Paper Machine clothing optimization

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ABSTRACT

Quality is the key factor for any specialty paper, at the same time cost is the key factor for the business. In the present scenario producing the good quality paper by controlling the manufacturing cost is the important factor for survival of the specialty paper industry. The Important function of specialty paper making is to get the uniform moisture, thickness of the paper throughout the cross direction and the dimension stability, here the paper machine clothing plays an important role. In the specialty paper making process performance of the machine clothing is critical to quality and the cost. This paper showcases the comparison of different designs of wires which improve machine runnability at competitive quality paper and cost.

Introduction

Almost throughout the whole paper machine the paper web is in contact with fabrics on one or both sides. Clothing plays an important role in forming, pressing, drying section of paper making. Hereby quality issues such as surface characteristics of the paper are also influenced by the machine clothing.

Literature

Forming Section

In the forming section the fabric filters the water and retains the fibers to “form” the sheet. This is a critical part of the process because it affects the sheet's final properties.

The main requirements **forming fabrics** have to meet are:

Uniform dewatering of suspension exiting the head box and uniform build up of the paper web.

Uniform web support during intensified web dewatering at foils, vacuum suction boxes and safe web transport to the couch position. Easy web release, sufficient hold up.

Modern forming fabric design helps in

1) Improve the fiber and filler retention on the paper, will result in improve the cleanliness of the system and reduce the losses of fiber and filler.
2) Improve in the quality parameters like formation

Demands on the forming fabrics:

Balanced fibre support and surface open area to promote a primary filtration sheet without drainage restrictions

1. Mechanical Retention
2. Improved Formation
3. Minimized sheet marking
4. Easy Sheet Release
5. Low fiber carry
6. Lower power consumption
7. Higher forming fabric life

Press Section

In the **press section** the formed web is mechanically dewatered under pressure. When the sheet is carried through the presses by the fabric, water is squeezed out and into the fabric, further reducing the sheet's water content. The paper surface finish is further influenced by the press fabric design. As the sheet leaves the press section, it is typically 40% fiber and 60% water, depending on the sheet grade and the paper machine. Here rewetting is the economic factor.

The main requirements **Press fabrics** have to meet are:

1) Smooth paper side surface for good printability.
2) Constant dewatering behavior over a life time.
3) High storage volume to store the water removed from the web.
4) Low abrasion at roll side.
5) Good dimensional stability.

Press felt fabric design helps in

1) To improve the dryness of the wet web which is entering into the dryer section, thereby reduce the load on the dryer section, and also reducing the rewetting of the web.
2) Better moisture profile and reduce the number of paper breaks at wet end will leads to increase in the machine uptime.

Dryer Section

In the **dryer section** the dryer fabric has to ensure the undisturbed web transfer through the section, to enhance contact heat transfer

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from the cylinder surface to the web and to reduce web shrinkage in CD. The primary function of a dryer fabric is to keep the sheet in contact with the dryer cylinders to provide maximum heat transfer from the cylinder to the sheet. If a wet object is placed against a heat source, the water on the surface will heat up. In the case of paper, the evaporation of the heated water creates a positive pressure that tends to lift the sheet off the dryer. This reduction or loss of contact with the dryer will result in poor heat transfer and poor drying efficiency.

The main requirements **Dryer fabrics** have to meet are:

1) Paper contact surface to have a high contact density for optimization of heat transfer from cylinder to web.
2) Smooth paper contacting surface and in-line seam for non-marking of the paper.
3) Sufficient vapor permeability to allow evaporative drying to occur freely. The permeability must be uniform across the cross direction.
4) Uncomplicated structure to allow effective cleaning
5) High performance and quality running lifetime in hot, humid conditions
6) Dimensional stability and high performance and quality during running lifetime, (typically 12 – 18 months) in hot, humid conditions.

Modern dryer fabric design helps in

1) Uniform moisture profile throughout the CD by improving the sheet to dryer contact, will lead to energy savings.
2) Improving air movement in dryer pockets, and providing resistance to fabric filling.

Some progressive papermakers have achieved significant improvements in machine speeds and operating efficiencies and reductions in energy consumption by installing modern clothing designs. Papermakers that are not taking advantage of these developments are missing some excellent opportunities of cost benefits. This is case Study on use of modern clothing designs to improve product quality and reduction in cost of manufacturing at ITC PSPD.

The fabric suppliers are giving the best suitable designs of fabrics as per specification of a particular machine and the criticality of the paper, it is the papermaker's responsibility to analyze the performance of the fabrics with respect to the quality of the paper and the machine runnability and to coordinate with the supplier to customize the fabric design which improves the product quality at optimum cost.

Case study-1

Forming fabric design optimization

The flowing methodology (TPM) followed in this optimization process.

1- Brainstorming session conducted to find out all possible parameters that are influenced by the forming fabric design.
2- From the prioritization matrix most influencing parameters listed out.
3- Identified the variables that are having impact on selected parameters.
4- Optimized and fixed all the parameters within the limit to compare the relation of these parameters with the fabric design.
5- Identified the fabrics which have given the best results in the above parameters.
6- Analysis of the best performing fabric for further optimization.
7- Discussed with the supplier to provide the fabrics closer to the arrived design.

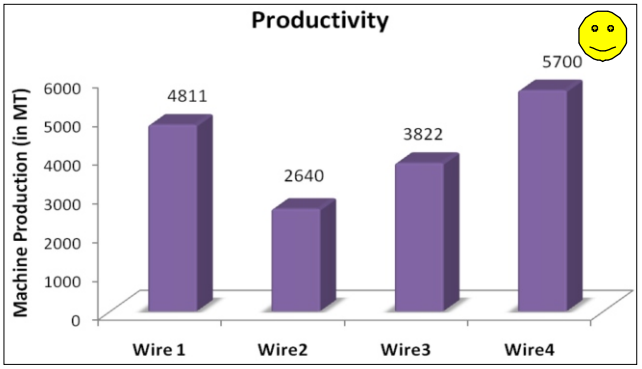
Step 1: First Brainstorming session done to find out all possible parameters that are influenced by the forming fabrics. (Annexure 1)

Step 2: With the help of the prioritization matrix (Annexure 1),High influenced parameters were listed.

- Formation index
- Ash retention
- Productivity
- Opacity
- Dryness after fabric
- Uniform moisture
- Basis weight variation

Critical to quality for thin printing grades is formation and the opacity, which are functions of following process parameters.

- ***Productivity***



- ***ASH Retention***

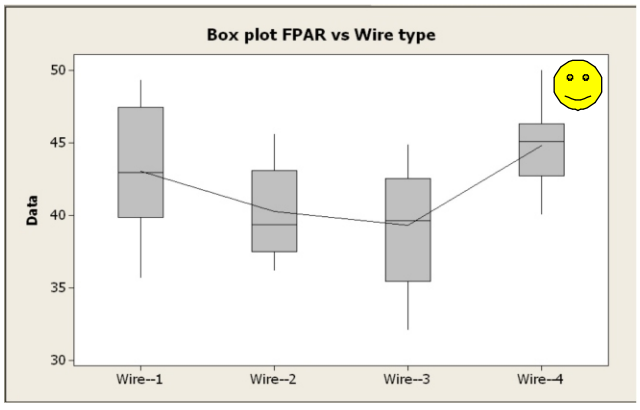


Fig.2 First pass ash retention Vs Wire type.

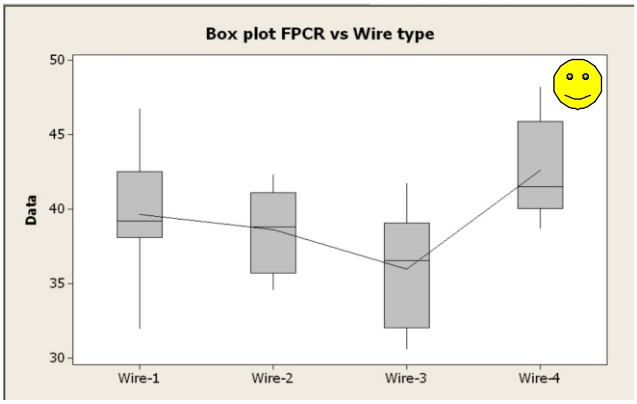


Fig.3 First pass chalk retention with wire type.

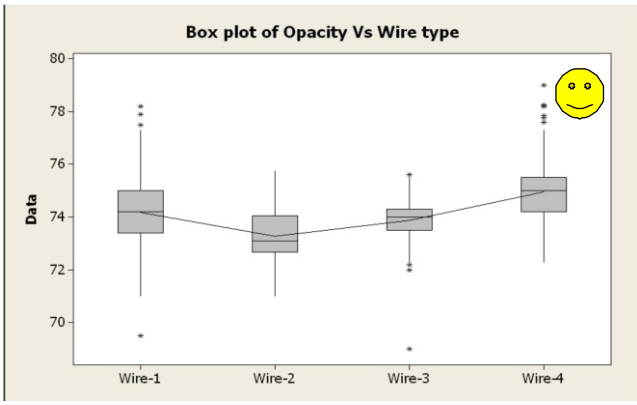


Fig.4 CTQ parameter Opacity with wire type.

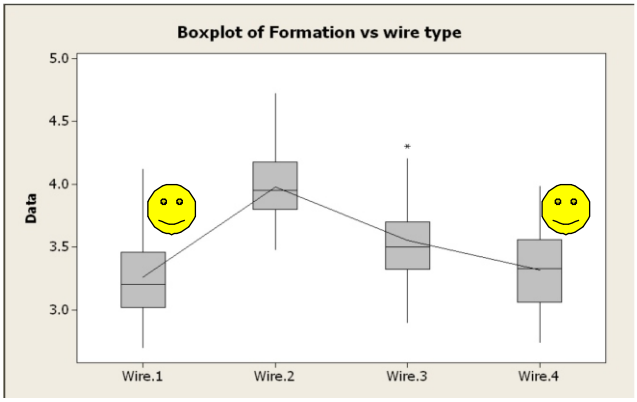


Fig.5 Formation VsWire type.

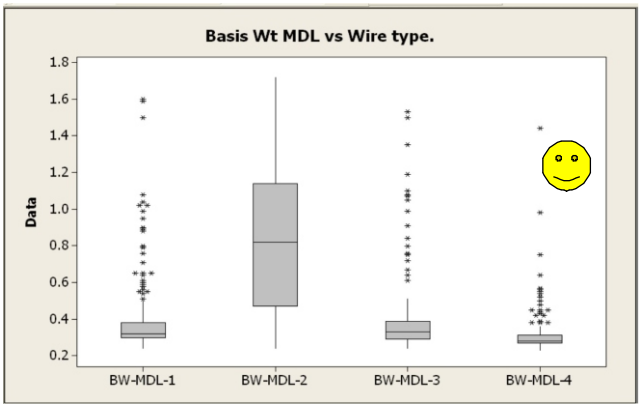


Fig.6 Basis wt MDL vs Wire type

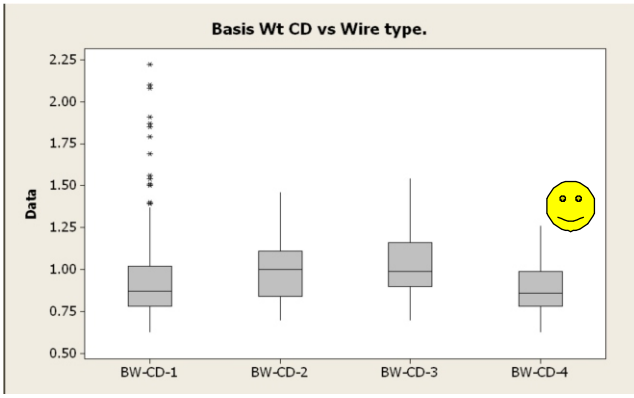


Fig.7 Basis Wt CD vs Wire type.

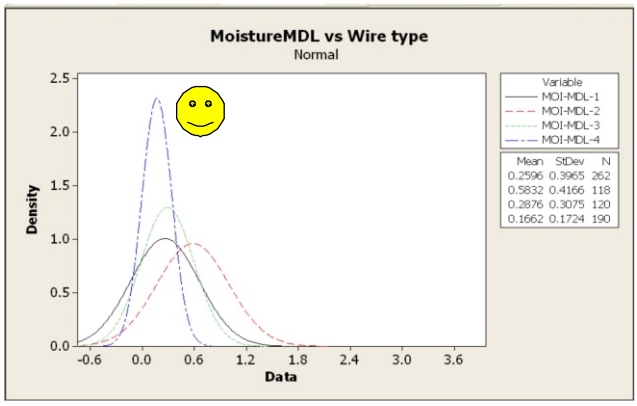


Fig.8 : Moisture MDL-Wire type

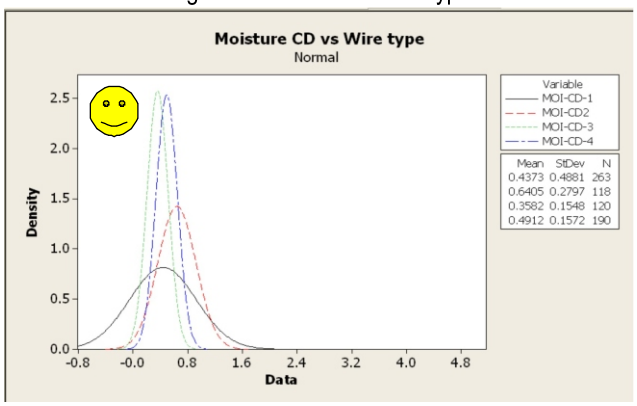


Fig.9 Moisture CD vs Wire type

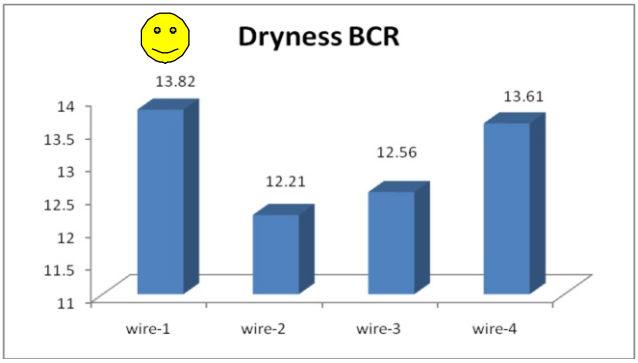


Fig. 10 Dryness before couch vs Wire type.

Observation

Better productivity given by the Wire-4.

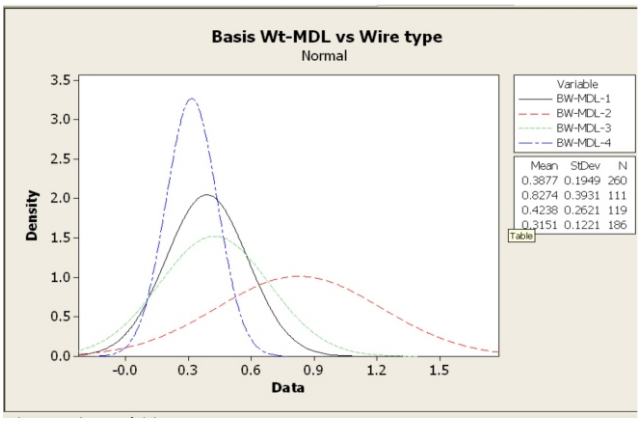
Better ash retention given by the Wire-4.
Opacity is more or less same for wire-1& Wire-4.
Basis variation is minimum with Wire-4
Moisture variation is minimum with the Wire-4 & Wire-1
Dryness before couch is better with Wire-1 & More or less same with the Wire-4

Wire type	Layers	CFM	Caliper	FSI	DI	Paper side drainage area
Wire-1	3	340	0.99	170		28.96
Wire-4	3	330	0.84	163	27.7	34.85

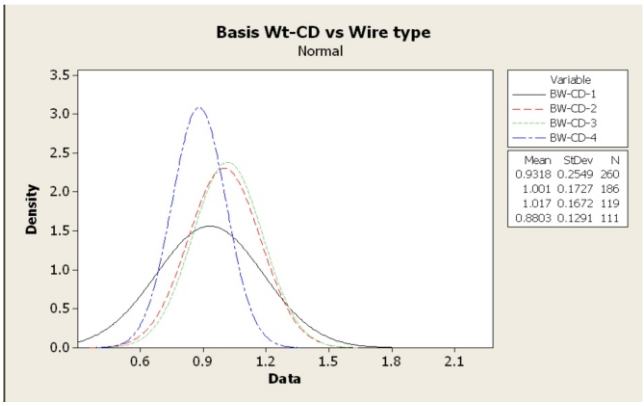
Factors affected by the forming fabric							
S. No	Factor	Mr.A	Mr. B	Mr.C	Mr.D	MR.E	Total Rating
1	Formation index	9	9	9	3	9	7.8
2	Productivity	9	3	9	9	3	7.8
3	Sheet release	3	3	9	1	3	3.8
4	Ash retention	9	9	9	3	9	7.8
5	Chalk retention	9	3	9	9	9	7.8
6	Drainage	9	9	9	9	3	7.8
7	Runnability	9	3	3	3	1	3.2
8	Strength properties	3	3	3	9	3	4.2
9	Wire mark on paper	9	9	3	3	1	5.0
10	Dimensionally stable	9	1	1	3	9	4.6
11	Less two sidedness of the paper	1	9	3	3	3	3.2
12	Life of fabric	9	3	9	3	9	6.5
13	Power consumption	3	3	3	3	9	4.5
14	Abrasion resistance	3	9	3	1	3	3.8
15	Elongation within the limit	3	3	3	3	9	4.2
16	Uniformity of moisture	9	9	9	3	9	7.8
17	Basis wt variation	9	9	9	3	9	7.8

Annexure.1
Brainstorming session.

Factors affected by the forming fabric	
S. No	Factor
1	Sheet formation
2	Productivity
3	Sheet release
4	Ash retention
5	Chalk retention
6	Drainage
7	Runnability
8	Strength properties
9	Wire mark on paper
10	Dimensionally stable
11	Less two sidedness of the paper
12	Life of fabric
13	Power consumption
14	Abrasion resistance
15	Elongation within the limit
16	Uniformity of moisture
17	Basis wt variation



Basis wt MDL Vs Wire type.



Basis wt CD vs Wire type.

Conclusions

From the above observations following is the conclusion.

Optimization Property	Critical parameter	Specification
Wire life	Caliper	More than the 84
Formation	Permeability	Less than 340
	FSI	Less than 170
	Drainage index	Less than 27.7
	Paper side open area	Mora than 28.96
Ash retention & Opacity	FSI	More than 168
	Paper side open area	Less than 28.96

Quality

Optimization of forming fabric design parameters

Cost

From the above observations wire-1 & Wire-4 are giving the more or less comparable results in terms of productivity and quality. But in terms of cost wireno.4 is cheaper and easily available than WireNo.1. So we have customized the Wire no. 4 fabric design as mentioned above.