Organic Micropolymer In Alkaline Fine Paper Making

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ABSTRACT

Micro polymer retention and drainage system are considered to be the extremely powerful tool for fine paper making in Alkaline environment. Hence retention components in modern high speed paper machines have been shifting from single component to latest advance with Micro polymer to get advantage of higher filler loading with better retention without having negative impact on other properties. In this paper comparison between dual component retention (Micro particle & Flocculant) and triple component system(Micro particle, Flocculant and Micro polymer) in lower grammages are discussed.

Introduction

Polymers for retention system were basically had acrylamide chemistry for producing high molecular weight linear chain molecules to improve fines and filler retention and contributing to improvement in drainage. The use of high molecular weight polymers gave high First Pass Retention and high First Pass Ash Retention, thus significantly reduced white water solids.

In late 1970s and early 1980s the first micro particle system was introduced using colloidal silica in conjunction with cationic starch (1) and later cationic polymer (2) to use as retention and drainage aids for paper and paper board manufacturing.

The colloidal silica based micro particle system got accepted in the early years of 1980s in alkaline / neutral sized and unsized coating base papers (3). In these grades the internal strength was improved with the high retention of cationic starch reducing picking, linting and enabled coating formulae to be changed with quality and cost benefit. This system was considered to be potentially superior to conventional retention aid system and are referred to as **"high performance system"**.

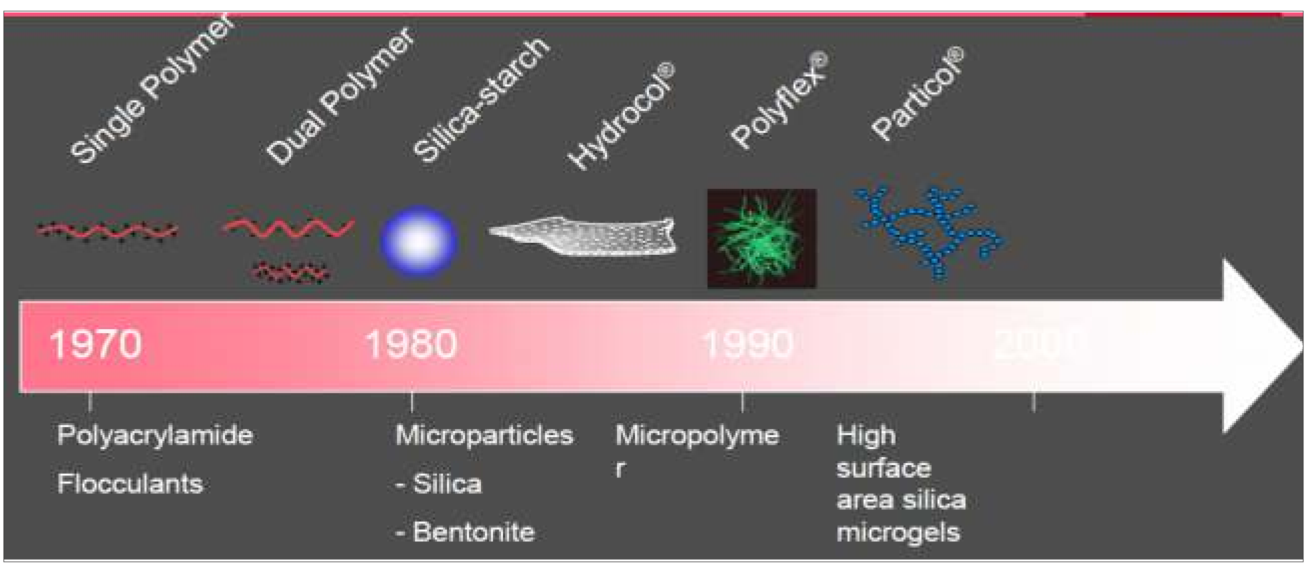

Fig.1 Advances in Retention Aid System over time

A bentonite based system had already been developed in late 1970s for use as retention and drainage aid was difficult to treat News Print and Mechanical Printing Grades which had very high cationic demand (4). Post introduction of silica as micro particle it was realized that bentonite had many similar characteristics to colloidal silica. When bentonite or the smectite crystals are hydrated in water they swell with very high surface area upto 800 m^2/gm and have very high anionic surface charge.

Apart from retention and drainage effect bentonite has the additional capability to adsorb anionic and non-ionic colloidal material onto its surface, contributing to cleaner system resulting in reduction of pitch and sticky material in the system with reduction in breaks due to sticky. It also improves stability in the wet end chemistry.

In the early 1990s a new class of

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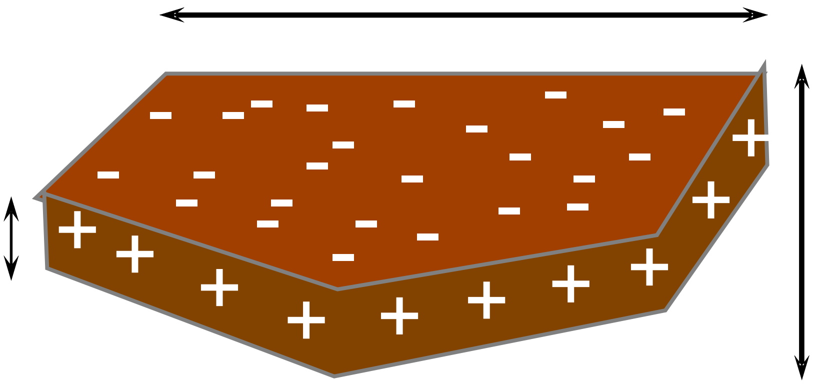

Fig.2 Bentonite - A Closer Look

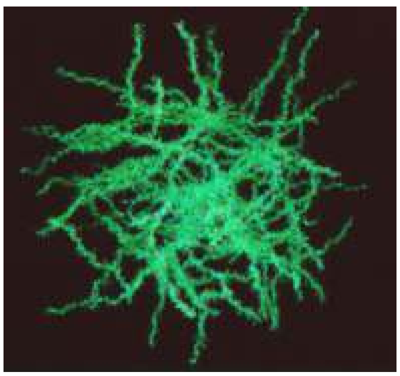

Fig.3 Organic micro polymer

retention aid system was introduced which is micro polymer system and uses organic micro polymer (5). The concept underlying the use of micro polymers is to optimize the performance attributes of both inorganic micro particle and polymeric coagulant and flocculant. The result is a water soluble filamentary micro network structure.

About the Mill / Processes:

M/s.ITC Limited is an integrated Paper and Paper Board Mill situated in Bhadrachalam, Dt.Khammam, Andhra Pradesh producing approx.400 MT of fine paper per day (PM II, III & VI) of various grammages and applications.

The mill was established in 1979 with recycled Board manufacturing with an annual capacity of 40,000 MT and grown to produce 4,50,000 MT as on date. The Mill has upgraded itself to expand and manufacture speciality Paper Boards and Fine Papers.

Machine Capability of PM VI:

- Designed Capacity 1,00,000 TPA
- Grammage 50 130
- Deckle 4760 mm
- Design Speed 1000 mpm
- Head Box Hydraulic
- Press Tri-nip shoe press
- Size Press Metering size press
- Calendar Soft nip

Fiber Furnish:

The Mill uses mix furnish of Eucalyptus, Casuarina and Subabul in different proportions.

RDA System:

Programme I

Adversities faced in Programme I

- Low First Pass Ash Retention
- Less filler loading in paper
- More number of deposit breaks

Though this programme was successfully running, there were some issues of poor machine runnability due to deposit breaks and lower ash levels in paper affecting plant economy. The mill went for Programme II with an addition of micro polymer in RDA system to address the problem.

Programme II

Keeping in view the adversities observed in Programme I, Mill has decided to go for micro polymer based RDA system along with existing two components to maximize FPR and FPAR along with change in starch from Amphoteric to Cationic.

Results:

Properties of PCC:

Wet End Properties:

With introduction of micro polymer system increase in FPR and FPAR is

Table 1

Sl No	Wet End Additives		Consumption/T of Paper	Dosing Point
1	RDA	Flocculant	850 gm	Pressure Screen Inlet
		Micro particle (Silica)	2.0	Pressure Screen Outlet
2	Sizing	Alkaline (ASA)	-	M/c chest suction
3	Filler	PCC (Satellite plant)	-	Thin stock
4	Starch	Amphoteric	-	Thick stock
5	Coloring	OBA and Pigment Dyes	-	-

Table 2 3*Change in additives

Sl No	Wet End Additives		Consumption/T of Paper	Dosing Point
1	RDA	Flocculant	295 gm	Pressure Screen Inlet
		Bentonite	1.35 kg	Pressure Screen Outlet
		Micro polymer*	350 gm	Pressure Screen Outlet
2	Sizing	Alkaline	-	Thin stock
3	Filler	PCC (Satellite plant)	-	Thin stock
4	Starch	Cationic*	-	Thick stock
5	Coloring	OBA and Pigment Dyes	-	-

Table 3

Particulars	Programme I	Programme II
Solid%	20	20
pH	8.0 – 8.5	8.0 – 8.5
Free Cao% (max)	0.15	0.15

Table 4

Particulars	Programme I	Programme II
FPR%	81	84
FPAR%	51	62
Charge Demand meq/ltr	15	10

Box Plots:

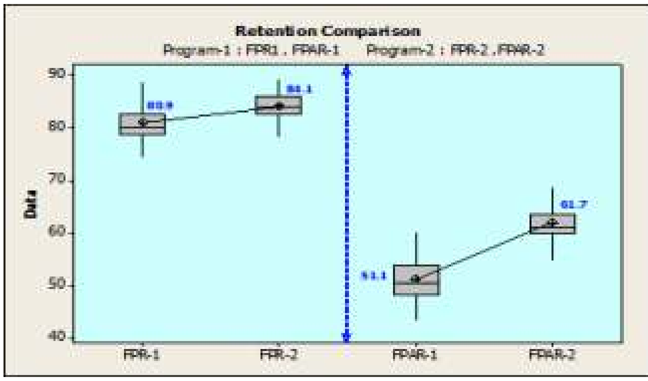

Fig.6 Box Plot of Retention

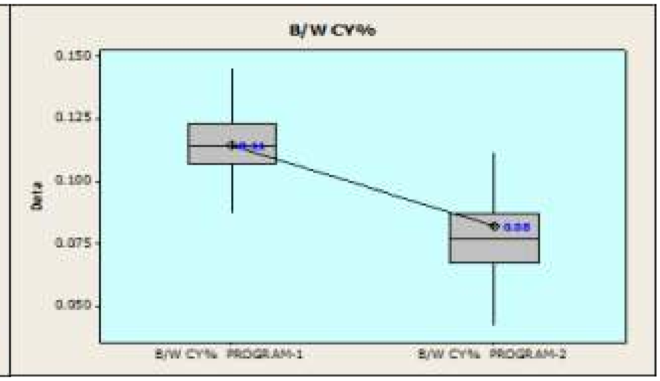

Fig.7 Box Plot of B/W consistency and Turbidity

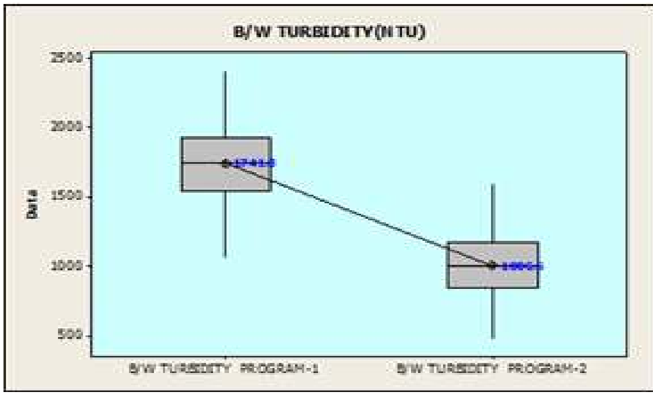

Fig.8 Box Plot of B/W Turbidity

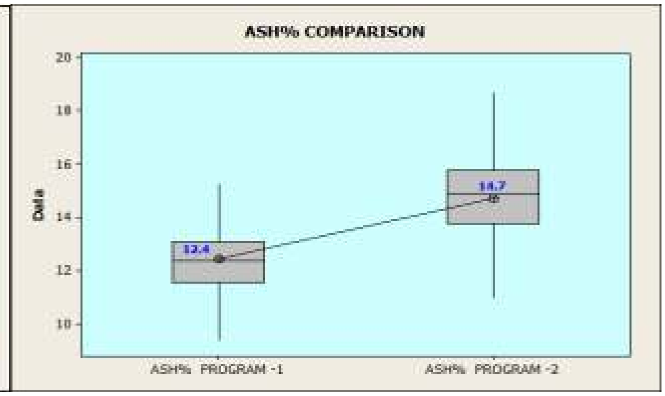

Fig.9 Increase in ash content in paper is observed with micro polymer system

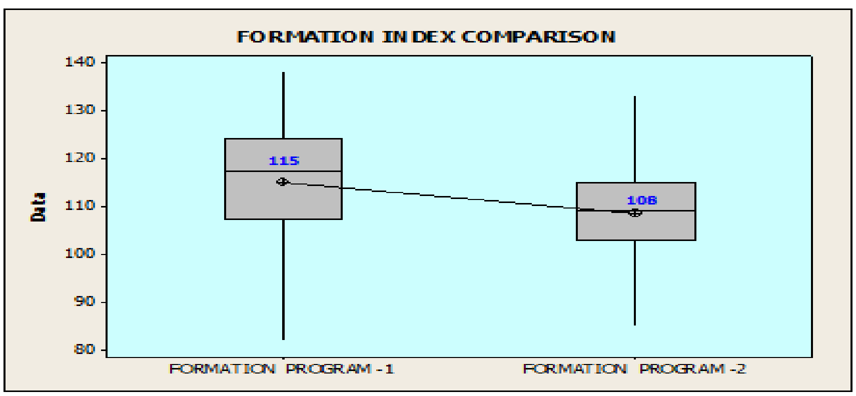

Fig.10 Formation Index

seen.

Comparison of Paper Properties:

Sl No	Characteristics		UOM	Programme I	Programme II
1	Grammage		gsm	55	55
2	Caliper		micron	73	73
3	Bulk		Cc/gm	1.33	1.33
4	Cobb60	T	Gsm	22	21
		B	gsm	23	22
5	Bendtsen Smoothness	T	Ml/min	150	145
		B	Ml/min	80	78
6	Porosity		Ml/min	490	508
7	Breaking Length	MD	Mtr	6400	6010
		CD	mtr	3200	3260
8	Brightness		%	90.5	90.7
9	Whiteness			128	128
10	Opacity		%	91	92
11	Ash		%	12.6	14.8
12	Formation Index			115	110
13	Wax Pick		No	13A	13A

Discussions:

With addition of micro polymer in Pressure screen outlet following improvements have been observed.

- Back Water solids reduced
- Improvement in FPR
- Considerable Improvement in FPAR resulting in reduction of filler addition
- Overall retention of filler increased to 95%
- Turbidity of Back Water reduced
- Ash content improved in paper
- Improvement in Recirculation of Back Water reducing overall water consumption

Improvements in above parameters has improved cleanliness in the system with minimum turbidity, consequently deposit free system. It has improved runnability of machine as a result improved production.

Paper properties in both the programmes remain almost unchanged though there is increase in ash content in paper by 2% in programme II.

Conclusion:

Micro polymer system with cationic polyacrylamide and swelling bentonite could both provide an excellent retention in high speed machine with higher ash in lower gsm fine paper with PCC as filler. Micro polymer system could handle the upset wet end system in a better way as compared to dual polymer system. In addition to this it has the potential to provide better retention and drainage with higher filler levels in the system with improved wet end chemistry. Paper properties were determined primarily by filler content at comparable retention and drainage, both the programmes had similar effects on paper properties as well as formation. Using micro polymer based system filler content can be further increased but due to customer requirement it has not been taken up further in lower grammages.

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References:

1. Sunden, O.Batelson, Per G. Johansson, H.E.Larsson, H.M. and Svending, Per J.U.S. Patent 4,388,150 (1990)
2. Rushmere, J.D., Patent 4,954,222 (1990)
3. Moberg, K. 1987 TAPPI Advanced Topics in Wet End Chemistry Seminar, Memsphi TN, TAPPI Press, Atlanta, p 7 (1987)
4. Langley, J.D., U.S. Patent 4,305,781
5. Honig, D.S. Harris, E.W., Pawlowska, L.M., O'Toole, M.P., and Kackson, L.J., Tappi J., "Formation Improvements with water soluble micropolymer systems", 76 (9): 135 (1993)
6. William E.Scott "Principles of wet end chemistry" Tappi 1996
7. Ciba Hydrocol system, Technical information
8. William E. Scott, "An introduction to Wet End Chemistry", TAPPI, Atlanta, USA, 1992
9. Hubbe, M.Nano Technology in wet end chemistry, PIRA. 13th March 2006
10. Swerin, A., Glad-Nodmark, Gunborg., Sjodin, U., Silica based microparticle retention system, Paperi Ja Puu 77 (1995)
11. Carr, S.Duncan, Effect of Nano particle in wood containing furnishes, TAPPI Paper summit 2002
12. Honig, D.S., Turn Bull, J Robert, Wheeler Clay, Paper makers conference, TAPPI, 1999