

## Automation in Pulp and Paper Industry

P.K. Suri, Mayank Jindal, Manish Srivastava

*JK Papers Ltd., Unit: JKPM, P.O. Jaykaypur – 765017, Dist. Rayagada (Orissa), India*

**Abstract:** *With the advent of New Technologies, the role of automation is no more limited to process control but it has reevaluated the relationship between man, machine, method, information system and environment. JK Paper has adopted state of Art Automation Technologies which is reducing the losses and increasing the efficiency while keeping the low cost of production. The integration of all the process through automation network can make a complete climatic change and enable to monitor & control the real time KPI's of entire plant from single location and also instrumental in increasing the manpower productivity.*

**Key words:** Pulp and Paper Industry, Automation Technologies, Climatic Change

### 1. Introduction

Being located in the delta area of several major rivers, The Netherlands have always been at the forefront of water works. Paper appears in many forms in every day's life like newspaper, colorful magazines, white copying Paper, glossy art paper and it is not possible to make all these papers with just one type of paper machine. A modern paper manufacturing mill required variety of today's high technology tools including internet, wireless communication and virtual reality due to the globalization and highly demanded customer based market. Everybody needs to meet these expectations for their sustainability and survival in the customer oriented market. Keeping in view, J K Paper Ltd. took the initiative to reforms the paper industry in India and installed highly modernize state of the art plant in 2013 at Rayagada, Odisha by investing Rs. 1850 Cr.

Pulp and Paper Industry is a matured industry and having many suppliers for the process and equipment. JK paper opted for latest technology for building competitive edge which also cares for environment health and society. Adoption of Innovative technology resulted very fruitful in this journey. Automation of course stood the key element to achieve the success in managing the complete operation. This integrated mill expansion starting right from wood handling until dispatch of Paper, was a dream project and in-spite of many hick ups in the midway, complete facility was fully operational within 29 months from ordering.

New plant includes Continuous digesters, 2 stage ODL followed by Acid stage and ECF bleaching from Andritz. Fully automated high-speed Paper Machine from Voith, Reel and Pallet ASRS for Paper was also added. With high Pressure Recovery Boiler, CF boiler and 55 MW TG JKPM became 100% self-sufficient on thermal and electrical energy.

### Climate Change by Automation

The rate of change through Automation & Information Technology is having a visible impact on Climate of pulp and paper industry. This **CLIMATE** has not only improved the Tangible benefits in the form of KPI's but also tacitly brings the knowledge culture in the Industry. JK Paper's Rayagada plant is one of the best example of change due to amalgamation of Pulp and Paper industry equipment's with Automation.

The positive **CLIMATE** change due to automation has derived the following benefits to the organization

1. Cost reduction
2. Loss Reduction
3. Integration of facilities
4. Manpower Productivity up scaling
5. Agile environment
6. Time Value for money
7. Ease of Operation and Efficiency

### 1. COST REDUCTION by Compact Footprint:

Technological Changes has not only increased the speed and Volume of the Product lines but decreased the Foot Print of overall plant as well. The Compact size of the plant has happened due to the combination of mechanical equipment and

sequential logics and interlocks in DCS. JKPM new plant has adopted the innovative technologies with latest automation, which has given the following benefits

- Reduction in plant size and area.
- Less capital expenditure.
- Less WIP.
- Easy Material handling.
- Stable quality of product.

For instance, the Re-Causticizing plant process consist the X filter, CD Filters and LMD Filter instead of conventional Clarifiers. These filters operate in sequences from DCS. Due to the adoption of these filters, the foot-print of the plant is reduced by one tenth if we compare this with conventional clarifiers.

### **1.1. Filters:**

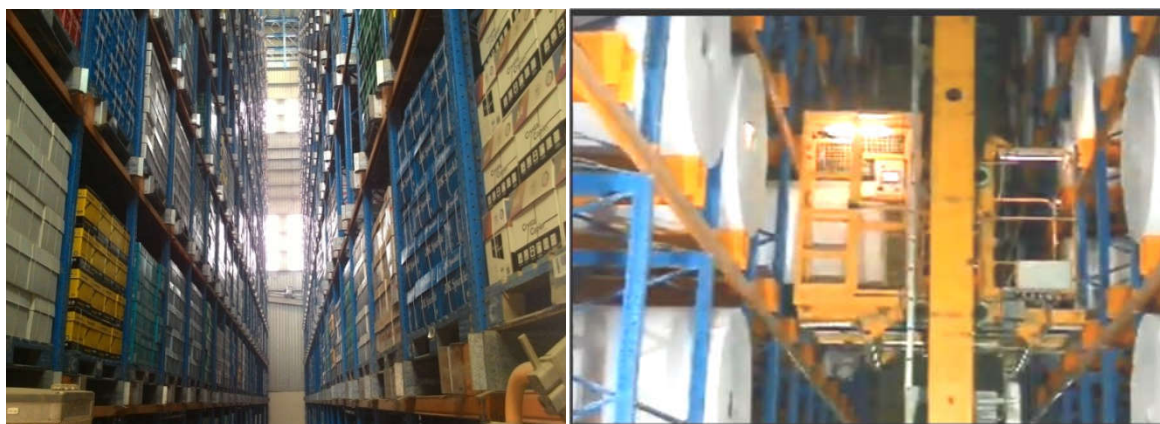
For 3100 m<sup>3</sup>/day equivalent white liquor processing X filter (3.4m diameter & 8.6m height) and CD filter (3.7m diameter) are installed against large size clarifiers for similar capacity. They operate in sequence with cross flow operation mechanism.



**Fig. 1.** One Tenth Compact footprint of new Filters compare to Clarifiers

### **1.2. Automatic Storage and Retrieval System for Reels and Pallets:**

Converting section is state of the art and embedded with latest technology which operates with minimum intervention of human efforts in lower space. The implementation of ASRS has reduced the coverage area of WIP reels and finished Goods as we are able to store the material vertically with Order management system, location management system, real time transaction processing and Optimized material flow, Easy Traceability and Tracking of material. The communication in this area is done through the IR based profibus.



**Fig. 2.** Overview – Reel & Pallet ASRS

## **2.0 LOSS REDUCTION:**

### **2.1 Quality Control System and CD Controls in New Paper Machine:**

To measure the quality apart from conventional sensors in QCS like Basis weight, Moisture, Ash and Caliper JKPM is having the Color Sensor by which we control the L, a and b Values in auto mode. This has resulted in less rejection due to the shade variation and the off quality generated during the grade change is very low.

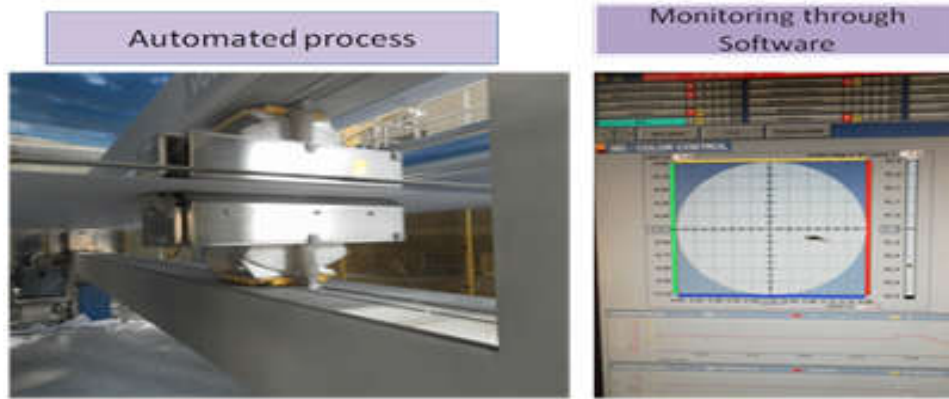


Fig. 3. QCS controls- color

Whole head box is covered with 56 Actuators to control the CD variation in Basis weight and Calendar is covered with Moduletherm with 72 actuators for CD controlling in Caliper which is enabling us to maintain the 0.3 sigma value and 0.5 sigma value in MD for Basis weight and less than 1 sigma value in caliper.

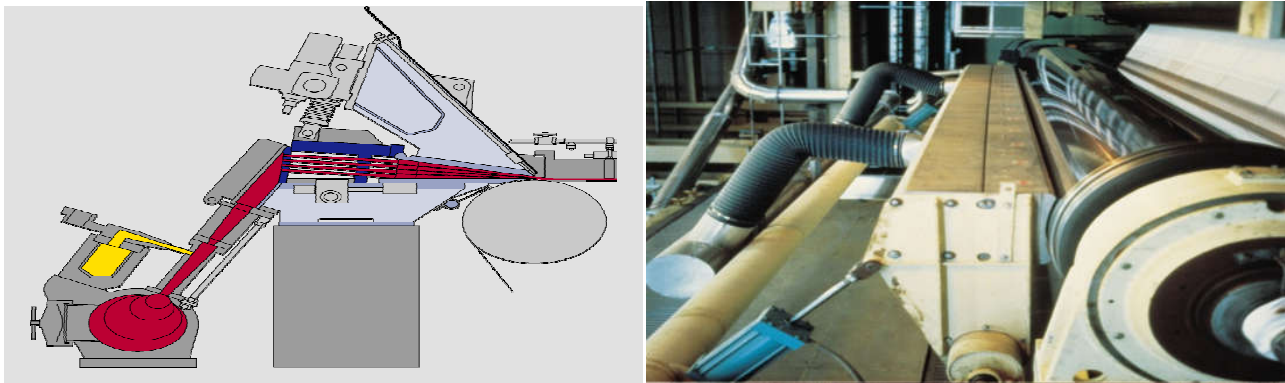


Fig. 4. QCS controls- CD controls for basis weight.

## 2.2 Web Monitoring System through Cameras:

There are 13 cameras to continuously monitor paper web online. These Cameras are used for break Analysis and other defects. Year-long historian with Management Information System having Break Event Library is a very useful tool for long term data analysis & trouble shooting.

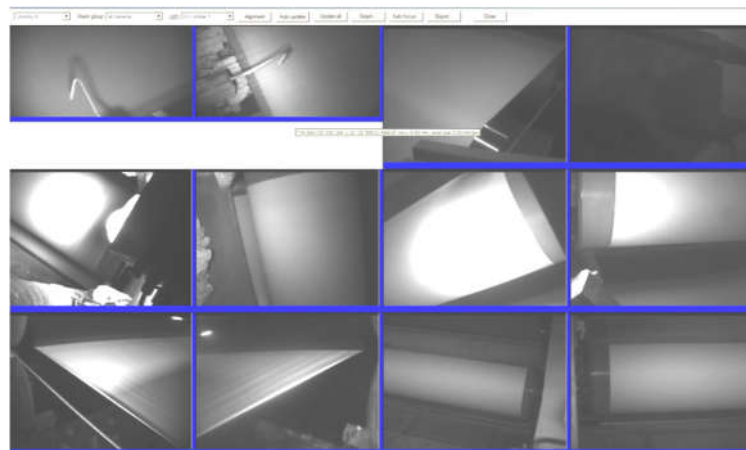


Fig. 5. On line camera view

## 2.3 Automatic Paper Laboratory:

Automatic paper laboratory in which we are just inserting the sample from the parent roll and we will get the quality report in one click for the Tensile, Smoothness, Porosity, Color, Caliper, Basis Weight, Tensile Stiffness Orientation, Bending Stiffness and Formation.



Fig. 6. Automatic Paper Laboratory

### 3.0 INTEGRATION OF FACILITIES:

#### 3.1 Integrating whole plant through Automation:

JKPM has gone for single DCS System for entire Mill New State of Art fully automated high-speed Paper Machine. Our Power Boiler, TG, Recovery Island and Fiber Line works at a single platform exception as JKPM having single and integrated control system. Our PM6 Machine is connected with hardwire connection for information sharing and better operational controls with rest of the plant which brings the whole plant under one umbrella. The level of integration includes 3 different networks in whole plant, out of which two of them are connected while the material handling server is intentionally isolated for physical quality check before final delivery.

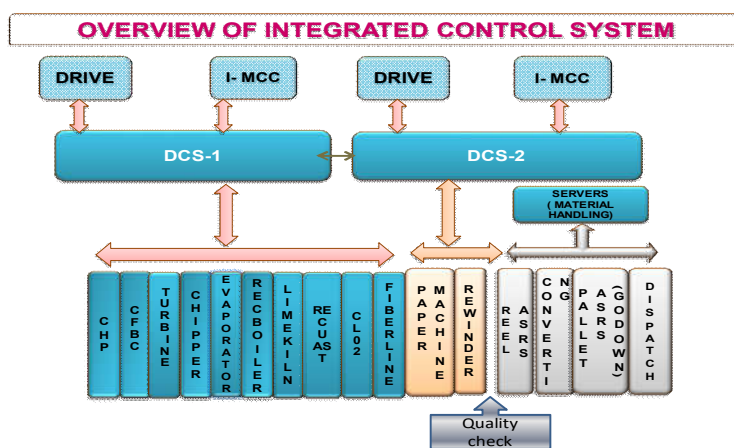


Fig.7. Overview – Integrated control system

#### 3.2 Centralized Control Room:

This whole section of Power Boiler, Evaporator, Causticizing and Fiber line is operated from one single Centralized Control Room facilities within 150m radius are operated and controlled through the CCR room. The local controls are not very much encouraged in this new plant so the process is more dependent on the Sensors, Actuator and Control system. The below is the picture of CCR where operating crew is sitting and controlling the process of plant remotely. Apart from Operational Graphics in our Integrated DCS System we can also see the mill wide Key Performance Indicators in Single Graphical Page. Moreover, Automation team can access the field instrument from Engineering Station and change instrument ranges remotely from HART compatible field bus software.

#### 3.3 Intelligent MCC:

It was yet another worth investment. The intelligent MCC provides a direct communication to DCS and work station. This gives sensitive protection to motors, reduces hardwire cabling thereby results in reduced maintenance and breakdown. Retrieving of motor trips, and online monitoring, Measurement & Annunciations are among its salient features.

### 4.0 MANPOWER PRODUCTIVITY:

The present Automation has increased the knowhow of the equipment. The parameters and functioning of equipment can be seen on the operating system. The discussions among the operating and maintenance crew are also data oriented and analysis are based on trends from the sensors. The implicit knowledge of Human capital can be explicitly converted into logics in the system for efficient manufacturing. This has start bringing the knowledge culture in our plant. Besides this, Automation has also increased the manpower productivity, the examples are as below.

#### 4.1 Palletizing Robot:

For the first time in India we have installed two palletizing robots in our converting section. The Cartons are coming from strapping machine sequentially via conveyor and these Robots pick these boxes and keep it on Pallet. Each robot can pick



and place about 18000 of Cartons per days in each line and sends the filled pallet to the ASRS with all required data like, quantity, grade, lot no. etc. with help of Barcode system and PLC. This has ensured minimal manual intervention hence resulting in higher efficiency and Safe work environment



Fig. 8. Robot- Overview

## 5.0 AGILE ENVIRONMENT:

### 5.1 AAQMS System:

Ambient air quality with all vital parameters is continuously monitored within mill as well as nearby habitant area. On-Line Stack Emission Monitoring System uses a hot extractive sampling technique which avoids loss or change in composition. The TOC is measured with FITR and no span calibration required. It is fully automatic measurement system with comprehensive safety measures.

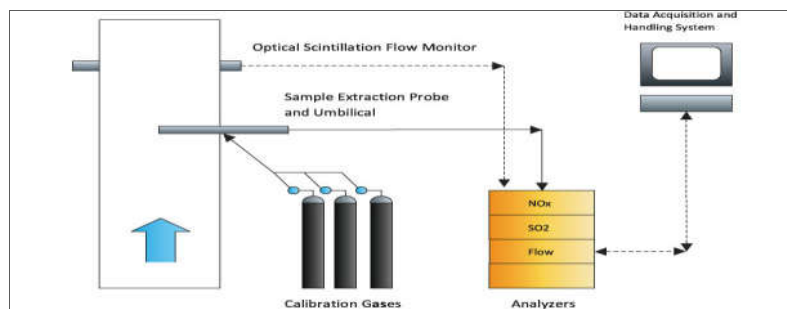


Fig. 9. Overview – Stack Emission monitoring

## 6.0 TIME - Value for Money:

### 6.1 High Speed Automation network in state of Art Paper Machine VI:

We have adopted most advanced and high technology Paper machine which is fully automatic and running at the speed of 1200 mpm. One of the requirement of High speed machine is, the rate and volume of Real Time Operational data transmission must be high between the CPU's and other network components, this is achieved by the network configuration consists of Managed switches. To ensure the safe working environment two safety Controllers are the integral part of automation in machine as shown in below figure.

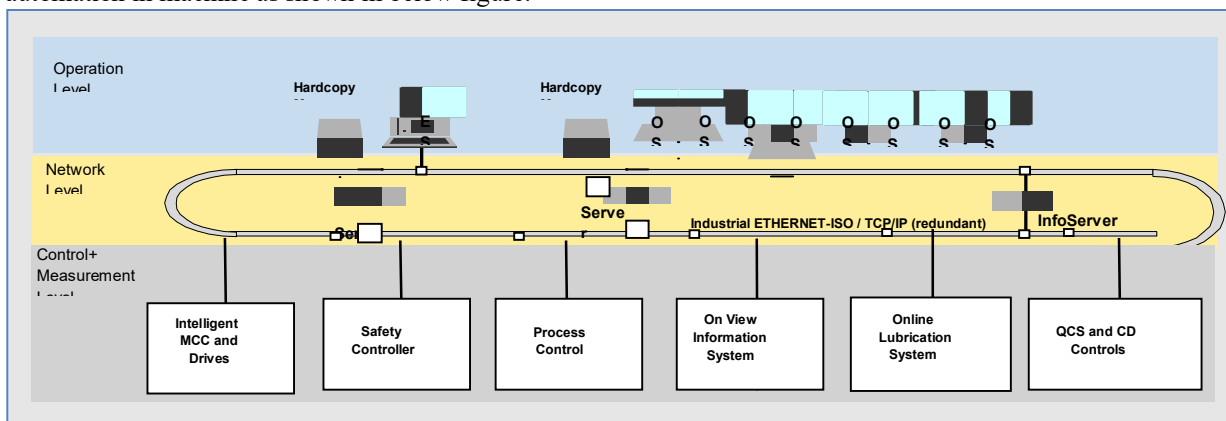


Fig. 10. Overview – PM6 Integrated Network.

## 6.2 Fully Automated High-Speed Winder:

JKPM is having a very high-speed winder. The max speed is 2800m/min that can operate with a wide range GSM ranging from 50gsm to 100gsm. It is having features like auto slitter system, Auto gluing unit, inbuilt safety Controllers and Sensors, auto threading system with auto reel change and Auto Core Feeding. This has resulted in less manual intervention and enhancing safe operating environment.

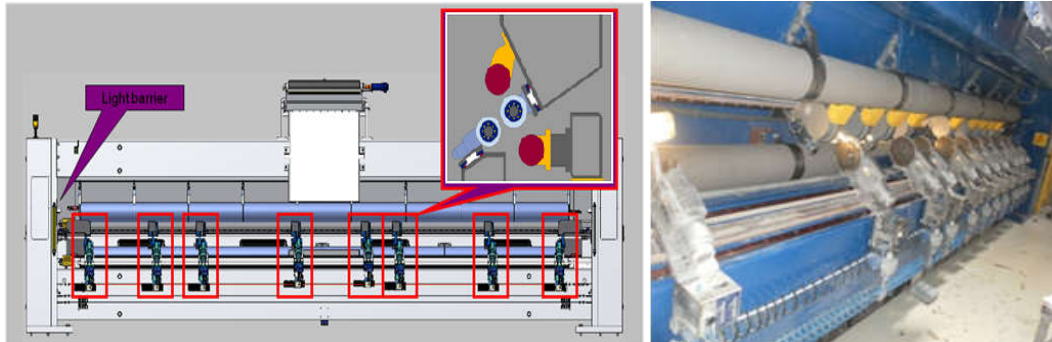


Fig. 11. Auto slitter arrangement-Winder

## 6.4 A4 Line:

The A4 Line is also advanced and having the latest Automation with high level of safety in sheeting and packing unit, not only this the reporting system is also through the MES where we can even see the Real Time OEE of the Sheeter section. The reporting system also shows the downtime, alarms and OEE even for months.

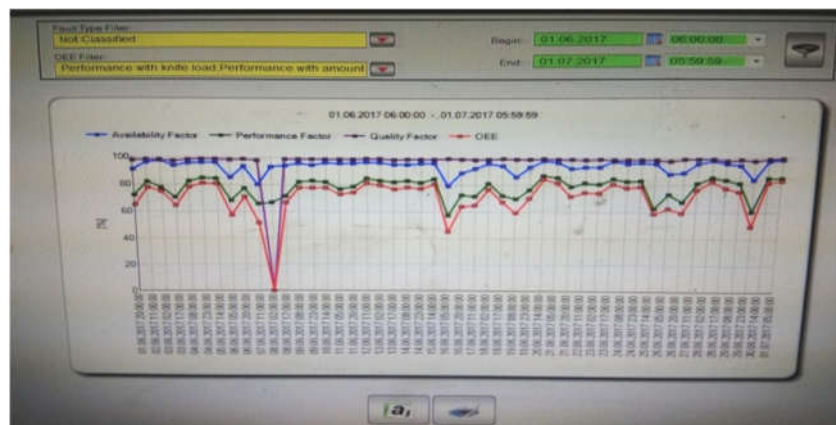


Fig. 12. OEE-Reports

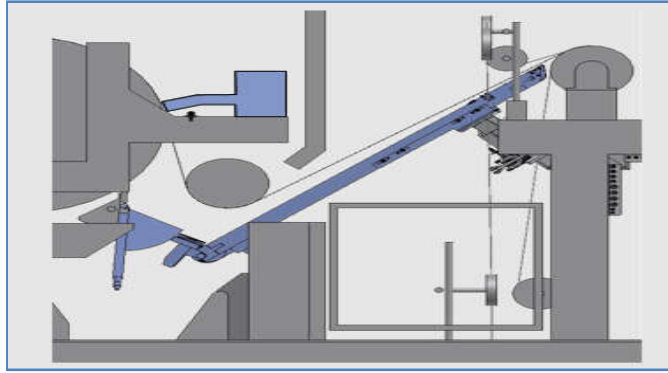
## 7.0 Efficiency and Ease of Operation:

### 7.1 Smart Instruments and efficient Controls:

In the Contemporary world of Automation, the Smart and embedded are the key word today. Our paper machine is also an example of this for pulp and paper industry as it is equipped with smart instruments and embedded controls some of the examples smart positioners. These positioners can auto calibrate the valve with precise positioning due to this we are having very efficient controlling of process parameters. Besides this Paper machine is equipped with instruments like IACP and IACR hydraulic valves which is having an inbuilt provision for measurement of Pressure and flow for fast and safe operations in Master Reel and Winder. Few more examples can be Freeness Sensor for reduction in power consumption and backwater optical consistency controls for reduction in fiber loss.

### 7.2 Automatic Vacuum Tail Threading in PM6:

The paper passing at high speed is with zero manual intervention with technology like duo stabilizer and Vacuum Tail threading. At the high-speed machine, we are having an automatic tail passing system with conveyors which is enabling us to pass the paper safely at minimum time without touching the paper by operators.



**Fig. 13.** Overview – Tail threading system

## 8.0 Following are the key benefits derived from 2013 Expansion Project (Table-1)

**Table 1:** Expansion & its Benefits

Particulars	Units	Before Expansion	After Expansion	% Improvement
Pulp Production	TPA	110,000	220,000	100
Paper Production	TPA	125,000	295,000	136
Specific Coal Consumption	Ton/Ton of Paper	1.6	0.64	60
Water Consumption	M <sup>3</sup> /T of product	73	40	45
Steam Consumption	T/T	10.8	8.2	24
Power Consumption,	KWH/T	1360	1140	16

## THE WAY FORWARD

Selection of advance automation for future expansion as well as up gradation of existing facility is a promising investment. Use of IOT to connect the manufacturing facility with the complete life cycle covering right from plantation till recycle of end product should be the next step to ahead. Automation can do wonders in connecting all these pillars together with much more transparency. Automation together with IT can take our industry to next level.