FiberLean™
natural strength

Micro-Fibrillated Cellulose/Mineral Composites for Paper and Paperboard Applications

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A Unique Process for Micro-Fibrillated Cellulose

- Processing of pulp to MFC in the presence of minerals.
  - The mineral acts as a very fine grinding media

- Robust and reliable equipment of relevant industrial scale.

- On-site manufacturing, using a minor side stream of pulp

- No pre-treatment of fiber required.

- The final product is a MFC/mineral composite.
An industrial scale, MFC process for on-site installation

Example of on-site installation with 3 000 dry ton per year capacity.
A Unique Method for Increasing Filler Content

- Composite of filler and MFC
  - Can be tailored to fit the application
    - Type of filler
    - Type of pulp
    - The level of MFC in the composite

- Optimized for strength in wet-end application
  - Fibrils are relatively coarse and low in charge
  - Provide good bridging of filler with the paper web
  - Minimum impact on wet-end chemistry
  - Allows significant increase in filler loading without detrimental side effects

- Low solids final product
  - Solids are typically around 5%
  - Ideally produced on-site using mill pulp as raw material
The Composite is made out of Filler and Fiber
Paper Surface with Applied Composite
Note the similarity between the original composite and the product as retained in the paper.

The association between the filler and the MFC remains through the paper making process.
Filler increase with GCC without strength additives

impact on paper properties when going from 20% to 30% filler

Lab study
Mesmer recirculating hand sheets (12 sheets)
70% Eucalyptus, 30% NBSK, 550 CSF

- ~26% tensile loss
- ~38% Scott Bond loss
- ~1.4 units opacity gain
- ~3% bulk loss
Impact of MFC on paper strength

It is possible to increase filler by 10% or more and maintain strength

Lab study
Mesmer recirculating hand sheets (12 sheets)
70% Eucalyptus, 30% NBSK, 550 CSF
Impact of MFC on optical properties

Lab study
Mesmer recirculating hand sheets (12 sheets)
70% Eucalyptus, 30% NBSK, 550 CSF
**Impact of MFC on other properties**

- **Density**
  - Density can be regained by trading the positive impact on smoothness and bond strength with less intense calendering and/or use of coarser fiber, such as CTMP.

- **Porosity**
  - The porosity impact can be important for ink or coating hold-out.

- **Initial drainage**
  - While initial drainage slows down there is a positive impact on couch and press solids.

**Lab study**

Mesmer recirculating hand sheets (12 sheets)
70% Eucalyptus, 30% NBSK, 550 CSF
PCC filler in 100% BHKP

Pilot machine trial data

- Adding 10% PCC filler with no MFC gave 25% tensile strength loss.
PCC filler + MFC Composite in BHKP

- MFC allows maintained strength at higher levels of PCC filler.
- In this case +12% filler from 3% MFC
MFC can also be used to increase strength at a given filler loading.
- In this case +35% Tensile from 3% MFC at constant 10% filler.
- Bringing strength back to where it started.
Initial wet strength increases (TEA index)

Wet TEA index (tensile energy absorption)

% MFC added to paper

Reference • Composite

Note:
From pilot trial at Innventia.

Excellent paper machine runnability despite increased filler.
Commercial example to increase WF Base Paper Filler: Tensile and Scott Bond Response

Topping up regular filler through increasing addition of composite containing 17% MFC and 83% GCC.

-9% @ +10% filler with 2% MFC

Runnability on paper machine maintained through increase in initial wet web strength.
Selecting correct filler loading - simplified example

Ideal strength and opacity

No filler - minimum sheet weight for required strength

No filler - minimum sheet weight for required opacity
Filler Loading and Basis Weight with MFC
Pilot paper machine data

- 84% Opacity no mfc
- 84% Opacity 2% mfc
- 84% Opacity 3% mfc
- 84% Opacity 4% mfc

Total Filler Loading (g/m² for target)
0% 5% 10% 15% 20% 25% 30%
Filler Loading and Basis Weight with MFC
Pilot paper machine data

- 84% Opacity no mfc
- 84% Opacity 2% mfc
- 84% Opacity 3% mfc
- 84% Opacity 4% mfc

Constant opacity
Filler Loading and Basis Weight with MFC
Pilot paper machine data

- 84% Opacity no mfc
- 84% Opacity 2% mfc
- 84% Opacity 3% mfc
- 84% Opacity 4% mfc

- 1.5 kN/m tensile strength no mfc
- 1.5 kN/m tensile strength 2% mfc
- 1.5 kN/m tensile strength 3% mfc
- 1.5 kN/m tensile strength 4% mfc

Graph showing the relationship between g/m² for target and Total Filler Loading with different opacity and tensile strength levels.
Filler Loading and Basis Weight with MFC

Pilot paper machine data

- **84% Opacity no mfc**
- **84% Opacity 2% mfc**
- **84% Opacity 3% mfc**
- **84% Opacity 4% mfc**
- **1.5 kN/m tensile strength no mfc**
- **1.5 kN/m tensile strength 2% mfc**
- **1.5 kN/m tensile strength 3% mfc**
- **1.5 kN/m tensile strength 4% mfc**

**Paper with no MFC**
- 63 g/m²
- 8% filler
- 84% opacity
- 1.5 kN/m tensile

**Paper with 2% MFC**
- 53 g/m²
- 17% filler
- 84% opacity
- 1.5 kN/m tensile

**Paper with 4% MFC**
- 38 g/m²
- 21% filler
- 84% opacity
- 1.5 kN/m tensile

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Conclusions

• Converting a small part of the pulp to MFC opens up new opportunities.

• The traditional idea of replacing pulp with filler and MFC is exciting and can offer nice cost savings.

• The idea of using MFC to tailor a paper grade to meet required opacity and strength targets with minimum raw material use is even more exciting.

• There could be major fiber savings.
  • The example given suggests:
    ➢ 24% fiber savings from 2% MFC
    ➢ 34% fiber savings from 4% MFC
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