An Experience with Alkaline Sizing

B.S.Bist, K.N.Tiwary, Pradeep Verma and S.K.Sharma

Shreyans Industries Ltd, Ahmedgarh, Punjab.

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Plant trial experience of Binary system of alkaline sizing has been discussed. Application of Binary system on wheat straw pulp furnish was tried for the first time. The system gave encouraging result during one and half months trial for manufacturing Super Printing paper. Appeal of paper was found better with 1.0 to 1.5% increases in brightness. Fiber and ash retention improved by 7±1 % and 11±2 % respectively. Breaking length and Burst factor improved by 5-6 % and 10-12 % respectively. Tear remained more or less same. Other factors like drainability on Fourdrinier wire table, steam reduction and dryness at different sections are under investigation.

INTRODUCTION

Wheat straw is the main fibrous raw material for pulping and Rice husk for Boiler. The mill established Fluidized Bed Reactor to treat Wheat straw black liquor, first time in the world, for Chemical Recovery. Pulp of 84-85% ISO brightness is manufactured and paper was made by employing Acid sizing till recently. With Acid sizing brightness of paper achieved was 82-83%. Taking base brightness of pulp as 84.5% there was about 2.5% drop in brightness from pulp to paper.

Keeping the customers preference of fluff free higher brightness paper, it was thought to go for alkaline sizing as it gives higher brightness, better appearance and lesser reversion of color and almost fluff free paper.

ALKALINE SIZING

Paper is sized to an extent that aqueous interaction of paper is controlled to the desired level. This is done by wet end addition of internal sizing chemicals. Generally, the sizing process is known for the pH range which prevails during sizing operation e.g.

Sizing	pH range
Acid	below 5.0
Neutral	5.0 to 7.0
Alkaline	above 7.0

Acid sizing is the oldest method of sizing, where a rosin-alum complex is used to develop water repellency in the cellulose fiber. In the process, use of ground or precipitated calcium carbonate is restricted due to its alkaline nature. Calcium carbonate is available in plenty in European countries and is a better choice of filler. This was the reason alkaline sizing came into being.

Since 1980 acid sizing has been replaced in most part of the world. A broad comparison of Acid as well as alkaline sizing is given in Table I. Comparisons of sizing agents are given in Table II.

Based on the information available, it was thought to go for a laboratory study before going to plant scale trial.

Laboratory study

Laboratory studies were made taking 100% wheat straw pulp; AKD and ASA were tried separately as well as in combination. The system is known as Binary system. It was observed that sizing demand in case of wheat straw was more in comparison to wood based furnish due to high fines content, where synthetic size was used. To overcome this problem a combination of AKD and ASA 50%:50% ratio of size demand was tried. It was observed that binary system works well with wheat straw furnish. This system was tried for the first time on wheat straw furnish. The other supporting chemicals like retention aid, size fixing agent and dry strength resins were evaluated and doses were established to get acceptable level of sizing.

Plant scale trial

Based on laboratory trial experience, it was decided to go in for binary system only. Prior to taking plant trial the dozing points were finalized as given in table III.

Chemical preparation

a. AKD- It is received in emulsion form ready to use. So it was used as such.

b. ASA- It is received in oily form which was emulsified in the emulsification unit by adding emulsifying agent and water as per standard procedure.

c. Size fixing agent.-It is received in viscous liquid form. It is diluted to about 0.5% concentration.

Table 1 : Comparison of Acid sizing and alkaline sizing.

Particulars	Acid sizing	Alkaline sizing
Sizing chemicals	Fortified rosin soap and Alum	Alkyle Ketene Dimer(AKD) Alkenyl Succinic Anhydride(ASA)
Filler used	Restricted	Unrestricted
Mechanism of sizing	Hydrophilic component of Rosin-Alum complex gets attached to the cellulose and hydrophobic component spreads on fiber making it water repellent	Hydrophilic component of Alkaline sizing reacts with cellulose and hydrophobic components stick to fiber making it water repellent
Retention aid	Cationic	Anionic/Cationic
Operating pH	3.5-5.5	7.0-9.0
Properties		
i. Optical	Lower	Higher
ii. Physical	Weaker	Stronger
iii. Fluff in paper	More	Less
Microbiological activity	Less	More
Drainage	Less	More
Fiber/Ash retention	Less	More
Machine runnability	Normal	Better, due to better drainage and dryness than acid sizing.

Table 2 : A comparison of sizing agents

Properties	Rosin	AKD	ASA
Curing	Fastest	Slowest	Similar to rosin except in mechanical furnishes
Operating performance	Easiest to control Sizing can be even variation in furnish High temp.retards sizing	Tendency for sizing reversion.Potential for slip problem It can react with water to hydrolyze and not create sizing Retention aid essential	More tolerant of furnish variation Temp.elevation and extremes of pH Mill emulsification is required Chances of deposits of pitch,press picking and desizing. Retention aid essential.
Self life	Fairly good	Low(Maximum up to 3 months	As ASA fairly good after emulsification few hours.

d. Retention aid:-It is received in micro beads form. A solution of 0.15 to 0.2% concentration is made and fed to static mixer where it is further diluted to 0.05%.concentration.before being used finally.

e. Dry strength resin.-It is received in viscous opaque liquid form which is diluted to 1.0% concentration.

The point of addition is given in figure. 1 & 2.

OBSERVATIONS

The plant trial results obtained during running of various substances of Super Printing paper were discussed. Through out the trial run the required Cobb 60 value and ash content in paper were maintained. The results are given in Table-IV and Table- V

Based on the trial results, following observations were made.

- The alkaline sized paper appeared whiter than acid sized paper. The paper was aesthetically appealing.
- The brightness of papers with the similar doze of whitening agent was increased by about 1 to 1.5 point.
- Shade variation remained minimum compared to Acid sizing.
- Head box consistency remained lower through out the trial and so the back water consistency.
- Fiber and ash retentions were increased by 7±1 and 11±2% respectively.
- Head box as well as back water pH remained in the vicinity of 7.5% through out the trial.

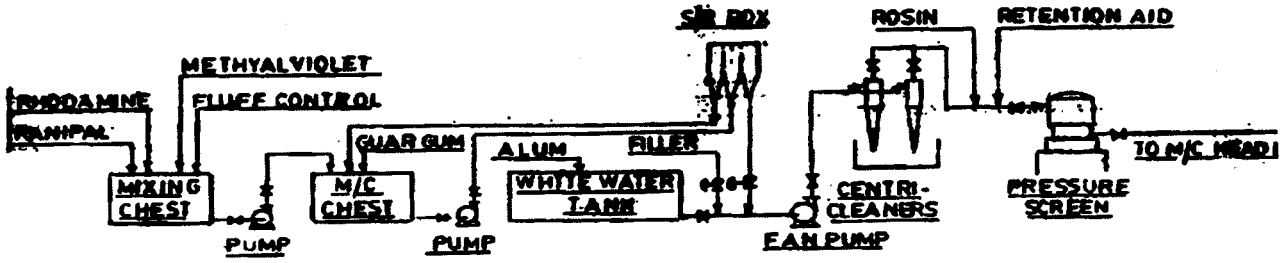

FIG. 1:— FLOW DIAGRAM OF ACIDSIZING

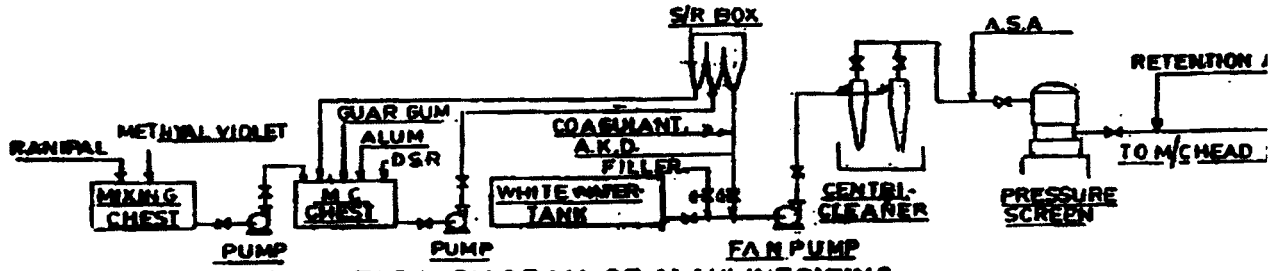

FIG.2:— FLOW DIAGRAM OF ALAKLINESIZING

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- Head box oSR reduced by about 5-6 oSR in all the varieties.
- Machine runnability was observed better than acid sized paper may be due to better drainage and web dryness. Dryness at different sections of machine and steam consumption is under evaluation.
- 5-6% increase in breaking length and 10-12% in burst factor was observed. However, Tear factor remained almost unchanged.
- Other related drawbacks associated with alkaline sizing such as felt filling, press picking, wire life etc are under observation. However, it was observed that fluff problem is almost eliminated.
- It is expected that slime growth will increase due to favorable conditions prevailing in alkaline sizing. To take care of the same, Generox Technology of slime control was tried but it could not provide desired results. Proper technology is being searched to take care of the same. Also, heavy deposits experienced in the system which may be due to hydrolysis of certain sizing chemicals. Care is to be taken to control the same.
- No slippage was observed in paper conversion and finishing section with binary sizing system.

CONCLUSION

Alkaline sizing is expected to give several benefits over acid sizing; however, there are certain drawbacks also in the system which have to be taken care of for getting benefit of the system.

Overall appearance and brightness of paper was better than those obtained during acid sizing.

The binary system of alkaline sizing suited better to the wheat straw furnishes. About one and a half months trial gave encouraging results. However, certain parameters are under observation to get a final conclusion.

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Table 3 : Points of addition and dosage of wet end chemicals

Chemical name	Point of addition	Dosage(Kg/T)
Dry strength resin	Machine chest	2-3
Alum	Machine chest	3-4
Cationic	SR box accept line	0.3-0.5
AKD	SR box accept line	7-10
ASA	Pressure screen inlet	0.8-1.2
Retention aid	Pressure screen outlet	0.15-0.20
Talcum	Fan pump suction	Depending upon gsm
Guar gum	Machine chest	1.5-2.0

Table 4 : Comparative operating conditions of Acid and Alkaline sizing

Parameters	Substance (GSM)				
	54	58	65	70	78
Headbox consistency(%)					
Acid	0.797	0.848	0.850	0.959	1.000
Alkanine	0.712	0.769	0.813	0.870	0.933
Headbox pH					
Acid	3.7	3.6	3.8	3.8	3.6
Alkaline	7.6	7.5	7.6	7.5	7.3
Headbox Ash(%)					
Acid	29.9	34.5	34.9	37.2	36.4
Alkaline	29.7	31.3	33.0	33.2	33.3
Headbox °SR					
Acid	57	57	58	57	57
Alkaline	51	51	50	51	51
Back water consistency(%)					
Acid	0.277	.0.284	0.280	0.323	0.245
Alkaline	0.209	0.225	0.228	0.245	0.218
Back water,pH					
Acid	3.7	3.6	3.8	3.8	3.6
Alkaline	7.6	7.6	7.6	7.5	7.6
Back water Ash(%)					
Acid	60	59.5	65.6	67.4	66.0
Alkaline	63.8	60.9	60.3	62.7	65.9
Ash retention(%)					
Acid	61.8	67.1	72.4	71.4	74.2
Alkaline	70.6	75.4	79.8	80.9	81.4
% increase	14.2	12.37	10.22	13.3	9.7
Fiber retention(%)					
Acid	65.3	66.3	67.0	66.8	75.5
Alkaline	70.6	70.7	71.9	71.8	80.2
% increase	8.1	6.6	7.3	7.5	6.2

Note: Increase in properties has been calculated taking acid sizing figures as base.

Table 5 : Comparative strength properties of paper

Parameters	Substance (gsm)				
	54	58	65	70	78
Increase in					
Breaking length, %	6.0	7.1	5.8	4.5	4.2
Burst factor, %	10.0	11.5	13.8	13.6	10.2
Tear factor, %	(-) 1.03	(-1.13)	1.4	1.3	1.7
Paper brightness, %	2.0	0.84	1.7	1.35	1.09

Increase in properties has been calculated taking acid sizing figures as base.

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