

A Case Study at Emami - Low Cost Technical Solutions Adopted For Improving The Performance Of Imported Second-Hand Newsprint Machine For Operating Beyond The Designed Speed

Choudhury B.

ABSTRACT

Emami Paper Mills Limited (EPML) is one of the leading Newsprint manufacturers in India. The said machine is India's fastest Newsprint Machine with latest technology and running at average speed of 1100 MPM at Pope Reel. Second hand newsprint machine was procured from Inland Empire Paper Company, USA and commissioned in the year 2007-08. Basically the machine was designed for operating speed of 1067 meter per minute at pope reel but average operating speed of the machine at Inland Empire Paper Company was 1040 meter per minute due to higher vibration amplitudes in forming section, press section and dryer sections. The standard furnish at Inland Empire Paper Company were 60% virgin and 40% deinking pulp producing average 60 GSM paper.

In spite of various problems and design constraints, the EPML team has succeeded to operate the machine at 1100 meter per minute on continuous basis after resolving various design problems and producing 250 TPD Newsprint of 45 GSM with 100 % deinked pulp.

The quality of newsprint manufactured on this second hand machine is at par with International Product. The pulp for this machine is supplied from deinking plant of Voith make.

The basic constraints for operating the machine at 1100 meter per minute speed and corrective measures taken for solving the problems are mentioned in this paper.

Introduction

The installed newsprint machine is having state of the art features with most advanced online automation provided by Honeywell, USA and ABB coupled with advanced technology from Beloit, USA, Kadant Inc and Voith, Germany.

With the constant endeavor by EPML team, we have succeeded to operate this machine constantly at 1100 meter per minute speed and reached up to 1125 meter per minute for a period of 30 days continuously. This is the fastest newsprint machine in India running with 100% recycled pulp and producing 45 GSM Newsprint.

Paper Machine Features, Constraints And Remedies-

I. Head Box-

Beloit Concept-III Head box is a hydraulic Head Box equipped with cross direction dry weight control for better quality product and is highly suitable for gap former. Head box is

equipped with Slice and Apron heating system to obtain good paper profile. The entire head box can be moved back and forth by hand wheel for fine control of Jet landing on the wire.

Constraint:

The Head box while handling at seaport, fell down and had made damages on the bottom apron i.e. lip was partially damaged and back side pond door damaged completely. The damaged apron was not in a position to allow smooth flow of jets due to bulging of apron surface, hence producing paper was not possible with this head box.

Solution:

The bottom slice lip i.e. apron was machined in local workshop and electro-polishing of surface was also carried out to regain the smoothness value of desired tolerance. The back side pond door was newly fabricated in local workshop.

II. Wire Section Belbaie IV Gap Former-

The wire section of existing machine was equipped with most advanced

forming zone with Bel Baie IV Gap Former. The Bel Baie IV Gap Former was converted from Bel Baie III by Beloit in Inland Empire Paper Company. Emami is the only mill in India having wire section with converted Bel Baie IV Gap Former.

The main features of Bel Baie IV gap former are Good Formation, Good CD profile, and Minimum two sidedness however due to some manufacturing problems the desired advantages could not be achieved immediately after commissioning.

Constraint 1:

High moisture content in finished paper at pope and poor formation.

In commissioning stage, even at machine speed of 800 meter per minute, the moisture peak in finished paper at drive end was more than 10% whereas the moisture was 4% only in front side. The blackening of paper took place and quality was affected due to higher moisture at drive end. The paper formation was also not up to the desired standard.

Solution:

The counter blade assembly, suction

*Emami Paper Mills Ltd.
Balgopalpur, P.O. Rasulpur
Dist. Balasore-756020 (Orissa)*

box and forming board settings were done in such a manner that finally EPML succeeded in getting the 8% uniform across the deckle moisture with 2 sigma value less than 1 in finished paper at the speed of 1100 meter per minute. The paper formation has also improved drastically.

Advantage:

Having 8% moisture in newsprint is a big achievement and paper formation and CD profile have also improved much.

Constraint 2:

Forming roll Vibrations had limited the machine speed up to 1000 meter per minute.

This machine couldn't operate more than 1040 meter per minute speed in Inland Empire Paper Mill, USA, due to higher vibrations in forming roll and same problem was also encountered by EPMIL after commissioning.

During speeding up the machine from 950 meter per minute to 1000 meter per minute the higher vibration amplitudes in horizontal and vertical planes of both forming and bow roll of Bal-Baie IV were noticed. Due to higher vibration amplitudes it was not possible to increase the machine speed beyond 1000 meters per minute at wire section.

To find out the source of force frequencies responsible for vibrations in wire part, EPML has contacted IIT-Kharagpur, to depute an expert in Vibration analysis and Finite Element

analysis. Even after carrying out the finite element analysis and vibration analysis of wire part structural members i.e. frames, the source of vibration couldn't be traced out by the expert of IIT-Kharagpur.

Finally EPMIL team has done the root cause analysis and conducted studies with help of its on-line and offline vibration system and got the solution of this complex problem.

Solution:

Temporarily, by providing the wooden supports under forming roll bearing housing mounting bracket, the forming roll vibrations were dampened and machine speed was raised to 1100 meter per minute at pope. With such temporary arrangement it was not possible to operate the machine for long and hence root cause analysis was done from the design point of view. The bending moment diagram of forming roll mounting cantilever bracket confirmed that higher vibrations in forming roll was due to more deflection of roll supporting cantilever beam at free end at higher machine speed.

After redesigning, the mounting location of rubber expander roll was relocated and fixed in existing cantilever beam in the same axis of forming roll bearing housings by modifying the mounting brackets of bow roll. The length of supporting cantilever beam was shortened i.e. centre to centre distance between the pivot pin and rubber expander roll

bearing housing, which in turn minimize the deflection at free end of the existing cantilever brackets. After the modification the vibration amplitudes of forming roll had reached the permissible limit.

Advantage:

After modifications, wire section of the machine is found suitable for machine speed of 1130 meter per minute with equipment reliability, with vibrations level in the permissible limit.

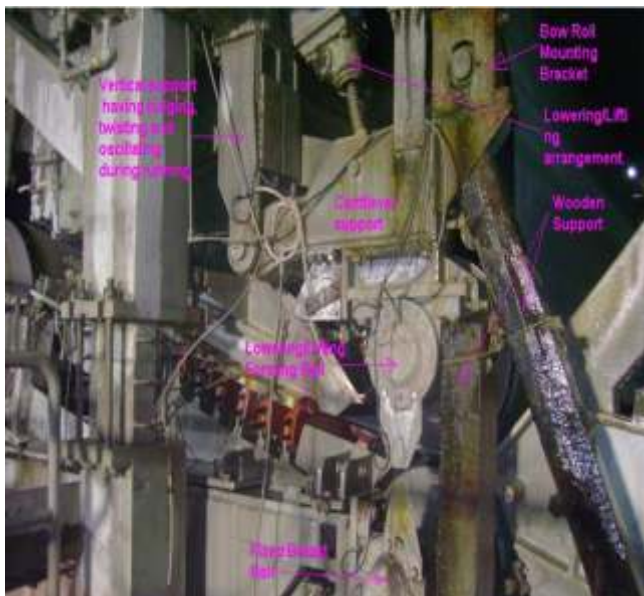
Constraint 3:

During erection of CIVB of Bal-Baie IV in the existing tapped hole of wire frames, different clearance was noticed between counter blade assembly and CIVB, the level difference was observed.

In commissioning stage higher moisture peak was noticed in finished paper and blackening of paper was observed. The problems were discussed with International consultants and machine suppliers, but could not get any concrete solution.

Solution:

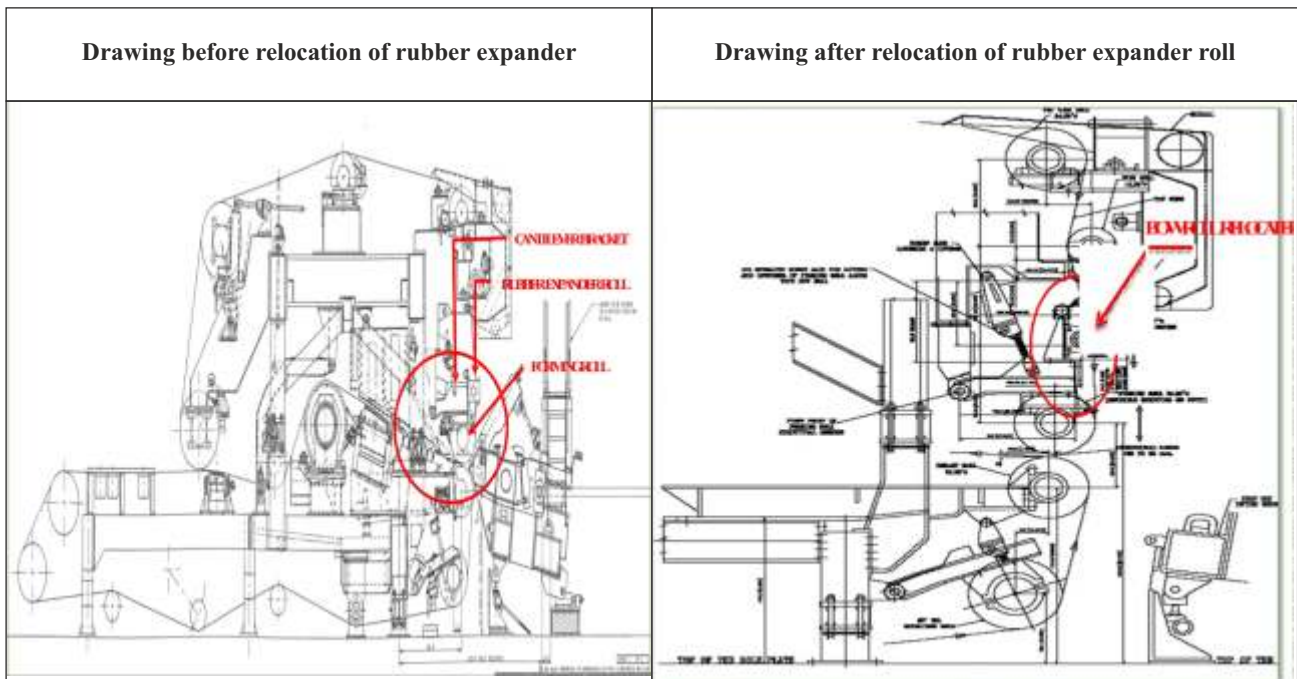
After modification of CIVB mounting frames, the unit could be fixed in the proposed location. Due to changed orientation of CIVB, other drainage elements such as counter blades and suction box were repositioned by offsetting at the boxes in fourdrinier frames. To avoid erratic moisture profile the Head box back side was kept lowered than front side during erection.



Before Modification (wooden supports)



After Modification (Without wooden supports)



Advantage:

The moisture peak in finished paper was reduced and desired drainage in wire section was achieved and subsequently paper formation was improved.

III. AUTO SLICE BLOWER -

Constraint:

After installation of auto-slice blower as per original machine layout, the performance of auto-slice was very poor which affected the paper formation. The breakdown of auto slice blower was a major concern due to accumulation of fines and fiber inside the blower.

Solution:

The performance of auto slice blower was improved and breakdown was reduced by relocating the auto slice blower to +14.00 meters floor from the operating floor. The existing separator was replaced with bigger diameter for improving the performance. The barometric leg was also modified and dropped in to the seal pit at +0.00 meter level.

Finally the problem of fibers and fines disposition inside the blower casing was resolved and desired vacuum was obtained as per operational requirement.

Advantage:

The desired sheet formation was finally obtained.

IV. Tri- Nip Press:

The paper machine has most advanced pressing zone equipped with Tri Nip Press with Nip-co Zone Control Rolls and Ceramic Coated Center Press Roll from Voith Sulzer, Germany.

Constraint:

Press vibration was one of the major issues in speeding up of the machine. In-house modification of existing installed press had helped to run the press section within the vibration limits at a speed of 1100 meter per minute with improved equipments reliability.

The higher vibration amplitudes in third press loading rolls were responsible for developing barring /corrugation marks in stainless steel cover top nip-co and ceramic coated centre press rolls surface within 03-04 months.

To find out the source of force frequencies responsible for press roll barring and vibrations in press, IIT-Kharagpur had deputed an expert in vibration analysis and Finite analysis. Even after doing the finite analysis of press section and vibration analysis the source of vibration couldn't be traced out by IIT-Kharagpur.

Finally EPML team has done the root cause analysis and conducted studies with help of its on-line and offline vibration system and got the solution of

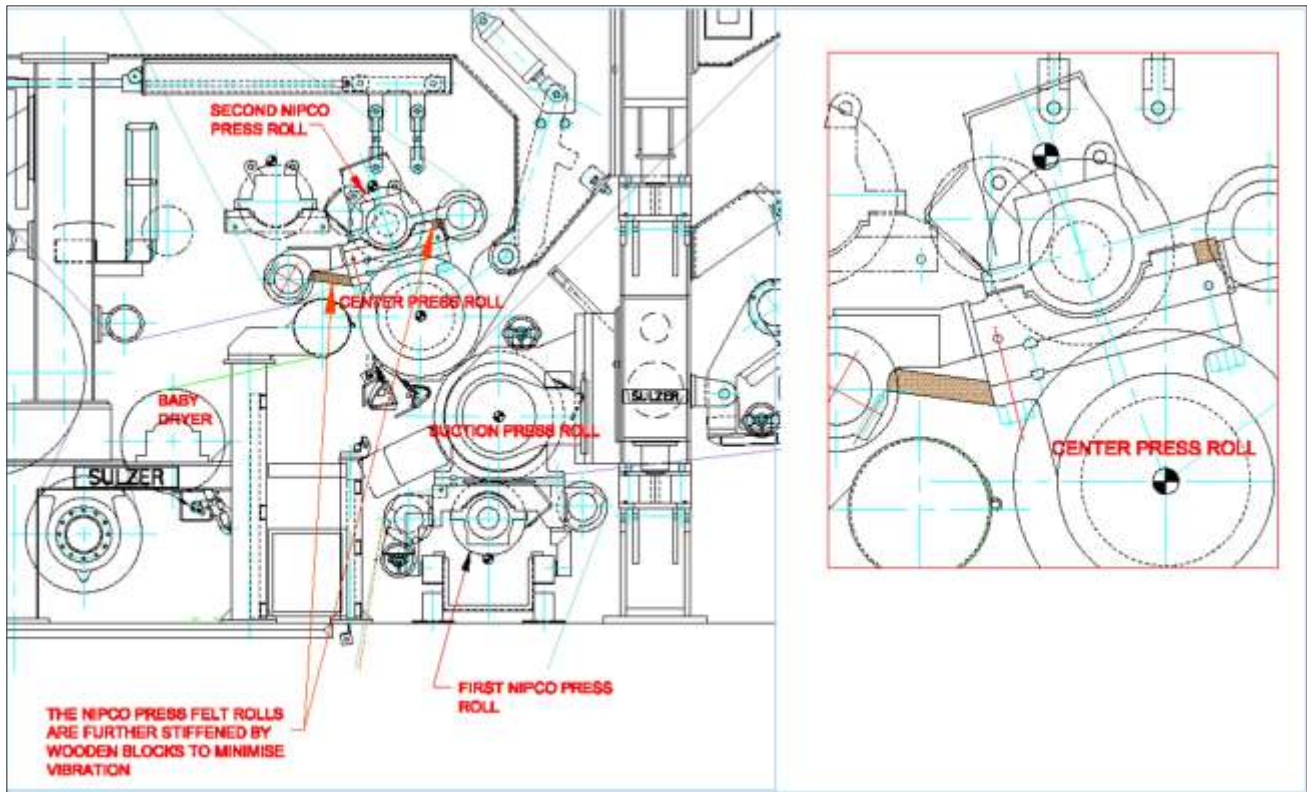
this complex problem.

Solution:

In-house modification was carried out in press section which includes changes in design of two press felt rolls mounting brackets in top felt circuit. Both press felt rolls are mounted in top nip-co bearing housing pedestal support in cantilever frame, hence amplifying the vibration amplitudes in rotational frequencies. The existing cantilever support was modified and this modification had helped to minimize the vibration, subsequently barring impression reduces in top nip-co/ceramic coated centre press rolls surface. After the modifications the roll change frequency has improved to 9 months from 3 to 4 months.

The barring phenomenon occurs in top nip-co and ceramic coated centre press rolls immediately after replacement of rolls due to hard nip configuration of top press. Stainless steel cover venter nip grooved nip-co roll is in contact with ceramic coated centre press roll during loading. To avoid the barring phenomenon, it is proposed to replace the top nip-co roll with polyurethane cover, which will help to increase the machine speed to 1150 meter per minute due to soft nip along with enhanced life of top press felt from 6000 MT to 8000 MT.

By modifying the press felt roll mounting configuration the force frequencies responsible for higher



vibration amplitudes in top press nip loading rolls are reduced and barring mark on roll surface are totally avoided. The barring phenomenon in top press nip rolls doesn't appear even after 1 year of operations.

Advantages:

After modifications the life of third press nip loading rolls has increased. By avoiding higher vibration amplitudes the individual zone of top nip-co roll can be controlled for maintaining required quality parameters and it is possible to obtain best control on cross moisture profile of paper i.e. best possible dimensional stability of newsprint.

V. Dryer Sections-

There are 32 drying cylinders installed in the machine with fully closed hood with ventilation system. The most advanced steam and condensate system from Kadant & Johnson's is installed with a stationary siphon inside the dryer with spoiler bars. The cascading system for steam and condensate is very well designed to get maximum output of condensate recovery and less consumption of steam.

The original dryer section from Inland Empire Paper Co. USA had many constraints to operate the machine at design speed of 1067 meter per minute.

Major constraints were vibrations in dryer section, fluttering of dryer screens and higher paper breaks resulting in reduced machine efficiency.

Constraint-1:

At design machine speed, the transferring of paper sheet from press to uniron dryer section was a problem even with installed vacuum sheet transfer roll and more paper breaks were of concern.

Solution:

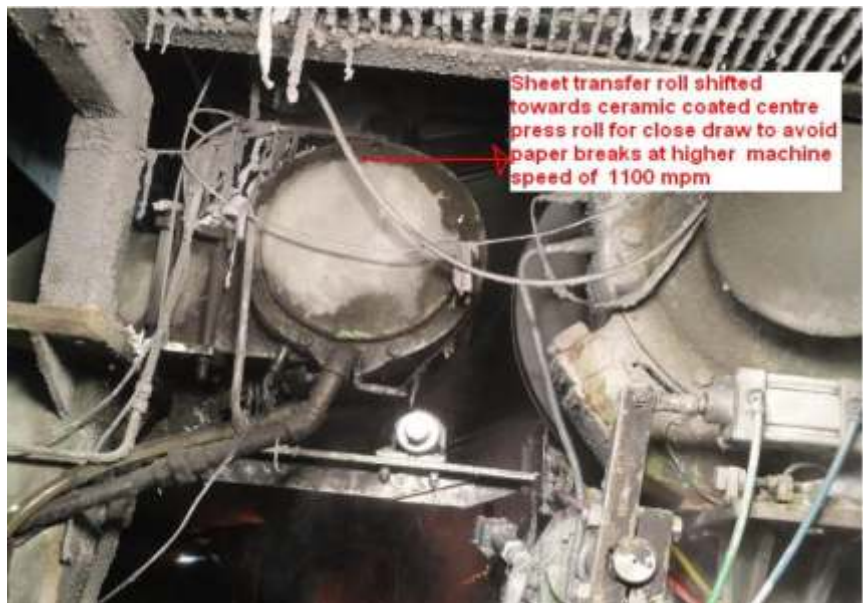
To improve the draw from press to dryer by reducing open draw, the sheet transfer roll was shifted towards centre press roll and subsequently blow box was modified. And finally the paper breaks in press section was reduced.

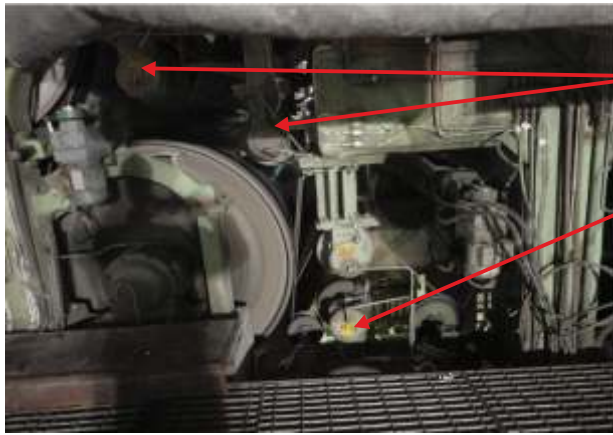
Advantages:

Less paper breaks in press section have contributed improving machine efficiency.

Constraint-2:

At higher machine speed the Sheet





Relocation of felt rolls

Additional Felt roll

fluttering was a chronic problem and the same was experienced while transferring the paper from uniron dryer to subsequent dryer groups. Sheet fluttering resulted in paper breaks. In high speed machines web stabilizers are must in uni-run dryer groups but due to higher financial cost and space constraints, Emami has not installed web stabilizers.

Solution:

The felt rolls adjacent to second group next to uni-run section were relocated and one additional dryer felt roll was added in the second dryer group to improve the close contact of sheet with screen. This modification has helped to avoid sheet fluttering to maximum extent and to improve machine runability.

Constraint-3:

At higher machine speed the fluttering in dryer screens was also a major concern and resulting higher vibrations in fabric rolls hence limiting the machine speed.

Solution:

At higher machine speed the positioning of guide and stretcher rolls matters a lot for efficient guiding of dryer screens. The same was

experienced and corrective measures were taken immediately after commissioning by relocating the guide and stretchers rolls in all dryer groups and finally got rid of this problem.

Constraint-4:

During installation the pneumatically operated rope stretcher assemblies of horizontal mounting configuration were fouling with sole plate columns due to bigger dimensions of civil foundations.

Solution:



BEFORE : Original Dryer Frame configuration



AFTER: Dryer Frame configuration with addition of Arch Beams

The rope stretcher assembly were redesigned and converted to vertical mounting configuration by changing the orientation of pneumatic cylinders in two tier arrangement during erection stage subsequently space constraint was resolved.

Advantage:

Two tire design of rope stretcher systems occupied lesser space and are maintenance friendly.

Constraint-5:

Higher vibrations of dryer frames.

Solution:

To avoid higher vibration amplitudes in dryer sections the existing dryer frames were modified by adding additional arch beams in the original frame and dryer doctors were added and mounted on the arch beams. In original machine did not have many dryers with doctor system due to virgin pulp furnish, but for waste paper furnish doctoring must be one in all drying cylinders.

The newsprint is being produced by using 100% de-inked pulp where stickies is a problem. To get rid of stickies problem and to have better

doctoring, the additional doctors were installed in dryer section.

Advantage:

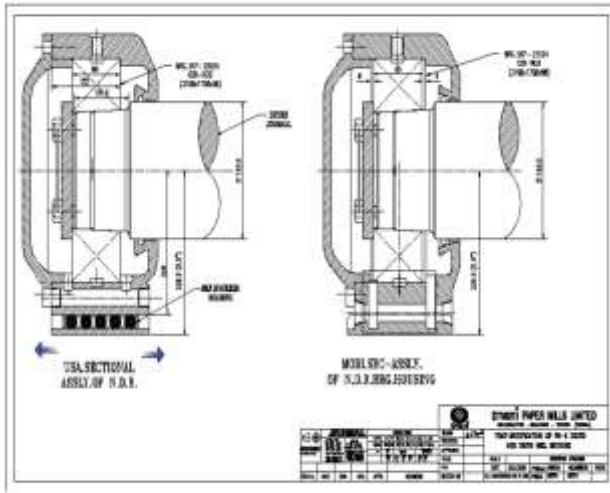
Rigidity of dryer frames has been improved by providing arch beams and additional doctoring system has helped to keep dryer surface clean and increases the machine efficiency.

Constraint-6:

Tender side dryer bearing housings of original dryer cylinders were fixed on rocker arm for floating of bearing housing whereas drive side bearings



Two tire design of rope stretcher systems



(Modified bearing housing -Front side)

were fixed bearing. The existing non drive end dryer bearing housings were of very old design and were constraint for operating the machine at higher speed.

Solution:

The front side bearing housing of dryer cylinders were replaced with standard bearing housings with bearing floating arrangement. The bearing housings of dryer cylinders were manufactured in local workshop.

Advantage:

The rigidity of dryer sections had increased by modifying non drive end bearing housings by which machine can be operated at higher speed than the designed speed of 1067 meter per minute without any vibrations.

Constraint -7:

Unwanted vibration in different dryer sections due to mounting location of few dryer felt rolls was one of the main constraints for operating the dryer section at higher speed i.e. more than designed speed.

Solution:

The dryer fabric rolls had been installed in suitable locations of dryer frames after redesigning the dynamic loads of fabric rolls. The fabric rolls were also balanced at 1200 meter per minute speed at our site. The balancing of rolls was carried out in the developed balancing test rig at site by offline vibration logger having facility of dual plane balancing system.

Advantages:

No vibrations at higher speed i.e. up to 1130 meter per minute were observed and the life of the fabric roll bearings has increased.

Constraint -8:

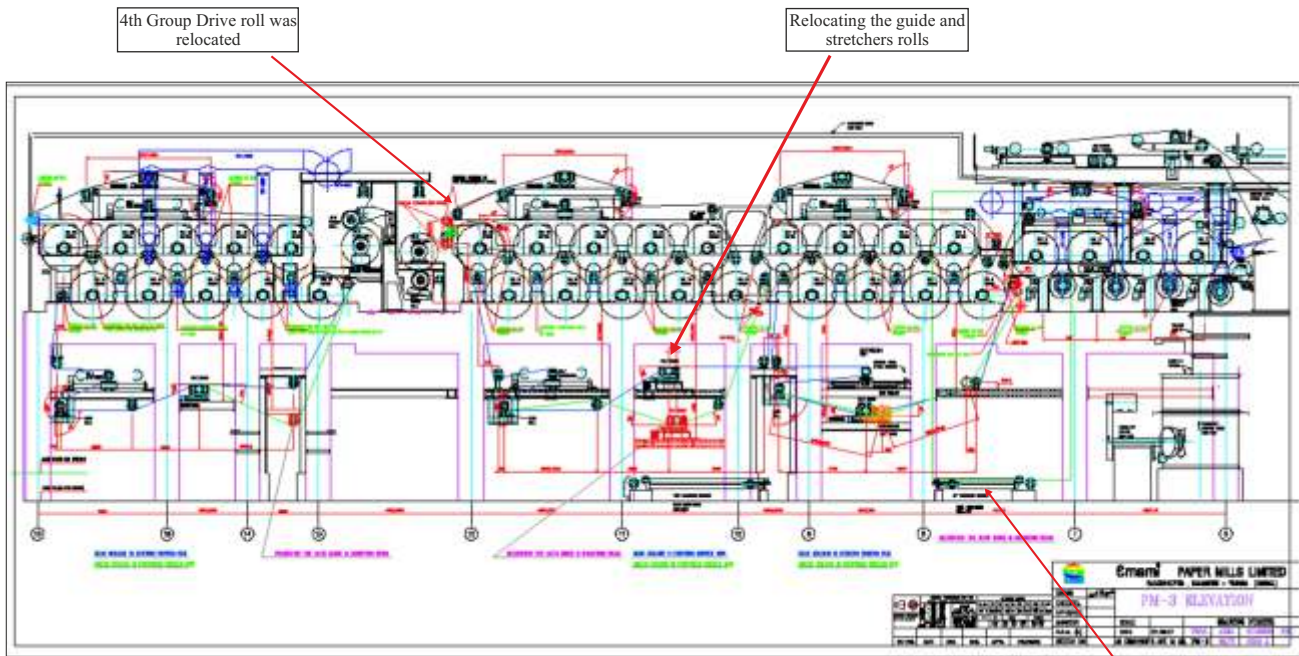
The top tier dryer felt drive roll of 4th group was constraint for operating the machine at higher speed due to fluttering of dryer fabric and less wrap angle with dryer cylinder.

Solution:

The position of top tier dryer felt drive roll was relocated during commissioning stage in order to improve more wrap angle with dryer cylinder and to avoid fabric fluttering.



(Dual plane balancing is done at both side of roll by a trigger and Vibration sensor, connected to a vibration logger having software of dual place balancing)



MODIFIED RELOCATED FABRIC ROLLS (MENTIONED IN RED LOCATIONS)

Advantage:

Screen fluttering was avoided.

VI. Calander Sections:

The paper machine is equipped with advanced Two Stack back to back Soft Nip Calendar with Heated Thermo rolls and full Hydraulic control.

Advantages:

With installed back to back calendar stack, the final product quality is of International standard. In back to back soft-nip calendar the following advantages are obtained,

- Two sidedness is significantly eliminated.
- Superior Paper surface on both sides.

- Uniform density of paper resulted improved printability.

Constraint-1:

Immediately after commissioning of machine soft-nip cover of 2nd stack swimming roll has partially peeled off at drive end due to paper wrapping on roll surface. The matter was brought to the notice of leading international machine manufacturers and the suggestion was for re-aligning of the doctor for avoiding the failure of composite cover. Even after realigning the doctor in both stacks, the peeling of composite cover could not be avoided. By seeing the type of failure, Emami

had removed the installed doctoring system to avoid such type of failure. According to our experience, during machine startup, sometimes moisture content in paper remains much higher and paper has a tendency to wrap around the roll and forces the doctor blade to open. Therefore, the chance of doctor blade digging increased and caused damage to roll cover.

Solution:

After removing the installed doctoring system such types of problems i.e. peeling of composite cover is avoided in totality.

All Rope stretcher assembly were redesigned

Doctoring system at soft

In house repairing of softnip roll surface



Repairing procedure of swimming roll composite cover The damaged composite cover was inspected and found that the peeled off surface was around 350 mm long, 65 mm wide, 7 mm deep. Since the extent of damage was more and it was a special covering, the offer was obtained from renowned composite cover manufacturing company. The minimum cost of composite cover was approximately Euro 43,000.00 (excluding Transportation, customs duty etc) and the recovering and to and fro transportation time was almost 05 to 06 months. Considering the cost and recovering time, the repairing works was carried out at site on trial basis and was successful. The repaired cover had same hardness as of original and was installed back on the machine and operated as per required nip load.

Advantages:

The same repaired roll is running till date and Emami has succeeded to save an appreciable amount of money. Emami has set a bench mark with a successful operation of repaired swimming roll.

VII. Rewinder-

Constraint:

The second hand winder is basically from Belloit and designed for 2000 meter per minute speed. To match the paper machine speed the rewinder speed has to be increased to 2200 meter per minute minimum.

Solution:

The existing slitting station was replaced by modern slitting station with AC frequency drives in all bottom slitters. The installed bow roll was replaced with higher capacity roll and existing guiding plates for core chuck and rider roll movements were also replaced.

Advantage:

The winder is now running at 2200 meter per minutes and meeting the demand of paper machine.

VIII. Paper Machine Automation-

The paper machine has latest Online Automation from Honeywell, USA for Cross Directional (CD) control of Basis Weight, Caliper, and Moisture by Auto Slice, Devronizer and Calcoil HT.

Advantages:

All the above basic requirements of Paper is uniformly maintained, which gives a constant quality printing throughout with good Roll density

PM 3 Newsprint Highlights:

- Uniform basis weight and caliper.
- Two sidedness is nearly eliminated.
- Best possible smoothness on both sides.
- Dirt and specs are negligible.
- MD/CD ratio significantly improved.
- Newsprint with best dimensional stability.
- Uniform Reel Density.
- Good runability on high speed printing press.
- Automated reel wrapping with bar coding improves reel management.

GSM	45±1%
Brightness	59.0 + (-) 1%
Opacity	93±1 %
Smoothness	140-160 / 120-140
Bulk	1.45±0.05
Tensile Index	45-50 / 15-18
Tensile ratio	2.8- 3.2

Paper Quality:

Power consumption	535 Units/T of paper
Steam consumption	1.45 T/T of paper
Water consumption	16 m3/T of paper

Utility Data:

Conclusions

We the team of EPML are successfully operating the second hand paper machine at a speed more than the originally designed speed of 1067 meter per minutes. Even USA Company failed to operate the machine at its designed speed.

Our team had resolved various problems of the machine successfully which improved machine runability at higher machine speed.

The installation of On-Line SPM /Vibration condition monitoring system of paper machine helps in identifying the problems of rotating units/rolls so that the machine down-time reduced drastically and productivity has increased

Our motto is to operate the machine at 1150 meter per minute speed and to

produce newsprint of international quality standard.

Acknowledgement

I am thankful to our management for having the confidence on me and to allow the engineering department to carry out in-house modification with the support of process departments. The modifications done in different sections of paper machine help in terms of operation, maintenance and quality improvements.