

Our Experience in Sizing of Yankee Posters At Seshasayee Paper-A Case Study

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ABSTRACT

As all of us are aware, sizing is an extremely important parameter in any paper. While carrying out sizing in Machine Finished (MF) papers is well established and has been found to be relatively easier, sizing of MG as well as Yankee papers has always been a problem and a subject for intense debate and discussions. At SPB, we have done many experiments for sizing our Yankee machine poster papers and we are sharing our experience in this article.

INTRODUCTION

Our experience in Sizing of Yankee Poster Papers

Internal sizing is more than simply an area of scientific interest for paper makers. It is a vital stage in paper making process and determines the quality of products. Efficient internal sizing produces paper with good strength properties suited to the needs of printers. However if sizing is not carried out properly, the product becomes unusable.

The purpose of sizing is to retard the penetration of aqueous liquids into paper. This is achieved by converting the high energy hydrophilic surface of fibers into a low energy hydrophobic surface. In rosin sizing, fibers are rendered hydrophobic by precipitating the size with alum and then converting the precipitate to aluminum rosinate. This ion facilitates the retention of size precipitate on the pulp by electro static attraction between preferentially adsorbed hydroxyl and sulfate ions on the fibers and this positive ion. The covalent nature of the aluminum rosinate bonds enhances the hydrophobicity of rosin and thereby promotes sizing after drying.

Generally three types of sizing processes are being adopted in paper making process:

- Acid sizing
- Neutral sizing
- Alkaline sizing

Out of the above three sizing process, in SPB, conventional acid sizing process is being practiced in Yankee variety products till now. However, considering some major advantages

with respect to paper quality/ brightness stability and pleasant shade/machine runnability, we have taken few trials with AKD sizing process.

Sizing process

Internal sizing involves reaction of a sizing agent, such as partially saponified rosin, modified rosin or a mixed emulsion of rosin and wax with aluminium sulphate, called as papermakers alum.

Rosin is the most widely used internal sizing agent in the paper industry. The important member of the family is Abetic acid. The one carboxylic group in Abetic acid is considered to be the reactive group in sizing reaction.

In this system, rosin size is added to the stock, reacts with alum to form a complex hydrophobic compound, called aluminum rosinate which is the actual sizing agent precipitates on the paper fiber. During sheet formation and drying aluminum rosinate covers the fiber to give relatively homogenous water resistance to the surface of paper sheet. The control of degree of sizing is achieved mainly by adjustment of the level of rosin added and the pH/ acidity of the wet end system.

Factors affecting sizing

- High stock temperature and long hold times adversely affects sizing efficiency. For this reason it is beneficial to continuously add the sizing agent close to the machine.
- The type of fiber furnish affects the degree of size receptivity.
- The amount and type of filler affect efficiency.
- First pass retention probably has the most significant impact on

sizing efficiency.

- Poor retention causes foam, felt filling, foil and wire deposits and wet end breaks.
- High calcium carry over along with the bleached pulp (due to poor settling of bleach liquor- high turbidity) will adversely affect internal sizing due to the formation of calcium soap.
- Moderate levels of refining may improve sizing efficiency because of the improvements in the formation of final sheet.
- Additives at the wet end such as, defoamers, slimicides, wetting agents, OBA etc., may have a negative impact on sizing efficiency depending on quality, point of addition and ionic charge.
- Increased wet pressing generally improves the sizing especially at low levels of sizing.
- Dryer temperature affects the degree of mobility or migration of the sizing agent after the sintering the temperature has been reached.

Description of Yankee machine

- The designation of "Poster" paper covers wide range of low-substances. In SPB, we are manufacturing posters from 28 gsm to 90 gsm. An important feature of this machine is that, the wet web is supported throughout the forming / pressing (suction pick up) and drying process.
- The Yankee cylinder is a large-diameter steam cylinder, which serves as the drying unit. The wet web is pressed against the highly polished surface by two numbers of hot press rolls. The drying cylinder itself is generally unclothed. Since Yankee cylinder is of higher diameter, the thickness of the wall is constructed

DETAILS OF YANKEE PAPER MACHINE AT SPB

Make of machine	KMW (Sweden)
Capacity (TPD)	25 (max)
Deckle (mtr)	2.38
Grades	Plain/ ribbed posters/kraft
Grammage (g/m ²)	28 -90
Speed m/min	250 (max)
Head box	Pressurized (Hydraulic)
Table	Four drainer
Wire length	22.2 mtr
Wire width	2.65 mtr
Mode of sheet transfer	Suction pickup
Press	Suction press
Dryer	Yankee cylinder
Drives	Sectional drives
Refiner	Disc/control

Comparative statement between Yankee and MF/MG machines

Particulars	MF/MG machines	Yankee machine
Grammage Gsm	MF-1 :45 /MG : 68 (min)	28 (min)
Machine speed m/min	200-300	100-200
Press section	I / II press	Suction pick up press
Dryer section	MF1: Pre dryer section After dryer section MG: MG cylinder in between pre / post dryers	Single Yankee cylinder
Sizing mechanism at dryer section	Low dryer temperature gradient can be kept in the initial few dryers in pre dryer section and gradual temperature rise can be done in the subsequent of pre / post dryer . By maintaining like this, aluminium resinate particle fuses into hydrophobic film on the fibre surface	If the temperature gradient of the yankee dryer is maintained optimum level , aluminium resinate will fuse and adhere on the surface of the fibre and no problem on sizing. But , if the dryer temperature gradient is too high , the size melts and adhere to the felt / dryer surface or evaporate from the sheet resulting poor sizing
Distribution of sizing chemicals	Uniform distribution of the size across the deckle	Non-uniform distribution of size if the temperature variation is high
Size difference between top / bottom side of paper	Marginal difference between top/bottom of paper	Vast difference in sizing can be observed between glaze and non-glaze side of paper due to the migration of size particles with water towards the heated side.
Porosity of paper (at same furnish)	Low due to high grammage	Porosity is very high due to low grammage and this high porosity is also one of the reasons for the quick evaporation / migration of the precipitate at high temperature level

to 2 to 3 inches than that of the conventional dryers. The Yankee dryer shells are made up of high grade cast-iron of very high tensile strength. The thickness of the metal results in an increase in resistance to heat transfer through the cylinder wall.

- Because of high rate of heat transfer and heavy drying load, the steam and condensate system in Yankee machine is efficient . The Yankee cylinder is enclosed with high velocity air impingement system to increase

the drying efficiency. As per our experience, the temperature gradient across profile in Yankee cylinder is maintained between 92°C and 98°C.

Why sizing is difficult in Yankee machine?

If all the conditions are ideal during the manufacture of products in MF/ MG machines, it is not at all difficult to carry out internal sizing of paper. But, in case of Yankee machine, the situation is entirely different. The comparative

statement of internal sizing process between MF/MG and Yankee machine is given on left.

During the manufacture of posters in acid media, the chemical consumption of sizing agents like fortified rosin (24 kg/t) and iron free alum (78 kg/t) are on the higher side which results in high cost of production (Rs 1200 / t). Besides, due to the detrimental effect of such a huge quantity of alum on brightness of paper, we are not able to size Yankee poster below 45 gsm.

Problem facing with acid sizing in poster papers:

- Ageing affect in paper is high
- Corrosion on machine equipment
- Reduce the brightness of paper
- Sizing cost is high
- High chemical consumptions

In order to reduce the cost of production and improve the quality of posters some of the trials were taken in Yankee machine by the introduction of AKD sizing process.

About AKD sizing

AKD is a widely used synthetic size. It is a complex molecule made from a mixture of palmitic acid stearic acid . It can react at a pH of 6.5-8.5

AKD molecule imparts 'sizing' or hydrophobicity it to papermaking fibres by reacting with cellulose to give the beta keto ester bonds.

This presumed mechanism uses the formation of the ester linkage as the means of anchoring the AKD molecule on the paper making fibre and the means of orienting it to give "sizing".

AKD sizing system has four components, the size / the precipitator / the catcher / the substrate .

1. AKD -Sizing chemical
2. Coagulant -Cationic scavenger
3. Flocculant -Retention aid
4. Substrate -Cellulose:

AKD trial in Yankee machine

Generally, Yankee poster paper is being used for making daily sheet calendars/bill books / Beedi wrapping

Details of AKD product analysis during the trial run:

Particulars	Uom	Test results
Physical appearance	-	Milky white emulsion
pH	-	3.2 - 3.6
Total solids	%	15.3 – 15.5
Solubility	-	Easily soluble in water in all proportions

Point of addition of AKD, Alum and Retention aid are as below:

Name of the chemical	Point of addition
AKD	Fan pump inlet
Iron free alum	Blending chest
Retention aid	Selectifier screen out let

Particulars	UOM	Trial I	Trial II
Average consumption of AKD chemical	kg/t	13.5	13.5
Retention Aid	g/t	50	20
Iron free alum to maintain pH of 7.0-7.3	kg/t	21.6	18.1
One pass solid retention	%	85-87	83.9-87.2
Ash retention	%	40-43	44-46
Wire pH maintained	-	7.0-7.3	7.0-7.3
Cost benefit	Rs/t of paper	Avg: 710/-	

etc., no sizing is practiced below 45 gsm. But, some of the customers are using our poster for the manufacture of clothing covers, some water resistance capability is required for the posters, otherwise, the paper will tear off very easily during the application of glue on poster. In order to improve the water resistance capability in poster, some of the trials were taken in Yankee machine by the introduction of AKD sizing as it is difficult to size the low grammage paper in acid media.

During the manufacture of poster in Yankee machine, the following target was kept for cobb sizing:

Paper substance	cobb sizing
28-37gsm	35 gsm(max)
Above 45 gsm	30 gsm(max)

Other wet end chemicals like Soap stone powder (High brightness), OBA etc. are added as is followed during the normal run of paper manufactured on this machine.

During trial the following parameters are monitored:

- One pass solid and Ash retention
- Paper properties

For comparison purpose, test results of paper manufactured with acid sizing is also given alongside for ready reference.

RESULTS AND DISCUSSIONS

The average consumption of the chemicals during the trial per ton of machine production is as given below:

AKD : 13.5 kg
Retention aid : 50.0 gm
Iron free Alum : 21.6 kg
pH maintained : 7.0 to 7.3

Following are the observations during the trial run:

- During the trial, one pass solid retention and ash retention values for 60 gsm (with SSP) are in the range of 85-87% and 40-43.0% respectively.
- Paper properties with respect to physical strength properties are marginally high compared to that of acid sized paper.
- Gloss of AKD sized paper is marginally high compared to that of acid sized product.
- Normal brightness of paper could be maintained during this trial with the reduction of optical

whitening agent at the rate of 2 kg/t of paper.

- The brightness stability of AKD sized paper, in terms of post colour number is found to be low compared to acid sized paper, indicates AKD sized paper is having brightness stability (5-6 and 6-7 respectively)
- During the trial, the colour coordinate values could be maintained in the normal range. AKD sized paper seems to be more bluish tint and Yellowness index are low compared to that of acid sized paper. Due to this reason, AKD sized paper looks pleasant shade.
- Target cobb sizing of paper, even for 28 gsm paper could be achieved in all roll samples (cobb sizing was tested after curing the paper sample in oven for 5 minutes at 105°C). Without curing the paper (after removing from machine), cobb sizing of paper is found to be in the range of 50-60 gsm. With acid sizing process, even after use of very high quantity of rosin and alum, cobb sizing of paper was achieved at 55-70 gsm.
- No adverse effect in COD of machine back water is observed by using this sizing chemical.

CONCLUSION

Our experience with internal sizing of Yankee poster papers is encouraging and our inferences are:

Alkaline sizing process is beneficial in Yankee poster papers compared to acid sizing process with respect to:

- **Improvement in product quality**
 - Improvement in the mechanical properties of paper
 - Marginal improvement in paper gloss
 - Improvement in internal sizing
 - Pleasant shade of paper (on visual eye perception)
 - Marginal improvement in permanence of paper
- **Improvement in production by increasing the machine speed**
- **Reduction in cost of production (by Rs. 700/t of paper)**

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Table -1: Test results of MG plain poster in Yankee with AKD sizing

Particulars	Uom	Acid sizing (28 gsm)	AKD sizing (28 gsm)		Acid sizing (37 gsm)	AKD sizing(37 gsm)	
			Trial-1	Trial-2		Trial-1	Trial-2
Machine Speed	mpm	170	180-200	190	165	190-200	190
Burst Factor	-	16-18	16-19	16-18	16-18	16-18	16-17
Tear Factor MD	-	40-44	40-44	45-47	41-44	40-47	40-47
Tear Factor CD	-	45-51	49-51	51-55	46-50	45-52	47-50
Breaking Length MD	m	4200-5000	4500-5500	5000-5600	4300-5500	4500-5800	4500-5000
Breaking Length CD	m	2400-3400	2700-3600	3000-3200	2900-3200	2700-3300	2900-3500
Porosity	ml/min	1000-1300	1000-1200	1100-1200	1000-1200	900-1000	1000-1100
Brightness	%	78-80	78-80	78-79	78-79	78-80	76-78
Gloss	%	27-32	28-34	27-33	28-33	28-36	27-34
Cobb Sizing (Non Glaze)	gsm	40.4-65.2	24.0-33.2	38.0-43.2	50.0- 56.5	24.5-31.4	25.9-38.3
Cobb Sizing (Glaze)	gsm	57.3-70.2	26.0-36.6	42.0-45.3	61.2-66.7	27.6-34.6	28.4-40.6
Paper Ash	%	1.0-1.3	1.1-1.4	1.1-1.2	1.3-1.6	1.1-1.4	1.1-1.2
pH of Wire water	-	4.5-4.8	7.0-7.2	7.2-7.3	4.5-4.6	7.0-7.3	7.1-7.3
Colour Co-ordinate Values							
" L "	-	88.31 to 89.35	88.78 to 89.38	88.05 to 88.82	88.16 to 89.53	88.35 to 89.45	88.08 to 89.49
" a "	-	0.83 to 1.55	1.10 to 1.51	1.42 to 1.52	1.23 to 1.34	0.90 to 1.15	1.46 to 1.76
" b "	-	-2.95 to -3.65	-2.84 to -3.78	-2.30 to -3.24	-2.52 to -3.01	-2.32 to -3.42	-2.30 to -3.64
Yellowness Index	-	-4.85 to -5.66	-4.50 to -5.64	-4.46 to -5.25	-4.21 to -4.88	-3.82 to -5.40	-4.89 to -5.65

Table-2: Test results of MG plain poster in Yankee with AKD sizing

Particulars	Uom	Acid sizing (45 gsm)	AKD sizing (45 gsm)	Acid sizing (60 gsm)	AKD sizing(60 gsm)	
					Trial-1	Trial-2
Machine Speed	mpm	150	170	125-130	130	130
Burst Factor	-	18-19	16-17	16	16-17	16-17
Tear Factor MD	-	40-45	43-51	44-48	41-45	44-51
Tear Factor CD	-	50-54	51-64	51	48	51-58
Breaking Length MD	m	4500-4600	5100-5400	4000-4500	5500-6000	4800-5600
Breaking Length CD	m	3000-3100	2900-3200	2500-2800	3200-3500	2500-3300
Porosity	ml/min	900	900-1100	900	1000-1100	800-900
Brightness	%	78-79	78-79	78-79	78-79	78
Gloss	%	31-33	30-37	30-35	31-37	30-37
Cobb Sizing (Non Glaze)	gsm	22.5-24.2	22.4-24.8	20-25.0	23.6-26.4	22.3-25.3
Cobb Sizing (Glaze)	gsm	24.0-28.6	24.8-26.5	22.4-28.0	26.4-28.6	25.4-28.4
Paper Ash	%	1.5	1.6	4.0-4.3	4.0-4.5	3.6-5.0
pH of Wire water	-	4.5-4.6	7.0-7.1	4.5-4.8	7.2 -7.3	7.0-7.3
Colour Co-ordinate Values						
" L "	-	88.80 to 89.12	88.31 to 88.95	88.29 to 89.01	88.83 to 89.18	88.6 to 89.2
" a "	-	0.93 to 1.14	1.43 to 1.70	1.0 to 1.52	1.25 to 1.40	1.30 to 1.48
" b "	-	-2.19 to -2.82	-3.03 to -3.42	-2.53 to -3.34	-3.30 to -3.45	-3.54 to -3.62
Yellowness Index	-	-4.02 to -4.70	-4.08 to -4.70	-4.75 to -5.49	-5.90 to -6.12	-5.80 to -5.98

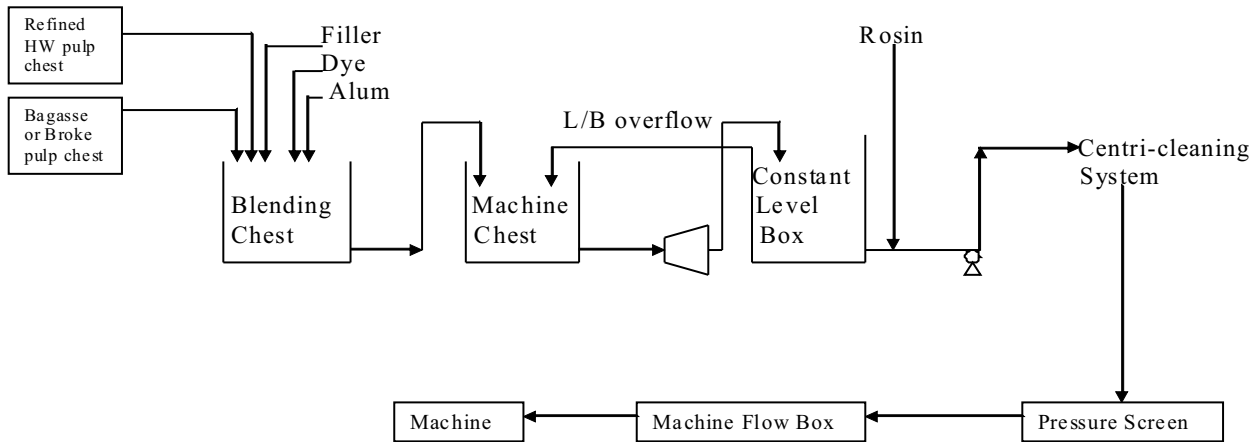
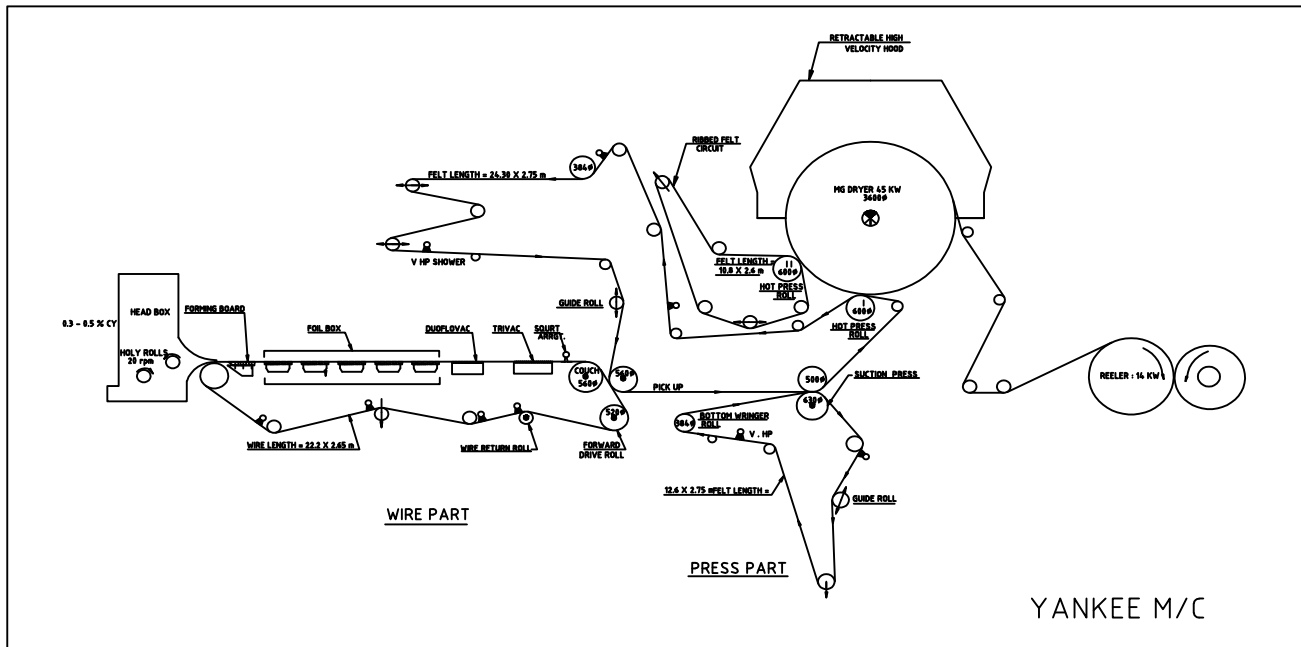


Figure : Flow diagram of Stock Preparation System (Yankee – Acid sizing process)

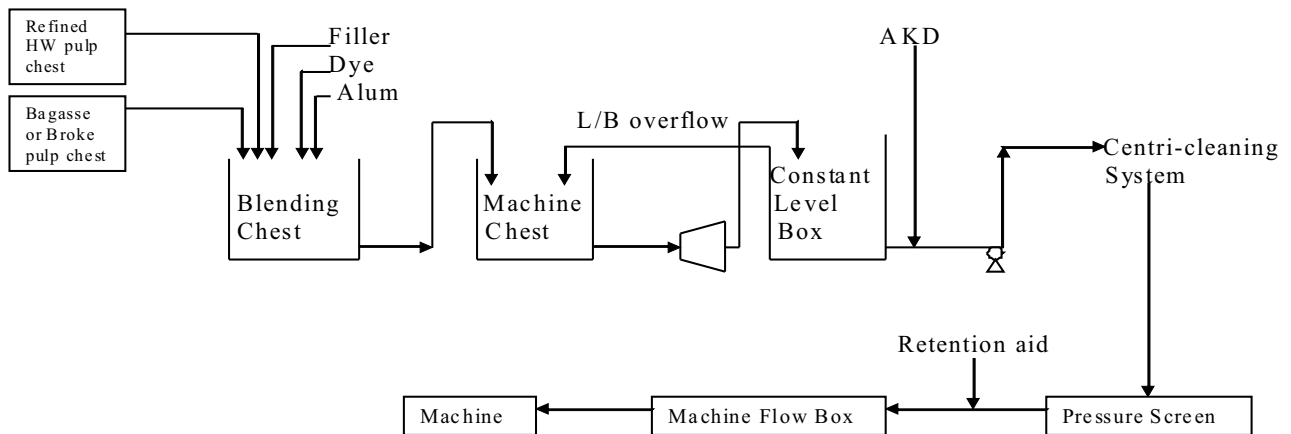


Figure : Flow diagram of Stock Preparation System (Yankee – AKD sizing process)