Speciality Chemicals in Paper Making

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In recent years, paper making has been changed to great extent and due to stiff competition and pressure from government agencies, the Paper Mills has no other option but to improve quality of paper, adoption of cleaner technologies to control emissions of waste water, gases and to increase the paper and plant life by introducing eco-friendly chemicals. Production of paper at neutral to alkaline pH, use of cheaper and better fillers to cut down cost without sacrificing printing properties, improved brightness and life of paper are main focus now. The use of retention aid, defoamers and other speciality chemicals help to produce better quality paper with appreciable reduction in production cost. This Paper is an attempt to enlighten the need of using speciality chemicals and benefits derived by various mills with respect to quality, runnability economics and environment.

INTRODUCTION

Indian Paper Industry have gone into overall upgradation during last two decades. Once upon a time paper making was treated as an orthodox system and paper makers were treating the technology as a closely guarded secret. Due to stiff global competition in paper qualities, economics and drive for preserving the environmental system, Indian Paper Industry has also come under tremendous pressure to upgrade the manufacturing system, human friendly technology and to produce better and brighter varieties of paper. Financial condition of most of the paper mills is not very strong and they are not in a position to undergo major expansions for upgradation of plant. The only one option is left and that is to find some speciality chemicals, which can help to improve quality, production figures and profitability.

In present Paper we would throw light on the different steps in conventional and modern paper making. The advantages have been achieved by going into new technologies. Due to stiff international competition, we have no other option, but to produce paper with less energy, steam and other utilities consumption without sacrificing the quality of paper.

COOKING

Poor raw-material conditions has forced pulp mill people to search some chemicals which can help to produce uniform pulp even after using sub-standard raw-materials. The small paper mills in India do not have soda recovery, so the effluent load and cooking cost is high. In large paper mills presently there is no certainity about the raw-materials. Everyday there is change in furnish, maturity of wood and mixed varieties of wood is loaded in one digester resulting wide variation in pulp quality. New generation digester cooking additives prove to be beneficial in production of uniform quality. The alkali consumption is also reported down by 4-10% according to the pulp mill conditions, with less screen rejects and better pulp yield.

Case Study - I

The trial of Anmopulp-MICR (Surfactant) in combination with Anthraquinone was conducted from 07.11.03 to 15.11.03 in mill no. 1. Production capacity of the pulp mill is approx. 360 M.T/day. The raw-material is hardwood and bamboo mix.

Objective

To study the effect of surfactant in combination with anthraquinone for reducing active alkali consumption during cooking, without affecting unbleached pulp $KMnO_4$ no. and also to observe its effect downstream.

OBSERVATIONS

1. Active alkali consumption was reduced by 8.2%
2. There was no change in cooking cycle time, as our aim was to reduce active alkali consumption.
3. Knotter screen rejects rate comparable with DA-2600 may be slightly lower.

Remarks

Combination of Surfactant and Anthraquinone seemed to have better effect in active alkali reduction during cooking rather than surfactant alone and has potential of reducing alkali consumption by about 8.0% when compared with no surfactant use situation. In order to fully establish the total effect of chemicals in system, a longer trial run of minimum one month is proposed.

Case Study - II

Mill No.2 is producing approx. 350 TPD pulp and raw material is hardwood (Sababul+Eucalyptus+Casurina) & bamboo mix.

Objective

The trial of was conducted to replace anthraquinone and to reduce the knotter rejects.

OBSERVATIONS

1. Reduction in active alkali consumption was 8%
2. Knotter rejects position was within control.
3. Variation in Kappa No. was also reduced

PULP WASHING

In most of the cases the pulp mills are running over capacity. The alkali loss remains high and requirement for bleaching chemicals also go up due to improper washing. The paper mill management try to produce maximum pulp without putting up a big capital investment. The wash aid chemicals helps to bring down alkali loss and improve the washing capacity with excellent foam knock down and de-aeration characteristics of Anmofoam-SID, the pulp mat in washers gets compact and washing capacity can be increased by 15-25%.

Case Study - I

The trial of was conducted by keeping defoamer dosing @ 60 grms/tonne of unbleached pulp. Dosing point of defoamer was kept in knotter accept pulp.

Objective

1. Reduction in soda loss
2. Reduction in foam
3. Improvement in washing efficiency
4. Cost reduction

Observations

Soda loss variation was between 26-30 kg/ tonne of pulp washed when dosing was kept at 60 grms per tonne of unbleached pulp. Defoamer dosing was further increased to 75 grms per tonne of pulp. During this period soda loss varied between 23-25 kg/tonne of pulp washed. Defoamer dosing again reduced to 65 grms/ tonne of pulp but soda loss again increased to 25-28 kg per tonne of pulp washed. During this trial washing rate was kept about 4.5T/hr. Reduction in foam was also observed when dosing was 75 grms/tonne of pulp.

Table-1

Defoamer Dose	Kg/t	0	60	65	75
Soda Loss	Kg/t	30-32	26-30	25-28	23-25

Remarks

Chemical seems to be effective as far as drainage rate is concerned. The drainage rate of pulp also increased at 75 grms per of pulp washed. Also reduction in soda loss observed when dosing was 75 grms/tonne of pulp washed. This defoamer can be used in the plant as its performance is satisfactory.

Bleaching

For producing white varieties, bleaching section has become very important because of mounting pressure from all sections of society and stringent effluent discharge levels fixed by the Pollution Control Board, everybody is trying to bring down AOX, B.O.D and C.O.D levels. The hazardous chlorine is main target to be eliminated from the paper making system. Various measures have been adopted like chlorine di-oxide, oxygen delignification, ozone bleaching, but it requires big financial investments. Some chemicals like Bio-Pulp Enzyme (Alkaline Xylanase) have proved helpful to bring down the bleaching chemicals consumption upto 30% depending upon the conditions of raw-materials and plant conditions. Optical properties of paper produced by using Bio-Pulp are better in comparison to conventional bleaching sequence. Pulp viscosity, whiteness and colour reversion show remarkable improvement.

Case Study - I

This mill is producing 215 TPD paper and raw material is mainly hardwood/bamboo mix. In this mill, the objective was to reduce 15% chlorine at the same brightness level of the final pulp.

Observations

1. After 2 days trial run, it was observed that after reducing 15% chlorine the brightness range was almost the same @ 295 gms Biopulp per tonne of pulp.
2. In normal bleaching, there was variation of 3-4 points in final brightness i.e. 82 .86 , but with Biopulp trial, this variation was limited to 2.0 only and the brightness remained between 83.5-85.5.

Table-2

Capacity	TPD	215	
Raw Material	Hardwood Bamboo		
Enzyme Dose	gms/t	0	295
Chlorine	Kg/t	x	x-15%
Final Brightness	%	82-86	83.5-85.5

In view of the performance of enzyme, it has been decided to take a longer plant run for one month to see the effects of enzyme after prolonged use.

Case Study-II

This mill is producing 100 TPD bleached varieties of paper using agriculture residue pulp like straw/ Bagasse/ Sarkanda etc. Following are the objectives :

- To achieve higher final brightness or reduction in chemical consumption
- To reduce organic chlorine level (AOX) in effluent
- To reduce colour reversion and yellowness.

After taking trial, the enzyme is now being continuously used and the following benefits have been achieved

- A reduction of 1 kappa no. after treatment in unbleached pulp.
- A reduction of 1.8-1.9 kappa no. after alkali extraction

in case of enzyme treated pulp compared to control.

No significant difference in brightness was found in control, enzyme treated pulp and those made with 2% less chlorine during bleaching.

SLUSHING

Fibre shortage is a known fact in India and we are compelled to recycle the waste paper. Big quantity of waste paper is imported and sometimes this waste paper contains different type of sizing material. The slushing consumes much power, time and energy. Some novel chemicals have been introduced recently which help better slushing of waste paper with less time, energy and less deterioration in strength properties of waste paper. By using these chemicals, 25-40% saving has been reported in time and energy.

Case Study - I

The objective of this trial is to enhance slushing for NDLK-II by slushing with Anmopulp-MIBR in Tridyne Pulper.

Observations

1. It has been observed that there is reduction of unslushed material in pulp from 20.75% to 12.01 % for the four consecutive batched without and with use of Anmopulp-MIBR with Caustic.
2. It has been observed that there is reduction of Tridyne pulper reject from 665 Kgs to 360 Kgs for the four consecutive batches without and with use of Anmopulp-MIBR alongwith Caustic.

Table - 3

Material	NDLK-II		
Slushing Aid	gms/t	0	555
Unslushed Material	%	20.75	12.01
Reject	Kg/batch	665	360

REFINING

To produce paper with better formation and strength properties, pulp is required to be fibrillated properly. In pulp fibre bundles remains and refiners are used which impart shear and the fibre bundles are broken into individual fibers. The refiners consume huge energy and by way of mechanical cutting lot of fines are generated which has no fibre value and create problem of picking. New generation chemicals, and especially the enzymes have helped to bring down the energy requirement drastically. The mechanism is based on the swelling of cell wall of fibre and with the help of brushing effect by refiners, the desired freeness levels can be achieved. Biorefine enzymes are being used by so many Indian Paper Mills which use softwood, hardwood, bamboo or agriculture residue furnish and shown excellent results. In kraft paper, the strength properties like burst, tensile tear and doublefold have shown improvement upto 15-25%.

Case Study - I

Trial was conducted with a dose of 300 grms/tonne of pulp.

Observations

1. After 45 minutes of beating at constant load, there was gain of 6° SR in freeness.
2. To get freeness 30° SR by using enzyme, 16 minutes time was saved.
3. There will be less generation of fines in the pulp as refining time will be reduced.
4. 100 KW load per tonne of pulp could be reduced by using enzyme.

Table IV

Refining Aid	gms/t	X	300
Retention Time	minutes	X	45
Initial Freeness	°SR	15	15
Pulp ph		7.2	7.2
Freeness after 45 minutes	°SR	24	30
Beating time upto Constant Freeness (30°SR) with Constant load	minutes	61	45
Freeness after 61 minutes	°SR	X	36

Case Study - II

A plant trial was conducted with an objective to reduce energy consumption during refining and improving strength properties.Trial was conducted by dosing @ 0.5 kg/t at 60 gpl through dosing pump in Raw Pulp Chest for Plain Kraft 180 GSM and Plain Kraft 240 GSM.

Observations

After the trial it was observed that there was an improvement in Burst Factor from 22-26 to 25-30 with reduction in load of Refiners by around 100 Amps

Table - 5

Material	Unbleached Hardwood Pulp		
Refining Enzyme	gms/t	0	500
Refiner Load	KW	x	x-100
Burst Factor		22-26	25-30

WET END ADDITIVES

The most important area in modern paper making is wet end chemicals. Wet End Chemistry is complicated and requires a deep study for each and every plant depending upon furnish, machine speed, sizing system,

fillers and the final produce. Presently, fibre being weakest area, everybody requires some dry strength improvers, wet end runnability enhances and some retention aids which increase the first pass retention of fines and fillers without compromise in the sheet properties. Dry strength resins play a significant role specially in case of waste paper and agriculture residue based pulps. Today calcium carbonate is proved filler for its better printability properties, if add calcium carbonate is selected as a filler the whole sizing exercise has to be changed.

In quality papers like for Photocopier, inkjet paper, multi colour offset printing paper other high value products, the DSRs have helped to increase the stiffness and surface properties by 20-30%.

Case Study - I

Trial of was conducted by keeping the dose @ 11.1 kg/ tonne of pulp.

Observations

1. No adverse effect was observed on machine run during the trial.
2. No foam problem was observed as Sodium Silicate was not used
3. pH variation was not observed
4. Stiffness of paper improved From MD 2.8 - 3.2 & C.D 1.5 - 1.8 To MD 3.5 - 4.0 & C.D 2.0 - 2.5
5. No shade variation observed

Table - 6

Furnish	80%Baggasse, 100% Hardwood & 10% Long Fibre		
DSR	kg/t	0	11.1
Stiffiness MD	°Taber	2.8-3.2	3.5-4.0
Stiffness CD	°Taber	1.5-1.8	2.0-2.5

6. Neutral size consumption reduced slightly

Case Study- II

Trial was conducted by dosing the chemical @ 13.0kg/ M.T of pulp.

Observations

1. Stiffness of copier paper remained between: M.D : 3.2 to 3.8 C.D : 1.8 to 2.3
2. Curling was between 40 to 70
3. No adverse effect on machine run was observed

Case Study - III

Plant trial of Anmosuper-UFS was conducted with an objective to improve the dimensional stability and hydrophobicity of paper.

Observations

1. Cobb values reduced by 3 points
2. Sizing (penetration test) significantly improved by 8 seconds
3. Water uptake was relatively lower with the addition of Anmosuper UFS
4. Linear expansion was relatively lower with the chemical.
5. Rate of moisture uptake was also found to be lower at 80% humidity level and in saturated humidity level.

SLIME CONTROL

In alkaline and neutral sizing, formulation of slimes is more. The waste paper also contains different type of binders like starches, latex, acrylic binders and fillers which is a major cause for slime formation. For smooth runnability of paper machine and especially a high speed paper machine role of biocides has become very important. Various biocides are available in market.

SIZING

Conventionally the sizing was acidic with use of rosin and alum, rosin was first to be cooked with caustic soda to make soap and it was retained on fibre with the help of alum and the sizing pH was kept between 4.5-6.0. The paper produced in this way was showing problem of ageing and has the tendency to become yellow after few months. Now, the sizing at neutral pH or alkaline pH is being done resulting in more brighter paper with long shelf life.

Surface sizing is become an important factor to upgrade the sheet properties.Conventionally starches and polyvenyl alcohols were used for surface sizing, but in latest multi colour high speed printing command, this paper gives problem.

To overcome this problem various surface sizing agents and crosslinking agents are used which includes styrene acrylates, styrene melicanhydrites, polyamides etc.

CONCLUSION

By using Anmopulp-MICR the reduction in alkali was upto 8.2% and knotter rejects reduced resulting in yield improvement. By using wash aid chemical, the pulp washing capacity was increased by 20% and soda loss also came down by 5 kg. per tonne pulp. Use of Alkaline Xylanase helped Mill#1 to reduce 15% chlorine in bleacing and in Mill#2, 2 points brightness gain was achieved in waste paper slusing use of Anmopulp-MIBR reduced the rejects by 8%. In refiing, Biorefine-L helped to reduce refining energy by 20%. The Dry Strength Resins improved specially stiffness by 20%. Thus, we can conclude that use of new generation process chemicals are responsible for economical and quality paper production, and will help the paper makers to use speciality chemicals as an effective tool to overcome the day to day problems and improve productivity and performance.

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