



Dispersion Barrier Coating for 3D Molded Fiber (MF)

Overview of Surface Application Technology

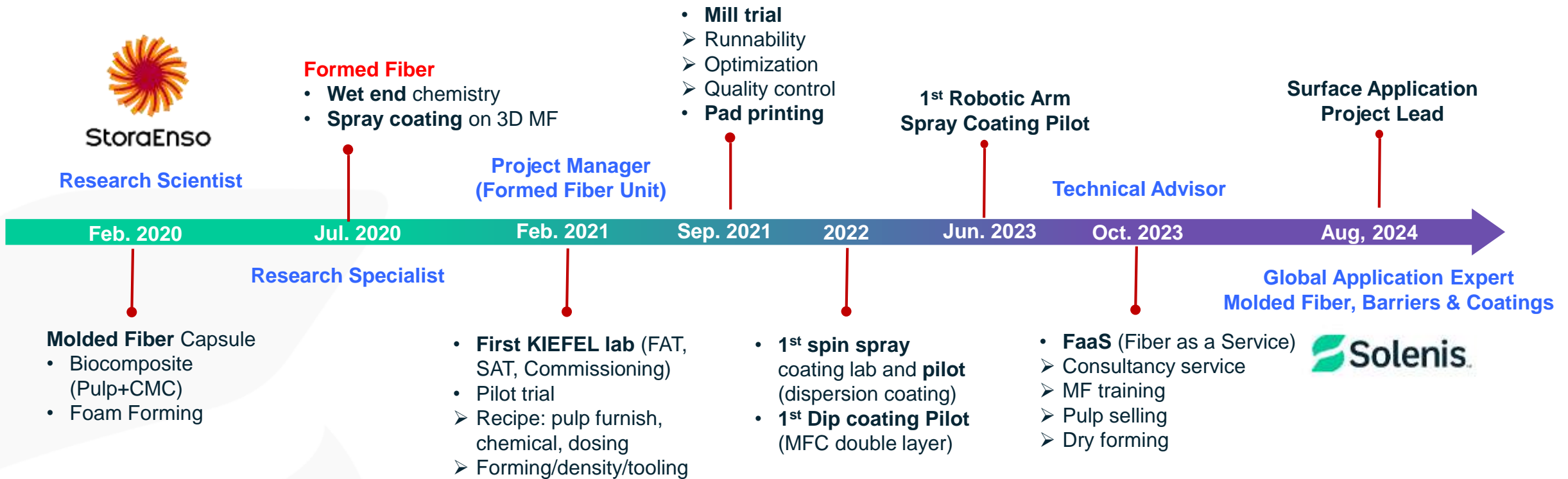
Thermoformed Molded Fiber Symposium | Umaine | Dec 10-11, 2024

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Global Application Expert - Molded Fiber, Barriers & Coatings



Self-Introduction

Work experience on MF/Surface Coating



Content Guide

1. Introduction
2. Molded Fiber
 - a. Forming and barrier technology in general
 - b. Barrier performance and market needs in food application
 - c. Challenges with surface coating
3. Surface Coating Application Technology
 - a. Dip coating
 - b. Pad printing
 - c. Droplet jetting / drum coating
 - d. Spray coating
 - ✓ Robotic arm spray
 - ✓ Fog deposition
 - ✓ Spin spray
 - e. Solenis pilot facilities
4. Conclusion
 - a. Acknowledgement
 - b. Let's Connect

Introduction to Solenis

Our global reach



Molded Fiber

Types of Molded Fiber



High-end segment

- Type 3 Thermal formed
- Primarily virgin fiber/ Recycled fiber
- High T and P
- High density, 400-700 gsm
- High smoothness
- Type 4 Post processing
- Die cutting
- Coating/lamination
- Printing

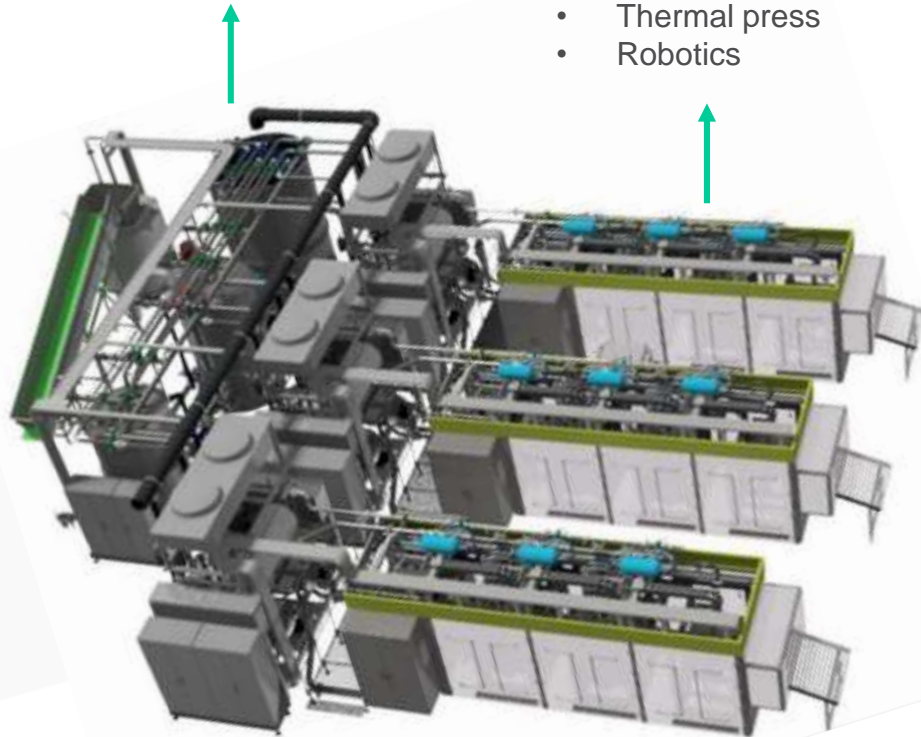
Molded Fiber: Typical WMF and DMF system

Stock preparation

- Pulp furnish
- **Wet end chemicals**

Thermal forming

- Forming
- Cold press
- Thermal press
- Robotics



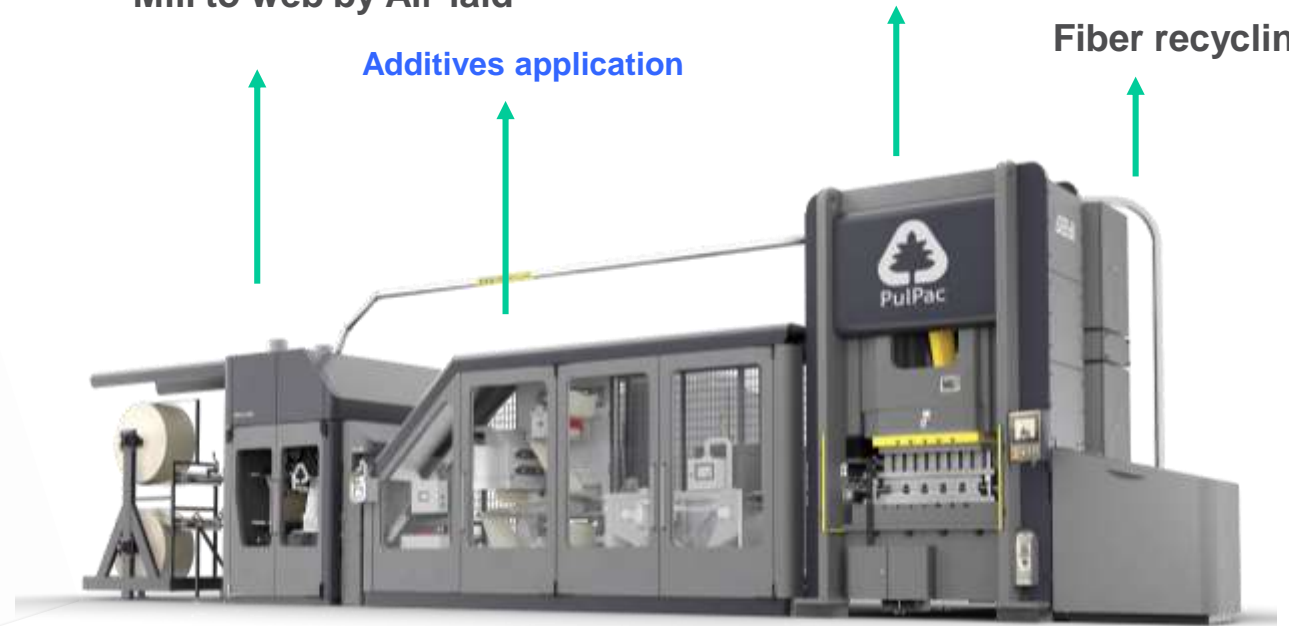
Adequate fiber interaction with wet end chemicals

Mill to web by Air-laid

Additives application

Thermal forming

Fiber recycling



Barrier apply in fiber defibrillation/ on web/ pretreatment of fluff pulp

Molded Fiber by Wet End Chemistry

Wet end chemistry



Foaming



Fiber flocculation



Tool clogging



Uneven formation



Key for MF:

- Optimized pulp furnish
- Right WOGR chemicals

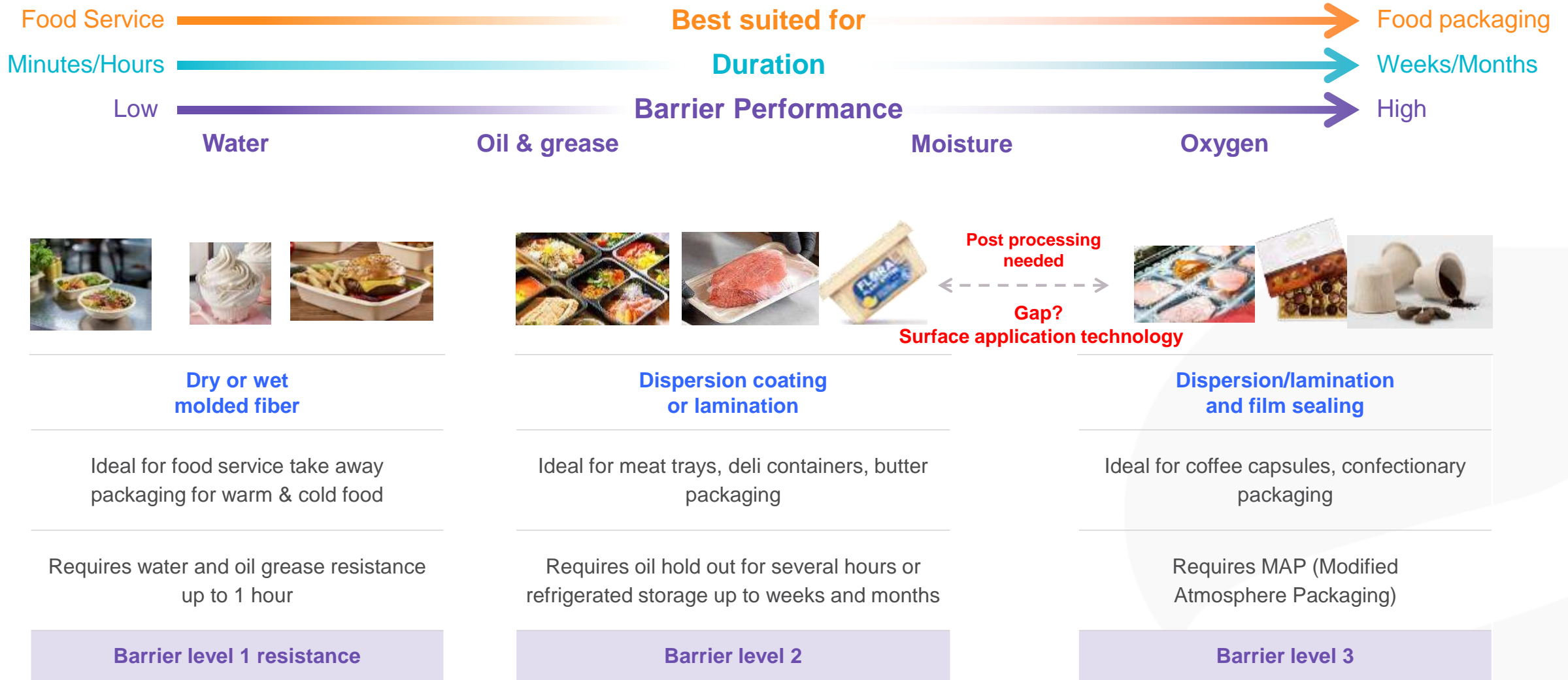
- Even formation
- High density

- Tool design
- Machine set up



Good enough barrier property?

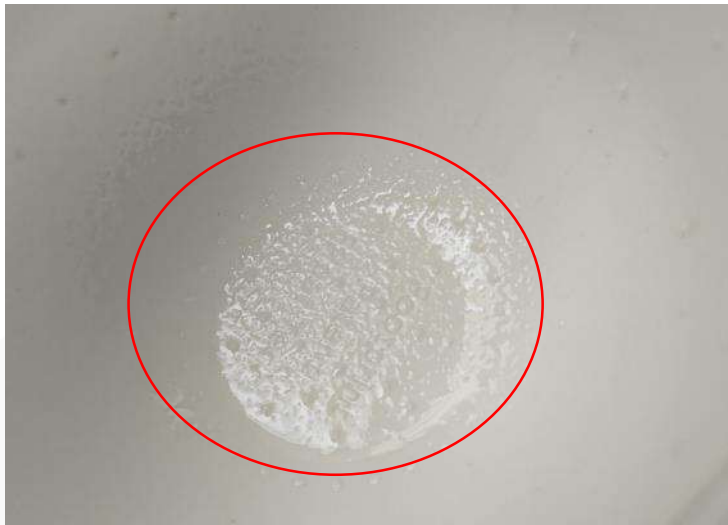
Mapping barrier performance across applications



II. Molded Fiber

Challenges by surface coating

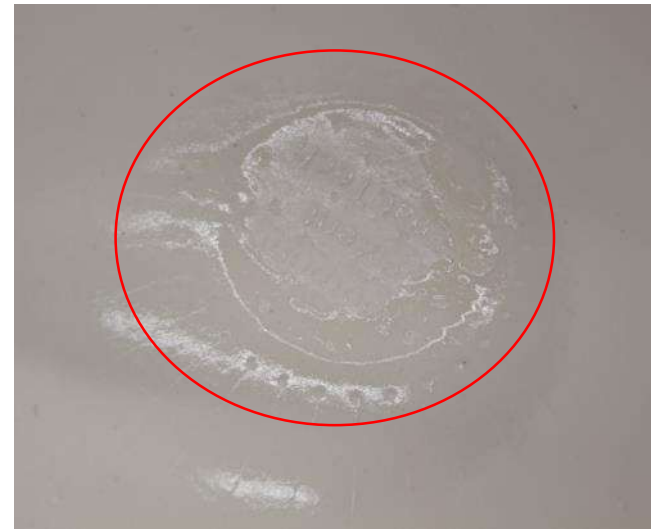
Poor barrier coating examples



Uneven coating



Pinhole



Pooling



Bubbling/blister

Other Challenges: Regulation, materials, higher cost, market needs, etc.

Note

Technical information, images and videos in the slides are either published or permitted by partners/suppliers.



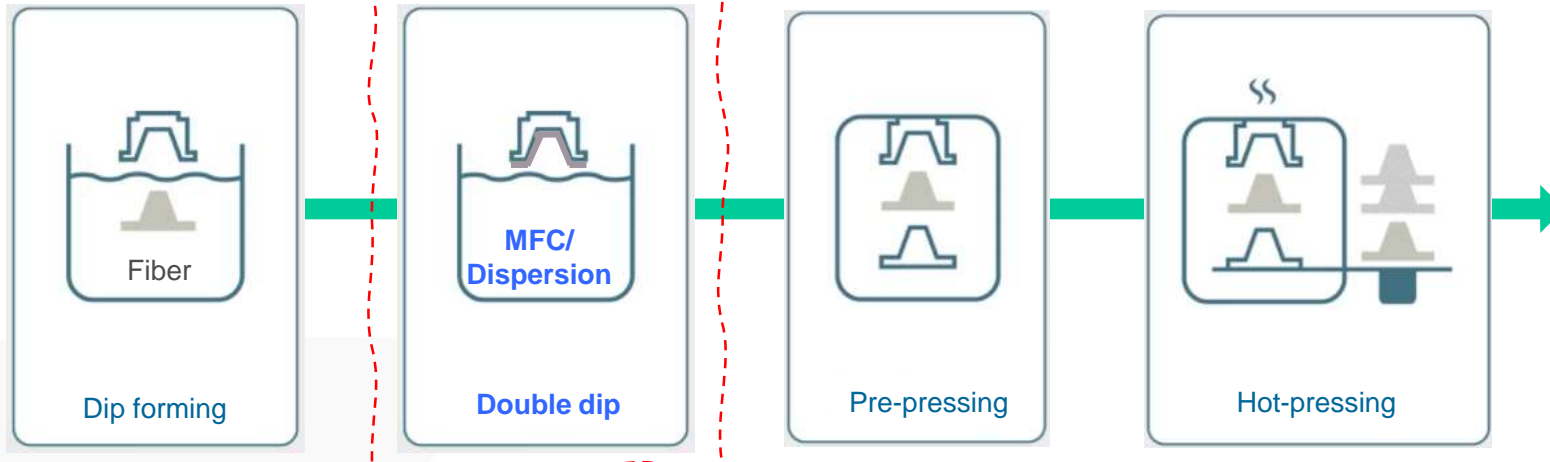
Surface Coating Application Technology

What is available?

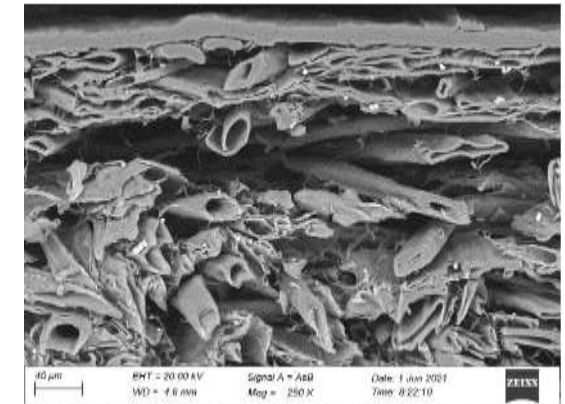
Surface Coating Technology

Dip coating

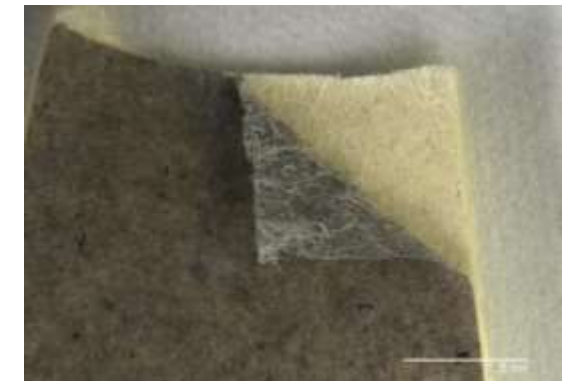
Built in solution without post process



Double layer structure



MFC layer ~10μm



Surface Coating Technology

Dip coating

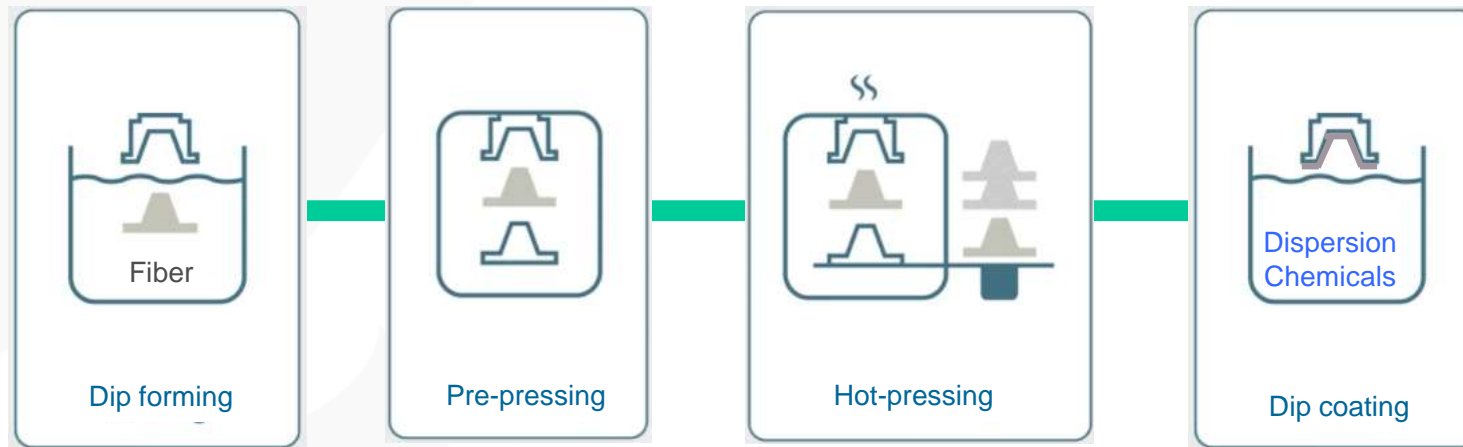
Advantages:

- 1) Easy built-in process to avoid post processing.
- 2) Uniform coating even on complex shapes.
- 3) Higher level barrier performance via double layer structure.
- 4) Additives in each layer can be designed accordingly.

Challenges:

- 1) Works well for relatively high refined pulp, but if using MFC, longer dewatering, prolong the drying time, thus Longer CT.
- 2) Second layer can be sticky to the mold, if using dispersion chemicals, affect the machine runnability.

Can be post processed



Challenge:

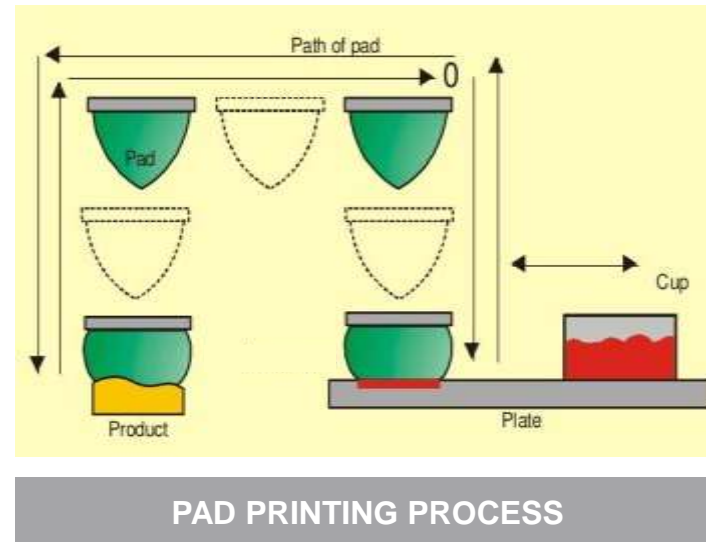
Product handling and Non-contact post drying



Surface Coating Technology

Pad Printing

- **Transfer printing technology**
 - Barcode
 - QR code
 - Passport
 - Logo
 - Colourful
- High productivity
- Applicable for 3D shapes
- **Replace printing ink with dispersion coatings**



Surface Coating Technology

Pad Printing



Demo trial with dispersion coating

- Theoretical works for multilayer purpose
- Each cup hold a dispersion chemicals
- Short CT. Each printing complete within few seconds



Tool design: Silicone Pad



Single cavity machine
(RISE)

Surface Coating Technology

Pad printing

Findings and challenges:



Pad + Rig

- Different silicone hardness
- Shape dependent on the MF products

Stickiness

- If high viscosity, coating left over
- Fiber stick to pad

Flowability

- If Low viscosity, no even distribution on pad
- No even coating

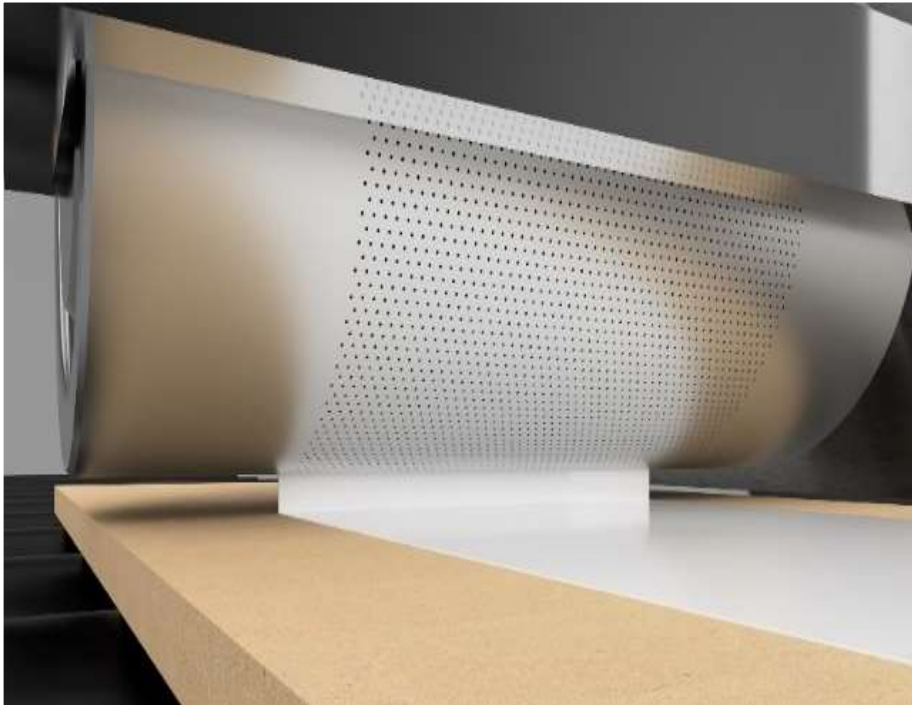
Transferability

- Hard to reach to the corner
- Uneven left over on pad after printing
- Weird pattern on substrate
- Potentially can work for round bowl

Surface Coating Technology

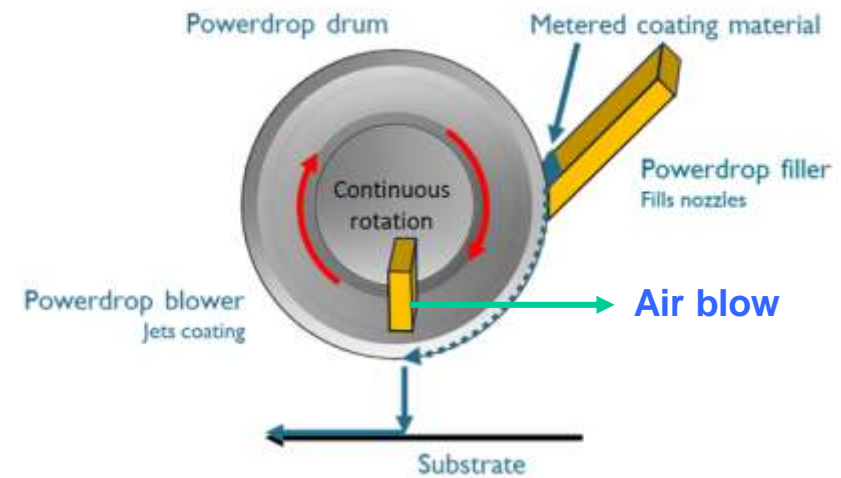
Droplet Jetting / Drum Coating

Core of the coating technology



The drum can be designed and suitable for 3D articles

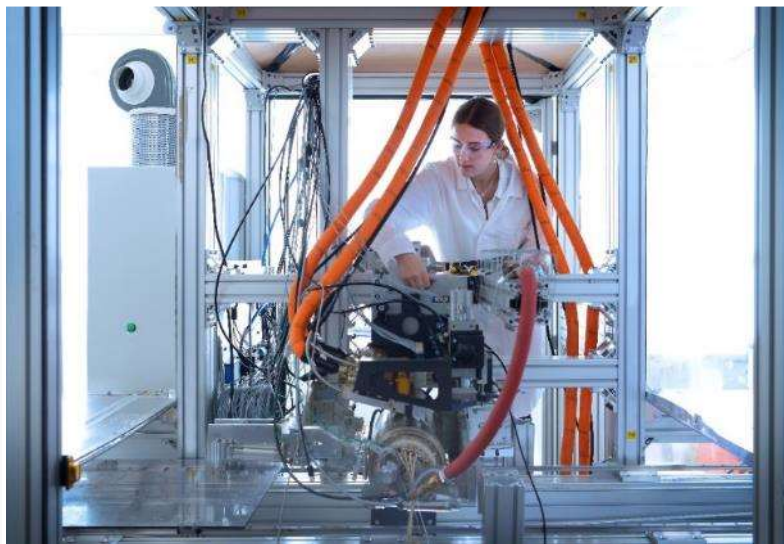
The Powerdrop™ coating process



Surface Coating Technology for 3D MF

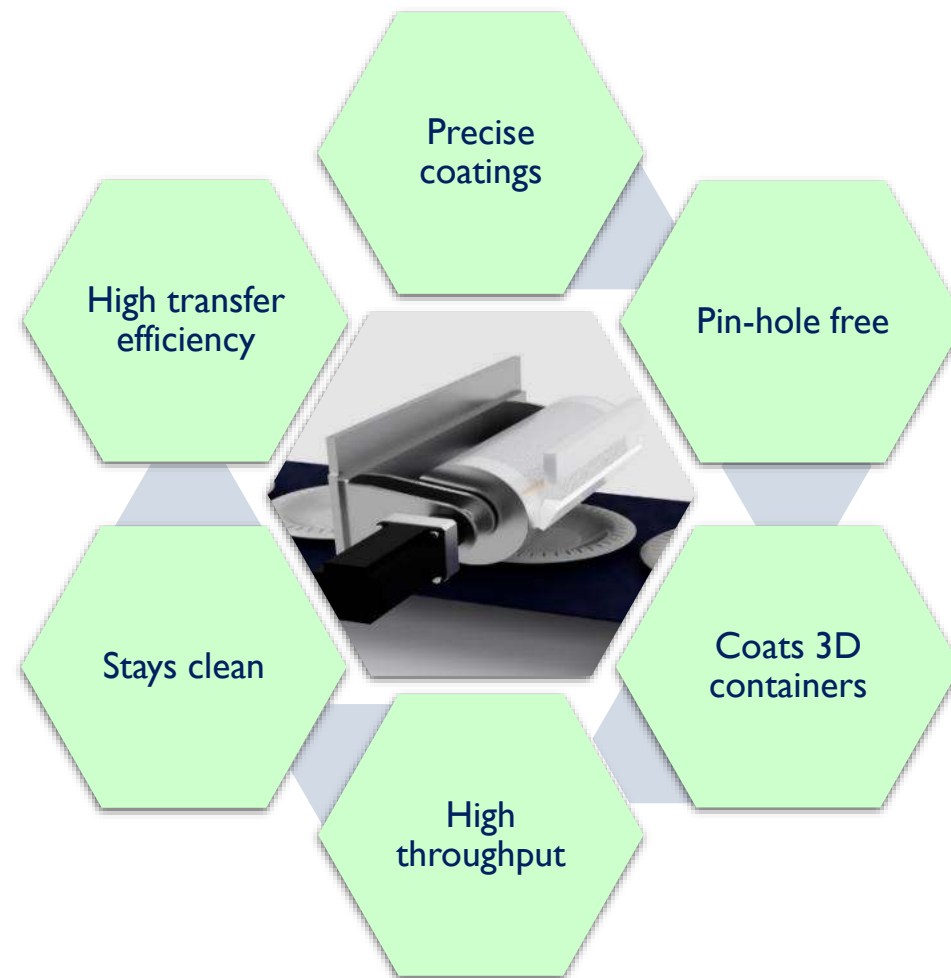
Droplet jetting / Drum Coating

The Power drop coating system



Challenge:

- Even coating for complex geometry
- Drum design suitable for each 3D
- Tooling Cost



Surface Coating Technology

Spray coating - Robotic arm spray

The Pilot Robotic arm spray coating system – Programmable and smart spray coating



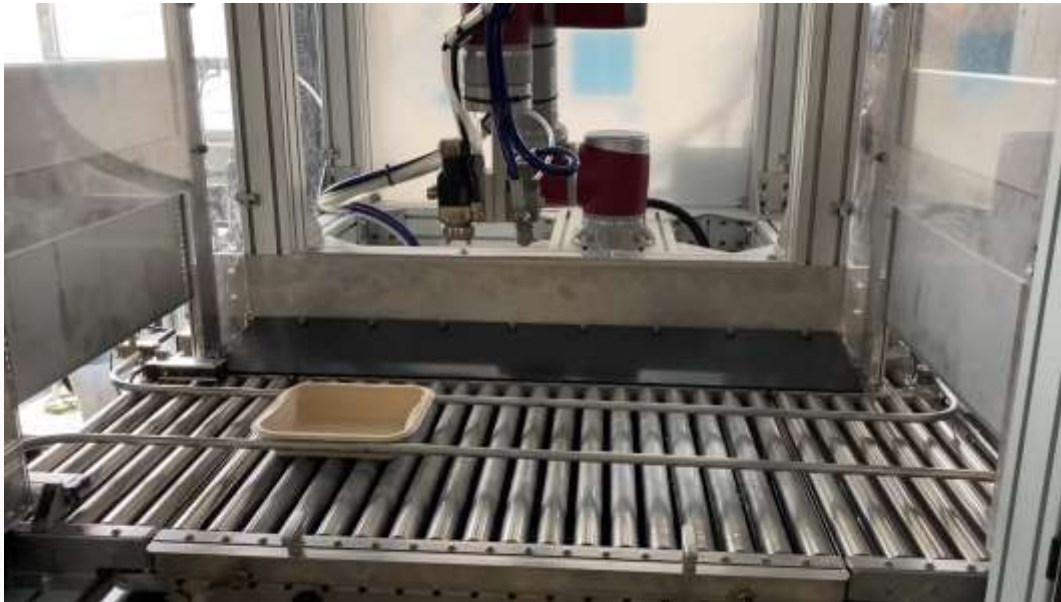
- Robotic arm spray chamber with double-spray gun
 - **Airmix & Airless** spray guns
- Sensor to detect the sample feed in
- Stainless steel roller conveyor with depressurized chamber
 - **Collect and reuse** the excess materials

- PLC-based monitoring and controlling system
- Robotic Arm monitoring and controlling unit
 - **Programmable according to the 3D geometry**
- Hot-air-circulating drying chamber

Surface Coating Technology

Spray Coating - Robotic Arm Spray

The Robotic arm spray coating system - Performance



Back and forth horizontal spray coating



Spray gun moving around the 3D MF tray, according to the programmed trajectory.

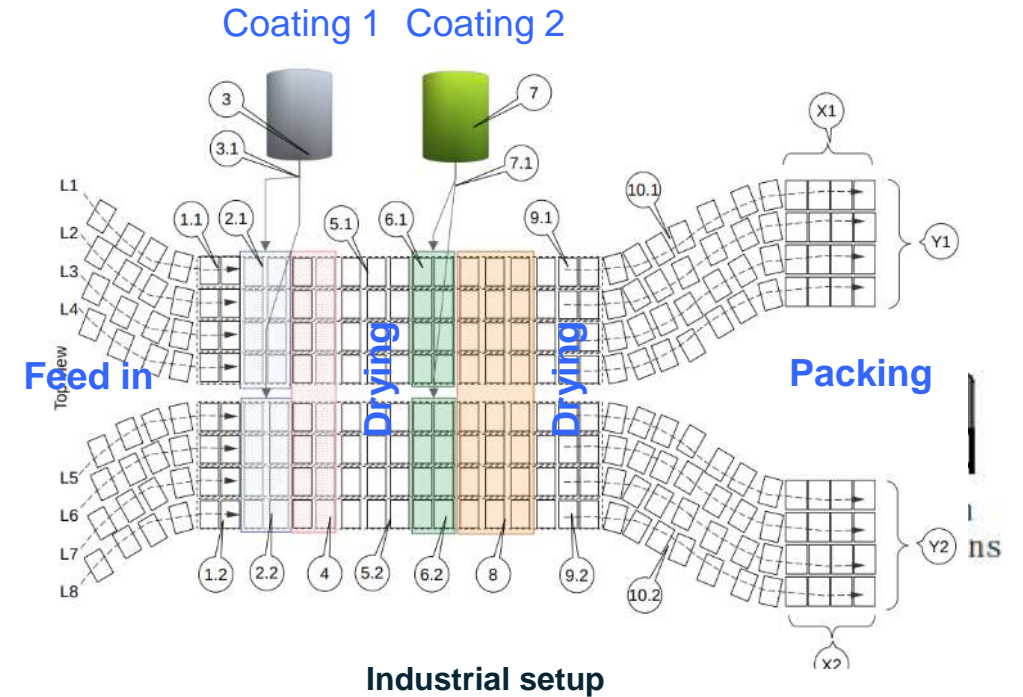
Surface Coating Technology

Spray Coating – Robotic Arm Spray

The Robotic arm spray coating system Industrial solution



Industrial trials



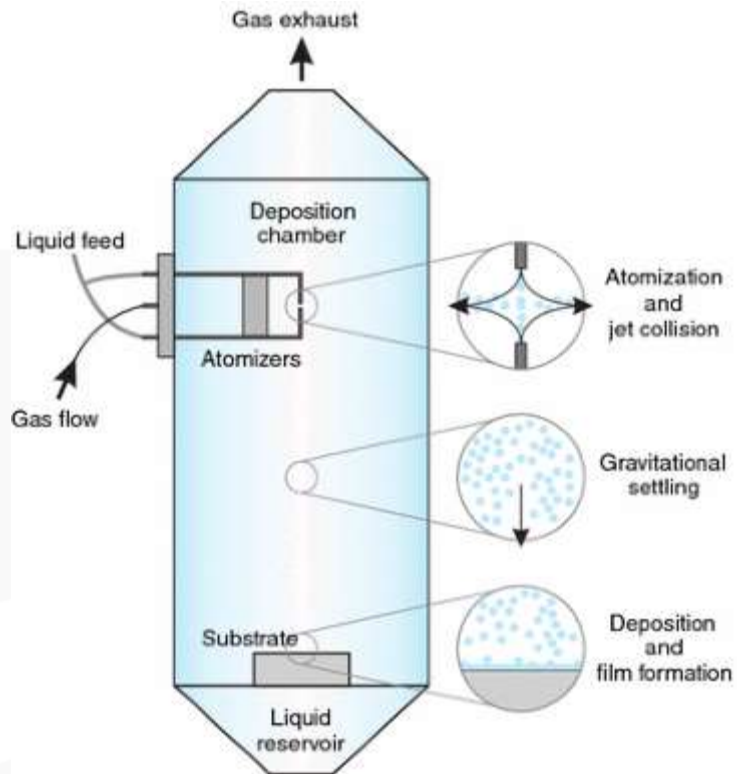
Target:

- With established spray trajectory from Pilot system, build the program for the spray gun at certain position, then apply coating while products pass through the spray chamber.

Surface Coating Technology

Spray Coating – Fog Deposition

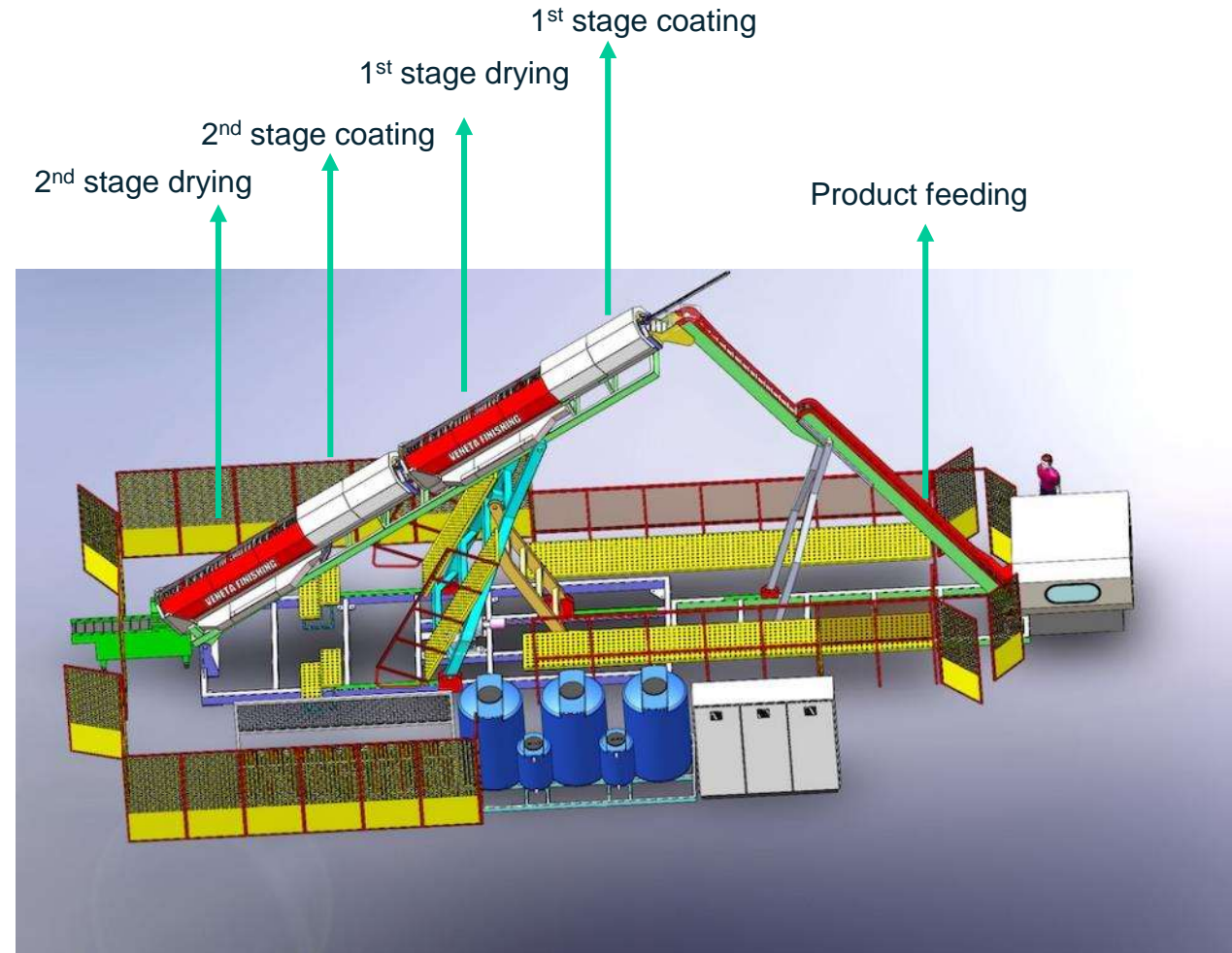
Fog deposition mechanism



nFOG, an aerosol-based wet thin film coating technique

Confidential and proprietary.

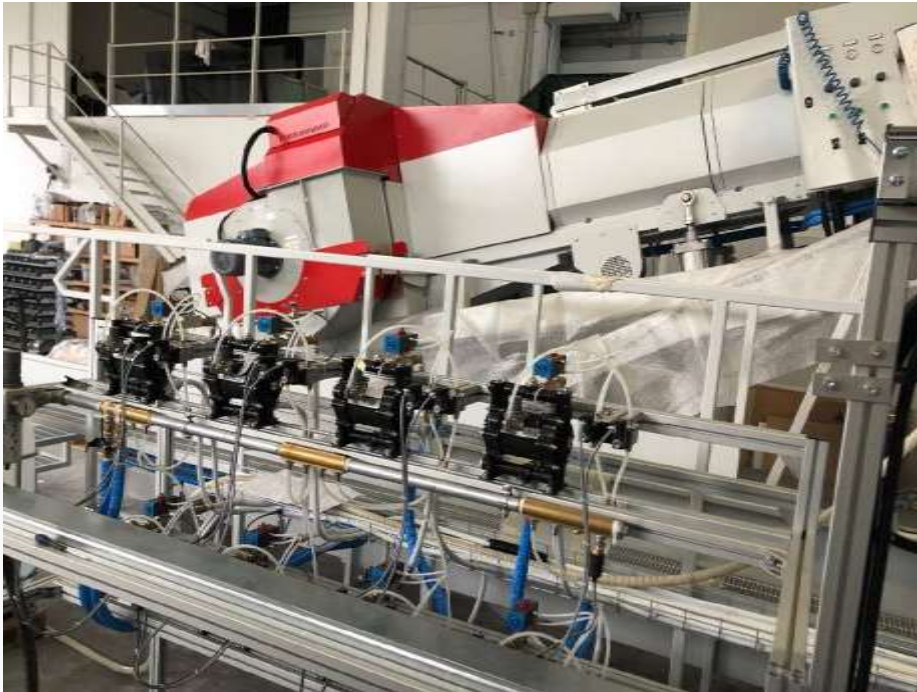
<https://www.bibac.eu>



Industrial set up

Surface Coating Technology

Spray Coating – Fog Deposition



Pumping system to create fog in the coating chamber

Advantage:

- Suitable for small articles, e.g., cutlery, ice cream spoons
- Super high productivity

Challenge:

- Barrier material need to be
 - low viscosity
 - dry fast



Coating on spoons

Surface Coating Technology

Spray Coating – Spin Spray Coating

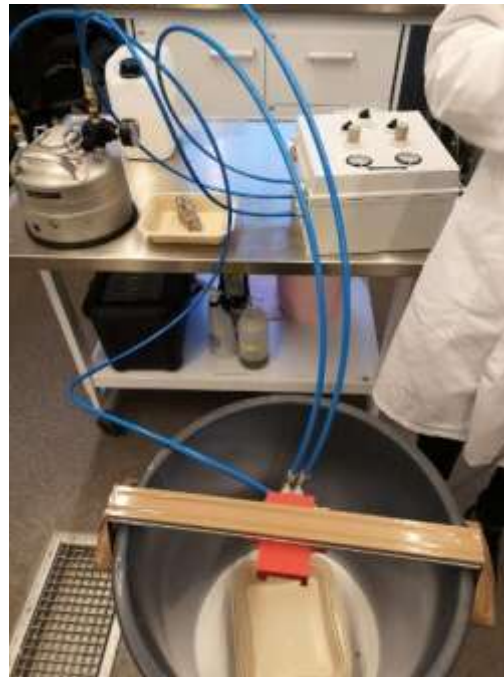
Spin spray coating lab set up

Advantage:

- Even coating with pinhole free
- Minimize the coating weight with adjusting the spinning speed

Challenge:

- Coating separately, challenge for high productivity



Spray control



Spinning speed control



Lab trial

Surface Coating Technology

Spray Coating – Spin Spray Coating

Spin spray coating pilot set up



Single station



Double station



Spray nozzle



Spray Chamber

Surface Coating Technology

Solenis Pilot Facilities



Pilot spin spray coater, single chamber



IR dryer, with conveyer belt

Will be available in Q1, 2025, Wommelgem, Belgium.

Surface Coating Technology

Spray Coating – Spin Spray Coating

Spin spray coating production set up

Method 1

Spray from the top



Prototypes

Spray underneath



Prototypes



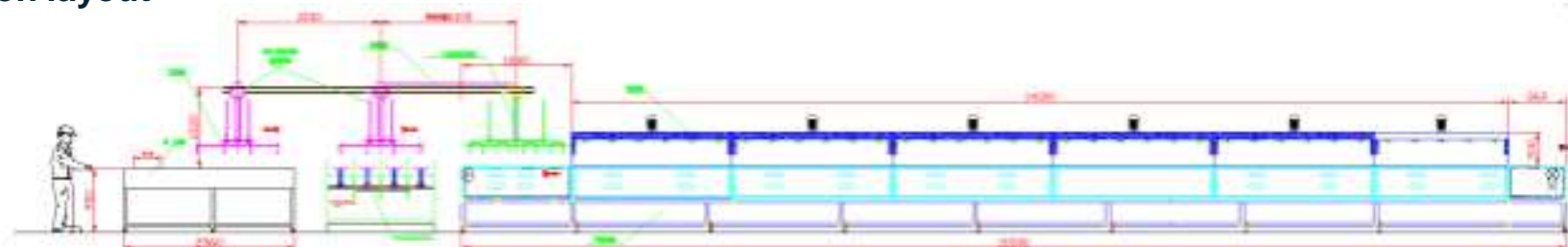
Hot Oil Test:
1L, 100°C, Pass

Surface Coating Technology

Spray Coating – Spin Spray Coating

Spin spray coating production layout

1). Manual loading



Product loading

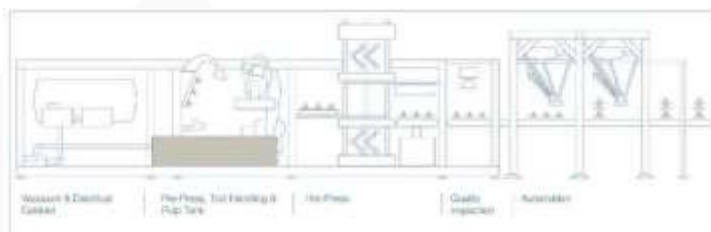
Spin spray

Drying

2). Fully automatic

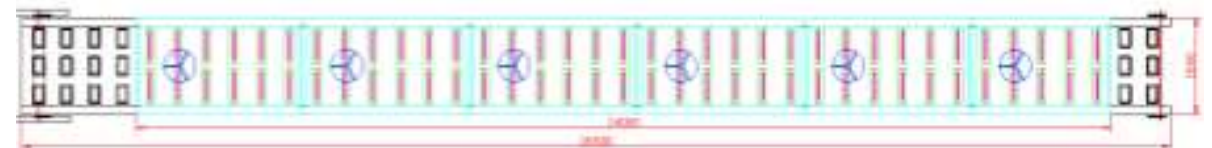


Thermal forming



Spin spray

Multi cavity in production
12, 24, 36 cavities available



Drying

Auto packing

Surface Coating Technology

Spray Coating – Spin Spray Coating

Other trials:



Product moving + Spray spinning



Spray coating on back side of the MF products

Conclusion

- Coating technology
 - Even coating with pinhole free
 - Minimize the coating weight to reduce cost
 - Less waste by reusing the coating
- Optimize substrate
 - Surface smoothness
 - Porosity
 - Hydrophobicity
 - Product design
- Others
 - Fossil based to biobased materials
 - Drying technology, less energy consumption and high efficiency
 - Choose the suitable coating technology for specific application



Challenges and opportunities

Requirement?



Application technology

Coating materials

Market needs

Regulations



Prototypes



Scale up

Joint development and collaboration!

Acknowledgements

StoraEnso, Sweden

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Any questions

?

Let's Connect

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