Paper Making - Retention of Fibres and Fillers

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ABSTRACT

Satia Paper Mills Ltd. is an agro based mill having a capacity of 150 tpd. PM-3 is a high speed machine having a speed of 400 m/min. Before head box, there is an octopus for uniform distribution. Head box is close type (hydraulically pressurized). There are total 24 no. of ceramic made hydrofoils of Couch is solid with FDR. There are three presses, first and second presses are bi-nip. Total no. of dryer group is 7 Kuster. Calender is used with alkaline sizing (AKD), the first pass retention is 7.4-75% and filler retention is 52-53%. A dual polymer system (Flocculants and Coagulant Combination) is used maintaining the zeta potential value around-10 mV in head box pulp stock. The variatoin in retention mechanism in different sizing and with different polymers is described in this article.

INTRODUCTION

Paper making is basically afiltration process, the paper machine wire can be regarded as a continuous filter on which a proportion of the solids in the stock is retained. The water and unretained solids drain through the wire to form white water. The separation time of these two phases determine the speed of the paper machine and the rate at which the two phases are separated, dictates the rate at which paper can be produced. The mechanism of retention is possible in two phases - The first introduces the notion of filler entrapment in the pore structure of the pare (two layer); is predominant in newsprint and magazine. The second is an electrokinetics effect between filler and fibre, which causes coagulation or flocculation phenomenon, mostly in writing and printing grades.

Two ways of utilization are possible: The first includes a single polymer retention system, where a polymer is unique and acts as a flocculant and second uses a dual retention system on using a flocculent and coagulant combination. In case of waste paper furnish the charge of the input system varies drastically in multiforals and leads to system charge imbalance which ultimately results into poor drainage in hydrodynamic system with poor retention and high deviation in quality, a cationic scavenger followed by cationic promoter is necessary to keep the system charge in control to enhance RDA performance. By virtue of that, the stock on wire drains maximum and leads to better fibre and filler retention.

EXPERIMENTAL

Retention and other problems in Acidic Sizing

The dosing of RDA polymer was kept at optimized rates at pressure screen accept line but in the retention part we were facing a lot of problems in papermaking during

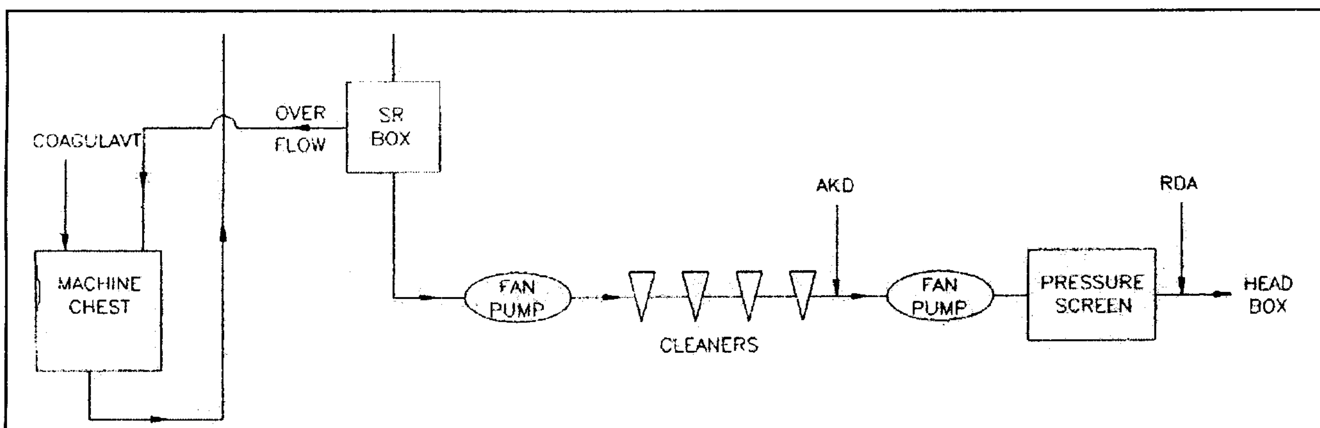

Fig. 1 Approach Flow System

acidic sizing.

- Excessive scaling of $CaSO_4$ and foaming in system due to addition of conc. H_2SO_4 in final deinked pulp to precipitate $CaCO_3$, present in imported waste paper furnish.
- Retention was still on lower side i.e. below 60%. In order to get rid of above problems we planned to switchover to alkaline sizing i.e. AKD or ASA.

Retention in AKD Sizing

Behaviour of all polymers is different in AKD sizing compared to acid sizing. In AKD sizing, RDA affects on followings.

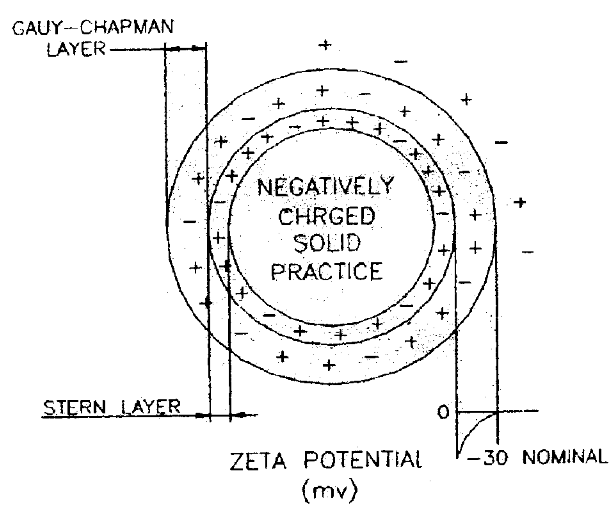

Fig. 2 Pictorial Representation of Zeta Potential

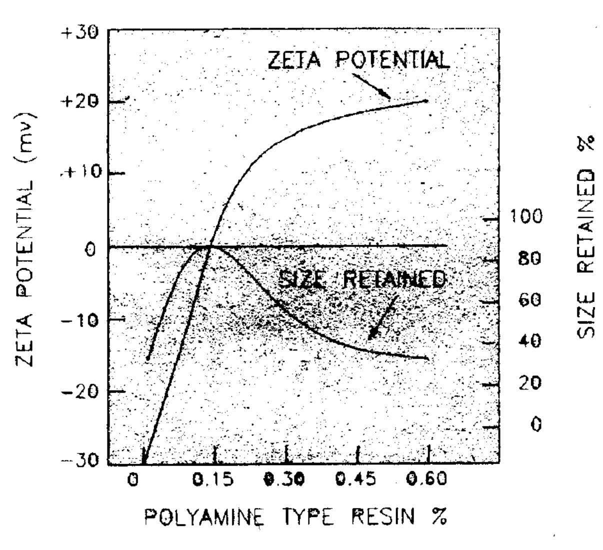

Fig. 3 Effect of Catlonic Retention Aid on Zeta Potential and Retention of Synthetic Size

1. AKD retention, 2. Fines retention, 3. Cationic demand of the pulp stock 4. Oven dried cobb values 5. Alkalinity of B/W

System recommended in AKD sizing → Single / Dual

→ Flocculant / Fixing agent & Flocculant

Mechanism → Fines aggregation & Coagulation by low molecular weight polymer.

→ Formation for bridge between patch by high molecular weight polymer

Alkaline size are synthetic nonionic or cationic organic compounds and they form covalent bonds with cellulose, which is extremely resistant to hydrolysis. Utilisation of cationic stablisers gives the emulsified particles a net positive charge, which provides an electrostatic retention mechanism.

RESULTS AND DISCUSSION

At initial stages our overall retention was around 40-45% while filler retention was 20-25% without using any polymer. The use of cationic polyacrylamide promotes filler as well as fibre retention on wire mesh. After starting the dosing of cationic polyacrylamide, our first pass retention improved upto 55-60% and filler retention upto 30-35%.

Table 1: Factors affecting retention during sheet forming process

1. Stock Factors	- pH
	- Consistency
	- Temperature
	- Fibre characteristics
	- Degree of system closure
2. Conditions on wire	- Sheet grammage
	- Sheet formation
	- Fibre characteristics
	- Type of dewatering elements
	- Machine speed
	- Shake (if used)
	- Degree of beating
	- Basis wt.
	- Stock consistency
	- Paper Machine operation
3. Additives	- Types and amounts of filler
	- Shape and density of mineral particles
	- Types and amounts of other additives

- Order of addition
- Ionic balance
- Level of anionic thrash

Table 2 Factors affecting molecular and Colloidal interactions

- Chemical concentrations
- Electrokinetics
- Polymer molecular weight, charge density, structure, conformation.
- Hydrodynamic shear
- Residence and mixing time.
- Electrolyte concentrations and valences.
- Floc strength and reversibility.
- Specific surface area
- Particle size and morphology
- Entanglement and filtration
- Thermodynamics and kinetics of adsorption/bulk solution reactions.

The term Zeta potential, applies to the electrical charges existing in fine dispersions. A solid particle (e.g. fibre, starch, mineral) suspended in a paper making stock is surrounded by another layer, more diffuse than the first, that has an electrical charge of its own. The bulk of the suspended liquid also has its own electrical charge. The difference in electrical charge between the dense layer of ions surrounding the particle and the bulk of the suspended liquid is the zeta potential, usually measured in milvolts (mv).

The best retention of fine particles and colloids in the paper making system normally occurs when the Zeta potential is near zero. Pulp fibres, filler and size particle usually carry a negative charge but the zeta potential can be controlled by absorbing positive ions from solution. The retention mechanism is a combination of ionic charges and long molecular chains linking fibres and particles together Synthetic polymers have less pH dependenc than alum and are used in very dilute form. Instruments are now available to meausre both zeta potential and single pass retention. Therefore the economics of utilizing polyelectrolyte polymer to optimize zeta potential and retention can be monitored continuously. Some researchers have found that simple adjustment of the paper making system close to zero potential will lead to optimum results. Others have found the optimum zeta potential to be approximately -9 mv. It appears that zeta potential is an indirect measure of a number of interacting factors, each of which could be a dominant under certain conditions.

The results of Zeta Potential and Mobility are listed below (Table 3 and 4) :

Table 3 Case Study No. 1

Sampling point	Mobility	Zeta Potential in mv
Deinked pulp	-1.91	-22.49
Virgin pulp	-2.62	-30.86
Mixing chest	-1.31	-15.43
SR box	-0.6	-9.06
Head box	+0.71	-12.36
Back water	0.80	-13.42

Cationic demand has been considerably reduced by the addition of cationic stabilizers. The high molecular weight polydadmac is most suitable polymer in our existing system.

Table 4 Study No. 2

Sampling point	Zeta Potential in mv
Deinked pulp	-25.40
Virgin pulp	-32.15
Mixing chest	-20.48
SR box	-12.56
Head box	-8.20
Back water	-9.30

CONCLUSION

Retention of fibre, filler, size, chemicals play very important role in economics of paper making. Good retention has numerous benefits. In our mill dual polymer system has given very good results. Flocculant alongwith coagulant combination is recommended in case of waste paper furnish where the charge of input system varies drastically. System charge imbalance gives poor drainage which results into poor retention and quality variation.

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