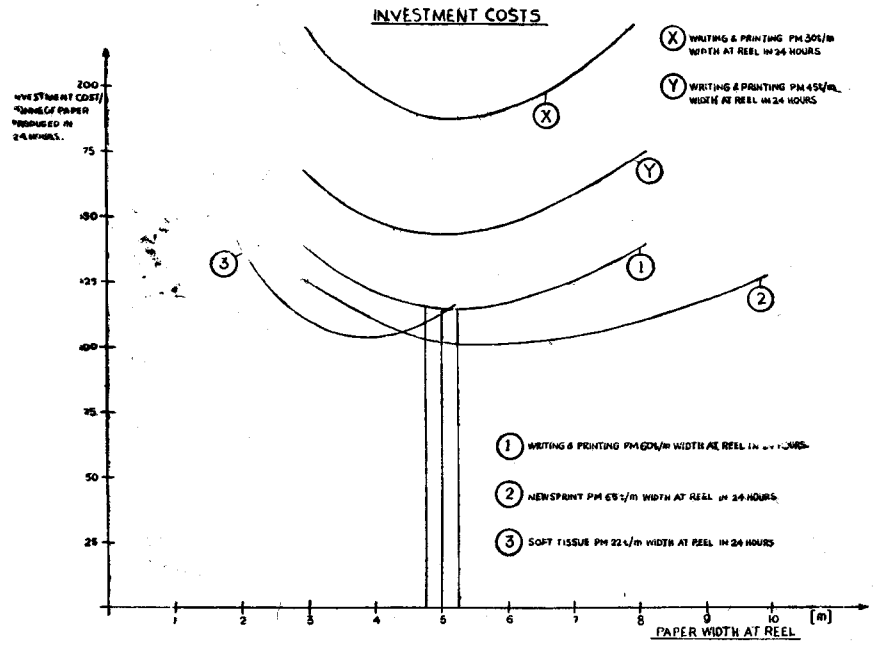

Fig. 2

It should be noted here that Fourdrinier machines of modern design, i. e. with vacuum pick-up, three presses of high intensity, dryer section of adequate drying capacity, calender stack, reel, ten tambours, heating system for the complete machine, central lubricating system, instrumentation, hoods with complete air circulation system and drive etc. have been considered.

From these curves we observe the following interesting points :

(i) For Fourdrinier machines with traditional dryer sections, the most economical width is about 4.8 to 5 metres on the reel, i. e. about 5.5 meters wire width.

(ii) Writing and printing Paper machines require higher investment than newsprint machines because of the Size Press and After-Dryer Sections required in the former. The Size Press and After-Dryer Section do not add to the output of the machine, but are required for manufacture of quality writing and printing papers.

(iii) On looking at curve No. 3 for tissue machines it may be asked why the optimum for this type of machine is not in line with the standard Fourdrinier machines for other papers. The reason is that these machines are being built for high operating speeds upto 1200 to 1500 meters/minute. These speeds require high stock heads in the headbox. For instance, at 1200 metres/minute the necessary headbox pressure is about 2.05 atmg. With an increased width, the headbox is to be stiffened tremendously to take up the deflection which would increase by a third power. Therefore, while increasing the width of the machine, the cost for the headbox goes up much more than what the linear increase in width shows. The other major cost items in a tissue machine are the Yankee Dryer and air-handling equipments.

2.3 Operational Problems

The operation of an extremely wide and high speed machine will require extraordinary carefulness of all the operators on the machine. A slight mistake or a slip on the part of an operator can damage the wire or felt which are extremely expensive for wide machines. The change of felt and wire will also require a very careful supervision and organized team. To avoid damage of felt and wires and other costly equipments, the whole machine will have to be equipped with very sophisticated instruments and controls and therefore, to maintain these sophisticated instruments and controls you will have to have specially trained personnel on your pay roll. In the absence of trained personnel, a minor instrumentation problem can be the cause of long stoppages of the machine, which no paper mill owner will be able to tolerate. The control of the paper quality, i.e. the basis weight throughout the width of the machine and the dryness of the end product throughout the

width, will also require particular attention.

2.4 Availability of Clothings etc. for the Machine

There are very few manufacturers in India who make the required wires and felt for even the existing paper machines. However, they are making constant progress, and we hope that they will be able to keep pace with the development of the paper industry in the country. However, we cannot expect them to gear up their production for only a few machines which are to be installed in the future with extremely large size of wire width. Therefore, considering the acute shortage of foreign exchange faced by our country, we should see that most of the clothings required for the paper machines are in the manufacturing capacity of our Indian wire and felt manufacturers.

The same is applicable in the case of rubberlining manufacturers as well as manufacturers of synthetic lining of various de-watering elements of the wire section, and other equipments.

2.5 Risk Factor

From the financial risk point of view, especially in the present industrial environment, it will be always advisable to have two paper machines of optimum size rather than having one machine of extremely big size. A paper machine is dependent on pulp mill, stock preparation, power generation and so many other sections of plant, and to keep the paper machine running, all the plants will have to be in perfect state all the time, which is very diffcult. Therefore, it is not advisable to have one paper machine of extremely big size, and two machines of optimum size are better.

2.6 Findings of the Study

From the above mentioned detailed study, it will not be incorrect to say that the optimum size of machine for various papers in general, and for writing and printing papers in particular, is in the range of trimmed width 4.5 metres to 5 metres, i. e. a wire width from 5 to 5.5 metres.

For general information of all concerned, I am giving here the saleable production of Writing and Printing Papers of different basis weights that could be achieved on Paper Machines of 5.0, 6.3 and 7 metres width.

For practical purposes, from now onwards in this paper, I would consider only 5 metres wire width size, as the basis for my further references.

TABLE I

Wire Width mm	Width at Reel mm	Basis Weight g/m²	Speed m/min	Gross Production with 100% effic. T/24 Hours	Net Production with 82.5% effic. T/24 Hours
5000	4500	50	550	180	150
			620	200	165
			750	244	200
		60	460	180	150
			520	200	165
			625	244	200
		80	340	180	150
			390	200	165
			470	244	200
		100	275	180	150
			310	200	165
			375	244	200

3.0 Configuration of Paper Machine

It is quite obvious that a paper machine which has to pruduce paper at a rate of 45–60 tonnes per metre width at reel in 24 hours, cannot have the traditional type of headbox, wire section, no pick-up arrangement, open presses, dryer section, calender stacks with many rolls, and reel. In configuration the modern machine will look as it has been shown in the schematic diagram.

I would now like to say a few words on the various sections of such modern paper machines.

3.1 Headbox

The traditional open type headbox is suitable only for machines operating with speeds upto 250 metres/minute. To meet the demand of high speed machines, we recommend a closed type headbox with pressure and vacuum system. This

TABLE II

Wire Width mm	Width at Reel mm	Basis Weight g/m²	Speed m/min	Gross Production with 100% effic. T/24 Hours	Net Production with 82.5%effic. T/24 Hours
6300	5700	50	440	180	150
			485	200	165
			600	244	200
		...	620	250	210
		...	750	300	245
		60	370	180	150
			405	200	165
			500	244	200
		...	600	295	245
		...	750	345	305
		80	275	180	150
			300	200	165
			375	244	200
		...	500	330	270
		...	600	395	325
		...	750	495	410
		100	220	180	150
			240	200	165
			300	244	200
		...	400	330	270
		...	500	410	340
		...	600	490	400
		...	750	600	490

... ... Theoretical Production Calculation

type of headbox is equipped with 3 rectifier rolls which ensure a flocculation free flow of stock through the headbox. Full width overflow is a very important feature of the closed type headbox for removal of scum and foam continuously from the system.

The headbox can be equipped with lateral approach flow system or central fed manifold distributor. These headboxes are equipped with level and pressure controllers.

It will not be out of place to mention here that very recently our collaborators developed a complete new design of headbox, i. e. honey-comb high turbulence headbox. These are comparatively easy in operation and give excellent uniform distribution throughout the width, and because of high turbulence, flocculation free flow is also ensured. Very shortly the first head box of this type will be commissioned in Germany, and after having satisfactory reports from our collaborators we will be able to offer the same to our Indian customers.

3.2 Wire Section

The wire section of such modern machine will not be equipped with traditional table rolls, but will be equipped with foil boxes. Because of the micro turbulence which will be created by these foils at the speeds indicated in the above tables, these will give good formation.

The foil boxes are equipped with easily and quickly changeable foil strips to suit the various furnishes and other parameters. Automatic wire stretchers and guides are also provided, to take care of these high speed machine wires. The suction couch rolls are provided with two vacuum zones in place of the traditional one zone.

3.3 Press Section

The web is picked up from the wire by a vacuum arrangement, as indicated in the sketch. Our modern machines are equipped with double compact presses which provide a vacuum pick-up as well as the first suction nip. The biggest advantage of this double compact press is that the first open draw will exist only after the second nip where the dryness of the web is already quite high, which ensures a trouble-free pick-up as well as very low breakages in the press section and gives quite higher dryness than normal through presses. The third press is a high intensity nip grooved press. A

TABLE III

Wire Width mm	Width at Reel mm	Basis Weight g/m²	Speed m/min	Gross Production with 100% effic. T/24 hours	Net Production with 82.5% effic. T/24 Hours
7000	6300	50	400	180	150
			440	200	165
			540	244	200
			600	270	220
			750	340	280
		60	340	180	150
			370	200	165
			450	244	200
			500	270	225
			600	320	270
			750	405	335
		80	250	180	150
			275	200	165
			340	244	200
			400	290	240
			500	360	300
			600	435	360
			750	545	450
		100	200	180	150
			220	200	165
			270	244	200
			300	270	225
			400	360	300
			500	450	370
			600	540	440
			750	680	560

... ...
... ... Theoretical Production Calculation

smoothing press is also part of our press section.

3.4 Dryer Section

The traditional Dryer Section with normal felt dryers and woollen felts will not be able to meet the requirement of these high speed machines.

The first dryer group will be equipped with woollen felts and felt dryers to avoid the marking of synthetic fabrics which are being used in all the other dryer groups. To provide uniform dryness throughout the width of the web, dryer groups are provided with pocket ventilation.

3.5 Size Press

Inclined type Size Press is a part of a normal writing and printing paper machine of this type. This type of size press will be able to give the desired pick-up for normal writing and printing papers. These size presses are extremely suitable for 0.8 to 1 gram pick-up per square metre on each side for the papers of basis weight 50 to 100 g/m².

3.6 After Dryer Section

At leats two drying cylinders just after the Size Press are either chrome-plated or, as it is difficult to get chrome-plated drying cylinders in the country, made of nickel-chromium alloyed cast iron to provide the required fine surface of the cylinders. At the end of the after-dryer section, two cooling cylinders with separate felt runs are provided to give appropriate cooling effect to improve the effect of calendering. These cooling cylinders are also made of alloyed cast iron.

3.7 Calender Stack

We normally do not recommend a 6-roll or 8-roll calender stack for wood-free papers, but recommend a 4-roll calender stack with the top and bottom rolls as swimming rolls. With the help of these swimming rolls, it will be posible to apply the desired nip pressure without chan-

ging the crowning of the rolls. The calendering effect of this small calender if not better, will, in any case, not be inferior to the traditional calender stack of 6 or 8 rolls. Lesser number of rolls in the calender stack has a big say in increasing the overall efficiency of the machine.

3.8 **Reel**

Hydraulically actuated reel is recommended for this size of machine. In this type of reel, paper roll density is controlled by hydraulic nip pressure. Proper winding and easy reel change without any risk of breaking the paper is ensured by providing reel spool starter.

3.9 **Accessories of Paper Machine**

Central lubrication system, adequately designed air handling system with heat recovery and efficient type of heat and condensate removal system, are also part of our paper machine.

As far as the drive of the machine is concerned; we recommend for paper machines of this width, i. e. 5 metres, a sectional drive with Thyristor type stationary converters.

4.0 Manufacture of Paper Machines at Utmal

With the present manufacturing facilities, UTMAL can supply Paper Machines of wire widths upto 5 metres; in other words suitable for production of 200 tons/day saleable writing and printing papers of 50 GSM basis weight.

In order to cater to such customers who may need still wider machines, although from technical and economic considerations this may not really be necessary, we have taken up the planning work in hand to equip ourselves to manufacture Paper Machines upto wire width of 7 metres. This will be achieved in two phases—in the first phase upto 5.5 metres and in the second phase upto 7 metres.

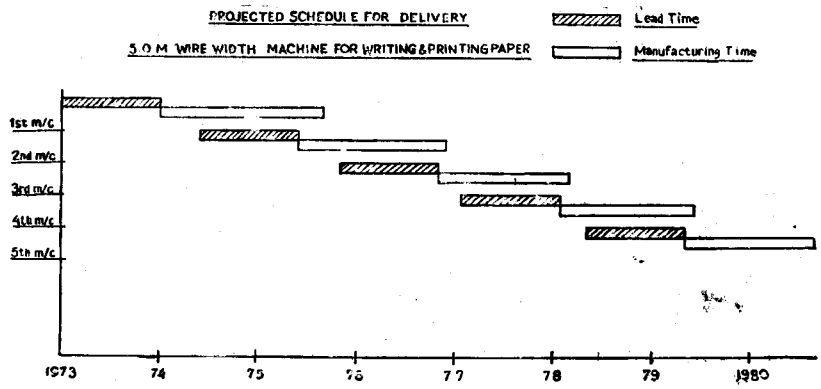

Fig. 3

For the first modern machine ordered on UTMAL conforming to the aforesaid description, UTMAL would need a manufacturing period of 20 months plus a lead period of 12 months for design, engineering and procurement. If the orders for such machines are properly phased, it will be seen from graph No. 3 that it will be possible for us to deliver such machines at the interval of 15 months each.

5.0 Conclusion

In the end it can be said that, taking into consideration the available raw materials, transportation bottlenecks, difficult economic situation including acute shortage of foreign exchange in the country, if we in the next few years to come install paper machines of wire width of 5 meters, we will be in a position to meet the growing requirement of cultural papers including writing and printing in the country, without abusing the foreign exchange resources, keeping pace with the modern technology in the field.

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