CIBA SPECIALTY CHEMICALS

Polyflex Introduction

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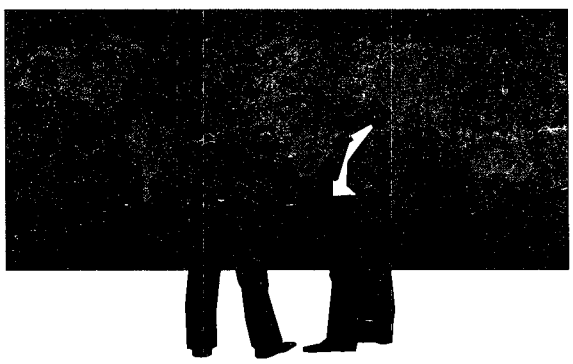
Water and Paper Treatments

1

POLYFLEX MICROPOLYMER



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MICROPARTICLE HISTORY

- U.S. Market - Anionic PAM, little understanding of promoters
- **1980** - Compozil System (starch and silica) developed to give strength at high filler levels.
- **1986** - Nalco instituted Anionic/Cationic PAM with Compozil to improve retention characteristics (Positek).
- **1986** - Allied Colloids introduced another inorganic microparticle utilizing bentonite clay (Hydrocol)
- **1993** - Cytec introduces totally organic micropolymer combining microparticle performance and polymer flexibility (Polyflex).

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WHY A MICROPARTICLE?

- **Increased Production**
  - Improved drainage
  - Easier drying and pressing
  - Reduced wet end breaks
- **Viewed as "Required" for High Filler**
  - Superior ash retention
  - Wet end stability
- **Improve Quality**
  - Improve formation
  - Reduce 2 sidedness

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MICROPARTICLE SYSTEMS

- **Conventional Polymer or Starch**
  - High molecular weight polymer
  - Cationic starch
- **Microparticle Component**
  - Ionic, submicron, and 3 dimensional
  - Generally anionic
  - Microparticle added last

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MECHANISM

- **Add Conventional Polymer/Starch**
  - Large macro floc is formed
  - Dispersed going through screen
- **Add Microparticle**
  - Floc reforms as "microfloc"
  - Tight, localized microflocs of fines and fillers do not retard drainage through the web

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SILICA MECHANISM

- Cationic starch added in high amounts (10-20 lb/ton) to adsorb onto fiber and filler
- Colloidal silica added last. The small size (5 nm) and high anionic charge of the silica particles allow them to collapse the flocs into a small neutralized floc structure. These small agglomerates are then adsorbed along the surface of the fiber

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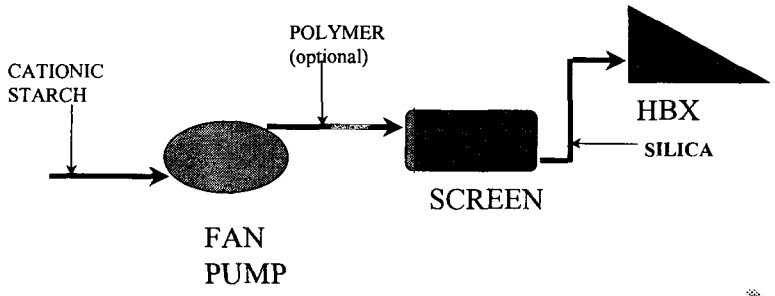
SILICA MECHANISM



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BENTONITE MECHANISM

- Cationic PAM added prior to shear to produce good mixing and to defflocculate the fibers, but not the flocs of the fines, fillers, and colloidal particles.

- High surface area bentonite clay (200-300 nm) added last to "supercoagulate" fines, fillers and colloidal material to the fiber.

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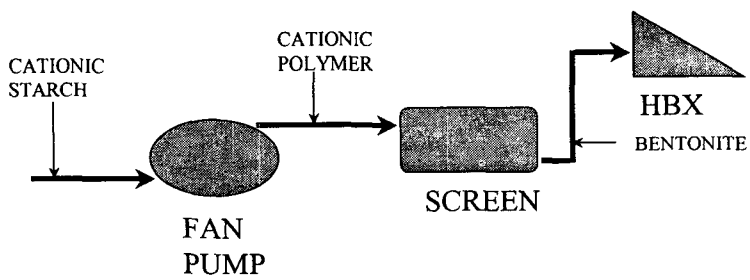
BENTONITE MECHANISM



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POLYFLEX MECHANISM

- Cationic starch or cationic PAM added first and adsorbed on fiber, fines, and filler.

- Polyflex added late in the system, interacts with furnish and cationic source already on the fiber, fines, and filler to produce micro flocculation. The ability of the micropolymer structure to contract as it interacts with furnish components result in smaller flocs compared to inorganic microparticles.

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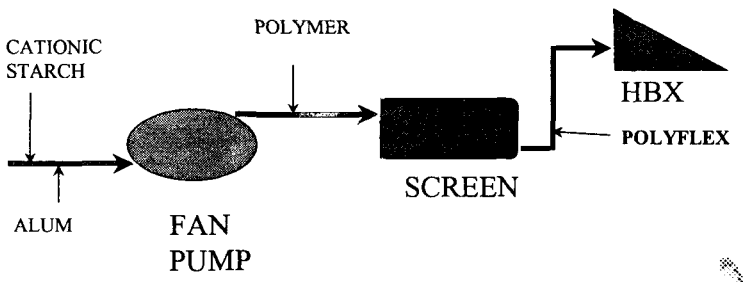
POLYFLEX MECHANISM



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PROS AND CONS OF SILICA

PROS	CONS
■ Easy to handle	■ High cost
■ Good formation	■ weak retention
	■ sensitive to starch

PROS AND CONS OF BENTONITE

PROS	CONS
■ Good drainage	■ Difficult to handle
■ Industry leader	■ Poor formation
■ Medium cost	■ Porosity

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POLYFLEX
&
Polyflex Applications

POLYFLEX

■ What is Polyflex?

– **Organic** Microparticle

– Very High *Molecular Weight*

– Very Strong *Anionic* Charge

– Very Large *Surface Area*

Polyflex Applications

I. System Components
II. Equipment Requirements
III. System Requirements
IV. Benefits of Polyflex
V. Polyflex Performance by Grade

System Components

- Alumina (sometimes required)
- Conventional Polyacrylamide (PAM)
- Polyflex

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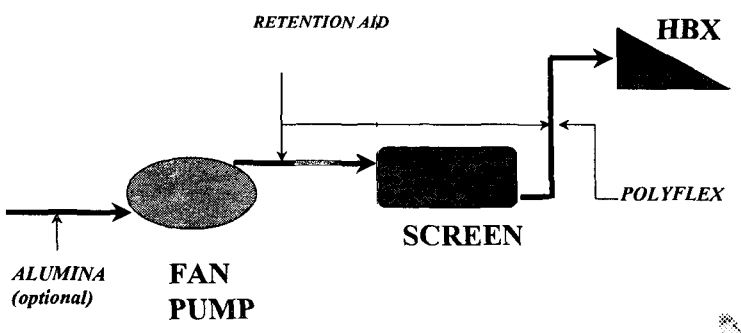
POLYFLEX SYSTEM



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System Components
(cont'd)

- Conventional PAM
  - Cationic PAM or Anionic PAM
  - Normally Required in non-board application
    - Longer Fiber Retention
    - Hardwood, Softwood, Mechanical Fiber, Recycled Fiber

System Components
(cont'd)

- Anionic PAM
  - A little goes a long way
  - Pre screen or Post screen
  - Most economical system
    - Kraft and PCC systems
  - Generally less than 1.5 #/Ton required

System Components
(cont'd)

- Cationic PAM
  - Required dosages higher than APAM
    - 1.0 - 2.5 kg/ton
  - Common in grades with dispersed GCC, TiO_2, or sulfite pulps
  - "Dirty" furnishes (OCC, Mechanical Furnish)

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System Components
(cont'd)

- Polyflex Micropolymer
  - Polyflex
    - Various products available.
    - Differing in Charge and molecular weight
    - Optimum Polyflex will be chosen from laboratory surveys conducted on site.

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Polyflex Applications

I. System Components
II. *Equipment Requirements*
III. System Requirements
IV. Benefits of Polyflex

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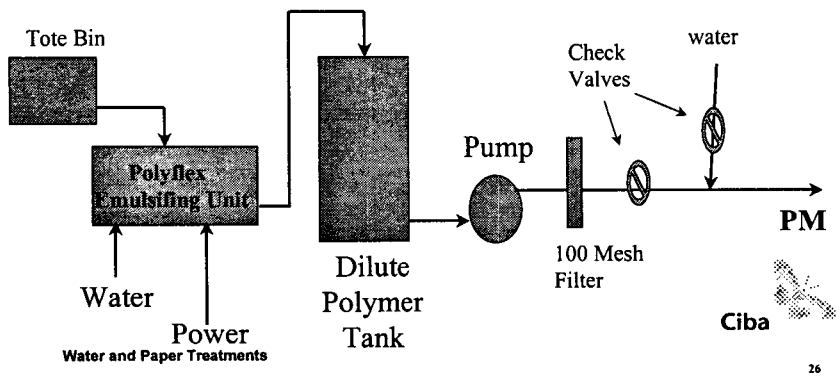
25

Polyflex Feed System



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26

Equipment
(cont'd)

- Polyflex Random (Post) Dilution
  - Less than 0.3% (as received); 0.1% or less when introduced into Thin Stock.
  - Higher velocity than stock velocity (2 m/sec).
  - "Quill" or "Sword" through Approach Piping recommended (after screens).

Polyflex Applications

I. System Components
II. Equipment Requirements
III. *System Requirements*
IV. Benefits of Polyflex
V. Performance by Grade

System Requirements

- Polyflex System Requirements
  - Cationic Source (starch, polyamide, CPAM)
  - Alumina: (Al^{+++}) (sometimes)
  - Alkaline pH (above 6.5)
    - CP.3 can work down to pH 5.5

Polyflex Applications

I. System Components
II. Equipment Requirements
III. System Requirements
IV. *Benefits of Polyflex*
V. Performance by Grade

Benefits of Polyflex

- Increase Production
- Lower Cost
- Improve Quality

Increase Production

- Eliminate Bottlenecks
- Increase Runnability

Increase Production

- Eliminating Bottleneck
  - Increase Machine Speed
    - Is machine drainage limited?
    - Is machine press limited?
    - **Is machine main section dryer limited?**
    - Is machine after section dryer limited?
  - Conclusion
    - Machines that are main section steam limited are likely to benefit from Polyflex.

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Increase Production

- Improve Runnability
  - Reduce Wet End Breaks
    - Better formed sheet
    - Higher couch solids
    - Fewer wet end upsets
    - Fewer holes
  - Improve Machine Cleanliness
    - Longer felt life
    - Longer boil out cycle

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Improved Production
Higher Couch Solids

POLYFLEX TRIAL
Reducing Wet End Breaks

Mill	B.W	Higher Consistency	WE Breaks	Comments
Finch Pruyn	35-95lb	Reduced main section steam 15%	significant reduction	documented over 1.5 year period
Grays Harbor	40-80lb	No documentation	significant reduction	Open draw entering 1st press
[illegible]Georgetown	45-65lb	Incr. Couch solids by 2.1% points	reduction during upsets	Machine averages 0.3 br/day normally
[illegible]Jay - PM1	35-65lb	Incr. Couch solids by 1.0% points	slight reduction	50% reduction in holes
[illegible]Wisconsin	45-55lb	decreased press MOI by 1.7% points	no reduction documented	
U.C. / Franklin	40 - 75lb	No increase in Couch Solids	no reduction documented	
Willamette/Albany	40-75lb	decreased press MOI by 2.0% points	no reduction documented	WE break reduction not doc in firs 6 weeks of trial

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Increase Production

- Improve Runnability (cont'd)
  - Can We Improve Runnability?
    - Does the mill measure wet end breaks?
    - Will the mill run 4 - 6 week Polyflex evaluation
  - Conclusion
    - Runnability is easy to measure, but difficult to document.

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Improving Quality

- Formation
- Reduce 2 sidedness
- Reduce defects: holes, spots, etc.
- Improve sheet strength
- Improve sheet density

Improve Formation

- Factors Affecting Formation
  - Furnish
  - Refining
  - Headbox consistency
  - Agitation on the wire
  - Rush/Drag
  - Setting the jet

Improve Formation

- How much paper do you currently reject for formation?
- How much is a 5% - 10% improvement in formation worth?
- Is Paper Machine willing to work on formation?

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Improving Formation

- Conclusion: "Formation can be improved using Polyflex as a tool to change the sheet characteristics. Rarely is formation improved by simply switching to Polyflex from a conventional system.

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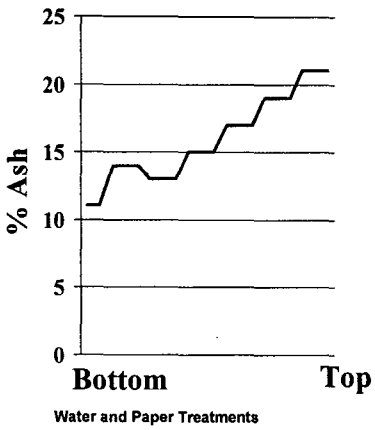
Reducing 2 Sidedness



- Fines and filler are washed out the bottom of the sheet
- Mechanical entrapment is primary force

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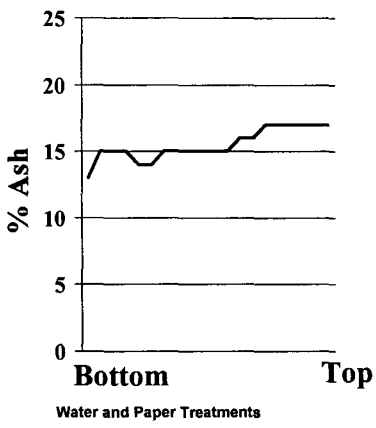
41

Reducing 2 Sidedness



- **Fines and filler are attached to long fiber and do not wash out of the sheet**
- **Ionic forces are present**

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42

Polyflex Applications

I. System Components
II. Equipment Requirements
III. System Requirements
IV. Benefits of Polyflex

Questions & Discussion