Alkaline Sizing ASA With PCC : Our Experience

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ABSTRACT

Alkaline sizing has tremendous potential in the process of papermaking to compete and sustain the market growth. In this alkaline conversion ASA has been chosen as internal sizing along with PCC as filler. The paper deals with the problem experienced during the process stabilisation along with product and process improvement.

INTRODUCTION

Conventionally paper sizing is carried out in acidic medium, i.e., rosin and alum. Owing to benefits of Alkaline sizing the papermakers are eager to change the sizing process Acid to Neutral to Alkaline. Since Alkaline sizing have some (ASA/AKD) advantages over acid sizing, the selection of sizing material is crucial. Furnish, filler content, machine hardware final product and the end usage are the critical factor in deciding the sizing material. Our Mill experience of converting from Acid to Alkaline sizing with ASA and PCC are dealt in detail.

(ASA) Alkenyl Succinic Anhydride: - it is extremely reactive and will complex with hydroxyl groups on cellulose, starch and water. The reactivity of the ASA means that the product will readily cure on the paper machine without excessive drying or the use of promoters. This means that most of the cure is achieved before size press, so allowing the paper maker to dry the sheet normally rather than over drying. This can give greater control of starch pick up at the size press, full sizing at the reel and improved productivity.

Another issue caused by this reactivity is the tendency of the ASA molecule to reacts with water. This forms a di-acid, which is hydrophilic at one end of the molecule and hydrophobic at the other end. The di-acid has the ability to react with metal ions such a Ca & Mg that are often found in water systems. The products of these reactions are sticky precipitates, which could potentially deposit on the fabrics and frame of the paper machine, although it has been shown that calcium salt can contribute to sizing. The aluminum source in the system is consequentially of great benefit. This ability to react with metal ions has been exploited in some mills, notably in Japan, where a potassium salt of low molecular weight ASA is made and then precipitated onto the fiber by using alum at acid pH in much the same way as rosin is used. Much of development work with ASA sizes in the 1980's was targeted at ensuring that ASA was easy to use in practice in the mills. In depth studies of the systems of mills have led to the development of programmes that are simple to use and which ensure that ASA hydrolysis is kept to an absolute minimum. This ensures high sizing efficiency, low costs and good machine run ability.

Application: ASA is supplied to paper & board mills as fluid oil, which has no charge and no great affinity for the anionic cellulose fibers. To ensure good retention, it is emulsified in a cationic carrier and then added to the thin stock system of the paper machine. Cationic starch & polymers are used as efficient emulsifying media for effective ASA sizing.

Polymer:

- The most common chemistry of these products is based on cationic polyacrylamides, although polyamine, polyamide and poly DADMAC chemistry have all been tried. Considerable success has been achieved with some of these products but never (so far) to the level achieved with starch. They do however have some considerable benefits.
- Polymer contact of the emulsion is much lower than the starch content would be.

Despite this, a number of mills are running polymer programmes very successfully; especially these mills that do not have a cooker for cationic starch in these cases, the capital costs involved in installing such a cooker make the polymer option a more attractive economic proposition. These mills that do use polymers for emulsification need to set up their equipment in a different way to ensure optimum results.

In our mill, we focused starch as an emulsifying agent of greater effectiveness compared to polymers. These are several choices on the form of cationic starch available. The choice of this will often depend upon the mill, its location and size, and economic factors,

- Liquid starch.
- Cold water soluble powder starch.
- Cooking powder starch.

STARCH

Liquid starch:

These starches are excellent products; It can be fed directly to the emulsifier. The only problem is it's shelf life is short.

Cold water soluble starch:

Cold water soluble or pre-gelatinized starch is a powder that has been treated to dissolve in cold water. These starches are normally dissolved, either using a manual or a fully automated, in cold (ambient) water at 3-5% dry solids.

Cooked starch:

This starch is cooked typically at 4-12% solids and quantized with further water to bring the solids down 1-5%, for ASA emulsification, it is normally recommended that 3-5% starch is fed to the emulsifier, but this depends upon the starch properties.

THE BASIC REQUIREMENTS FOR ASA SIZING

1. High retention of fibers & fillers: Since ASA is non-ionic molecules that have no attraction for anionic fibers & other substances, such as cationic starch and cationic polymers must be used as size retention aids. We have maintained

FPR 86% -88%
FPAR 60% - 65%

2. Uniformly distributed on fiber surfaces: ASA is to be uiformly distributed on fiber surfaces, the particle size of the ASA must be between 0.8-1.2 microns of the 90 % values. The temperature of ASA emulsion must be less than 35 degree centigrade.

3. Selection of suitable calcium carbonate filler: As fillers adversely effect the sizing performance of all sizes as fillers are having higher specific surface area than fibers.
The shape and partical size of the PCCs play vital roll in establishing sizing.

Selection of suitable/compatible dyes: Dyes were selected those having better compatibility with higher pH that is 7.5-9.0 and having good dispersing property.

4. Selection of suitable deposit control programme: As alkaline sizing having the system pH range 7.0-9.0 therefore there are more chances for slime generation and deposit in the system. Selective deposit control programme was used.

5. Boil out programme: Whole systems was given for boil out with caustic, anti slime and surfax (detergent) to clean the system periodically. After every two caustic boil outs , one acid boil out is recommended.

BEST PRACTICES FOR ASA SIZING:-

- ASA is usually added to the thin stock between fan pump and pressure Screen accepts.
- 1 to 3 kilograms of alum per ton of paper on dry basis is recommended to add in fan pump suction.
- A good biocide program is also important to maintain system cleanliness & minimize deposit & sheet defects.
- Avoid close additions of size to filler, surfactants, and oxidizers.

TRIAL REPORT ASA with PCC

Trial Objective: To obtain better Optical properties & surface properties of paper.

Quality / Gsm: Hi-Brite Paper / 70 /80 gsm

Machine Speed: 288 mpm

The conditions before & during the trial were:

	Without PCC	With PCC
Furnish:	- Clo_2 pulp-100% - Clo_2 pulp-50% + Sheet Pulp-50%	- Clo_2 pulp-100% - Clo_2 pulp-50% + Sheet Pulp-50 %
Pulp brightness	: 87.6 – 88.5 %	87.7 – 87.8 %
Pulp pH	: 6.0 – 6.7	6.1 – 6.6
Pulp Viscosity	: 7.5 – 7.9 cps	7.4 – 7.9 cps
B/w pH	: 6.5 – 6.7	7.0 – 7.2
Head Box (HB) Charge	: -23	-9 to –12
Charge Demand	: 0.0175 ml.eq./ Lt	0.01 - 0.0125 ml.eq./Lt
FPR	: 85.4 %	81.2 – 82.4 %
FPAR	: 56.9 %	50.2 %
Entrained Air in HB	: 0.3 %	0.42 %

Chemical Dosages:

		Without PCC	With PCC
Talcum	(kg/T)	: 175 – 180.0	Nil
PCC	(kg/T)	: Nil	98.0
Alum	(kg/T)	: 1.7	3.2 / 2.5
ASA	(kg/T)	: 1.6 – 1.8	2.8 / 2.2
Fino-Fix	(gm/T)	: 25	200 / 100 / 75 / 50
Fino-Floc	(gm/T)	: 60	60
Dynazyme-R	(gm/T)	: 50	50
OBA	(kg/T)	: 1.3	0.95 – 1.1
Dye	(gm/T)	: 28	20-24
Defoamer	(gm/T)	: 100	300

Properties of Precipitated Calcium Carbonate (PCC)

	Sample	Specification
Brightness %	: 98.2	97 Max
pH (10 % slurry)	: 9.6	10.5 Max
Moisture %	: 0.92	1.0 Max
Retention %	: 0.026	1.5 Max
CaCO3 %	: 92	97 Max
MgCO3 %	: 2.01	2.2 Max

- Utilize surface size to minimize internal size consumption.
- Make good quality emulsion using efficient equipment.

We optimized and were able to overcome the issues experienced during the process of ASA sizing.

1) Cationic starch replaced polymer as an emulsifying agent.
2) Degree of substitution in starch 0.025 to 0.030 & nitrogen content 0.3% was preferred.
3) Residual lime (free cao) with PCC allowed (0.15 % max.).
4) No carry over of extractable, pitch & oxidizing agent.
5) Good felt and wire online conditioning chemicals of selected.
6) High pressure showers in felts.
7) Low pH felt conditioning chemical.
8) Usage of alum in cooked cationic starch.

PCC with ASA
2nd TRIAL REPORT

Trial Objective: To obtain better Optical properties & surface properties of paper.
Quality / Gsm Alfa plus—60 gsm
Machine Speed: 290 - 310 mpm

The conditions before & during the trial were:

Particulars	units	Without PCC	With PCC
Furnish	%	Clo2 pulp-100%	Clo2 pulp-100%
Pulp brightness	%	85.0– 90	85.0 – 90
Pulp pH	-	5.6 – 6.9	5.6 – 6.8
Pulp Viscosity	cps	7.31 – 7.68	7.38 - 7.97
B/w pH	-	6.5	7.2 – 7.5
Charge Demand (PCD)	ml.eq./ Lt	0.018	0.007 –0.015
FPR	%	83.3 %	85.38 - 86.9
FPAR	%	55.0 %	58.8 – 61.42
Entrained Air in HB	%	0.3	0.4
Broke pH	-	Not Monitored	7.3 –7.8

Chemical Dosages:

		Without PCC	With PCC
Talcum	(kg/T)	125 – 165	Nil
PCC	(kg/T)	Nil	128 - 200
Alum	(kg/T)	10 - 12	40
ASA	(kg/T)	1.1 – 1.5	1.6 -1.9
Fino-Fix	(gm/T)	30	150 / 200
Fino-Floc	(gm/T)	0	40
Dynazyme-R	(gm/T)	50	50
OBA	(kg/T)	5.0 – 5.5	5.7 – 6.5
Dye	(gm/T)	176 - 185	185 - 232
Defoamer (Antimussol BH)	(gm/T)	Shut	Shut
Surface Sizing Chemical at Size press	Kg/T	Not used	Not used

Following are the advantages of ASA sizing which we experienced on machine.

1. Significant reduction with dryer fluff.
2. Improved Brightness & opacity with the final product
3. Bulk Improved
4. No of breaks on machine reduced.
5. Porosity of paper reduced

Issues :

Transparent spots .
Reverse sizing

A detailed study was done to find the possible causes of transparent spots by both in house lab & out side lab which established due to ASA hydrolysis.

Following are the action plans initiated to overcome the above issues.

1. Monitoring of particle size and improving emulsification efficiency of turbine.
2. Alkalinity maintained around 250 ppm in head box.
3. Excess dosing of ASA was avoided to the extent possible.
4. Small amount of Alum used to be added in back water to take care of unreacted ASA.
5. Head box filtrate turbidity maintained <25 ppm
6. Back water conductivity monitoring

Trial Observations:

1. Lot of foam generation in wire pit was observed.
2. After 7 Hrs of run Foam along with dye spots were observed in final product.
3. Defoamer consumption increased.
4. Dye & OBA consumption has reduced marginally.
5. ASA consumption increased by 30-40 %
6. Alum consumption has also increased

Trial Observations:

1. Defoamer discontinued.
2. Absence of foam generation in wire pit..
3. There was increase in Dye & OBA consumption than normal Alfaplus 60 gsm.
4. Broke pH was also monitored additionally to monitor the fluctuation.(7.3 7.8)
5. ASA consumption was more than in normal Alfaplus 60 gsm, Dosage ranges from 1.6-1.9
6. Opacity of paper increased by 3 units
7. Alum consumption also in higher side.
8. Floc continued thro' the run @40 gm/ton

Due to higher consumption of ASA and Hydralised ASA problems tried with Talcum & PCC combinations. Results are given table-1

OBSERVATIONS:

1. ASA got incresed with increase of pcc
2. After 80:20 , in 40:60 spots in paper observed because of high dosage of ASA
3. Avg bulk values are achieved uniform in all ratios
4. Opacity values increased with increase in PCC
5. Dye and oba consumptions increased in 80:20 ratio
6. Enzyme increased in 80:20 due to low surface strengtgh property
7. Retention aids increased in 80:20 for better retention
8. No foam generation in wire pit in all the ratios
9. Backwater terbidity maitained less than 1000

CONCLUSION

Significant improvement observd by phasing out neutral sizing with ASA sizing in combination with PCC filler in brightness, whiteness,opacity & productivity etc.The paper was more bulky compared to neutral sized paper. Since sizing was effective at higher pH system was very clean and permanency of product was better. Starch as an emulsfying agent over polymer was found more effective during our trial.

TABLE -1

RATIO OF PCC : TALCUM

PARAMETERS	(50 : 50)	(60 : 40)	(70 : 30)	(80:20)	(40:60)
RAW PULP					
FURNISH	100 % Clo_2	100 % Clo_2	100 % Clo_2	100 % Clo_2	100 % Clo_2 /
PH (Range)	6 - 6.5	6 - 6.5	6 - 6.5	6 - 6.5	6 - 6.5
VISCOSITY (Range)	6.86 - 7.86	6.79 - 7.53	6.94 - 7.38	7.16 - 7.53	6.94 - 7.75
BRIGHTNESS (Range)	86 - 90	86 - 89.7	86 – 89.4	86 - 88.4	86 - 90.4
GSM / DRAW	60 / 3.57	60 / 3.57	60 / 3.57	60 / 3.57	60 / 3.57
NO. OF REFINERS IN CKT	2	2	2	2	2
DYNAZYME (gm / T)	50	50	50	50 / 60	50
DEG.SR DETAILS					
HOURLY RANGE	32 - 35.5	34 - 35.5	34 - 35.5	34 - 36	33 - 36
SR BOX	35	35.5	35.5	36	35.5
RETENTION DETAILS					
RETENTION AID DOSING					
FINOFIX (gm / T)	200/250/200	200	200	250	100 - 300
FINOFLOC (gm / T)	60/70/80/60	60	60	80	40 - 100
MICROPARTICLE (kg / T)	0	0	0	0	0
FPR (%)	84.14 - 86.69	83.05 - 84.17	82.54 - 83.77	82.5 - 84.01	82.2 - 86.52
FPAR (%)	56.25 - 57.93	56.3 - 58.67	56.1 - 58.17	56.56 - 58.1	56.01 - 59.7
DRAINAGE (ml / 5 sec)	165 - 180	165			
CHEMICAL DOSING					
PCC (kg / T) (Avg)	76 - 105	100 - 115	100 - 150	135 - 200	50 - 66
TALCUM (kg / T) (Avg)	76 - 105	65 - 86	55 - 70	40 - 65	76 - 96
ALUM (kg / T) (Liquid basis)	3.2	3.2	3.2 / 4.3	4.3	3.2 / 4.3
DYE (gm / T)	170 - 226	165 - 190	170 - 200	190 - 250	170 - 220
OBA (kg / T)	4.3 - 4.8	4.2 - 4.7	4.3 - 4.84	4.9 - 6	4.2 - 5.4
STARCH (kg / T) (FBP X1)	6.5	6.2 - 7	6.5	6.2 - 7	7-Jun
ASA (kg / T) (Avg)	1.2 - 1.4	1.3 - 1.35	1.3 - 1.6	1.6 - 1.85	1.2 - 1.5
BROKE pH (Avg)	6.9 - 7.3	7 - 7.3	6.9 - 7.5	7.1 - 7.4	7 - 7.4
CHARGE DETAILS (finor)					
TCD	0.02125 - 0.025	0.023 - 0.025	0.023 - 0.025	0.0225 - 0.0255	0.02 - 0.0255
SCD	0.01 - 0.0125	0.01 - 0.0125	0.009 - 0.0125	0.01 - 0.0115	0.00875 - 0.0125
PCD	0.01025 - 0.0144	0.011 - 0.014	0.0115 - 0.014	0.0115 - 0.014	0.0107 - 0.014
WATER ANALYSIS					
BACK WATER					
PH	6.8 - 7.8	6.7 - 7.9	7.4 - 7.8	7.2 - 7.8	7.4 - 7.9
TURBIDITY (NTU)	492 - 650	580 - 984	414 - 680	578 - 680	310 - 720
ALKALINITY (PPM)	132 - 290	164 - 268	140 - 380	160 - 280	142 - 240
CONDUCTIVITY(MIC.SIM)	580 - 710	560 - 1170	580 - 670	590 - 740	540 - 684
CLEAR WATER					
TURBIDITY (NTU)	36 - 151	37 - 180	27 - 130	17 - 82	19 - 186
TOTAL HARDNESS (PPM)	NA	240	212 - 232	NA	NA

Based on our mill experience the best performance of ASA sizing can be achieved by monitoring the desired particle size of the emulsion ,optimising FPR & FPAR,right selection of dosing point and bio cide with determining the frequency of boil out.

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