The Next Generation of Paper Recycling.

Biobond. Improving the Sustainability of Paper℠ Program*

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Ashland Water Technologies

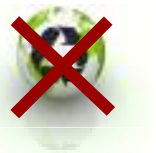
"The Biobond Program significantly improves **paper strength** and **machine operation** by recovering starch from waste paper"

- Concept
- Mechanism
- Case Histories

Biobond Concept

Current recycling practice:

95% fibre and filler



5% starch (mainly native starch)

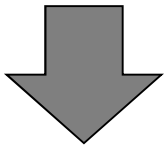
Starch is the most valuable component:

- 1 ton waste paper: 170 €/ton
- 1 ton fresh starch: 450 - 550 €/ton

Starch Loss in Paper Production

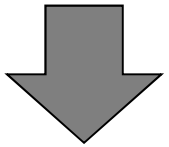
As waste paper is pulped, starch separates from the fibres:

Path 1: Starch is microbiologically degraded

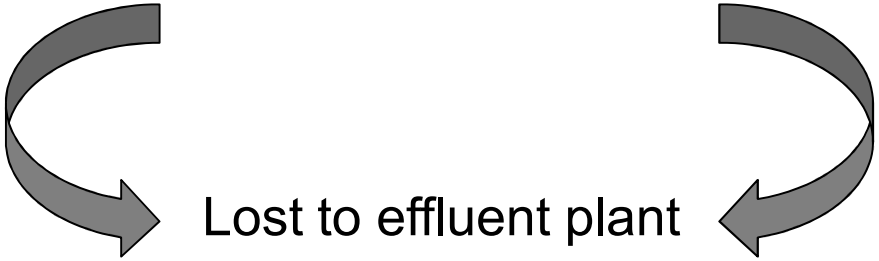


Conductivity, VFA, odor, H_2S, pH drop, scale

Path 2: Starch is <u>not</u> microbiologically degraded



But no longer has affinity to fiber



Lost to effluent plant

Patented Two Step Mechanism

Two Step Mechanism

- **Two step process:**

Step 1: Starch Preservation

Prevents microbiological degradation of starch

- Can recycle approximately 10% of the starch

Step 2: Starch Re-fixation

Attaches the preserved native starch to the paper fiber

- Enables >50% starch recycling
- Previously “lost” or unusable raw material becomes a strength agent

Step 1: Starch Preservation

Amylase Control

- Prevents degradation of starch
  - To be effective, must control the entire system, any place, any time

Ashland Water Technologies (AWT) Products

- Spectrum™ XD3899 ammonium bromide technology combined with Spectrum™ RX preservation technology

Result

- 50-70 kg/tonne of starch is now available in its original form
  - **But** without further treatment, this starch will be lost to the effluent plant

Step 1: Starch Preservation

- Starch concentration increased in system
- Starch deposition at machine frames

Step 2: Starch Re-Fixation

Starch Retention

- Ionic re-attachment of starch molecule to bonding sites on paper fibre

AWT Products

- Praestafix™ fixative combined with Hercobond™ dry strength resin

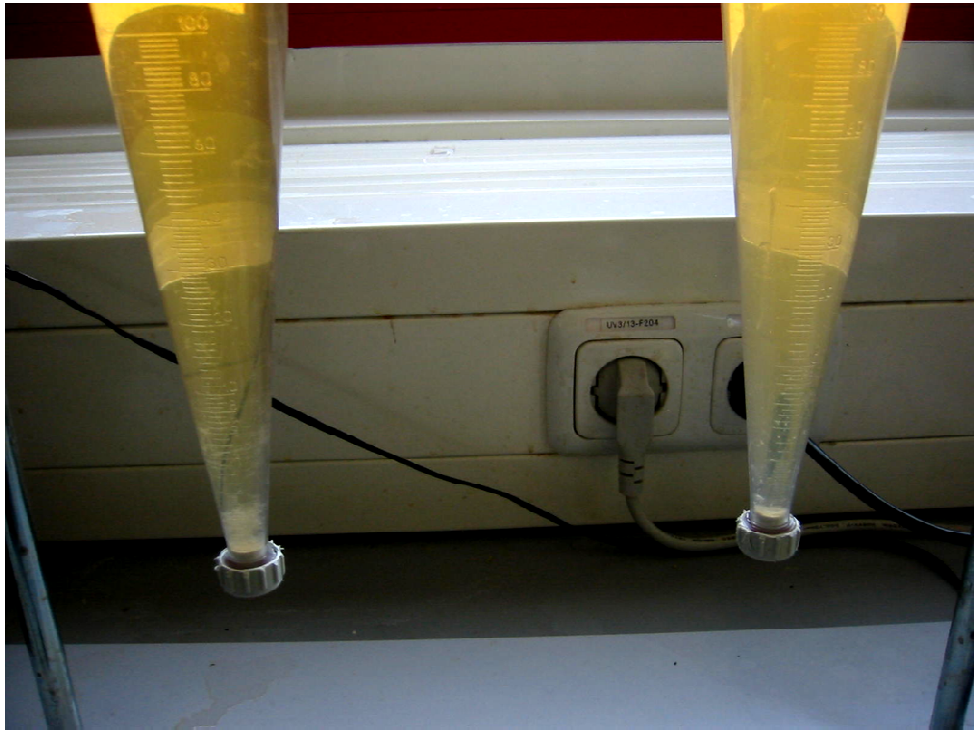
Result

- > 50% of preserved starch is retained and ends up in new packaging paper
  - Provides strength
  - Increases yield
  - Saves fresh starch

Step 2: Starch Re-Fixation

- Clear filtrate with starch in process water

- Clear filtrate with Biobond technology: starch fixed to new paper



Benefits

- Reduction of fresh starch and/or increased paper strength
- 2-3% yield increase – starch and fibre savings
- 7-15% improvement in dry strength
- 50% lower conductivity
  - Polymer additive performance improved
- 15-20% BOD / COD reduction
- Overall cleaner system
  - Improved runnability
- Fresh water savings
  - Complete system closure possible
- Decreased chemical consumption
  - Retention aid
  - Fixatives
- Possibility to run only with one side of size press
- Reduced basis weight

Typical ROI Calculation

Saving	Range	€/T Min.	€/T Max.
Yield Increase	1.2-2.5 %	1.90	3.00
Incumbent MB	100%	3.00	3.50
Retention Aid	25%	0.38	0.60
Surface Starch	15%	2.22	3.33
Fresh Water	1-2 m^3/T	0.04	2.25
Effluent Volume	1-2 m^3/T	0.25	1.05
PM Breaks per Day	0.5 – 1.0	1.11	2.22
Cleaning Time	2 hr/month	0.59	0.58
Cleaning Chemical	100%	0.05	0.10
Basis Weight	1-2 gsm	1.99	3.78
COD			
Total Savings		**€11.41**	**€20.41**

Typical ROI Calculation

Saving	Range	€/T Min.	€/T Max.
Yield Increase	1.2-2.5 %	1.90	3.00
Incumbent MB	100%	3.00	3.50
Retention Aid	25%	0.38	0.60
Surface Starch	1		
Fresh Water	1-2		
Effluent Volume	1-2		
PM Breaks per Day	0.5		
Cleaning Time	2 hr		
Cleaning Chemical	1(		
Basis Weight	1-2		
COD			
Total Savings		**€11.41**	**€20.41**

- Improved cost performance versus other dry strength programs
- Internal starch reduction provides additional savings of 4 €/ton to 6 €/ton
- Biobond program in all cases paid for itself

Case Histories

Case History # 1 – Central Europe

Customer Overview:

- Segment: Packaging
- Product(s): Fluting and testliner from 90 g/m² up to 160 g/m²
- Equipment: Two layer fourdrinier with size press
- Capacity: 70.000 tons/year
- Furnish: 100% waste paper, household collecting and OCC grades
- WWTP: Anaerobic (UASB reactors) and aerobic

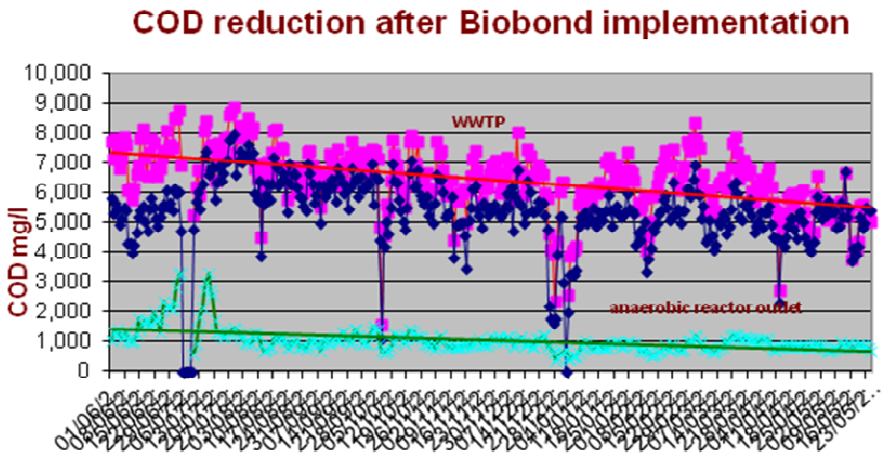
Problem Summary:

- After the start-up of a new paper machine, the mill was experiencing difficulties with their existing effluent plant. It was too small to cope with the increased Chemical Oxygen Demand (COD).

Customer Objectives:

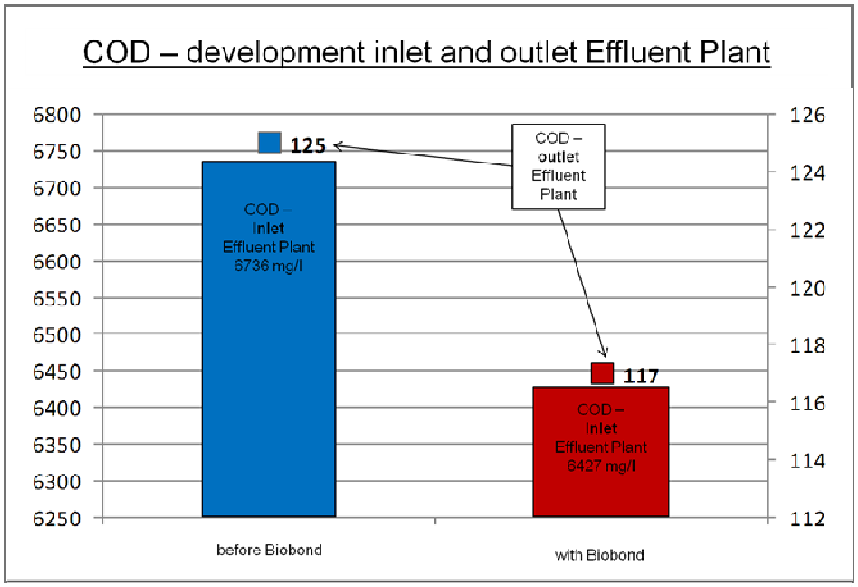
- Reduce COD in the effluent plant
- Improve strength parameters in paper
- Improve runnability of the paper machine

Case History # 1 – Central Europe

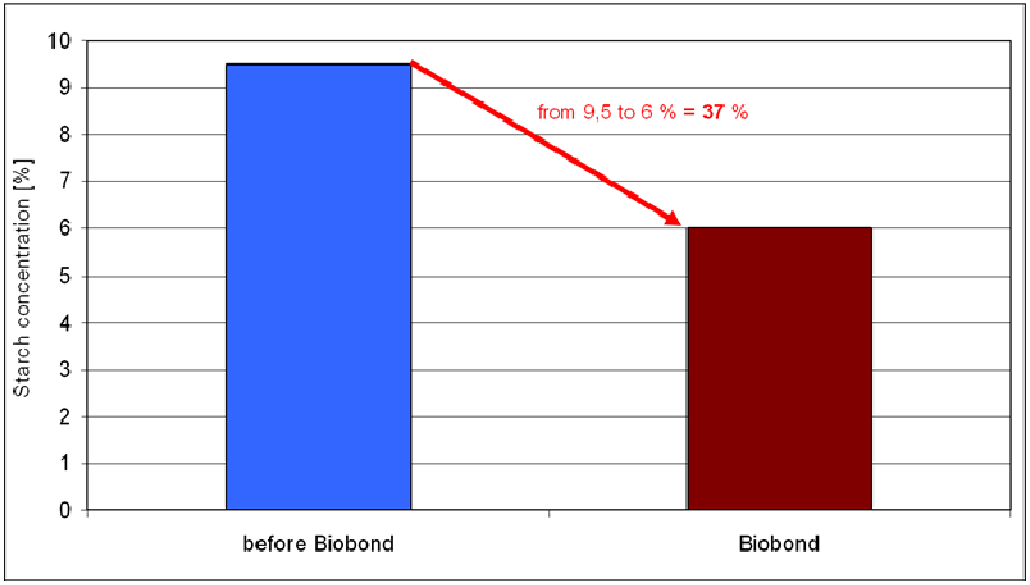


Customer Benefits:

- Reduced COD load and stable process conditions at the effluent plant
- Improved runnability of the paper machine
- Improved strength parameters
- Reduced usage of surface starch
- Positive ROI. Savings on surface starch and overall improvement on machine runnability



Reduction of starch concentration at size press



Case History # 2 – Eastern Europe

Customer Overview:

- Segment: Packaging
- Product(s): Testliner, corrugated medium, 90 - 175 g/m²
- Equipment: Fourdrinier with size press
- Capacity: 90,000 tons per annum
- Furnish: 100% waste

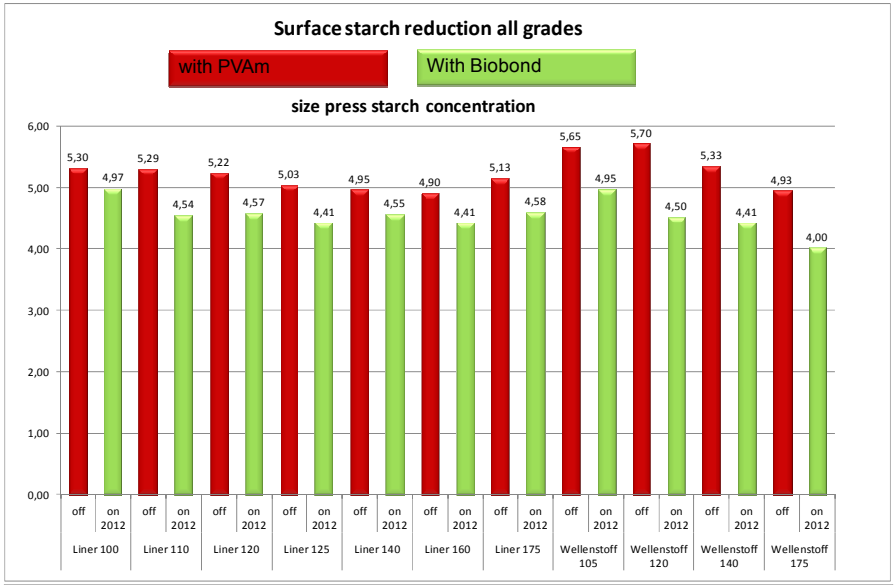
Problem Summary:

- The mill wanted to optimize the treatment program that would help them improve strength and also reduce overall treatment costs.

Customer Objectives:

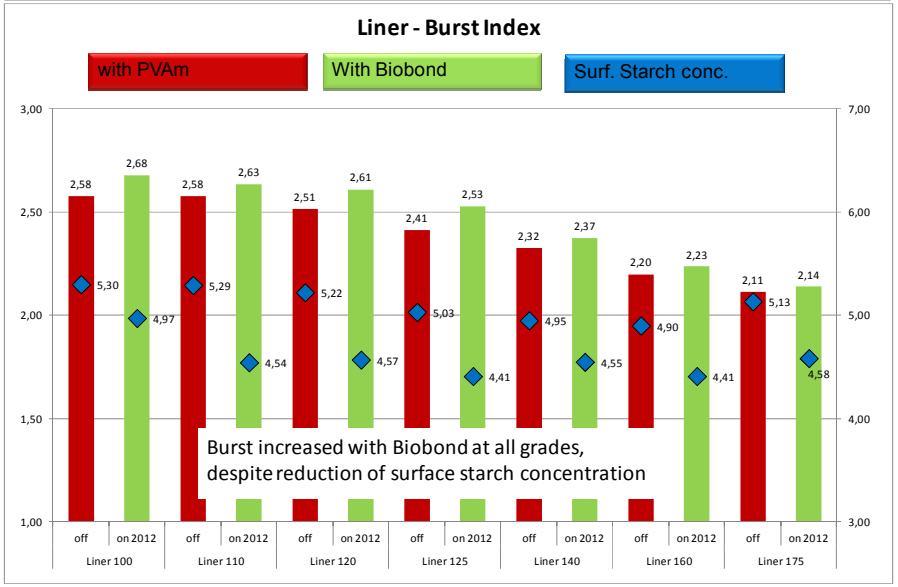
- Reduce cost
- Improve strength
- Maintain drainage
- Maintain runnability

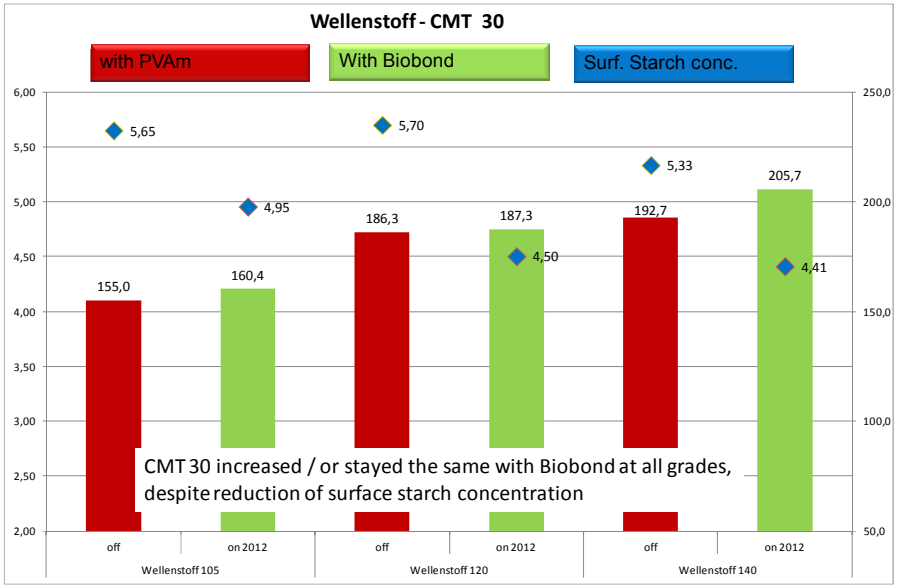
Case History # 2 – Eastern Europe



Customer Benefits:

- Stop their previous treatment program including PVAm
- Maintained strength with 13.7% reduced starch concentration in size press
- Reduced COD by 20% in the effluent
- Improved retention and overall performance
- Overall cost reduction of 12%





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Case History # 3 – Central Europe

Customer Overview:

- Segment: Packaging
- Product(s): Fluting and testliner from 100 g/m² up to 160 g/m²
- Equipment: Two duo formers with size press
- Capacity: 360,000 tons/year
- Furnish: 100% waste paper
- WWTP: 100% closed mill – no effluent, no discharge of water possible

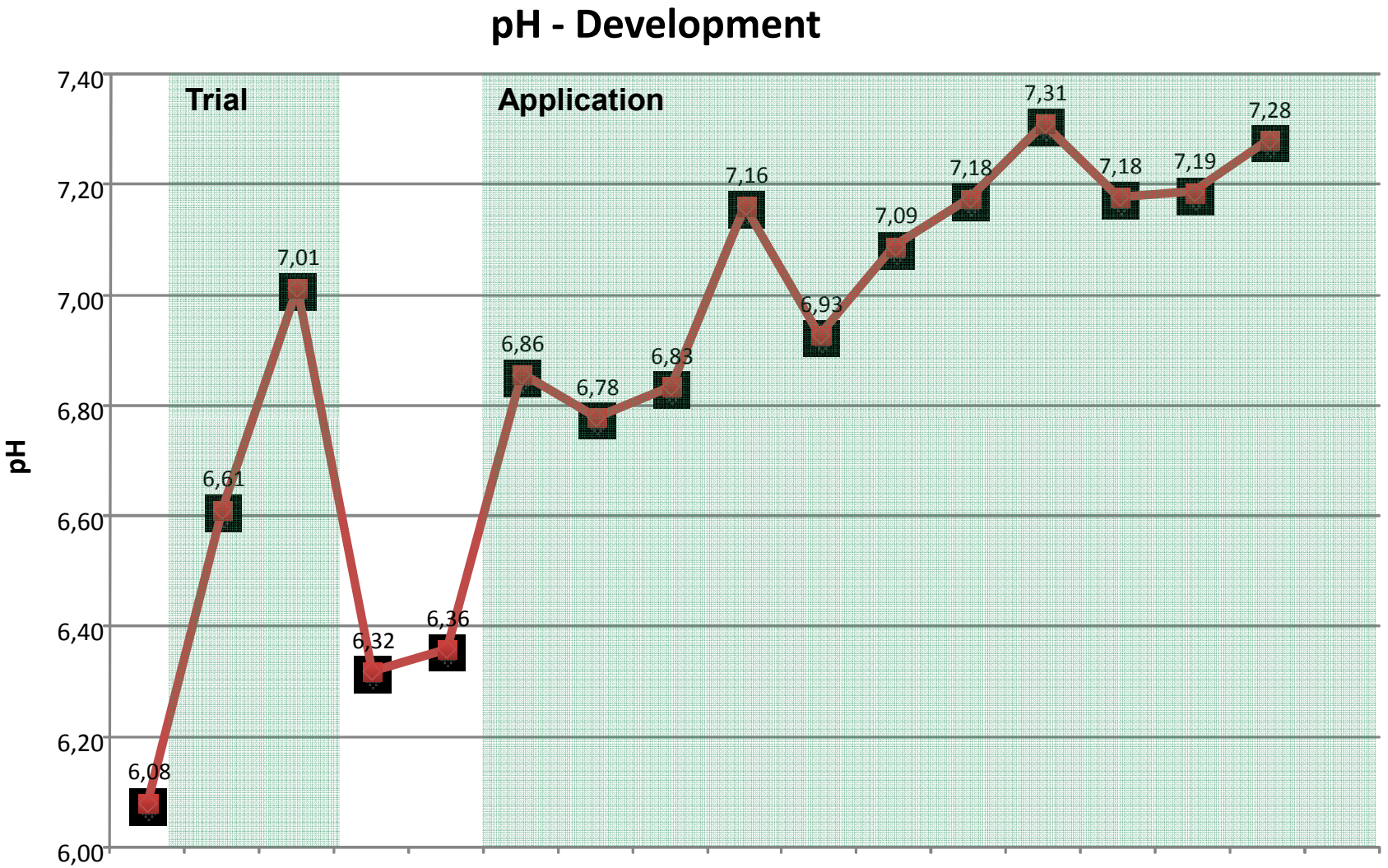
Problem Summary:

- Bad odor in produced paper, in the mill and neighborhood due to acidification in the process water, org. acids ~15.000ppm. High production cost due to bad runnability of the paper machine caused by low system pH, high conductivity and anaerobic system conditions.

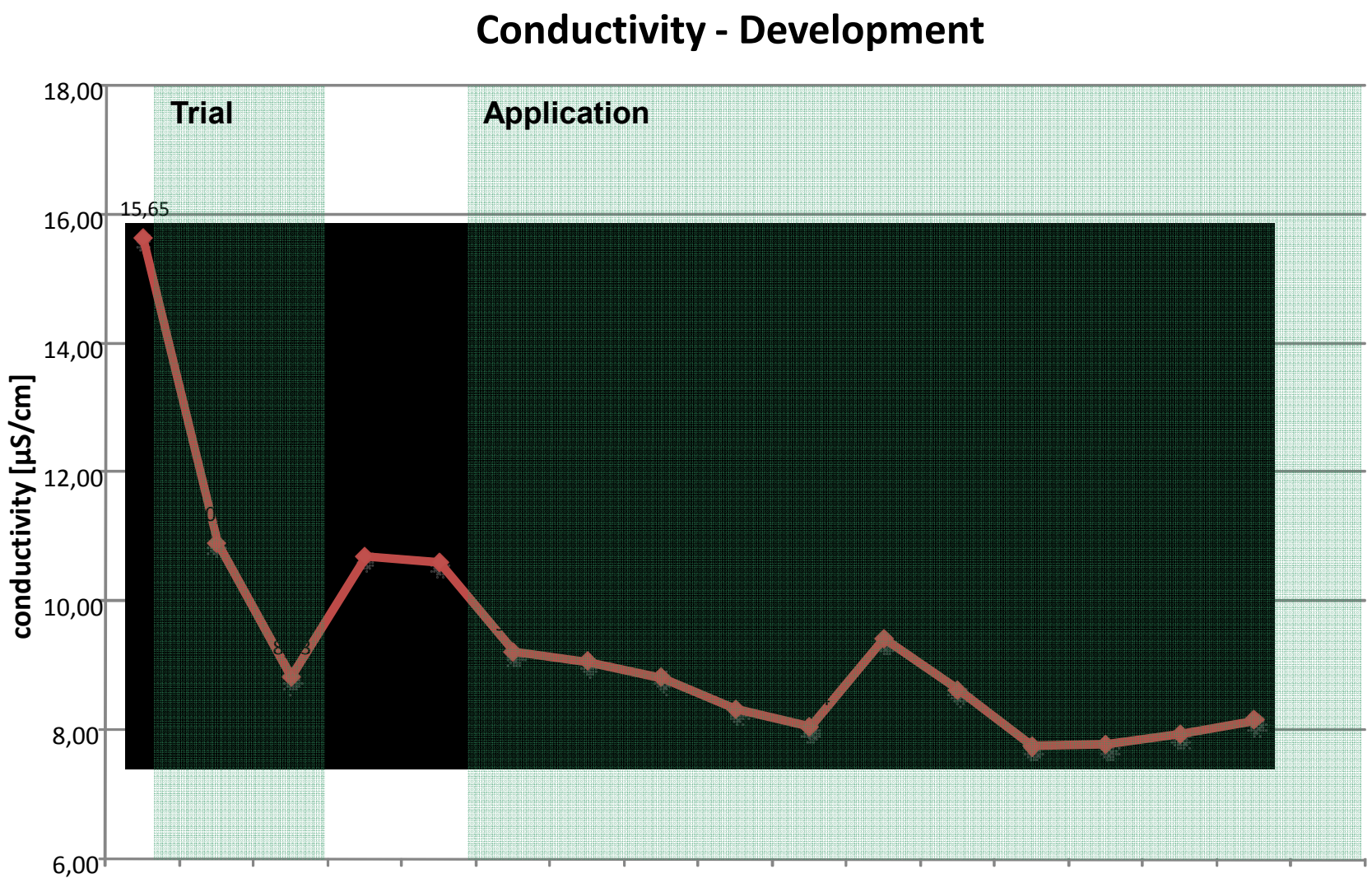
Customer Objectives:

- Elimination of odor issues and microbiological-related production problems
- Improve runnability of the paper machine

Case History # 3 – Central Europe



Case History # 3 – Central Europe



Case History # 3 – Central Europe

- Cleaniness from shut-down to shut-down
- Reduced or eliminated sheet defects and breaks
- Reduced time and cost for cleaning
- Clean machine spray areas
  - Improved runnability

Case History # 3 – Central Europe

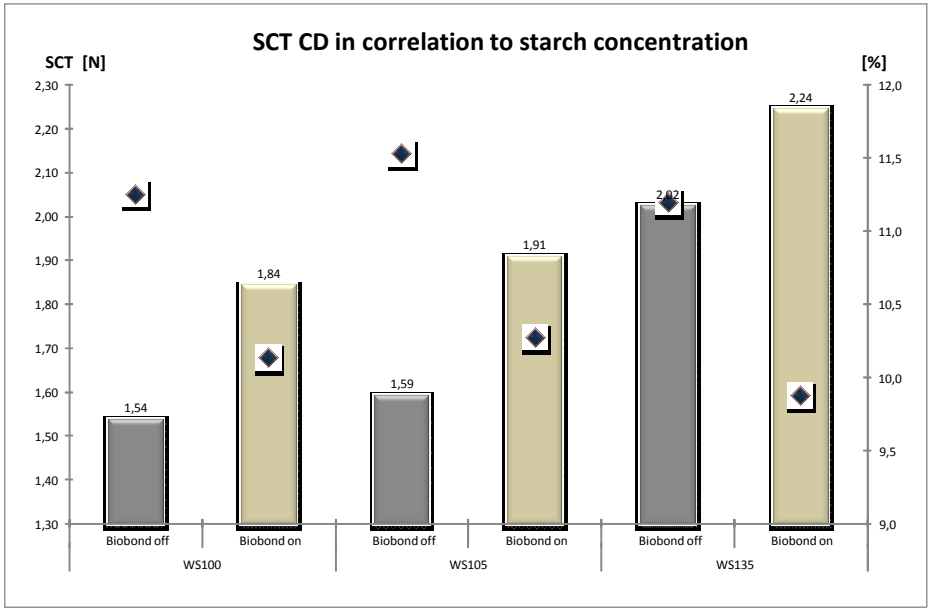
Results:

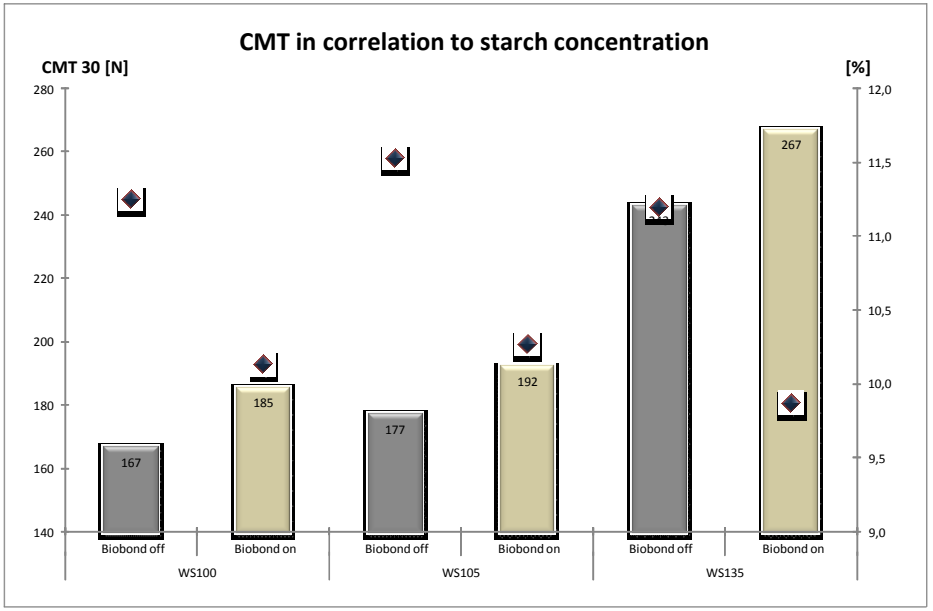
- Increased pH
- Positive ORP
- Reduced Ca load and conductivity
- No odor issues
- Reduced deposition
- Improved system cleanliness
- Improved runnability

Case History # 3 – Central Europe

Results:

- Reduction of surface starch
- Improved strength properties
- Reduced chemical consumption






Recycle more.
Recycle starch.
Recycle strength.

With good chemistry great things happen.™