Smart Paper Machine Upgradation

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ABSTRACT

Trends show that the Indian paper manufacturing companies are trying to adopt a strategy which is directed towards globalization, though the industry has a lot to introspect and act. In an era of the world wide web, e-filing, email, pod cast etc., and several options to choose from the electronic saga poses a big threat to the paper industry. According to the law of natural selection, the strongest will survive and lead. However, as per imminent paper industry trends become evident, the consumption of paper related articles is expected to escalate,Increasing demand for "green" and "sustainable" products; A consorted effort will benefit the industry immensely in the next few years to come. This paper dwells on the various trends and market conditions observed in India and tries to substantiate the preemptive steps ahead, with specific insights from the scenario in North America and China . Many of the advantages of modern machines can be utilised to upgrade old technology , thus giving both production and quality without having to invest in a new machine. Rebuilds such as that, are designed to address the problems inherent in some older designs.The paper tries to portray that one of the key mechanism to forge into the next decade, is the method of economical up-gradation of various sections of the machines, focusing both on quality and capacity which ought to help the Indian paper manufacturing leap to the next level.

Introduction

The new millennium is going to be the era of the knowledge and growth in India. Demand for paper would increase, purely considering the paper industries strategic role for the society and for the overall industrial growth, it is critical that the Indian paper industry performs well. Paper industry is a priority sector for foreign collaboration and equity participation, wherein 100% ownership receives automatic approval from RBI. Several fiscal incentives have been provided to the mills using non conventional raw material, however a lot more is desired and in the pipe line. Immaterial of the cited positive market trends , the industry has a lot to address and execute as enumerated in the next lines not only as a player catering to the local expectations but also creating an impact globally with cost effective upgrades of sections of the machine , which exhibits visible and tangible improvements in bottom lines.

Indian Paper Industry Scenario And Growth Prerequisites

Growth Prerequisites

Addressing the following issues make it mandatory to sustain the growth of the Indian paper Industry.

- Sustained availability of good quality of raw materials and bulk import of waste paper to supplement the availability of raw materials.
- Adequate and intelligent modernisation of existing obsolescence manufacturing assets.
- Improvement of the indigenous infrastructure and investments from European machinery manufacturers.
- Quality improvements and reduction in cost of production with smart up-gradations.
- **Positive Government Policies**
  1. Import policy conducive for import of material, critical equipments, instruments, raw materials & technologies which directly influence bearing of the quality, sustainability and environment.
  2. Accelerated depreciation to partially mitigate high capital intensity.
  3. Allow duty free imports of new & second hand machinery /equipment for Technology Up gradation.
  4. Better availability & quality of coal. More uniform Energy Policy by States.

American Analogy

India needs to take a leaf out of the Situation which transpired in north America and derive an analogy on the next steps to stamp their authority in the world scenario, quite aptly dominated by China . In order to understand the same let me enumerate the probable reasons for the apparent decline of paper industry in north America are:-

- more exposure to global imports & competition
- Very few new and up gradation paper machine within last 10-15 years
- Average technical age of paper machine lines is over 35 years (compared to 29 yrs. in Europe and 20 yrs. in China)
- Many paper producers have to rely heavily on external know-how from Europe or sustaining production and keeping assets up to date.

The reasons cited look ominous and can draw similarities with the trends observed in India ,pertaining to conservative short term investments focus. India is expected to face similar situation as cited above and needs to proactively consider appropriate and relevant preemptive steps to nuetralise the same. Immediate challenges as envisaged by Indian paper industry are , apart from issues as experienced in the north American market :-

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GapCon family in Germany , Italy , China and India

- Cost pressure for producers of commodity grades is increasing (e.g. energy, raw material, personnel cost) which is hard to counter with aging assets
- Electronic media are cutting into publication paper grades, especially in last 2-3 years
- Investor expectations in India are still significantly more short-term-oriented than in other regions on the world
- Lack of Local expertise in manufacturing machineries and service
- Cost of investments
- Lack of FDI
- Manpower Attrition

Chinese Scenario

With the advent of China as a Global player, following inferences can be arrived at for their phenomenal growth.

- Ongoing investment activities are part of long-term strategic planning of Chinese government (heavily encouraged and supported)
- Production increase mainly to satisfy growing domestic demand
- Export of paper mostly in form of consumer end products(e.g. books, packaging of other products)

Since Last decades all the development of technology has been focusing on China, with some of the biggest and modern machines being installed. The massive growth of pulp and paper industry in China has fuelled growth not only in the local paper industry but also in investments by OEM's, allied industry in manufacturing and development of indigenous engineering knowledge, which has subsequently reduced the investment costs for modernizations of the Chinese paper Industry. This in turn , makes further growth more viable and effective. The Chinese procurement model is tested and its effect is felt worldwide including India. Very soon you would see a machine exclusively produced in Europe has moved its manufacturing focus in China. Chinese mills , have been known to assemble and engineer complete 10m machines in-house, with all critical equipments procured from various sources in Europe and the metal work locally, these machines have been known to run at 1600mpm. This is a model we have to emulate partly considering the high cost of investments and lack of local engineering support , still depending on Europe for the key components.

Indian Scenario

India's per capita consumption of paper is one of the lowest in the world. With the expected increase in literacy rate and growth of the economy, an increase in the per capita consumption of paper is inevitable. The demand for upstream market of paper products, like, tissue paper, specialty, packaging, tea bags, filter paper, light weight online coated paper, medical grade coated paper, etc., is growing up. Since last 5 years importance is being given in India to retailing and the different policies adopted in the multinational consumer goods market. The advent of retail culture has opened doors to massive growth in packaging grades , substitution of plastics etc. Even for very mature products (e.g. newsprint), investments in new lines for cost-competitive production have been successful. A weak INR currency discouraged competitive imports and promote export of paper products. Generally, demand increases due to population growth and developing living standards. These developments are expected to give the much anticipated fillip to the industry. Environment friendly articles are given more importance these days. The use of recycled paper is on the rise. Better facilities of customer support and other value added services is gaining importance.

Indian paper industry continually face increasing demands on paper quality due to changing customer expectations and the anticipated onslaught of cheap Chinese world class produce. These demands are not just driven by the expectations of the market and printers regarding the print quality but are also influenced by increasing efficiencies, which require improved paper properties. The capabilities of a remarkable number of paper machines in India , with relatively obsolete technology, are increasingly unable to satisfy these demands. They often struggle to keep their product in an ever more demanding market. As a result, even newer machines need to undergo selective and prudent up-gradation to allow the production of different grades than originally planned. There are, at present, estimated about 515 units engaged in the manufacture of paper and paperboards and newsprint in India. Recent performance of the industry has been relatively lack luster and constrained due to high cost of production caused by inadequate availability and high cost of raw materials, power cost and concentration of mills in one particular area. The capacity utilization of the industry is low at 60%. Substantial small mills, are sick and /or lying closed. This paper will address the technical solutions to various issues plaguing the industry .

Technicals Steps

This paper presents an overview of prudent and smart up-gradation and rebuilds of Headbox ,wire, press , dryer sections and calender and the corresponding measures achieved. This paper will give a brief overview of various rebuilds/up-gradation possible on different production machines in order to get increased value from existing equipment with a potential to produce not only enhanced qualities but quantities, a combination of which lies a payback.

Opportunities to Reduce Investment costs on up-gradations

- Global sourcing of key components at times from different sources which economizes the investments and has a positive impact on returns
- Modular guarantees and in-house efforts to integrate operation
- Maximize off-site pre-assembly
- Maximise / streamline project interfaces which substantially reduce investments
- Long term investments in knowledge base and R&D

Headbox Upgradation

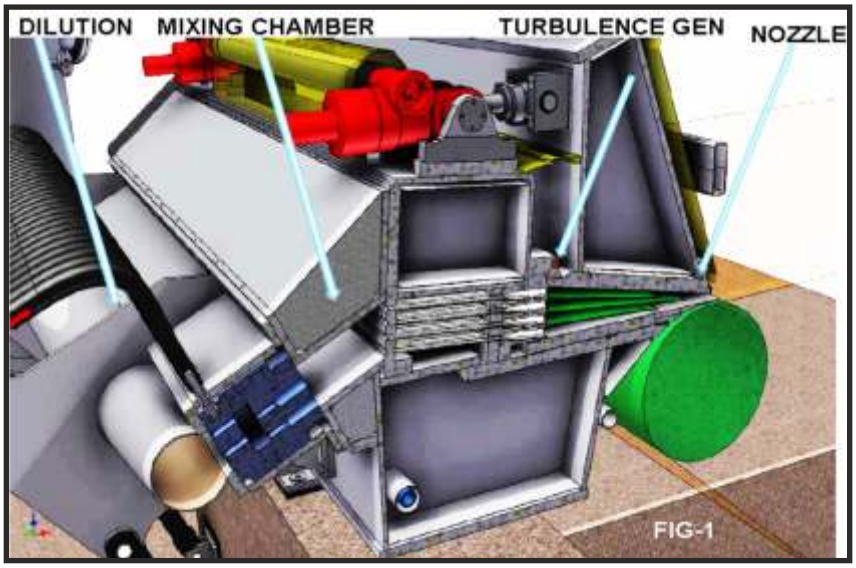
Far more demanding and a challenge to the teams of the supplier and the user are rebuilds of existing hydraulic headbox to dilution headboxes with the capability to create a web with a low CD basis weight variation profile and low fiber angle can benefit all paper grades. As an example, headbox with dilution system depicted in FIG-1 is an up-gradation of existing hydraulic headbox , which can be designed to operate initially on a flat fourdriner and in the future on a gap former, if a wet end rebuild is done in separate steps. One of the most unwelcome characteristics of conventional headboxes are bad fiber orientation due to slice blade distortion for basis weight adjustment. The principle of the dilution headbox as illustrated in FIG-1, is that the cross-machine basis weight profile is controlled by locally adding low consistency dilution water,

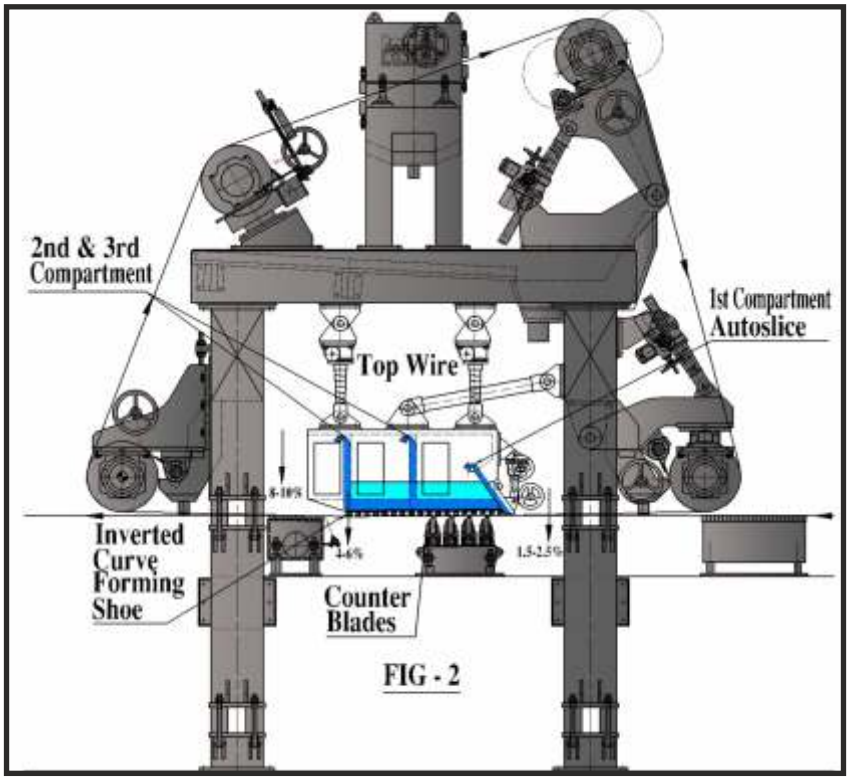
usually white water, to the high (main) consistency stock flow via a small header and series of metering valves across the width to the various zones. The zonal flow rates are constant, but individual mixing concentrations can be varied. The basis weight change with a dilution water valve adjustment is significantly narrower than the slice lip adjustment, resulting in improvements in CD basis weight variation and better over a conventional slice lip controlled headbox.

White water as a diluter , has an advantage for the following reasons:-

- Self-regulating cross-profile despite retention fluctuations
- Substantially reduced time for grade changes
- Closed-circuit primary loop and thus no additional load on disk filter
- Whitewater is the only diluting agent with identical chemical and physical properties to the stock itself
- By using a diluting agent containing fines and fillers, the fines and fillers profiles are unaffected.

The Stated up-gradation would have the following positive effects:-





- **O**utstanding structural uniformity contributes to even basis weight and fiber orientation profiles
- Improved formation and strength properties.
- Optimized the flow structures and reduced flow variations, generating a fully homogenized, disturbance-free flow.
- Minimize web defects, such as streakiness and cockling.
- Uniform distribution of fibers, fines, fillers, and chemicals ,evenly in the slice jet .

Wire Upgradation

Survival of the Industry, makes it mandatory for the same to incorporate flexibility in grade changes frequently with low transition duration. In India evaluation of formation still remains a visual concept, checking the fiber dispersion uniformity, whereas there are tangible measuring methods not only for measuring the degree of formation , but also give you a hint to optimise the same. Ambertec utilises the mass variation index using the beta rays, discounting the corrections done by the ash content.

Due to the single-sided dewatering process on a conventional fourdrinier table, there is a higher ash content on the top side of the web. With a top former the dewatering process occurs towards the top and bottom side of the web and therefore the ash content is way more evenly and symmetrical distributed in z-direction of the web, consequently symmetrical finishing of the web on both sides. The concept of the curved top former shown here in FIG-2 ,is suitable for almost all paper grades and for rebuilds of existing flat fourdrinear table, leaving as much as possible existing equipments untouched.

The top wire drainage unit is a top wire unit for increasing the drainage capacity of the forming section and at the same time the formation of the web. The core of the unit is a inverted curved forming shoe, with three drainage compartments under vacuum, as illustrated in FIG-2. The first compartment receives the free water from the web surface from the inlet transfer box, via an auto-slice arrangement. The second and the third compartment operates under increasing levels of vacuum. The water drained by the top wire unit is discharged laterally in a save-all

system. The counter-blades at the bottom wire penetrate the wire in strategic positions in order to improve drainage and formation impulse. The loading of the counter blades is pneumatically operated by air tubes wherein each blade loading is isolated therefore it will be possible to load as much blades as required, hence providing the papermaker a more flexible instrument to control the web formation, by changing the shear forces required to break long fibre flocs in the web.

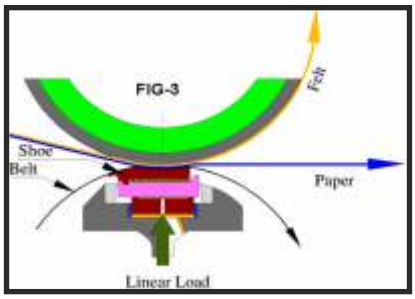
The top former will substantially improve both the web formation and its surface smoothness. To achieve best performance from the unit, an inlet stock consistency range in between 1.5% to 2.5% is preferred. Micro turbulence and shear forces are generated both by the counter blades , the nip pressure inducted on the sandwiched stock by the counter blades and the inverted curved forming shoe. Drainage is generated by gravity as well as by the vacuum differential pressure. The drainage capacity between the bottom and top wire is shared 70% (bottom wire) and 30% (top wire) , from the bottom by means of gravity, and from the top, by means of suction. Drainage time is significantly reduced, which results in a far more efficient production process, with the added advantage of reduced filler/ash two-sidedness of the web.

The Stated up-gradation would have the following positive effects

- Improvement in the Ambertec formation.
- Improvement in MD/CD tensile ratio and CD basis weight profile
- No reduction of opacity
- The two-sidedness of the ash distribution could be reduced to less than 1 % absolute
- Significant increase in dewatering capacity which allows for possible speed increase.

Press Upgradation

The amount of draw from the press section to the dryer section is a very important figure in determining the runnability of a paper machine. Low dryness after press usually contributes to high draw after the press because the strength of a web with low dryness is poor and it tends to stick to the cylinder surfaces. It is paramount that we focus on the press for any machine up-



gradation , as this directly influences higher drying potential for increased production whilst maintaining bulk. The press section also has a great effect on sheet surface properties such as roughness and surface density .

A typical problem with conventional press sections are that dryness after the press is too low. This consequently leads to other problems, such as limited dryer section capacity and runnability, in addition to high draws. In some paper grades, these problems can cause high sheet porosity. The amount of water removed in the pressing section is proportional to the magnitude and the duration of the pressure applied to the web. The product of pressure and nip residence time is called the 'press impulse' . Press impulse depends on the speed of the machine, the length of the press nip and the linear load applied. The area under the curves are the 'press impulse' , as exhibited in FIG-4. In conventional presses both the pressure applied and the nip residence time were constrained (FIG-4- Graph 1). Pressure could not be increased unlimited, because the web would be damaged (especially at higher machine speeds), due to high peak of the specific nip pressure. Nip residence time decreased with increasing machine speeds. The constrained press impulse of conventional roll presses was overcome by shoe press technology.

Since 1984, shoe presses have been in operation on paper machines for

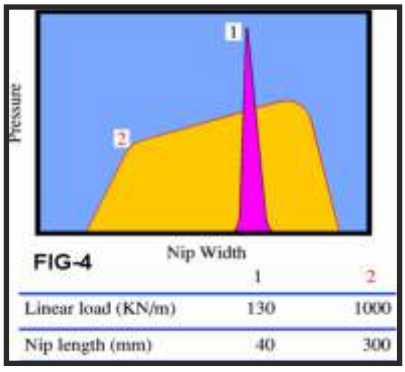
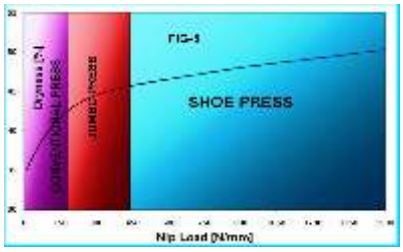


FIG-4

	1	2
Linear load (KN/m)	130	1000
Nip length (mm)	40	300

different paper grades and a variety of speeds. Meanwhile, these presses have certainly proved their influence on both production and quality. The shoe press consists of a shoe roll covered with a polyurethane belt(FIG-3, FIG6). The belt usually has a grooved surface for efficient water handling. The shoe inside the shoe roll is hydraulically pressed against the surface of a counter roll. Both rolls have rigid structures, because the operational linear loads of a shoe press may be from 100 kN/m up to 1,500 kN/m. In a shoe press, though you have a situation wherein the line load is much more, the specific nip pressure is lower and the 'press impulse' much higher as shown in FIG-4-Graph 2.The far lower pressure gradient of a shoe press, along with a higher dwell time resulting in a higher press impulse at lower maximum specific pressure, results in a higher dewatering capacity compared to a conventional roll press. The high press impulse in the shoe press is achieved by a long nip dwell time longer than in a conventional roll press.

With a shoe press the specific pressure is created by a concave pressure shoe which presses a polyurethane belt against a counter roll. Compared to a conventional roll press, the longer press zone achieves a longer pressing time , resulting in a higher press impulse. For optimum product quality, the dewatering process during pressing should take place with an optimum pressure development. The shoe press technology in comparison to conventional and jumbo press has distinctive advantages as exhibited in FIG-5 , pertaining to its ability to impart a much higher line load and corresponding effect of web dryness.



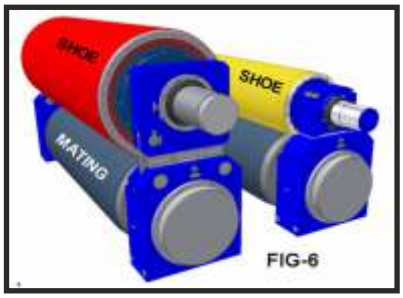


FIG-6

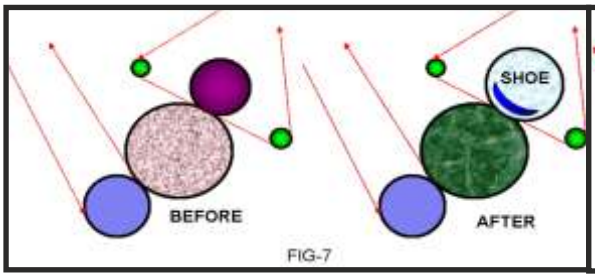


FIG-7

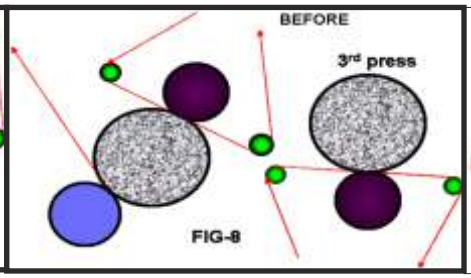


FIG-8

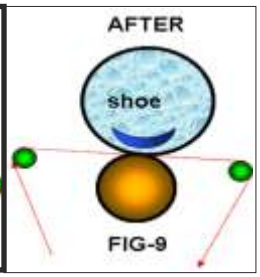


FIG-9

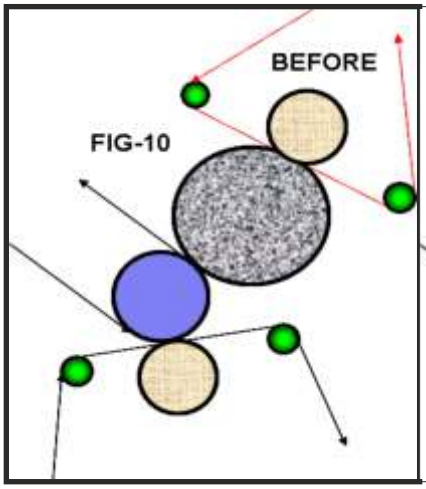


FIG-10

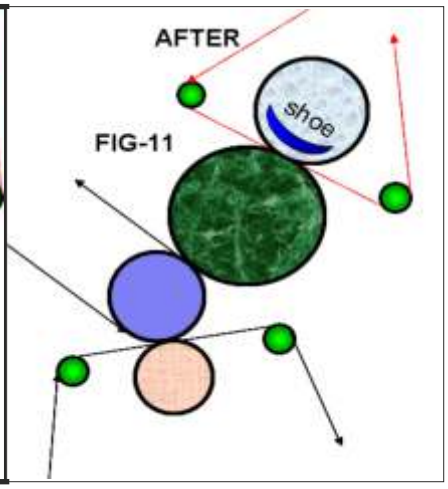


FIG-11

The shoe press module comprising of a stationery shoe roll and a mating roll designed for higher line load as illustrated in FIG-6, has significantly improved the productivity on both existing and new machines. For printing and writing , newsprint grades, full utilization of the shoe press can decrease the web two-sidedness and improve printability. In addition, the higher after press dryness allows faster machine speeds. For kraft,liner and board grades, the improved dryness also means that density-related strength properties like burst and SCT are improved. For bulk sensitive fine paper and carton-board grades, the gentle dewatering and low specific pressure on the fiber network, created in a shoe press, will lead to an increased bulk in the final product, compared to using a conventional roll press. This improves the important bending stiffness properties.

The Stated up-gradation would have the following positive effects:-

- higher dryness after press - Less power consumption and reduction in dryer steam/ton
- Dryness improved with improvement in Burst, bending stiffness, wet Tensile, Bond & Compression strength.
- Increased production in drying-limited machines at same bulk
- even density distribution in z-direction and improved printability
- lower two-sidedness regarding roughness
- higher felt life
- No paper breaks in the press section anymore
- Less refining on strength grades
- Less OCC, more mixed waste
- Reduction in draw
- Decreased web two-sidedness and improved printability.
- Owing to loading with identical pressure across the web width, a uniform moisture and caliper profile after the press can be expected for every nip load.

Following cost effective press upgrade concepts can be considered as effective tools to meet all target on existing machines, utilizing as much as possible existing equipments and framing.

Concept 1 -
Rebuilding a standard Binip with a shoe press , with a new centre roll and a shoe, keeping the fabric run nearly unchanged, refer FIG-7

Concept 2-
As an option the 3rd press can be replaced with a new shoe and bottom roll , refer FIG-8 & FIG-9 (Post upgrade)

Concept 3-
Rebuilding a standard trinip press with a shoe press in the 3rd nip, with a new shoe and centre roll. FIG 10 and FIG-11(Post upgrade)

Concept 4 -
Rebuilding a conventional straight through press section comprising of 3-4 nips with a shoe press replacing 2 nips. FIG-12 and FIG-13(Post upgrade)

Specially when facing space limitations as with a Binip/trinip press with the pick-up suction roll forming the first nip, rebuilds with shoe presses in the 2nd or 3rd nip are the most suitable and often only solution and advantageous regarding capital investment because of the cost saving design:

- no pick-up roll and spare roll necessary
- less vacuum required
- reduced number of drives
- simple framing of felt run.

Dryer Upgradation
Not only on the wet end but also in the dryer section, productivity and quality can be improved by rebuilds. In many paper machines it is not possible to increase the speed since it would lead to uncontrolled web flutter, wrinkles, quality defects, more web breaks, and more dificult tail threading after the breaks. The drying process of the web, after the press, is of the utmost importance to optimize the elastic and mechanical properties of the sheet and beyond that, to improve the general paper machine efficiency and runnability.

Although there are several other aspects of the papermaking process that affect dryer section runnability, air movement close to the web surface plays a very important role, especially at higher machine speeds. Air flows at high running speeds cause significant pressure build-up in the nip areas, causing the web to separate from the fabric. Due to limited efficiency of conventional and mostly older dryer sections regarding web run and rope

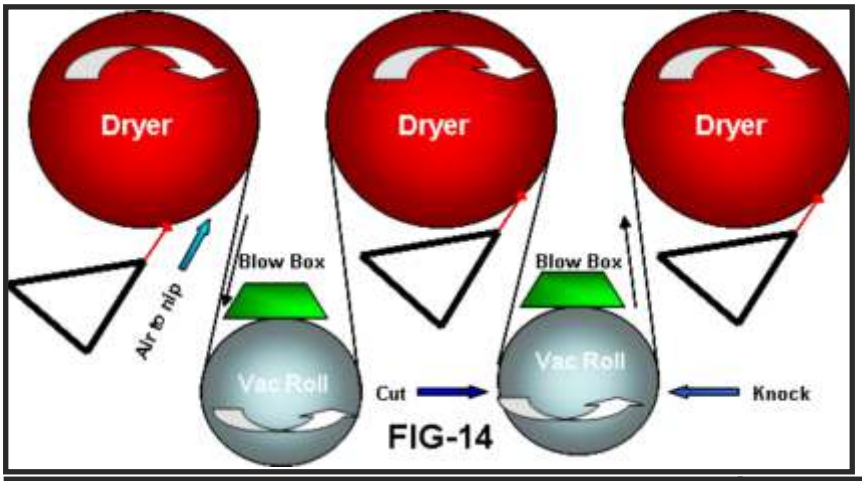


FIG-14

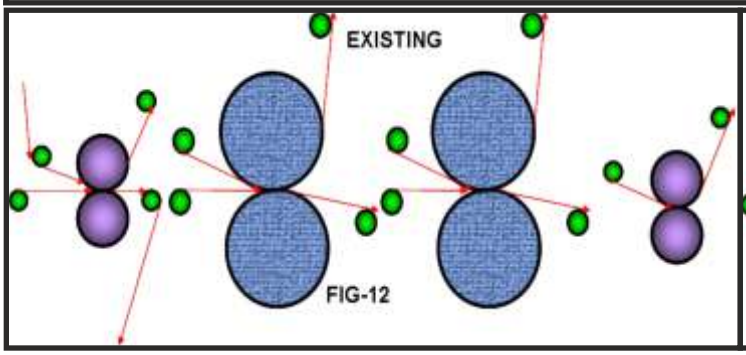


FIG-12

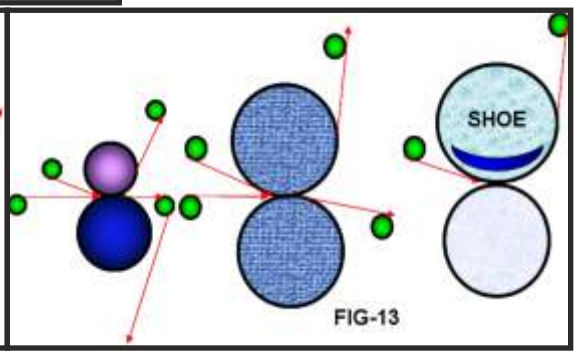


FIG-13

run, the production and quality problems faced are:

- increased number of web breaks
- wrinkles
- loose edges
- unacceptable threading times

In order to tackle the above-mentioned points, systems are available based on experiences gained with state-of-the-art dryer sections. Those systems can also be installed in modules on a step-by-step basis as explained herein.

At the beginning of the dryer section, the web dries rather slowly. Excellent runnability at the beginning of the dryer section is a great challenge when machine speeds are continuously being increased. With machine speeds increasing, it will become more dificult to maintain web stability. Due to the natural under-pressure created when the web separates from the dryer cylinder surface, at the opening drier cylinder nip, wherein the web is more inclined to follow the smooth dryer cylinder surface than stay flat on the dryer fabric. Adhesive forces also negatively affect the web release from the dryer cylinder. This tendency is increased if not enough draw is applied between the press and the dryer sections to create web tension. Usually the dryer section runnability is adjusted by changing the draw between the press section and the dryer section, the pulp refining level, etc. This often leads to defects in paper quality and limits the machine speed and efficiency. This critical bottleneck can be avoided by placing a proper stability system in the first groups of the dryer section and we need to move to a longer or total single felting dryer section configurations.

Sheet stabilizers and blow boxes need to be installed, to protect the web itself from air currents at higher speed and for drying capabilities improvement. blow boxes should be placed over the single tier lower drilled vac rolls. The blow boxes will have two functions: the first one to stabilize the web and to let it adhere onto the fabric by means of Coanda effect, by blowing through slots cross machine wide. The second function will be to generate the vacuum on the vac rolls, for stabilization and for automatic tail threading purpose. If needed, the tail threading can be interrupted and restarted through the Knock and Cut . The Knock guides the tail into the basement and the Cut just cuts the tail for a restart (FIG-14). The tail threading through the pre-dryer section is thus automatic.

The blow box would also operate as a web stabilizer and would also ensure a secure run of the web with the dryer fabric at higher speeds. This solution is possible on any type or design of the lower vac cylinders . The excellent web stability provided by the blow boxes makes it possible to adjust the draws, not only in terms of runnability, but also in terms of paper properties. This solution as illustrated in Fig-14 , shows the modification of existing single-tier and possible double-tier sections into a single-tier concept. The improved runnability, results from greater web wrap and constraint. CD web shrinkage during drying can be reduced to less than 1%, to give a squarer paper and slightly greater maximum trim width. This benefits papermakers by enabling them to control the web draws and thus optimize paper properties.

To achieve a stable dryer configuration such as to eliminate the open draws in the initial part of the section and to control the shrinkage in the cross machine direction during the drying process, at varying speed, the first two group could be modified into unirun group , the lower vac rolls could be made out of the existing dryer cylinders. During the passage into the unirun sections, the web is not able to shrink as it dries, because it is supported on the fabric and held in position. This improves the web elasticity in the close draw where the most of the evaporation takes place.

Calender Upgradation

The objectives of the calender like other sections of the machine is to transfer energy in form of line load and temperature, to alter the properties of the visco-elastic web. Controlled application of temperature, ash and moisture help to deform the outer layers in a desirable way, leaving the inner part of the web untouched. This is called gradient calendering, which can be temperature gradient calendering or moisture gradient calendering. The alteration of web properties is not only

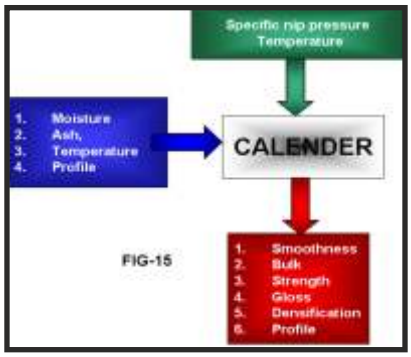


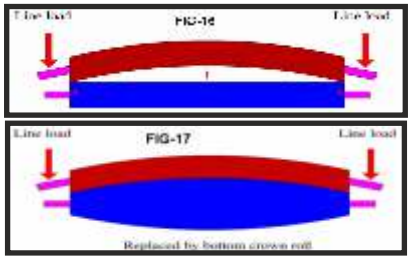
FIG-15

time dependent i.e. not the calender nip dwell time itself but also the increased specific nip pressure. The effect of calendering is always limited on the incoming moisture, ash, web temperature and the profile vis a vis moisture and GSM. The objectives are to utilize controlled application of uniform line load or specific nip pressure and temperature to alter specific features namely smoothness, gloss, densification and caliper as illustrated in fig-15.

With conventional plain rolls , when load is applied at the bearings, it deflects as illustrated IN Fig-15 , producing a gap in the middle and gives an uneven nip profile in CD. To combat the gap a camber is applied. Camber is the curvature given to a roll and can be defined as the difference in diameter at the centre compared with ends as illustrated in FIG-16.To calculate camber certain factors need to be taken into consideration as follows:- Width of the roll, Load to be applied, Material and method of construction, Speed of machine etc .Once calculated none of these factors can be altered, which is improbable and does not give calender the flexibility required to produce various grades. So to ensure even pressing at these variable loadings and speeds variable camber rolls have to be used .

The objectives of the variable camber rolls would be

- to provide a uniform nip load over the face width
- to compensate the bending of the mating roll.



- to vary the crown, depending on the nip load
- to correct long wave CD profile deviations

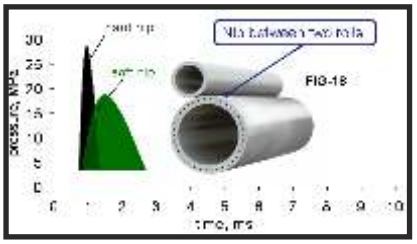
In the absence of a heated mating roll , the energy flow happens from the relatively hot web to the cooler roll surface. Web moisture profile thus influences the roll surface temperature , and corresponding roll surface profile , effecting the caliper correction ability of the calender system, wherein the roll surface assumes the profile of the incoming web. The location of the heated roll is decided to ensure that the rougher side of the web entering the calender is in direct contact with the heated roll. In the absence of a heated roll , the calender does not meet its objective to correct the paper profile nor does is able to address issues pertaining to 2 sidedness.

In India most of the calenders are run , without any control to vary either the line load or surface temperature. In a nut shell the basic calenders have to be equipped with minimum control of line load and heat, which influences the eventual calendering results. It thus becomes mandatory for a calender to utilise a heated roll and a variable camber roll, to meet its primary objective. Existing calenders should be rebuilt depending on the grade and the prerequisites either to a single hard or a soft nip concept moving from a traditional 3 nip calender or a single hard nip calender with a heated roll or a variable camber roll and with Hydraulic loading etc , utilizing existing systems.

The Stated up-gradation would have the following positive effects

- Improved smoothness or Gloss as applicable
- Suitable for all grades and objectives
- Improved caliper profile and reel build up
- Improved 2 sidedness
- Improved Printability

Soft nip calendering utilizing gradient calendering , is the call of the future for most of the grades for reasons cited in the next line, wherein a composite soft cover is used on the variable camber roll and in tandem with a heated roll , is able to operate at much higher line load and surface temperature , however with lower specific nip pressure. A traditional Hard Nip calander produce narrow nips with high specific pressures and high strain rates at the nip



entrance. The soft calender provide a more gradual application of the calendering impulse. With a long nip dwell time, a lower specific nip pressure is required to gain the same calendering effect on the surface than with a short nip dwell time as illustrated in FIG-18. Existing hard single nip calenders could be under certain conditions rebuild to a soft nip.

Soft nip further improves the followings:-

- More uniform gloss and smoothness of the micro surface
- Better printability (uniform density) at the same smoothness
- Good Caliper and / or gloss control
- MD tensile strength is preserved
- CD tear is preserved
- Less loss of strength and preserves stiffness and stretch values at higher smoothness
- Reduces structural web mottling and blackening
- Achieves a higher printing gloss
- No blackening at high moisture
- Wide flexibility in nip load and temperature; independently to adjust

Conclusion

It is time that the industry gears up to meet the challenges presented to itself by the market with effective and consciences long term planning which secures their investments and be globally acceptable. Existing trends also show that the companies which were able to adapt themselves promptly to the need of any situation thrived in the long run. Efficient administrative and smart expansion policies are the order of the day.

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References

GapCon's know-how