



# **Cellulose fibre-based single use food packaging: Regulatory considerations – a case study**

*FiberLean MFC grinders and MFC*

---

Presented by:

David Skuse

**Managing Director**

8th September 2026

# Presentation outline



- Company Overview.
- Why MFC?
- Why FiberLean MFC grinders?
- The regulatory clearance process.
- Current status.
- Conclusions.

# Company overview



## FiberLean Technologies sell FiberLean MFC grinders

Leading independent MFC equipment supplier.

Operating since 2016.

World-class technical expertise in MFC technology and production.

Operating industrial-scale MFC plant in Trebal, Cornwall producing MFC for trials and interim supply.

State-of-the-art industrial research and application laboratories.

Capability to conduct onsite MFC trials worldwide.

Experienced engineering and project implementation team.

Leading research on MFC use and application with extensive patent portfolio.

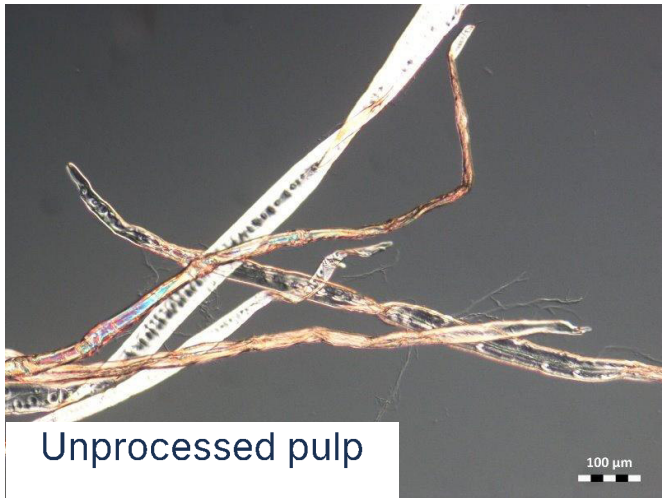
Equipment supply and fabrication partners.

# Why MFC?

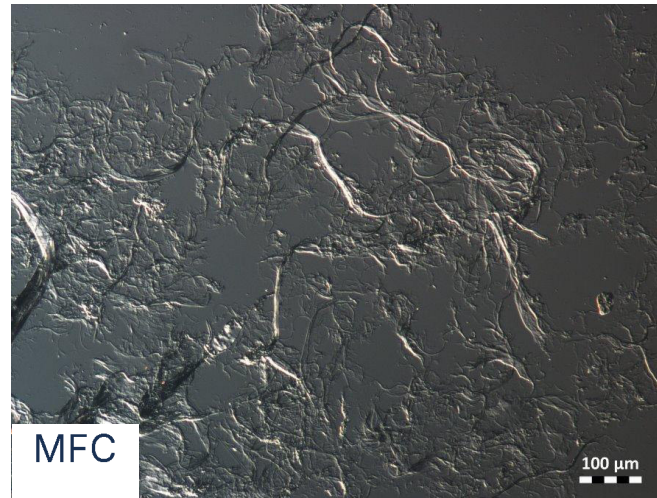


## What is MFC?

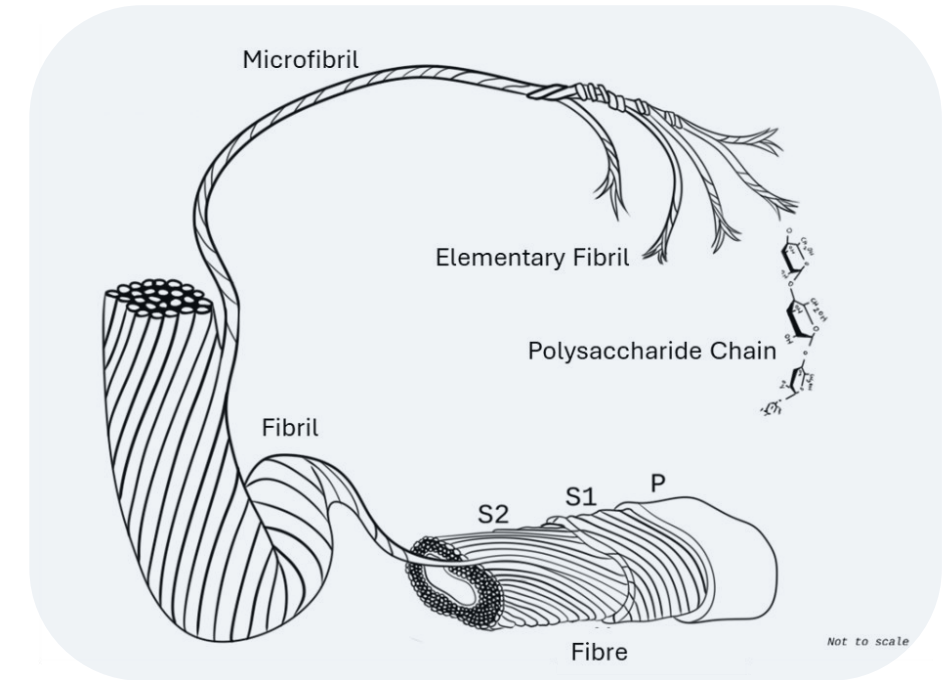
- Micro-fibrillated Cellulose (MFC) is made from cellulosic feedstocks such as wood pulp, which are **mechanically disintegrated** to liberate **their fibril and microfibril sub-structures**.
- This greatly increases specific surface area and fibril aspect ratio. Enhances bonding ability.



Unprocessed pulp



MFC



# Why MFC?



MFC has promised great value for many years but take-up has been slow.

Obstacles – Production equipment, cost, regulatory clearance, material availability.

Reliable cost  
effective MFC  
production  
equipment:

***FiberLean MFC  
Grinders.***

Integrated  
production of  
MFC €150-350  
tonne.

Broad regulatory  
clearance.

Multi-tonne  
production of  
MFC for trials  
and interim  
supply.

**The route to adoption is now clear.**

# Why MFC?

Using MFC in a paper furnish or coating



- MFC is a wet and dry strength agent.
- Enhanced bonding.
- Formation of closely packed, dense layers.
- Recyclable, compostable, sustainably sourced.

- Lightweighting.
- Reduced long fiber, increased filler.
- Improved mechanical and elastic properties.
- Reduced porosity.
- Improved coverage.
- Barrier properties.
- Improved environmental performance.
- Improved runnability.

# Why MFC?



Many applications: Specialty papers, moulded objects, barrier bases, white outer layers, graphic paper, recycled boards and tissue...

- **PFAS-free food wrap.**

Barrier performance of wet-end applied MFC significantly reduced sheet porosity and surface closure ratings up to 2113 (sec/100ml) in Gurley porosity testing.

- **8gsm MFC + starch.**

- **Grease resistant paper for food wrap.**

- **Food trays.**

Increased density.

Increased smoothness.

Increased Scott bond, tear, tensile and SCT.

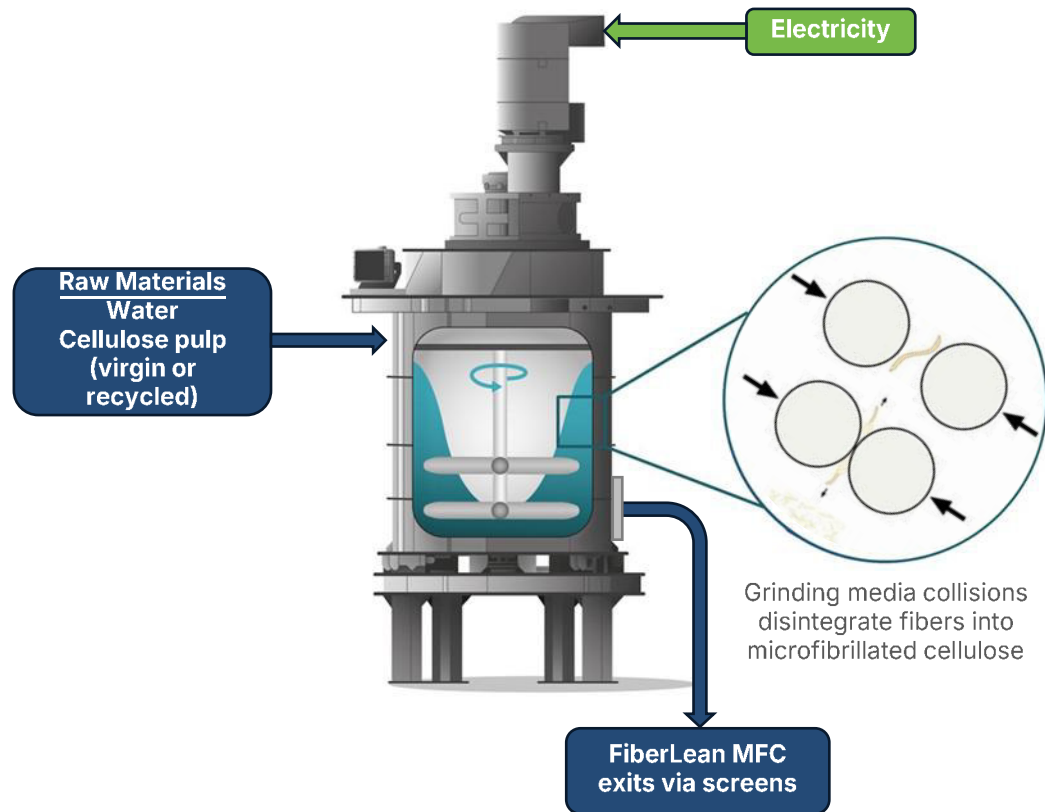
- **90% reduction in porosity.**

- **30% reduction in weight.**

# 1. Why FiberLean MFC Grinders?



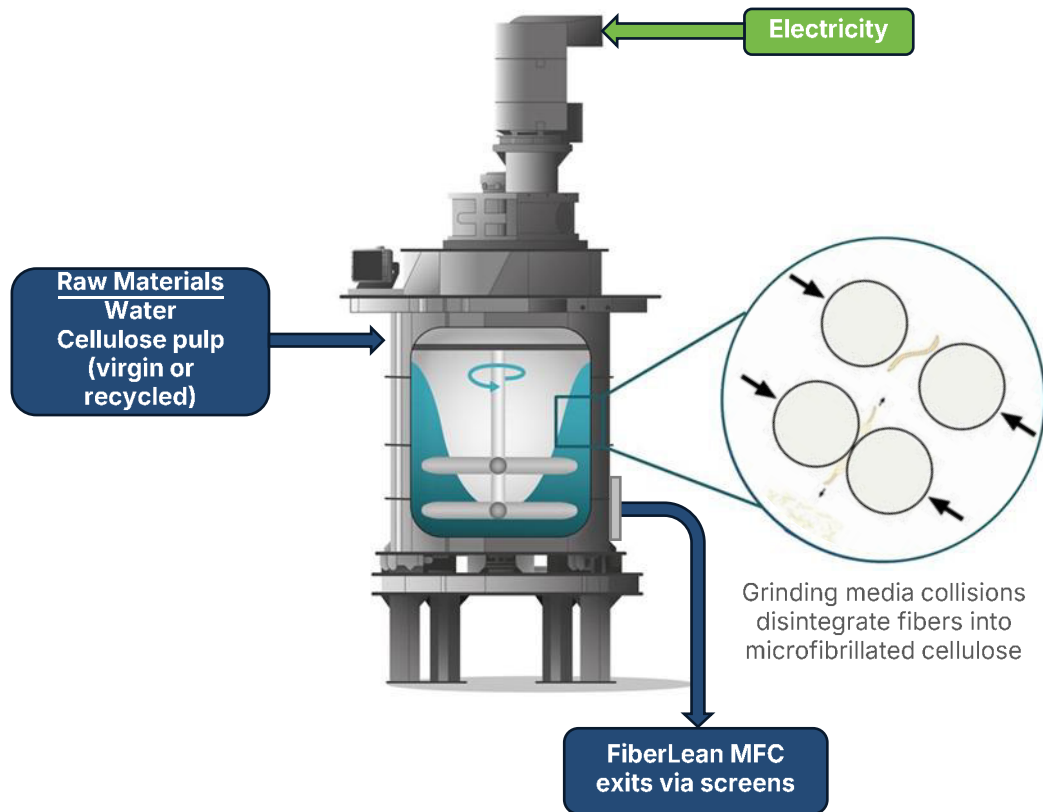
## Vertical Wet Stirred Media Mill Grinders



### How it works

- Stirred vessel, charged with water, pulp and ceramic grinding media.
- Fibrillation occurs when pulp gets trapped between colliding grinding media particles.
- Grinding media are the 'working surfaces' for fibrillation; very high active surface area; permits high throughput and efficient production of MFC.
- Pulp suspension is added continuously to top of mill.
- Product exits continuously through screens near bottom of mill.
- Energy input is controlled with outlet flow rate and motor power.
- Mechanical, additive-free process.

## 2. Why FiberLean MFC Grinders?



### Advantages

- Simple, robust, cost-effective design.
- Easy to operate with low supervision.
- High uptime > 98%.
- High-quality MFC from a wide range of feeds.
- Highly tunable – optimise structure property relationships for applications.
- MFC cost is energy + consumables.
  - €150-350 per tonne of MFC.
- Low total project capex – fast payback times.
- Outperform competitive technologies by ~30%.

# FiberLean MFC Grinder Models



|                                                                |      | FiberLean G125*         | FiberLean G175                  | FiberLean G250                        |
|----------------------------------------------------------------|------|-------------------------|---------------------------------|---------------------------------------|
| Typical use case                                               |      | Moulded fiber producers | Tissue mills, small paper mills | Medium to large paper and board mills |
| Footprint (m)                                                  |      | 3.4 × 2.1               | 2.0 x 2.0                       | 2.6 × 2.6                             |
| Max. height (m)                                                |      | 3.85                    | 4.90                            | 7.50                                  |
| Capacity<br>(at energy inputs of<br>3500 kWh/t – 750<br>kWh/t) | kg/h | 11 -53                  | 40 - 190                        | 96 - 447                              |
|                                                                | tpa  | 95 - 440                | 340 - 1600                      | 790 - 3700                            |



\*G125 footprint includes electrical panel, G175 and G250 footprints refer to the grinder only.

# The regulatory clearance process



Moral/ethical responsibility to produce safe materials and comply with legislation.

- Legislative requirements vary around the world.
- Typically, aspects include:
  - **Manufacturing and occupational exposure.**
  - Human toxicity.
  - Ecotoxicity.
  - **EU Nano material regulations.**
  - **Food contact clearance.**
  - Environmental impact.

All the above aspects were addressed, only those in **bold face** are presented here.

# Manufacturing and occupational exposure



## Multiple considerations

### Chemistry

- Extensive testing required by various regulatory agencies.

Fibre dimensions (Fiber Analyser)  
Particle size (light scattering)  
SEM Fibril width

Shape  
Surface charge  
Viscosity  
pH  
Hydrolysis  
Zeta potential  
.....

Molecular mass/ range  
Morphology  
Aggregation  
Chemical composition  
Thermal decomposition profile  
Solubility

- **No changes detected compared to feed pulp other than size.**

### Dusting Testing

- Utilised PM10 nanoparticle detecting technology.
- Testing at UK MFC manufacturing facility, US pilot and full-scale paper machines and paper shredding simulation.

- **No nano dust beyond background detected.**

### Discharge

- <10 kg cellulosic residue/tonne MFC.
- Either processed through mill effluent system or used for soil remediation.

# EU nanomaterial regulations



EU updated definition of a nano material in 2022 (2022/C 229/01).

**".....50% or more of these particles in a number-based size distribution fulfil at least one of the following conditions:**

**(a) One or more external dimensions of the particle are in the size range 1 nm to 100 nm....."**

- Guidance on implementation was published in 2023 (JRC132102\_01).
- The guidance offers clarity on the interpretation of several important topics.
- **The meaning of 'particle' and 'external dimension(s)'.**
- **The differences between nano material and nano structured material, The EU regulations cover nano materials not nano structured materials.**
- **Acceptable methods of measuring the external dimensions of particles. Complex shaped particles (such as MFC) should be characterised using both maximum inscribed circle and Feret dimension approaches.**

Feret<sub>min</sub>



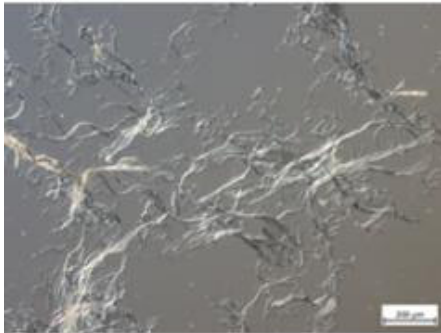
Maximum  
Inscribed Circle



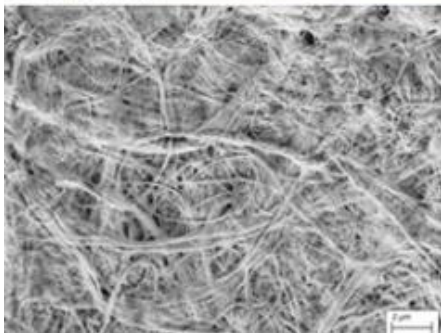
# EU nanomaterial regulations



Unprocessed  
pulp



Optical  
micrograph  
showing MFC  
coarse  
macrostructure



SEM showing  
MFC fibrillar  
micro and nano  
structure

| Sample                         | Measurement                 | D50 (nm) | % < 100 nm |
|--------------------------------|-----------------------------|----------|------------|
| FL MFC finest<br>psd prototype | Maximum inscribed<br>circle | 202      | 11         |
|                                | Minimum Feret               | 303      | 11         |

**The (coarse) external dimensions of the particles in FiberLean MFC products preclude its classification as a nanomaterial according to the updated EU definition.**

**FiberLean MFC is a nano structured material that is not subject to the EU nano material reporting requirements.**

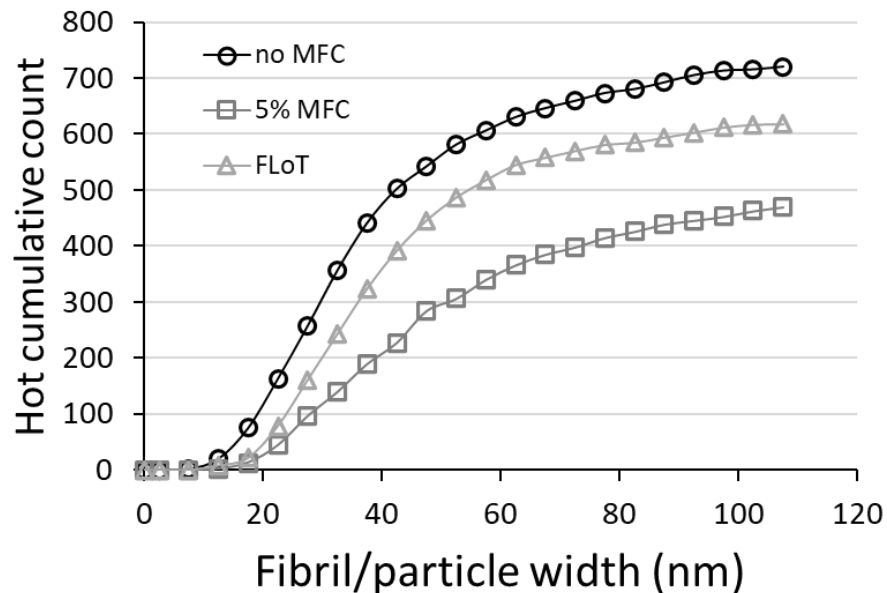
*EU Nano or not nano: An unbiased approach to classifying FiberLean microfibrillated cellulose, Hewson et al, Cellulose, (2024). <https://doi.org/10.1007/s10570-024-05980-z>*

# Food contact clearance



The most stringent regulation (BfR) hinged on demonstrating less migration than with control sheets.  
Technique development was required - Comparative analysis of migrated MFC using quantitative SEM.

MFC containing sheets migrated less than control.



## Conclusions

Fewer counts from sheets made with MFC than from sheets made with standard furnish.

- **16-83% less migration from cold water tested samples.**
- **14-58% less from hot water migration samples.**
- **29-75% less from dry abrasion tested samples.**

# Food contact clearance



## USA – FDA FCN 2413

- As an additive, a raw material component, or coating in the manufacture of food-contact paper and paperboard
- As a coating on food-contact polymers under a polymer barrier layer
- As a component of adhesives used in the manufacture of multi-layer food contact materials
- With the limitation that “The FCS is not for use in contact with infant formula and human milk”. The FCN notification can be found [here](#).

## Germany – BfR

- MFC listed in recommendations on Materials for Food Contact: food contact use paper and board for food contact (XXXVI), cooking papers, hot filter papers and filter layers (XXXVI/1), Paper and Paperboard for baking purposes (XXXVI/2) absorber pads based on cellulosic fibres for food packaging (XXXVI/3) and polymer dispersions (XIV).
- “Microfibrillated Cellulose formed by mechanical treatment of cellulose pulp with or without a mineral according to section A.II (Fillers) of the BfR-Recommendation XXXVI. The fiber content of the ground mixture is 80-100% by weight. The amount of the finest fraction after centrifugation must not exceed 10%. The mean fibril diameter by number is >20 nm. Enzymes are not allowed to be used in the manufacturing process”. The listings can be downloaded [here](#).

## Brazil – ANVISA

- Coming soon

**“The amount of the finest fraction after centrifugation must not exceed 10%. The mean fibril diameter by number is >20 nm. Enzymes are not allowed to be used in the manufacturing process.”**

# Food contact clearance



Samples representing range of materials from FiberLean MFC grinders were characterised.

| Sample   | Finest Fraction (wt %)<br>Must be < 10% | Mean Fibril Diameter (nm)<br>Must be > 20 nm | BfR Compliant? |
|----------|-----------------------------------------|----------------------------------------------|----------------|
| Coarse   | 2.5                                     | 36.1                                         | Yes            |
| Moderate | 2.0                                     | 27.0                                         | Yes            |
| Fine     | 3.9                                     | 36.6                                         | Yes            |

All MFC samples produced from FiberLean MFC grinders fall within the BfR regulation.

# 1. Current status: Grinder-produced MFC



Regulatory, End-of-life, ESG

- **BfR, FDA, ANVISA, Canadian and Chinese food contact paper clearance.**
  - FDA FCN 002413, BfR Recommendations XXXVI, XXXVI/1, XXXVI/2 & XXXVI/3.
- **Not a nano-material** according to US EPA and EU definitions.
- **No negative health effects found.**
  - Dietary Study
  - Physical, chemical, and toxicological characterisation
  - Inhalation risk analysis
- MFC not a final product but we have carried out the following testing to confirm MFC has no negative impact on end of life:
  - **Recyclable** – PTS-RH 021:2012 – bleached and unbleached MFC coated papers passed.
  - **Biodegradable** – OECD 301B – MFC suspensions with and without biocide were biodegradable.
  - **Compostable** – ISO 14855 – bleached and unbleached MFC coated papers were biodegradable under industrial composting conditions.
- Allows lighter products, reducing transport related emissions.
- Supports recyclability and circular economy by enabling plastic replacement in packaging.

# Conclusions and comments



- Regulatory clearance for MFC from FiberLean MFC grinders is in place.
  - Manufacturing and occupational exposure, human toxicity, ecotoxicity, nano material regulations, food contact clearance, and environmental impact have been addressed.
- Regulatory clearance takes time. Start as early as you can.
- You can't start until you have a product or product range definition. Try to think ahead - How might your product change in the time needed to get the clearance?
- Use expert third party contactors where it makes sense. We acknowledge the great work from Vireo Advisors LLC.

## **The historical obstacles that limited the uptake of MFC have been removed.**

- FiberLean MFC grinders are simple and robust, have a cost-effective design, are easy to operate with low supervision and are proven.
- Integrated production cost of MFC is ~ €150-350/ tonne of MFC. An order of magnitude less than merchant MFC.
- Broad regulatory clearance for MFC is in place.
- Multi -tonne production of MFC is available for trials and interim supply.



# Thank you for your attention

**David Skuse**  
Managing Director  
[david.skuse@fiberlean.com](mailto:david.skuse@fiberlean.com)

**E:** [info@fiberlean.com](mailto:info@fiberlean.com)

**W:** [www.fiberlean.com](http://www.fiberlean.com)

 **FiberLean Technologies**