# Experiences with Voith's "Duoformer" Twin-Wire Paper Machine for Newsprint Manufacture at Hindustan Newsprint Limited, Newsprint Nagar

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SUMMARY

The Paper points out the limitations of the Fourdrinier Paper Machines with respect to speed increase requirements and two-sidedness of Paper.

The Paper deals with general need and development of Twin-wire Formers due to short-comings of Fourdrinier machines.

The Paper also gives types of Twin-wire formers developed, their classification and also the advantages over Fourdrinier machines. The Paper then gives detailed section-wise description of equipment and machinery (from stock preparation to finishing) and process of manufacturing Newsprint at Hindustan Newsprint Limited, Newsprint Nagar.

Lastly, the paper deals with the problems being faced by us at present, the reasons, proposed remedies and planned course of action.

The Manufacture of paper from Fourdrinier paper machines presented no problems at low speeds, but in recent years it became obvious that there were real limitations in increasing the speeds. The use of table rolls to support wire and remove water at high speeds created stock disturbances and disturbed the formation. Again the length of entire forming area required at higher speeds was also getting out of hand.

Also, two sides of finished paper were different in texture and quality as one surface of paper is formed against the wire and the otheer side is at an air interface. One directional removal of water also caused uneven distribution of fibres and fillers.

Technological advances with development of new types of dewatering elements such as different type of foils, wet suction boxes, vacuum foils etc. only helped to some extent, but did not solve the problems.

## DEVELOPMENT OF TWIN-WIRE FORMERS

Further advances and developments resulted in an Inverformer machine, proving that formation of web between two wires was possible. This was designed as replacement for cylinder machines.

This technique was logical extended and led to Twinver former for production of light weight single-ply papers.

Another twin-wire concept utilising vertical flow of stock is the vertiformer, and initial results were encouraging. Time Inc former was built and later developed by Beloit.

Then, came the concept of papriformer from pulp and paper research institute of Canada.

With these developments came twin-wire formers for writing, printing papers, newsprint, tissue papers, boards from more or less all the leading paper machine manufacturers, such as, papriformer by Dominion, Papriformer and Periformer by KMW, Bel Baie formers by Beloit, Duoformers by voith, Symformers and speed formers by Velmet etc.

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## CLASSIFICATION OF TWIN-WIRE FORMERS :

The Twin-wire formers can be classified in the following groups.

Group A—Twin-wire formers with stationary dewatering elements

Group B—Twin-wire formers with formation roll

Group C—Hybrid formers

Group D—Board machines with two or more formation units

**Group 'A'**—Twin-wire formers with stationary elements

The stationary dewatering elements create pulsating dewatering in two directions contributing a good formation and a sheet of high density.

Types of machines in this category are :

1) Bel Baie formers from Beloit.

2) Vertiforma from Black-clawson.

**Group 'B'**—Twin-wire formers with formation roll.

Quick dewatering under constant pressure between two wires, which run over a formation roll. These machines give quick dewatering and allow high speeds are especially useful for newsprint and tissue. There is very less wear of wires due to absence of stationary elements.

**Types of machines for Newsprint :**

1) Duoformers from Voith
2) Periformer from KMW
3) Speed-former from Valmet

**Types of machines for Tissue :**

1) Tisco-Former from Escher Wyes
2) Beloit Tissue
3) Valmet Tissue

**Group 'C'** Hybrid formers

A fourdrinier section with top wire, dewatering in fourdrinier section, which can be controlled by dewatering elements followed by formation between two wires and dewatering in two directions. This offers very good formation and less wire marks and pin holes.

**Types of machines :**

1) Symformer N & F&R from Valmet
2) Duoformer F & H from Voith
3) Bel Bond from Beloit

**Group 'D'**—Board machines with two or more formation units. The type of machines are Arcuformer, Inverformer, Ultraformer. This is worth mentioning here that it has been possible to go for high speeds due to the following reasons.

1) Development of better dewatering elements in fourdrinier machines.
2) Development of good head boxes suitable for high speeds.
3) Developments in press sections with close nip configuration and higher loading.
4) Developments steam and condensate systems and hood ventillation system.
5) Development of machine clothing keeping pace with requirements of high speed paper machines.

**Advantages of Twin-wire formers :**

The main advantages of Twin-wire formers over Fourdrinier machines are as follows:

1) Short forming area and so lower capital costs.
2) Higher speeds
3) Two sided drainage and so improvement in two-sidedness
4) Higher wire life.

**Manufacture of Newsprint in Hindustan Newsprint Limited :**

The mill has a Twin-wire former, namely Duoformer-C, manufactured and supplied by M/s. J.M. Voith, West Germany.

The basic furnish as per design is 35% Reed chemical pulp and 65% Eucalyptus Chemi-Mechanical Pulp.

The details of furnish preparation and Newsprint manufacture are given underneath.

**Stock Preparation** : The bleached chemical pulp from High density tower is taken to low density CP Chest at 4.5%consistency Similarly, the chemimechanical pulp from CMP High density tower is pumped to LD. CMP Chest at 4.5% consistency. These two pulps are separately refined in double disc refiners and taken to the refined CP & CMP chests The two streams along with broke are taken to blending chest through a proportionating system.

The broke from couch, press pit and dry end pulper is taken to broke chests from where it is pumped to blending chest through a high density cleaner and deflaker. The stock from blending chest is pumped to machine chest and partly to disc filter seveall as sweatner stock. The sweatner stock addition is in the pump suction having interlock with the feed valve which opens only when the pump is running. The saveall feed pump is interlocked with saveall drive which in turn is interlocked with repulper. Clear fillrate is utiiized for the low pressure and high pressure showers of the duoformer, saveall cleaning and sheet knock off shower, vibrating screen showers, press pit, couch pit and dryend pulper showers. The Cloudy filtrate is utilised for consistency control saveall vat dilution and recovered fibre consistency control.

**Approach flow system** : The approach flow system is with four stage deculator cleaning system. The wire tray water is taken to silo and the excess white water is used for reject header dilution, and reject tanks level make up. Stock from machine chest is added through stuff box into the suction of the primary fan pump. The accepts from primary cleaners are taken to secondary fan pump and through pressure screen (2 Nos.) accepts are taken to headbox. The recirculation from headbox is connected back to silo through a control valve (manually operated) to maintain uniform pressure across the header. The rejects and vent from the pressure screen are taken to vibrating screen the accepts of which are connected to silo. Control valves are provided in the feed and delivery of the pressure screens which will automatically open with secondary. fan pump start up. Secondary fan pump will start only with running, deculator system on and also it is interlocked with sheet knock off shower pump.

Alum, dye and defoamer are added in the primary fan pump suction. Provision is made to add dye and defoamer in machine chest pump suction also. Earlier talcum addition was in the suction of the secondary fan pump, but later it was changed to blending chest. Talcum addition was found to be beneficial for pitch dispersion.

**Paper Machine** : The newsprint machine was started in Feb '82' it was supplied by M/s. J.M. Voith of West Germany. It is designed for a maximum production of 382 TPD at 100% efficiency at 750 mpm and to produce 289 TPD at 610 mpm of 52 gsm, (The operating speed range is 450-750 mpm) using a furnish of 65-70% of chemimechanical pulp and 35-30% of reed sulphate pulp. The machine is designed with the twin wire former, Duoformer-C model and hydraulic head box (Type-W).

**Head box** : The main components of head box are :

- Tapered header with lateral stock approach from drive side with stock recirculation on tender side.
- Primary tube bank, followed by mixing chamber with a full width slot of 6 mm for a small amount of stock overflow to the air chamber.
- The mixing chamber is followed by secondary tube bank, the tubes with circular inlets and expanded to hexagonal shape on the outlet, forming a honey-comb structure.
- Long and converging lip with top lip fixed and hinged bottom lipwith spindles for micro adjustment. The advantages are that no moving parts rectifier rolls in the flow path and inside surface is provided with high finish One shower is provided in the air chamber to keep the walls clean. The shower can be rotated to the required position.

  There is provision for swinging the head box up and down so as to adjust the angle of jet impingement. Mechanical level controllers are provided to maintain constant level in the overflow chamber.

**Duoformer** : The duoformer-C consists of two wires, the No. 1 wire is top wire and the No. 2 wire bottom wire. Both are 100% synthetic wires, of the same length of 21.35 mts.

The jet from the headbox is directed upwards between the two converging wires. The angle of impingement is adjusted in such a way that the jet is hitting the forming roll in a tangential way. The jet should not hit the breast roll, as the breast roll drainage disturbs the sheet formation. The forming roll in the top wire circuit, is provided with two vacuum zones and the vacuum in the I zone is kept very low, to effect gentle dewtering. The forming roll in construction is a suction roll with honey comb structure and shrunk over this is a synthetic fabric (a shrink sleeve). In the top wire circuit, one vacuum deflector (the only stationary element in duoformer circuit) is provided to remove water from top wire and directs the water flung off by the forming roll to the saveall pans. The water and air are removed through a separater and the vacuum is derived from forming roll second zone.

The couch roll is with 4 vacuum zones. The I vacuum zone is designed to ensure that after separation of the wires, the sheet follows the

bottom wire and vacumm flap in the II zone will open, after sheet is carried on the bottom wire, with a pressure switch actuation, but this arrangement has been removed.

Sheet formation in duoformer takes place over a very short distance. Dewatering takes place on both sides, on the bottom side under the influence of the wire tension, jet pressure and the centrifugal force and on the top side under the control of jet pressure and vacuum inside the forming roll.

The forming roll and couch roll are driven. In both top and bottom wire circuits all rolls are positioned inside, excepting the guide rolls. The guiding system of the wires is through water jet tracer system.

**Shower System** : For forming roll sleeve cleaning, 40 bar oscillating shower (hydraulic) is provided, which is run continuously. For top and bottom wires cleaning, HP showers oscillating (hydraulic) fan type (maximum pressure-40 bar) are provided which are mostly run coninuously. For suction couch roll shell cleaning, 60 bar needle showers oscillating (hydraulic) is provided which is run periodically. All rolls are with Pneumatic Oscillating doctor blades and 2 bar pressure clear filtrate is used for all the roll showers and knock off showers (14 bars). One set of trim knock off showers is provided in top wire circuit. In the bottom wire circuit two sets of trim knock off showers (before and after stretch roll), one full width knock off shower after stretch roll and another knock off shower before stretch roll (in this shower, normally it is 2 bar but during stock on wire, this is changed to 14 bar shower, through a control valve) are provided. The showers are all self cleaning type with built in brush.

The wire life both in top and bottom position is about 5 to 6 months and we are using single layer fabrics. The good performance of the fabrics may be due to absence of stationary elements and good shower cleaning system. In case of over run of any of the top or bottom wires, initial alarm is provided to attend and if over run continues, the duoformer and the secondary fan pump will trip. In case of sheet knock off shower pump failure, vacuum pumps failure, primary fan pump tripping, the secondary fan pump will immediately trip. To remove the water vapours, air currents and the mist from HP showers, exhaust system is provided behind top wire.

**Press Section**:

The press is off the closed tri nip configuration with stainless steel venta nip swimming rolls for crown correction in I and III nip position' rubber covered suction press roll and granite roll are the other two rolls. The first nip is a double felted nip. The design nip pressure are 60, 80 and 100 kg/cm$^2$, and the normal operating pressures are 60, 75 and 90 kg/cm$^2$.

The pick up roll is with a vacuum zone width of 150 mm and the suction press roll with two vacuum zones (low vacuum zone in the I nip and also acting for carry over zone and high vacuum zone in the II nip). Spreader rolls are provided in the I (bottom) and III (top) press felt circuits. For cleaning of the felts, one LP lubricating shower, oscillating (hydraulic) 2 bar fan type and one oscillating HP shower needle type are provided, before uhle boxes The HP showers are run twice in a shift for a short duration, depending upon the felt condition (20—25 bar) Two numbers of uhle boxes (each) are provided for pick up and bottom felt position and one for III press felt. Slot width of the uhle boxes is 15 mm. The uhle boxes can be swung or rotated during running (air motor operated) for cleaning and can be returned back to normal position against a fixed stop.

**Chemical cleaning of the felts** :

The felts are cleaned regularly with 5% caustic during any shut and also sometimes as and when the wet end Press breaks are more which is suspected to be due to felt plugging, the felt cleaning is done with stock taken off press. But, continuous on machine cleaning is yet to be tried.

During start up, as the sheet is picked up, III press nip loading is kept to the minimum to avoid any damage in the nip and only after the sheet is transferred, pressure is changed to maximum nip pressure and in this connection, additional interlocks are incorported to overcome any accidental damage.

Earlier, the pick up felt used to run with seam leading in the centre. For this, the stretch roll (worm roll) was replaced by a plain negative crown roll and now it is running straight.

**Vacuum System** :

The ten vacuum pumps are supplied by Nash. The vacuum flumed water is utilised back in the seal water system with fresh water addition through a pressure control valve.

**Dryer Section** :

The dryer section consists of 37 dryers (last dryer used as sweat dryer), divided into four drive groups (7, 10, 10 and 10 dryers) and three heating groups (wet end 7, intermediate 10 and dry end group 20). The dryers are all with rotary siphons, steam inlet being on Drive side and condensate

removal on tender side. Here, instead of the conventional cascade system, we have thermocompressor system, where the flashsteam from a particular heating section is utilised back in the same section through thermocompressor. The thermocompressor utilises motive steam to entrain the low pressue flash steam and discharges the same at the required/preset pressure. 3.5 bar steam is fed to the system ie: to the three heating groups. 21 bar steam is used as motive steam for operation of the thermocompressors. The three heating groups are operating at different pressures. The first four dryers operate under vacuum. The flash and blow through are collected in tne separators and the flash is condensed in the condensor. The non-condensibles through a separator are removed by vacuum pump. The first five dryers are provided with individual pressure controller and also to control blow through, steam traps were provided but as the condensate removal was not proper and as it was resulting in increase in drive load, the traps were removed. Similarly, the condensate and blow through from II and III heating groups are taken to condensate separators. The flash is utilised in thermocompressors and the condensate from different tanks is collected in a final condensate tank from where it is pumped to boiler house.

One selector switch is provided for operation and break mode control. During both the operation modes, the three valve openings increase or decrease to a p eset valve through a ratio setter that can be adjusted. During sheet break, as the differential pressure comes down due to low condensing load, the D.P. Control valves operates to maintain the differential pressure across the group. The dryer section hood is completely closed with sliding doors on the Drive side and lifting doors on Tender side which are lifted during break time. Three exhaust fans are provided. The pocket ventillation system is through 2 fans blowing hot air through 29 P.V. ducts (14 are regulating type) positioned in between dryers above felt rolls.

Electrical motor operated oscilating doctors are provided for all the seven dryers in I dryer group and first and last dryers of other three groups.

Some dryer screens were damaged due to over running of the screens due to guide failure. For this over run alarm system with tripping of the particular drive group is being provided to avoid such damages in future. In all the dryer screens bowed seam leading in centre was noticed. For this, two rolls with negative camber were installed successfully, in some groups and same has to be done in the remaining felt circuits Ist bottom dryer screen was removed due to damage during commissioning time and later also it was not installed due to fluff problem causing breaks in the I, II group or at calender. In the near future,it is proposedto go for single felting in I group.

**Calender** :

The 6 roll calender stack is designed for maximum loading of 120 kg/cm, with swimming rolls in the bottom & III (from bottom) position. Normal operating nip pressure is 100 kg/cm. The tail feeding at the calender is by air nozzles and doctor is provided for king roll only.

Other essential inter locks provided for drive are that drive will not start unless lubrication is on and drive motor cooling fans are on. Similarly, drives (wetend/dry end) will trip after a preset time in case of lubrication failure for which alarm is provided. Similarly, oil failure to the swimming rolls in wetend/dryend will trip the drive.

**Finishing House** :

Winder is supplied by M/s. J. M. Voith with maximum design speed of 2250 mpm. Normal operating speed is 1200-1500 mpm. Salvage winder is supplied by M/s. Jagenberg. The roll wrapping machine and the lowerators are from M/s. Kleinwefers, West Germany. Cores are made as per the requirement using grey board, mill board and kraft paper. The core making machine alongwith slitter winder are supplied by M/s. Gushkey Tonnesmann, Wes Germany.

## PROBLEMS ENCOUNTERED DURING COMMISSIONING

Some problems encountered during commissioning are described below :

**1) Low Instrument and Mill air pressure :**

Initially even though separate mill and instrument air receivers are provided and because some instrument lines were taken from mill air header much pressure drop problems were faced (during paper break times' partlcularly for guide units and air motors, resulting in guide failures and over running of the clothings. So instrument and mill air are separated and now always instrument air pressure is maintained constant and mill air is throttled for maintaining constant instrument air line header pressure. To make up for the mill air requirement, one additional compressor has been installed in paper machine. As a stand by require ment, it is proposed to install another compressor in future, as all the three original compressors have to be run continuously.

**2) Pressure Screens jamming :**

This problem was faced due to the spinning of the reed fibres and back pressure build up. To over-

come this reed sulphate pulp was refined more and also we changed over to the screen baskets of 2.2 mm perforation (initially installed with 1.6 mm perforation)

**3) Head box jamming :**

As mentioned above, this was due to spinning of the reed fibres and to overcome this refining was increased. This problem is faced sometimes presently too.

**4) Feeding problem :**

Some minor problems are faced for feeding the paper tail from press to dryer and later from sweat dryer to calender. This was also due to the reason that I bottom screen was removed during start up (when it got damaged due to foreign material falling in.) Later it was not put to avoid the fluff falling and carry over alongwith the sheet which was resulting in calender picking and jamming.

**5) Calender picking :**

This calender picking problem was faced for few months, for which calendar rolls are heated before machine start up, but later it used to result in poor parent roll condition with loose edges. It was noticed later that calender picking was due to improper setting of the doctor blade.

**6) Creasing of Paper at reel :**

Creasing problem between calender and reel was faced. For this, the reel drum that was having crown was ground to plain and the paper roll before the reel was given camber.

**7) Roll build up :**

Parent roll build up was not satisfactory, inspite of good B. W. profile. For this, the CD profile was adjusted much for good roll build up. This is due to the calender roll grinding and inadequate calender cooling system (with low pressure and more temperature of cooling air and with the nozzles spacing not being close enough).

**Problems being faced presently :**

Some problems being faced presently, remedies proposed and action plan are given below :

**1) Consistency Controllers :**

The Consistency Controllers performance is not satisfactory, right from the beginning resulting to much variation. It is proposed to procure and install few to stabilize the consistencies in early stages. This causes variation in refining and furnish composition, and so affects machine runnability.

**2) Broke system :**

The Broke system capacity is less and design is inadequate. Since the broke pumps delivery lines from press pit and dry end pulper are connected together, both pumps cannot lift together, sometimes which results in high level or over flow from dryend pulper. Similarly higher consistency from dry end pulper could not be maintained, as minimum requirement of water is essential to direct the sheet for proper slushing. To overcome this it is proposed to separate the line from press pit and connect to couch pit and also to install a thickner which is expected to reduce the problem considerably. In addition a bigger broke tower is also planned.

**3) Vacuum flume :**

The vacuum flume pumps seal water system utilises back the flume water, but because of too many fines and fibres, the filters are getting choked up and also, the cooling tower structure has collapsed because of fibre/filler accumulation. This also results in jamming of the sealing water lines. To overcome this, it is proposed to install back wash filters or screens in the system. Presently lot of mill water has to be used as make up to minimise the above mentioned problems.

**4) Fluff and fines :**

With more fines, the problems faced are Ist group dryer doctor blades passing, granite roll doctor passing and also Calender pick up and jamming. The fluff carried over to calender causes calender stamping, which affects the winder performance, apart from affecting the paper quality. This has been reduced to significant extent, with higher refining, which results in better bonding between fibres. With stabilization of CMP Plant, further improvements are expected.

**5) Feeding Problems :**

As mentioned earlier, the Ist bottom dryer screen has been removed, during trial runs, and it was not put back to avoid fluff problem. Similarly, for the No. 5 dryer, the inlet steam connection is from header with low pressure and condensate is connected to the header where pressure is higher. Since available differential pressure is less, the removal is not proper, resulting in slack draw. To overcome the above two problems, which are causing feeding problems, it is proposed to go for unifelt circuit in Ist group and modify the condensate connections in first group.

**6) Dryer Screen Seams :**

It was noticed that seams of all the dryers

screens were bowing and leading at the centre. For this two rolls with negative camber were installed in some groups successfully. The same is to be carried out in other groups too.

**7) Deposit in II group dryers :**

All the dryer cylinders in I group and first and the last dryers in each of the other groups are provided with oscillating doctor blades. There is heavy fibre deposit in the II group dryers. For cleaning the surface, it is proposed to try with chemicals and also install doctor blades.

**8) Steam control after breaks :**

Another problem being faced is steam control after breaks, due to the wide difference of steam requirement, between break mode and operation mode control. Due to this, it takes long time for the header pressures build up and till such time paper goes damp and slightly higher set point, results in overdrying. It is being studied by Instrument and utility personnnel.

**9) Calender cooling and roll build up :**

The parent roll build up is not satisfactory because of inadequate calender cooling system, as the cooling temperature is high and the cooling nozzles are also widely spaced. For this, cooling system with low temperature (15°C) and nozzles with narrow gap has been planned. An automatic caliper profiler will be extremely helpful and has to be thought of as the Newsprint made is more or less 100 percent in reel form. It is also planned to modify the 6 roll stack to 4 roll operation. Presently reel moisture is maintained low, which helps in better roll build up. With 4 roll operation, it is expected that reel moisture can also be increased with better build up of the parent roll.

**10) Water dripping :**

Much problem was faced with water dripping due to condensation, which was affecting the paper quality runnability of paper machine and wind r. False ceiling with two exhaust fans has been provided above calender reel and winder and if required more exhaust fans would be installed.

**11) Fibre loss and effluent load :**

Presently cloudy water is utilised for consistency dilution. Excess quantity is going to drain, since we do not have any back water tower, from where it can be utilised. Similarly the flume water and clear filtrate is also being partly drained which is increasing the effluent load and fibre losses. For this it is proposed to utilise all the excess cloudy water in press and dry end pulper showers with make up requirement from clear filtrate CP and CMP Plants, apart from the areas where it is already used.

We would like to further add that there are some more items mentioned below which will help in improving the machine runnability.

**1) Basis Weight and Moisture Controller :**

This system is not working properly from the beginning. If this works, there will be definite improvement in machine runnability, apart from quality of newsprint.

**2) Chemical Pulp :**

Due to shortage of reed, sometimes Eucalyptus wood and bamboo are also used and due to this variation in the pulp quality was noticed. But when wood is used, more problems were noticed on the machine with more fines, it is slightly better when bamboo is used. When reed is used, headbox jamming problems is being faced, due to spinning which has been mentioned earlier. The increased refining has helped to overcome this problem considerably, and now we have started using reed and bamboo in a fixed proportion on a trial basis to minimise the variations in pulp quality. A uniform chemical pulp should improve the machine runnability as the furnish will be more uniform.

**3) Chemi-Mechanical Pulp**

The CMP Plant has not yet yielded the pulp quality as expected from trials and assurance from Defibrator. The pulp has low long fraction and more fines and the variation are also more resulting in erratic run of paper machine. A uniform pulp of normal long fibre fraction will improve the machine runnability considerably, as long fraction will increase and furnish will be more uniform due to uniform quality of pulp after stabilization of CMP Plant.

We are trying to stabilize the machine runnability with our own CMP for sometime under the guidance of Voith, our machine supplier. The first step was making furnish uniform and optimise the furnish composition and parameters of each component.

We are going in for single-felting in first group and four roll calender stack.

Some modifications have been suggested in press section and further modifications at later stages have been suggested in first and second dryer group.

We have also to see how much our Chemi-Mechanical pulp improves. depending on which and machine runnability, utilization of imported mechanical pulp on a regular basis is to be considered. In such a case, we will have to go for an independent third street for imported mechanical pulp.

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