



**FiberLean**<sup>®</sup>

Technologies

Innovative by Nature.

With MFC it is possible to  
coat in the paper machine  
wet-end.

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PTS Coating, Bamberg  
September 13-14<sup>th</sup> 2023

Per Svending – Project Leader FiberLean on Top

August 2023

# FiberLean Grinding Technology: The most efficient and effective way of making MFC at scale

## Ultra-fine grinding in FiberLean mills



The unique  
**FiberLean® process:**

Creates  
interconnecting fibre

**Networks**

that are highly-  
fibrillated for

**Strength**

and

**Performance**

Our **robust grinding** process transforms fibres through **milling** with carefully **controlled intensity**, liberating an **optimal "micro fibrillated" network** structure.

## High-performance MFC produced onsite

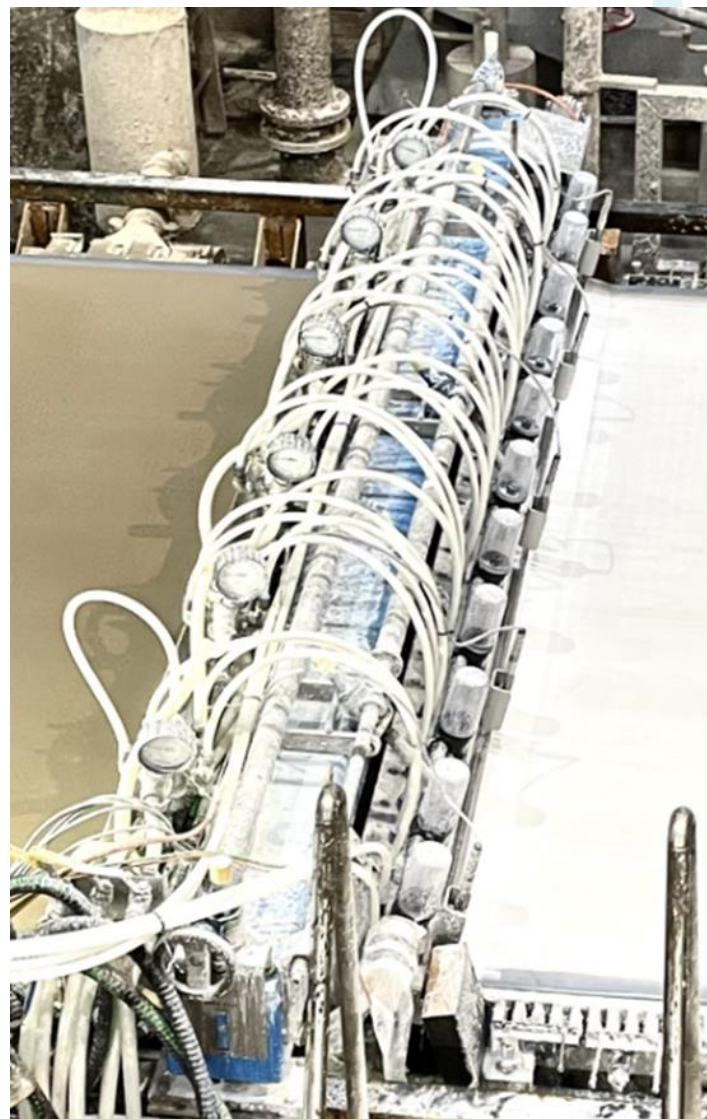
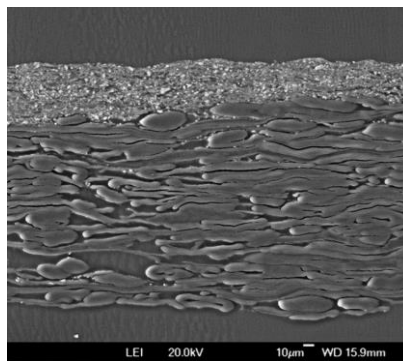
- ✓ High-throughput continuous operation.
- ✓ Low maintenance costs and high uptime (>95% plant availability).
- ✓ 100% mechanical process, Chemical-free process.
- ✓ Highly-automated modular plant design with online monitoring.
- ✓ Top performance reached in one single stage
- ✓ Low energy consumption and low operating costs



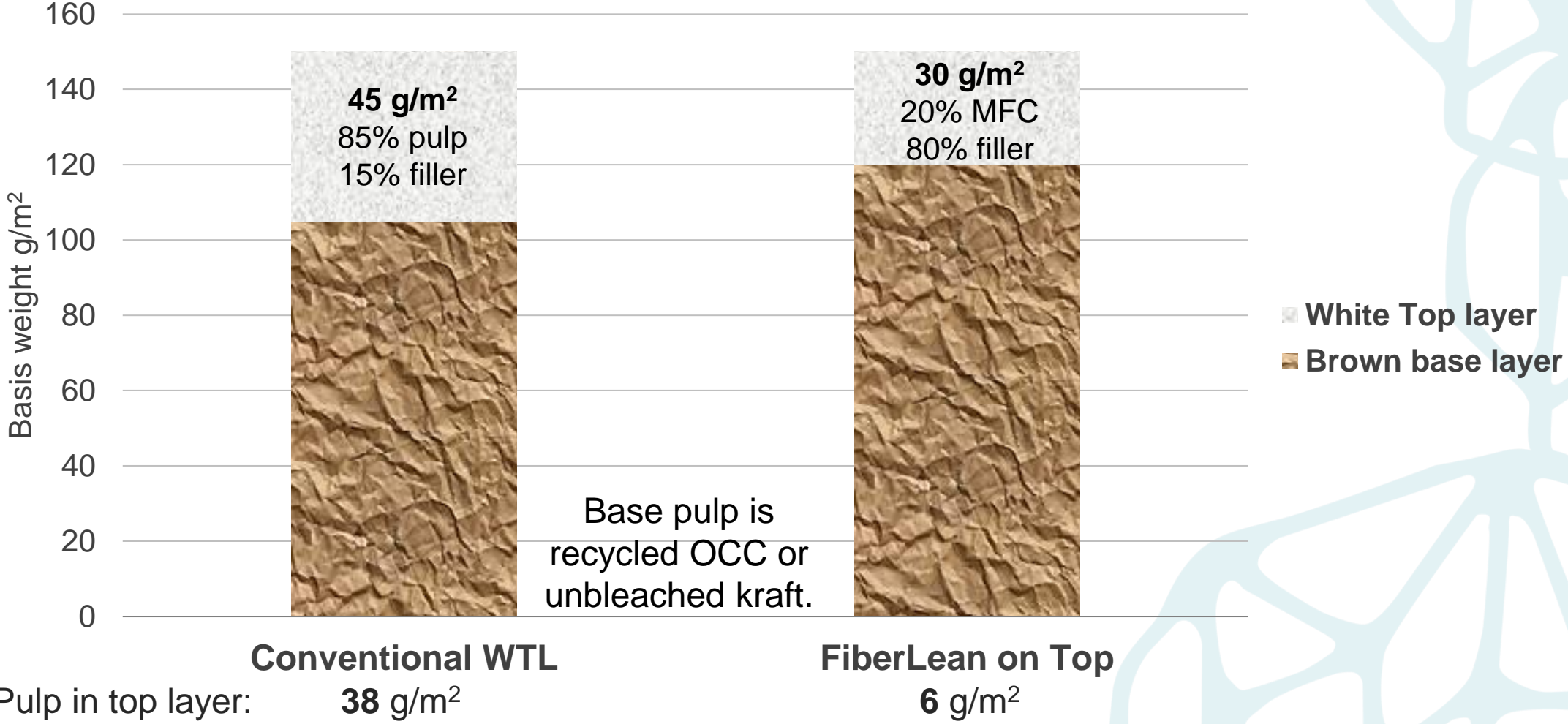
# A breakthrough in papermaking technology

## Surface application of MFC: FiberLean® on Top (FLoT)

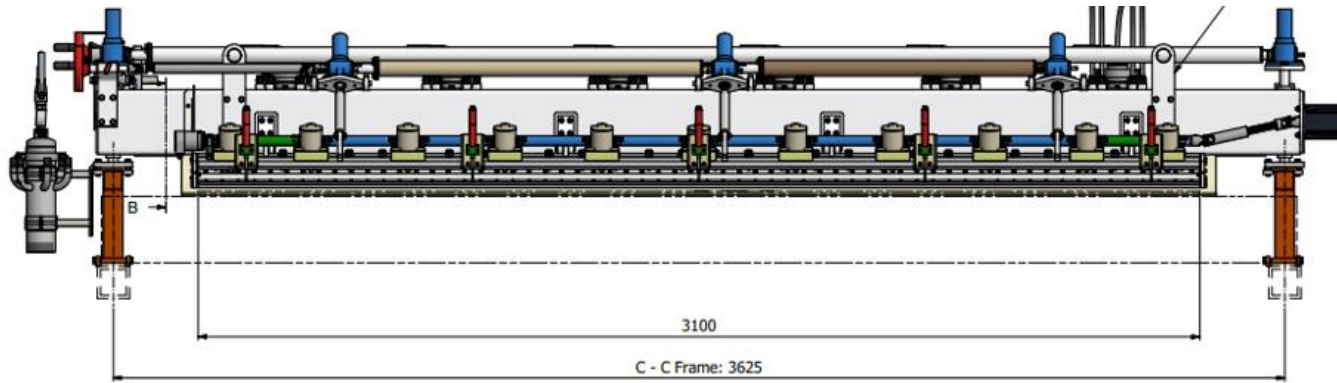
- Drain, press and dry using existing paper machine equipment.
- Low CapEx requirement.
- Convert existing production lines to new grades.
- 2-layer sheet functionality achieved with 1 forming section and no coaters.
- Prototype applicator available at 3,1 m width (or slightly less when applying water at the edges)
- FiberLean are the original inventors & patent owners globally of this exciting technology



# Coating with MFC and mineral is cost-effective and minimizes the need for white pulp



# The patented in-house design of the FiberLean applicator



1/10000 sec exposure photographs



Water, 500 m/min



20/80 MFC/CaCO<sub>3</sub> 500 m/min

- Specifically designed for application of optimized MFC with jet speed similar to wire speed, i.e., at high-shear conditions. Gradual shear-thinning of MFC through the approach flow system, with final jet still having a laminar flow.
- Low cost and light weight, for easy mounting across paper machine.
- FiberLean has partnered with a major coating equipment manufacturer to provide the engineering, fabrication and servicing of these applicators.
- FiberLean is committed to continued development of this technology and has multiple additional patents pending. We believe that the FiberLean products and applicator will remain at the forefront of this technology.



A view of the applicator in action from another paper machine.



Feeding the application requires a large flow of MFC-mineral composite. The coating is typically 20-30% of the total WTL weight, i.e. several dry ton per hour. Slurry flows are in the  $\text{m}^3/\text{min}$  range.

Multiple trials have been run in different mills with well over 100 ton of WTL made.



# FiberLean on Top approach flow system feeding the applicator



- Intermediate slurry storage
- Pulse-free pump feed
- Air removal system
- Pressure screen
- Chemicals dosing



Having the capability to run large volume trials is key to industrial evaluation of MFC



MFC trial make-down unit, re-dispersing granulate FiberLean MFC to slurry for use on paper machine.





# Merchant Supply of MFC within Europe from Cornwall (UK) Delivered in IBC Bags as granulate & redispersed into slurry onsite



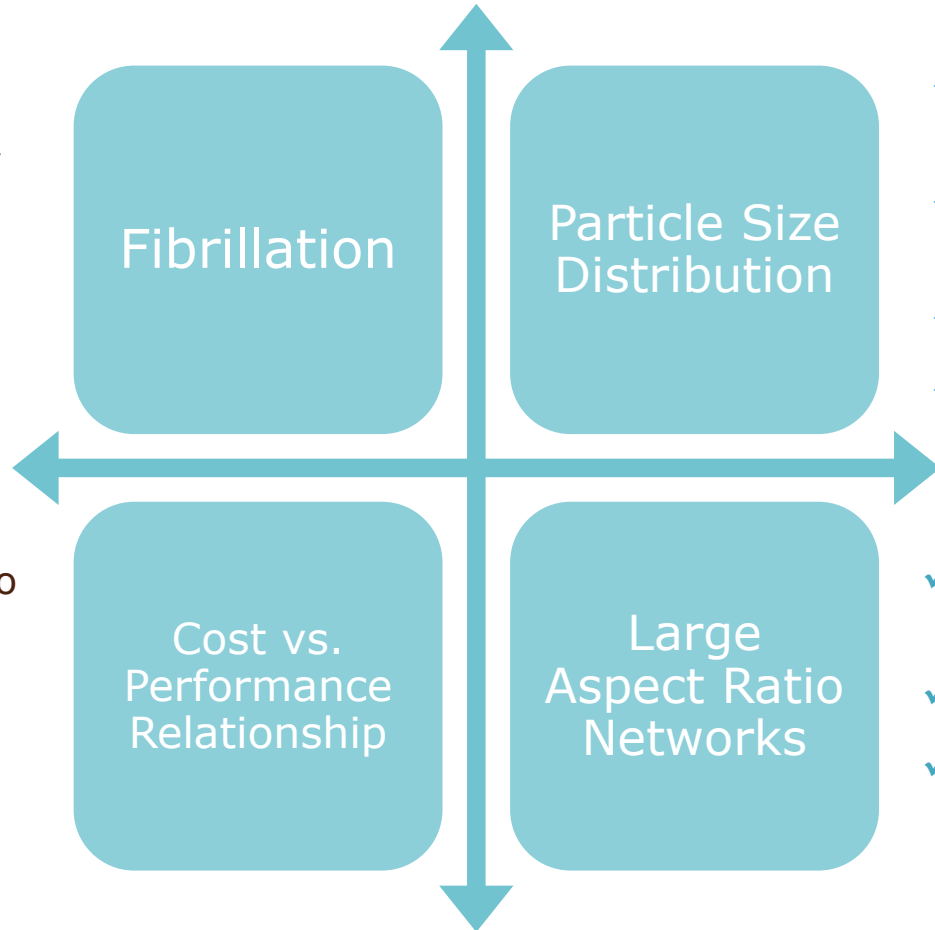
- ✓  $\leq \sim 2,000$  dmt/year MFC capacity from the UK plant.
- ✓ Operational since Q4 2013.
- ✓ Granulate product form.
- ✓  $\sim 1,000$  kg/IBC bag (wet).
- ✓  $\sim 15-18\%$  MFC solids.
- ✓  $\sim 150-180$  kg/IBC bag (dry MFC)



# FiberLean® MFC products optimized for surface application

Carefully selected properties based on years of process & application development

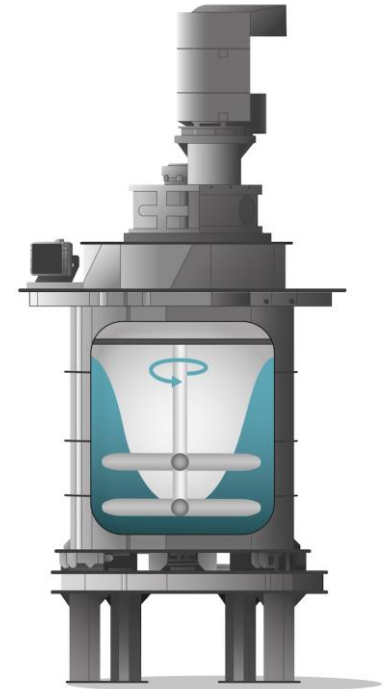
- ✓ Barrier performance
- ✓ Strength / Durability
- ✓ Binding capability
- ✓ Viscosity
- ✓ Drainage



- ✓ Avoidance of applicator blockages
- ✓ Coating uniformity / formation
- ✓ Viscosity
- ✓ Drainage

- ✓ Process throughput to match peak demand
- ✓ Dose / Coat weight required
- ✓ Cost effectiveness

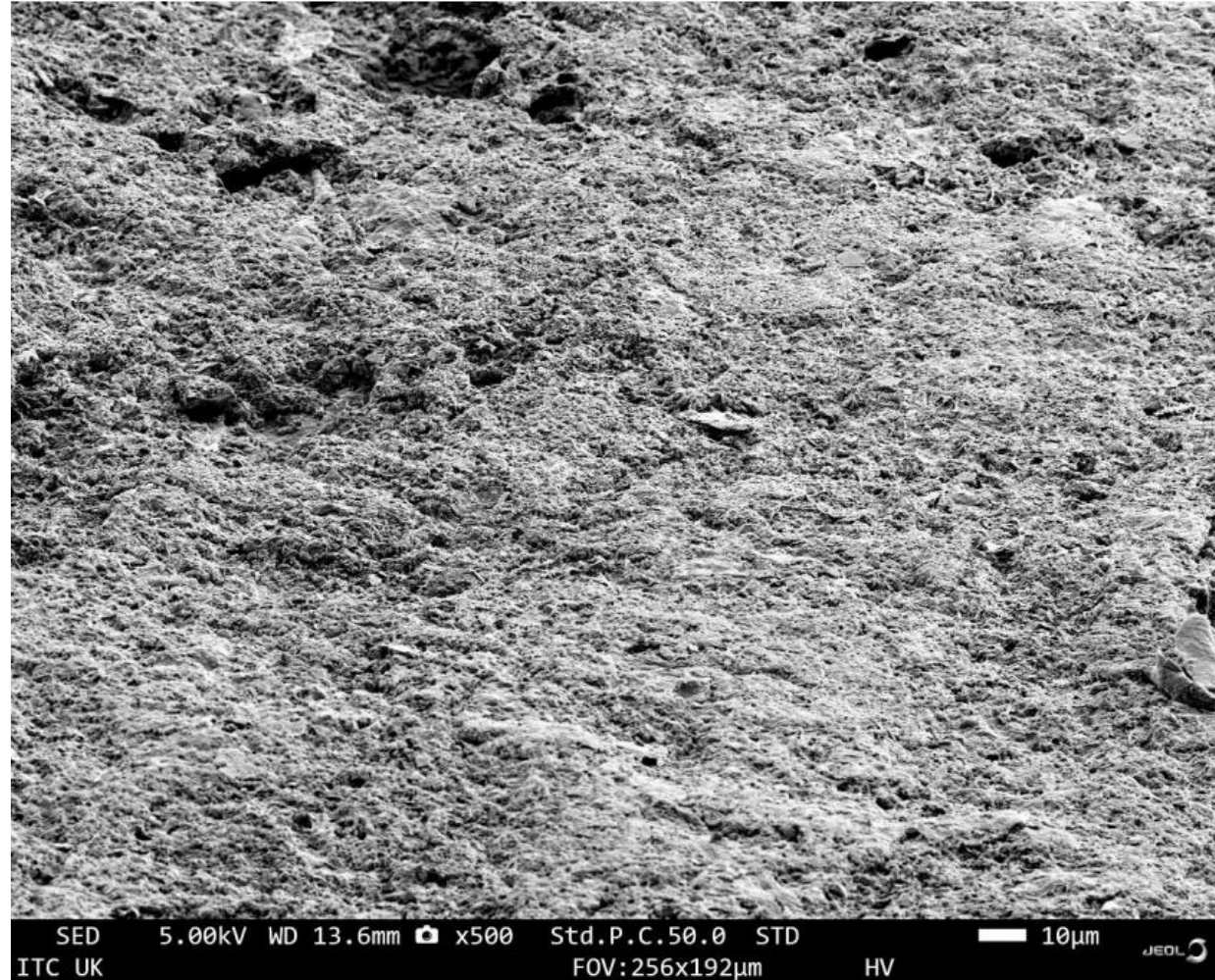
- ✓ Network bridging / film-forming
- ✓ Porosity control
- ✓ Surface hold-out



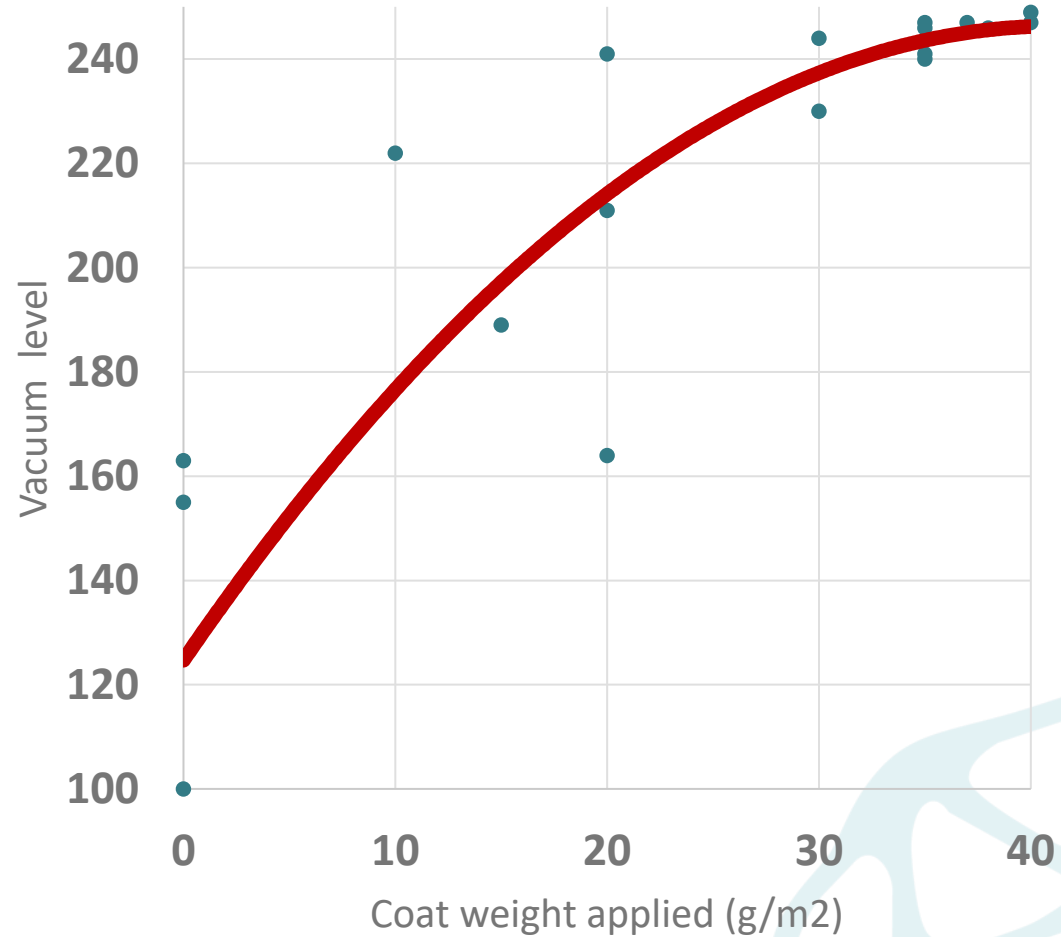
**Delivered efficiently through the use of FiberLean® ultra-fine grinding technology**



The coating jet must be applied gently in order to make an even coating layer.



# Vacuum needs to increase significantly in order to drain the low permeability coating



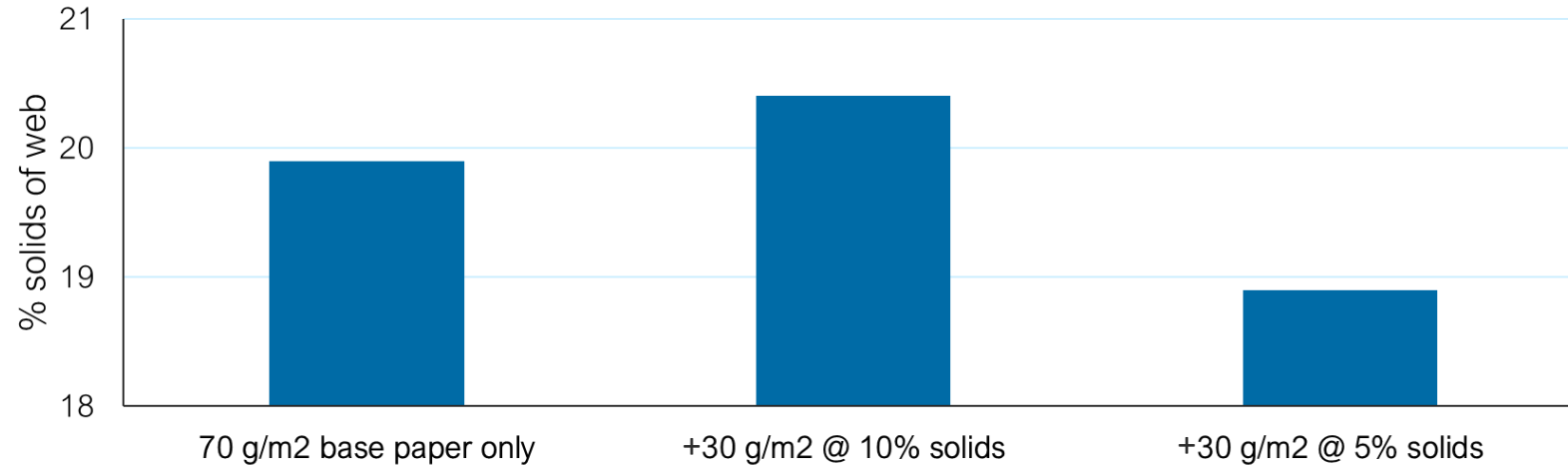
Vacuum pump Ampere increased 50%.

*Vacuum measurements made in full scale trials on paper machine operating at 500 m/min.*

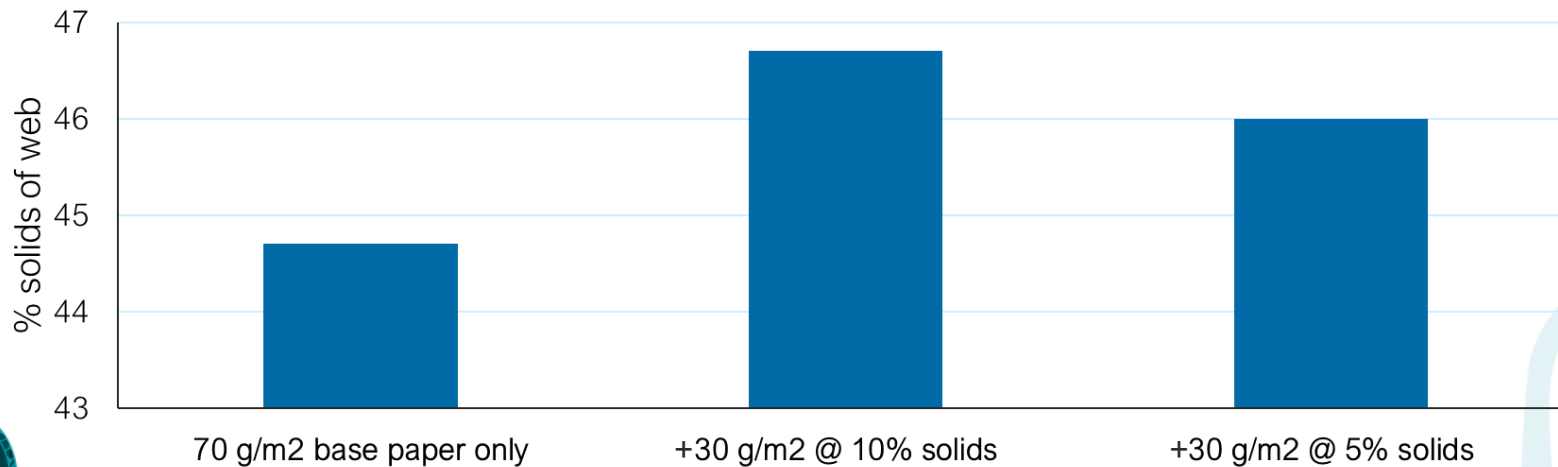


# Couch and press solids are dependent on PM equipment and on keeping application solids high

## Couch solids:



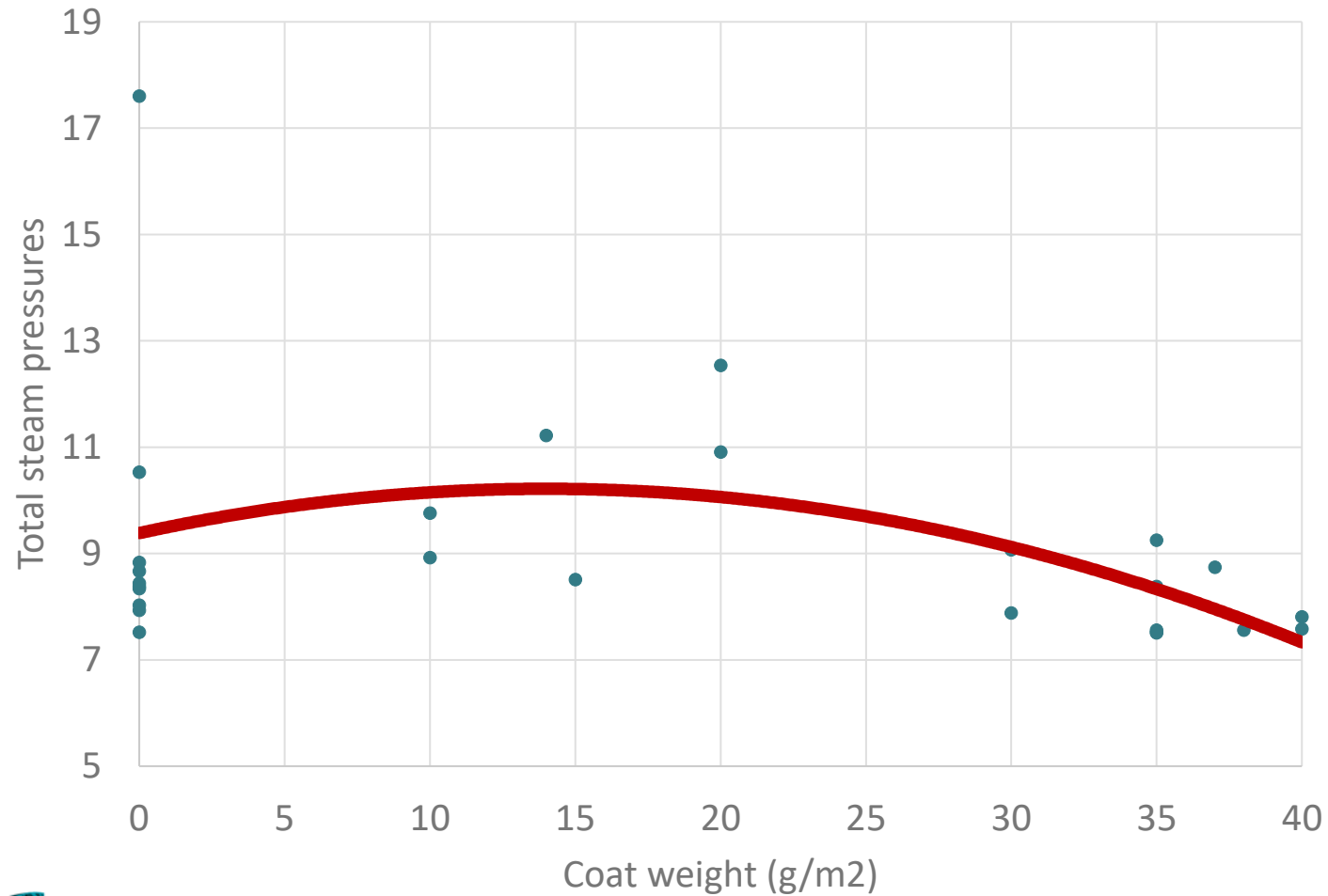
## Press solids:



*Web solids measurements for coatings of 20% MFC and 80% calcium carbonate made in pilot trials on RISE Fex in Stockholm, Sweden.*



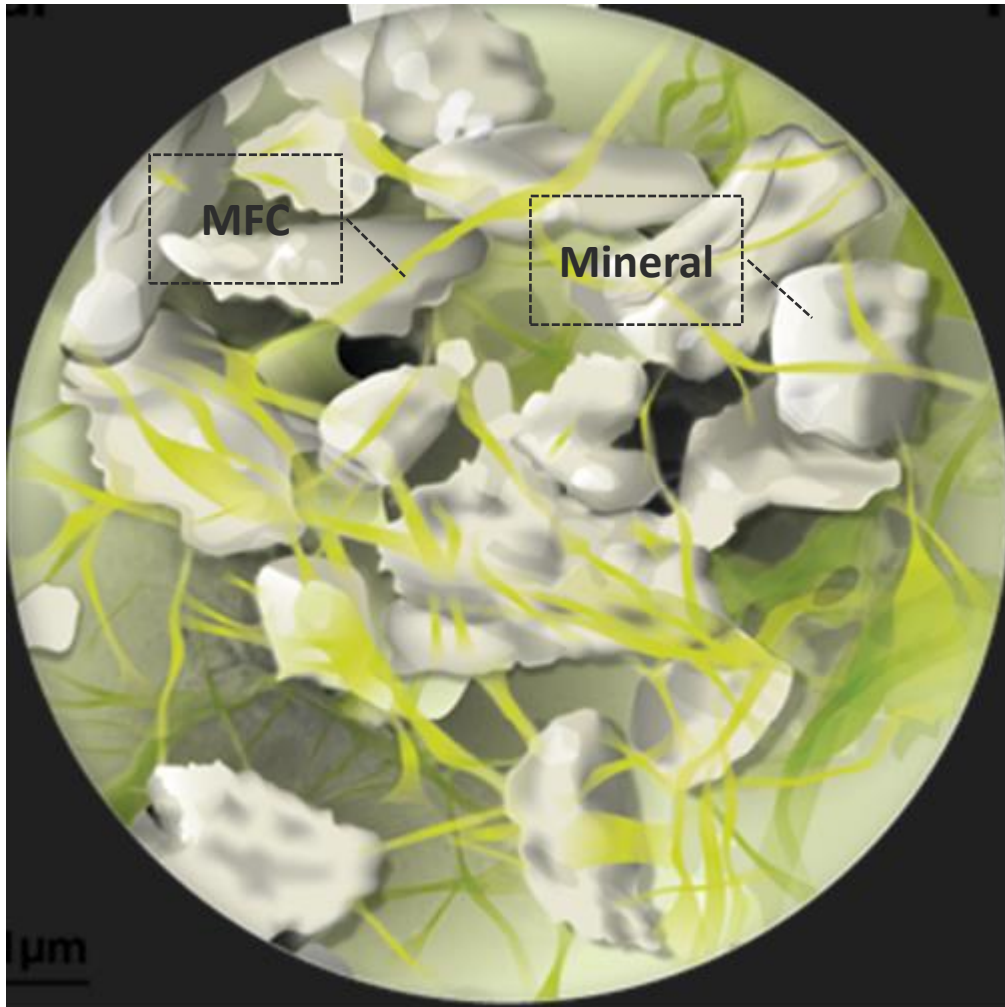
Steam consumption is broadly maintained with increased coat weight at constant speed and total basis weight.



*Steam measurements made in full scale trials on paper machine operating at 500 m/min.*



Starch granules are much larger than filler particles and retain well when applied as MFC-mineral-starch mixtures.



Typical corn starch

Starch and/or mineral on their own would not stay well on the surface if applied wet-in-wet on top of the wire. MFC, as a binder, also has the important role of preventing penetration of coating components into the base web.

Typical wheat starch



# FiberLean® MFC applied via wet-end coating

Provides many interesting properties for barrier products



*"A revolutionary way to use MFC to enhance barrier properties of packaging materials and enable the replacement of plastics and other fossil fuel-based materials; increasing bio content and improving sustainability."*

## High Performance



- ✓ Oil & Grease resistance.
- ✓ Oxygen & Aroma barrier.
- ✓ Mineral oil barrier.

## Durable & Versatile

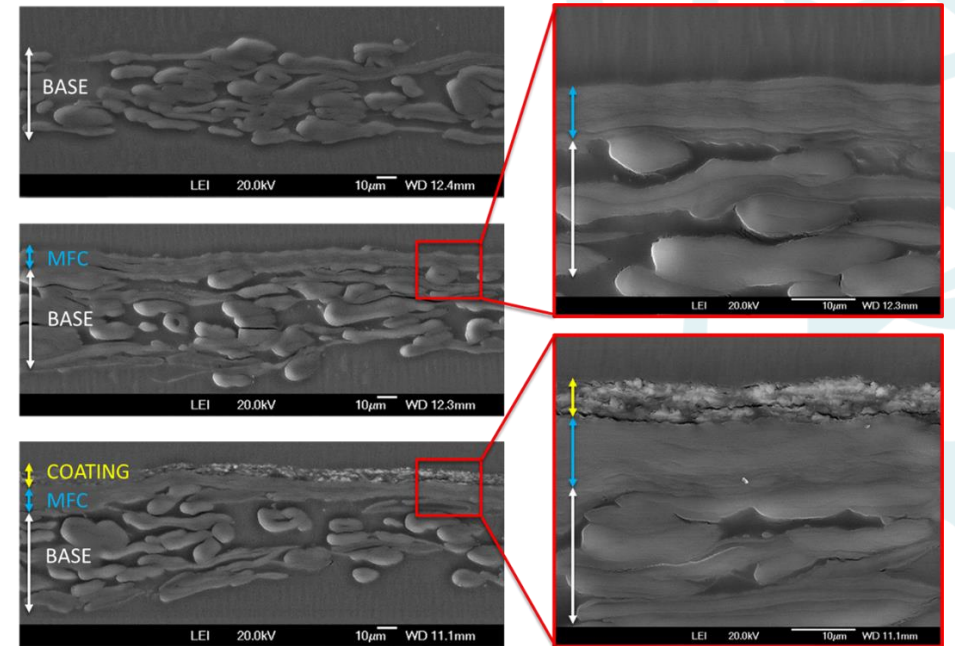


- ✓ Very smooth & closed surface.
- ✓ Excellent substrate for subsequent coatings.
- ✓ High-strength & fold/crack resistant layer.

## Sustainable



- ✓ High bio-based content, sustainable packaging.
- ✓ Replacement of PFAS & Petrochemical materials.



Scanning Electron Microscope (SEM) Cross-section Imaging

- FiberLean® MFC remains on the surface, forming a fibril-film.
- The MFC layer has a very closed structure, preventing penetration of oil and air.
- The surface serves as an excellent substrate (primer) for subsequent coatings (i.e., topcoats to achieve moisture / water barrier).





# Conclusions/Summary

- ✓ The concept of applying MFC on top of a draining base paper was introduced to PTS Coating Symposium already back in 2017.
- ✓ Most of the six years of development since then have been spent on equipment design and understanding how to manage MFC rheology during application at high speed.
- ✓ Through multiple full-scale trials, we have now proven that MFC-mineral coatings are suitable to make White Top Liner.
- ✓ The keys to success are,
  - The novel design FLoT applicator.
  - MFC quality optimization.
  - The ability to make major quantities of correct quality MFC available for trials.
- ✓ This new “FiberLean on Top” application technology can also be used to apply pure MFC for barrier purposes.





# Thank you!

