

Flame-resistant Meltblown Nonwovens made from Melamine Resins

- Manufacture and Potential Applications

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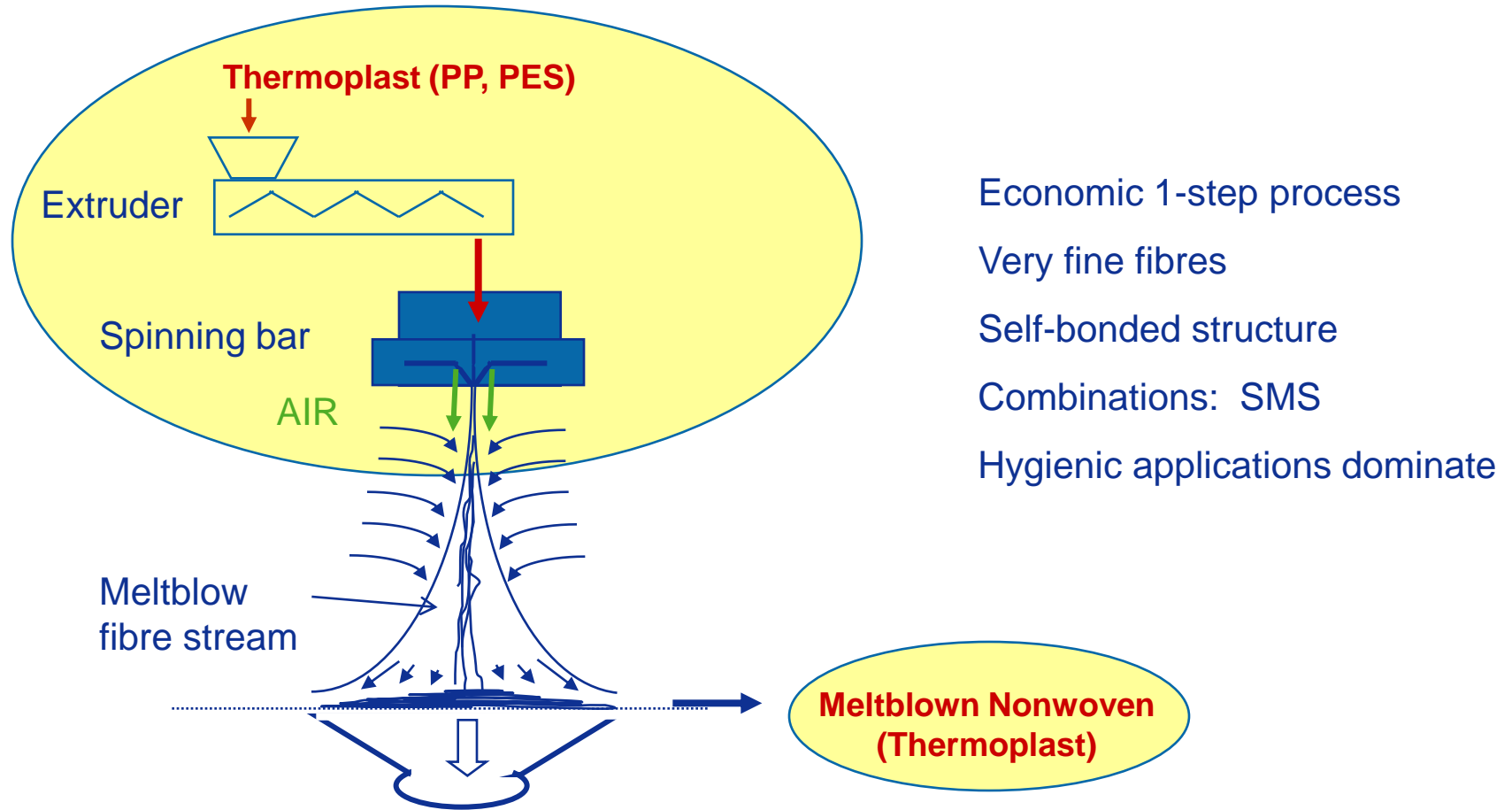


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 - Key Properties → Applications & Markets
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Conventional Spunlaid / Meltblown Processing



Challenge for Extrudable Melamine Resins

CONVENTIONAL MELAMINE RESINS

FINAL PRODUCT PERFORMANCE

- High thermal stability
- No melting
- Inherent flame resistance
- High hardness
- Excellent adhesion

PROCESSABILITY

- Thermosetting resin
- Polycondensation of liquid resins
- No thermoplastic processing (extrusion, ...)

COMBINE



NEED FOR

NEW EXTRUDABLE MELAMINE RESINS

AS RECENTLY DEVELOPED BY BOREALIS AGROLINZ MELAMINE

New Extrudable Melamine Resins: Key Properties

- Solid thermosetting resin with thermoplastic processability
 - Thermoplastic processing window between 90 and 140 °C
 - Controlled reactivity and crosslinking
 - Process stability of uncured resin at 120 °C is >>1h
 - Tailored rheology → very low viscosity at 120 °C
 - Excellent melt extensibility and filament spinning capability

- Thermal crosslinking into thermosets by polycondensation
 - Reaction rate can be controlled by catalysts

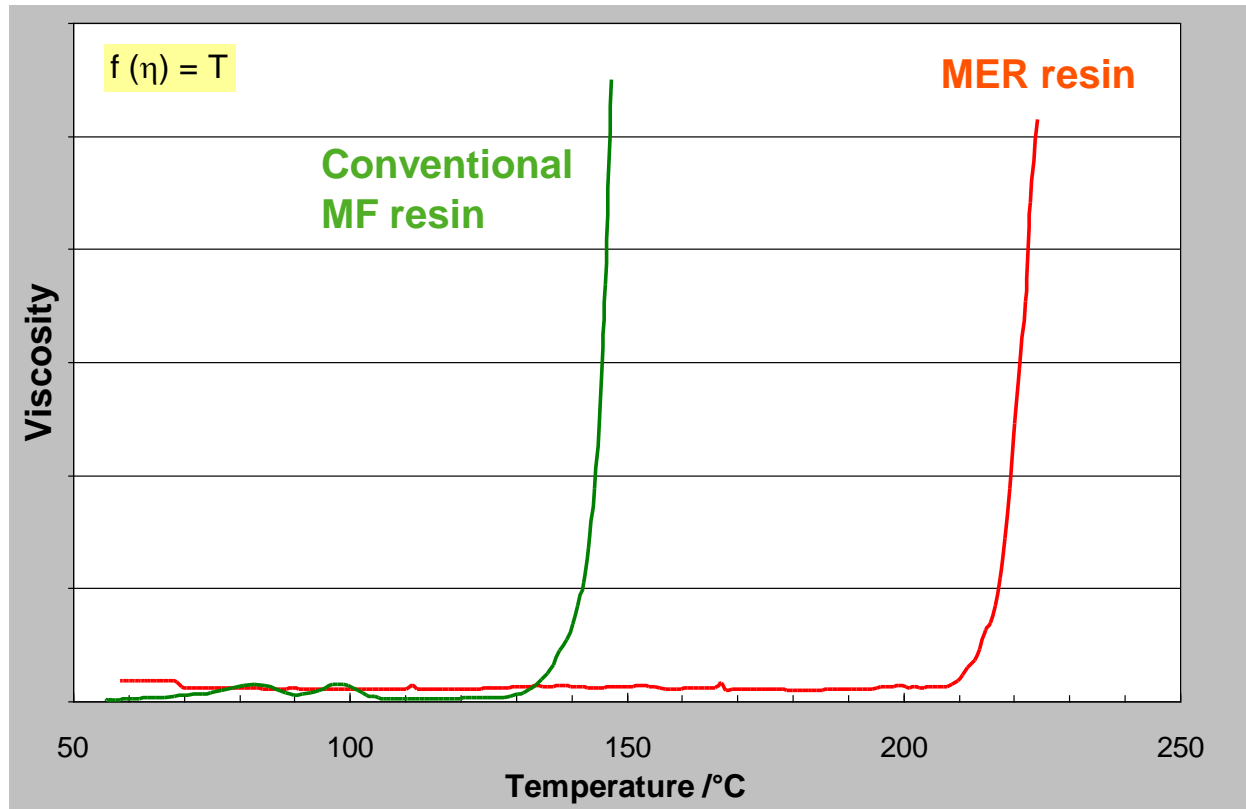
- Crosslinked resins have outstanding performance:
 - High thermal stability (no melting; decomposition ~400°C)
 - Inherent flame resistance

- Easy handling and feeding of free-flowing resin flakes

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New Extrudable Melamine Resins: Key Properties

- Thermoplastic processing window -

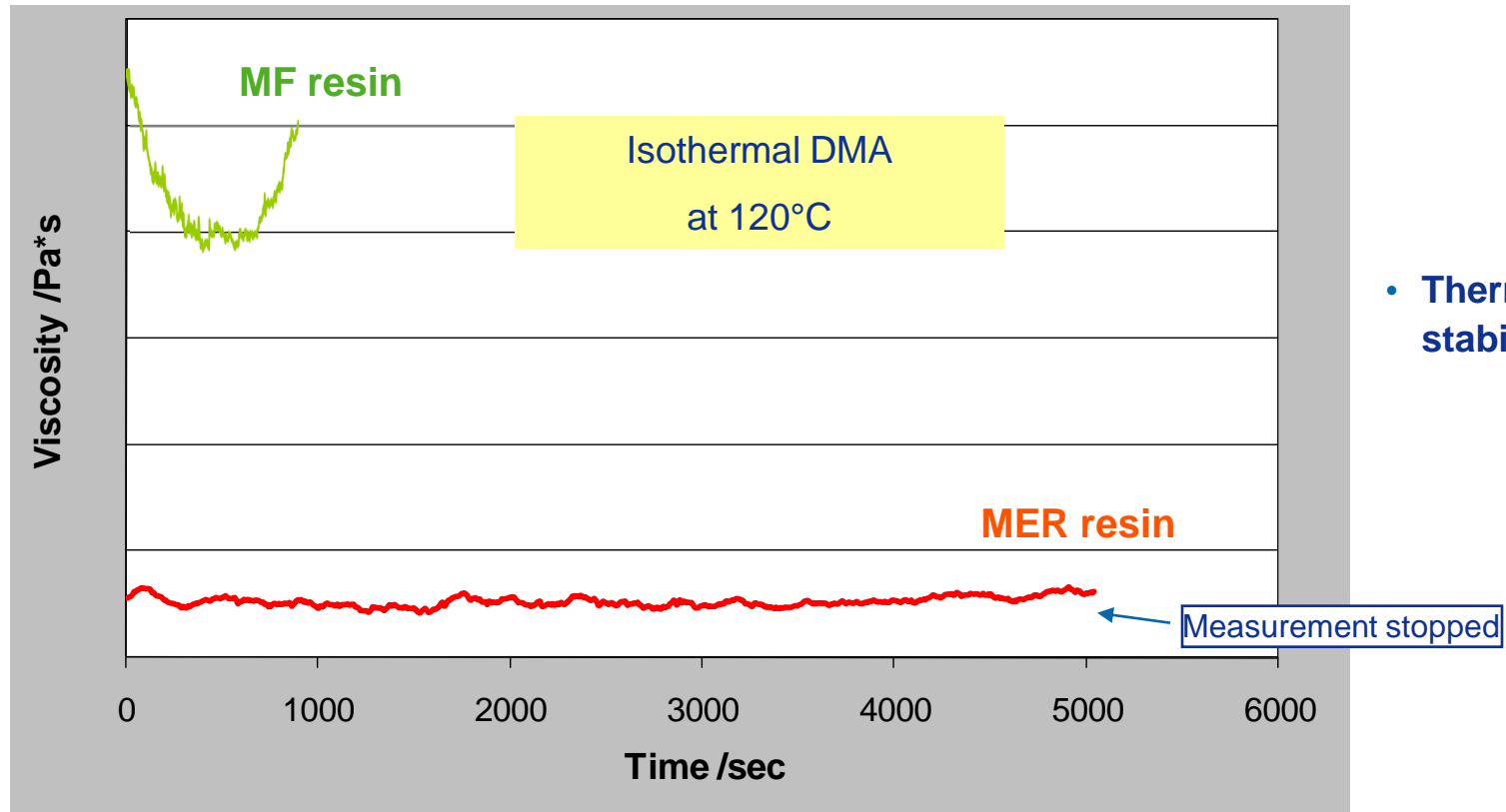


DMA
(10 K/min)

- Crosslinking shifted to higher temperatures
- Very low crosslinking rate at 130 °C

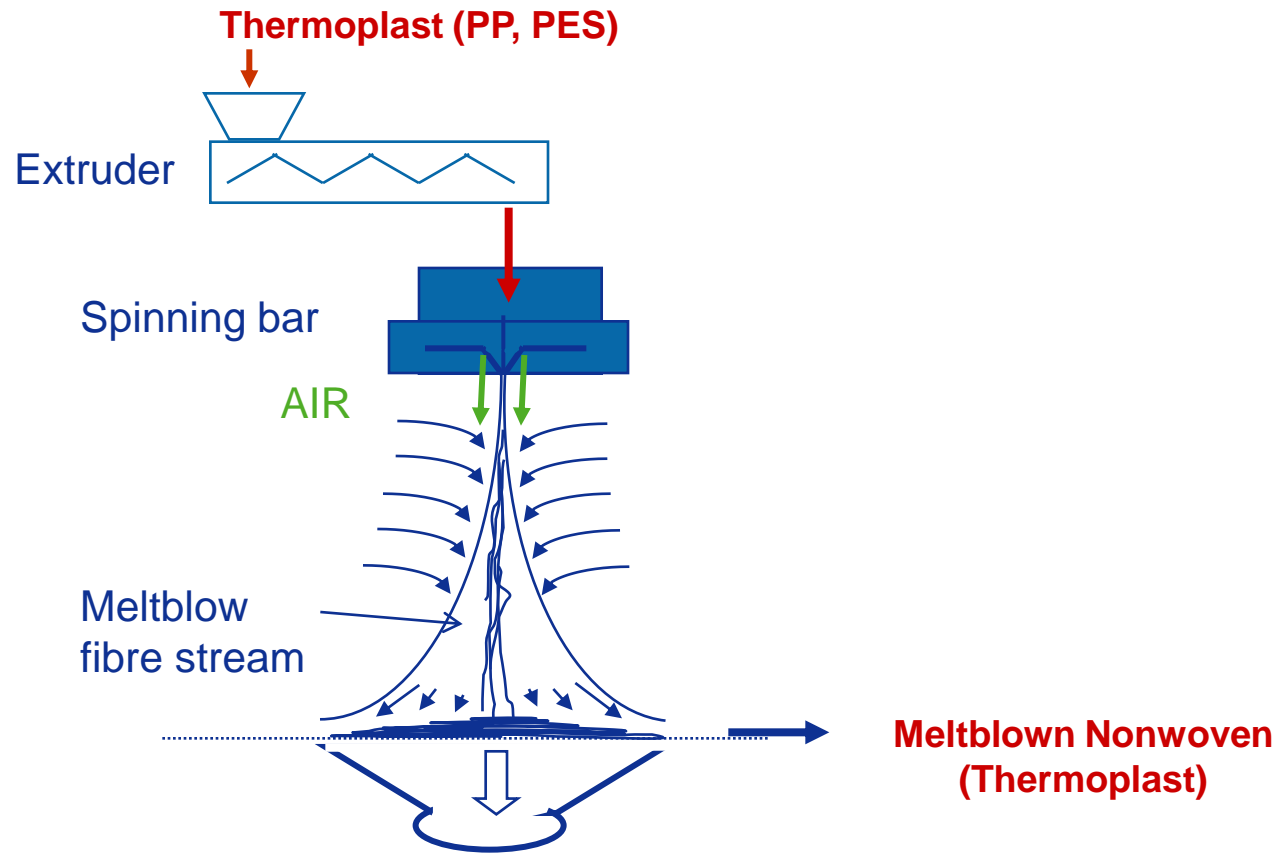
New Extrudable Melamine Resins: Key Properties

- Thermal process stability -

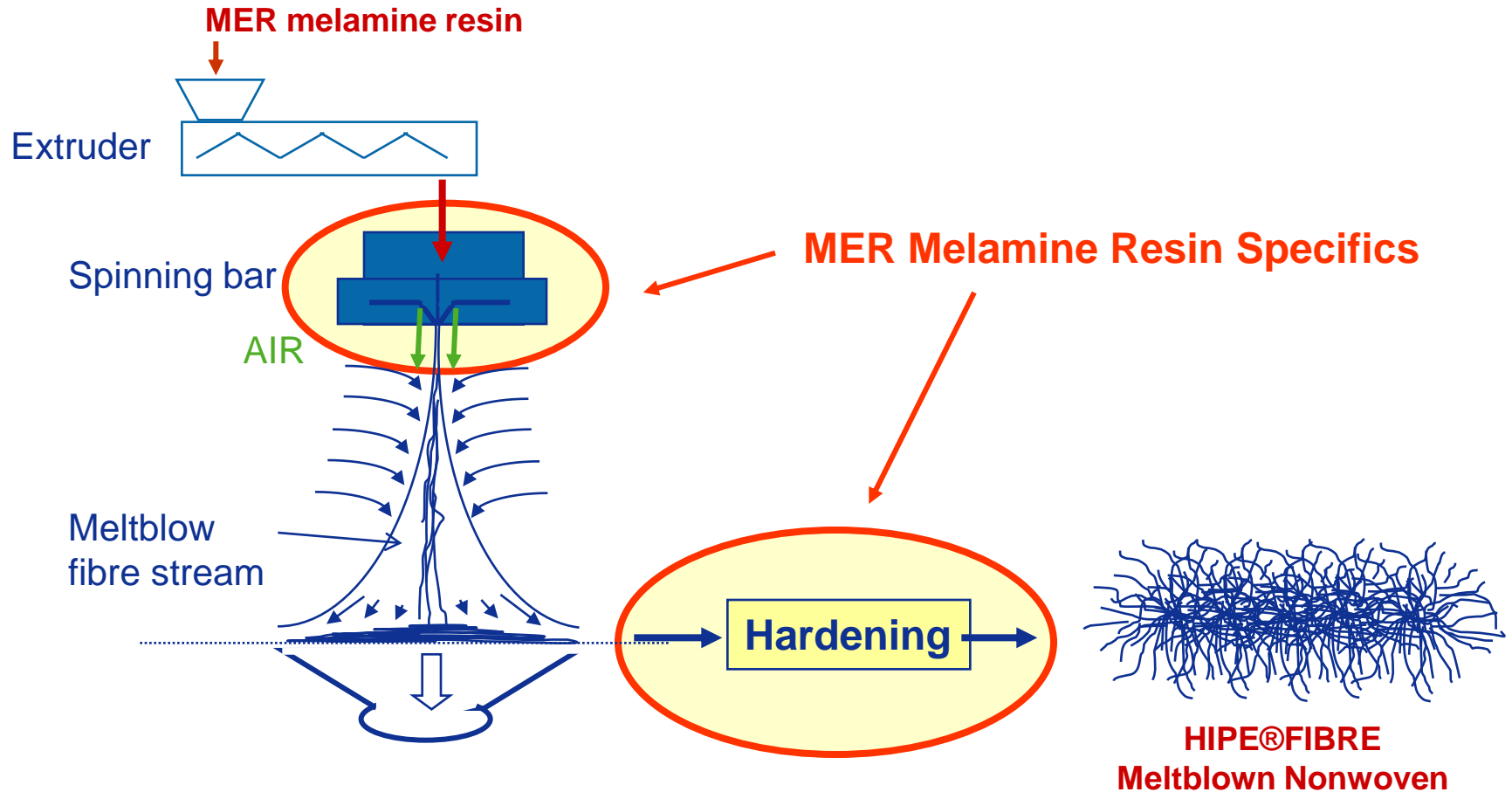


- Thermal stability >>1h

Meltblown Processing: 1-step process for fine nonwovens

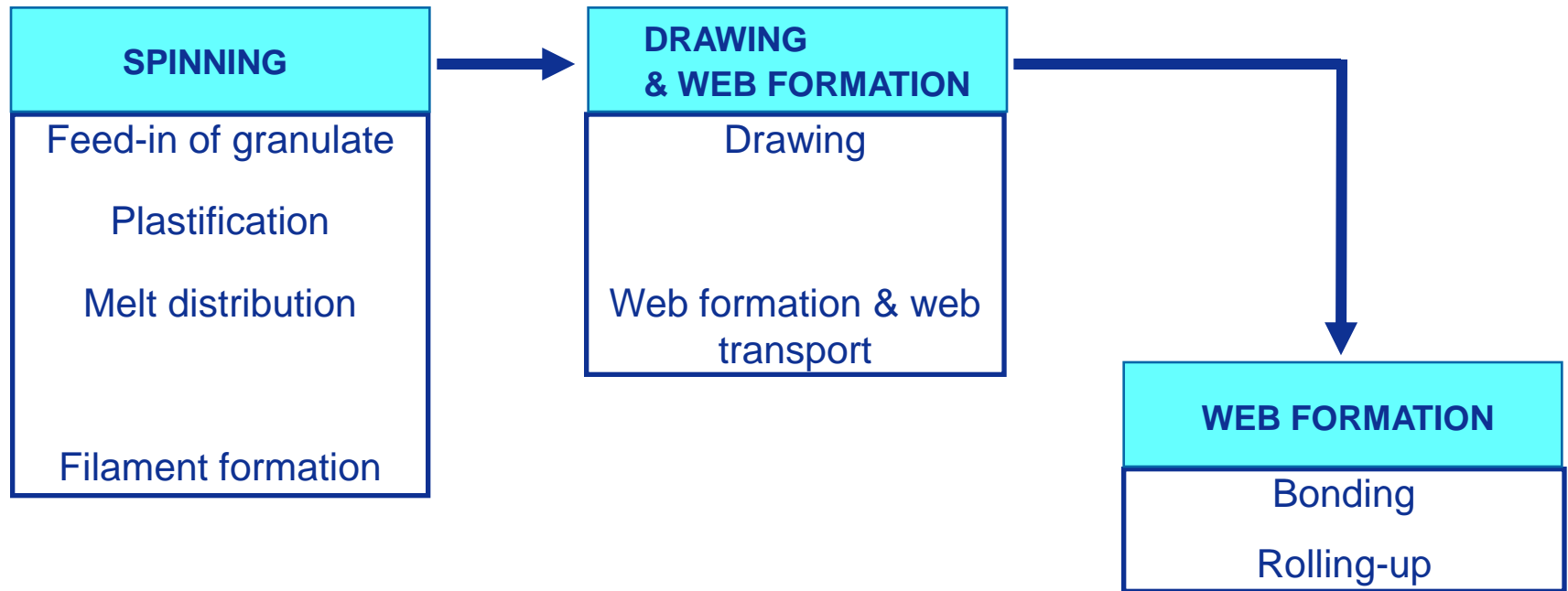


Innovative Meltblown Process: Modified MB Technology



Innovative Meltblown Process: Basic Process Steps

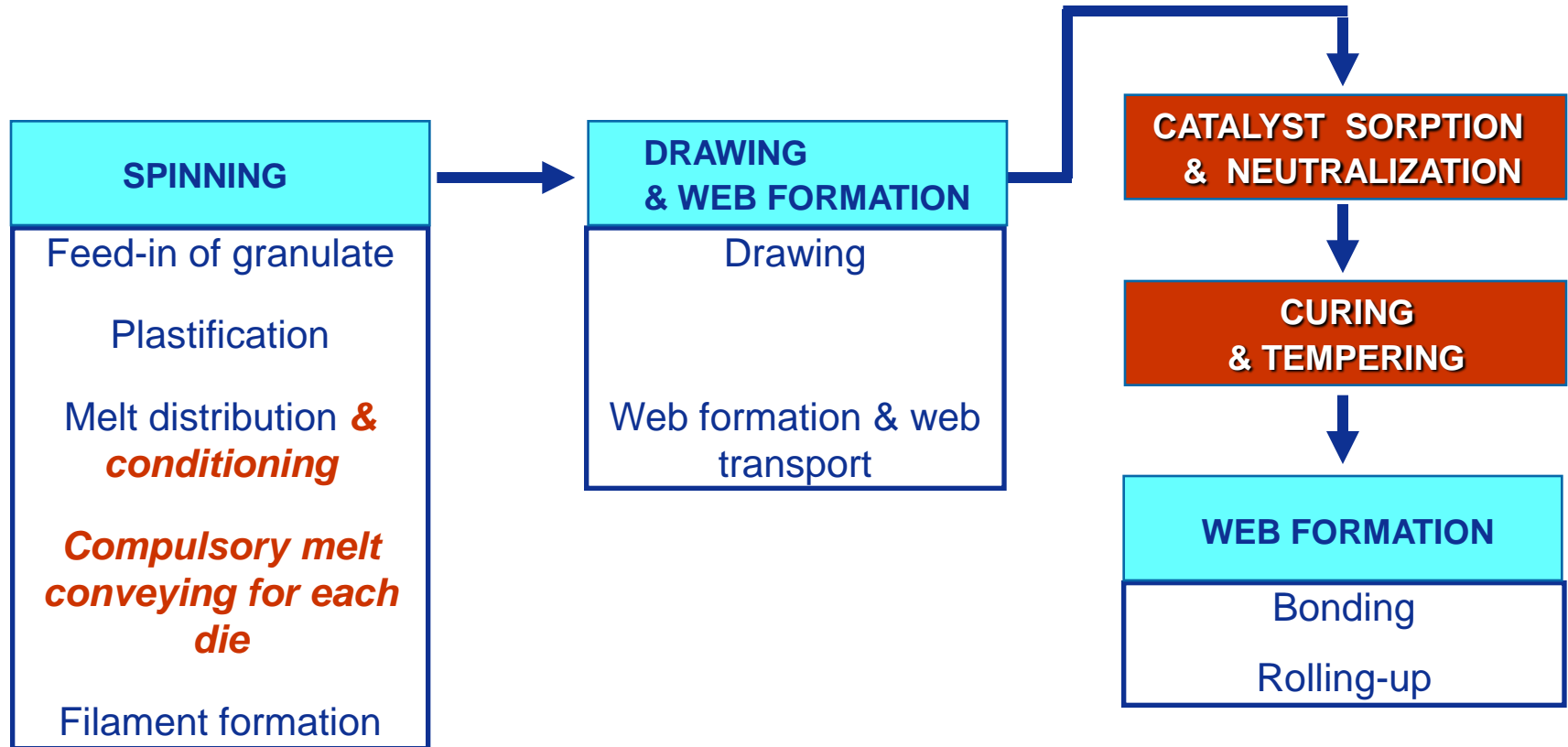
- Conventional Spunlaid / Meltblown)¹ -



)¹ „Nonwoven Fabrics“ by Albrecht, Fuchs, Kittelmann

Innovative Meltblown Process: Basic Process Steps

- HIPE®FIBRE Meltblown -



Innovative Meltblown Process: Results & Status

- **Special melamine resin is necessary: new, extrudable MER resin**
- **Adaptation of plant components is essential**
- **Additional plant components are needed**
- **Small-scale meltblown pilot line developed and available:**
 - **Technology proven → Basic design & know-how package**
 - **MER melamine resin optimized and proven**
 - **HIPE®FIBRE meltblown nonwoven sample production**
- **Typical value ranges: 18 - 10 - ~1µm, 35-350 g/m², 30cm width**
- **Proprietary meltblown technology ready for upscaling**

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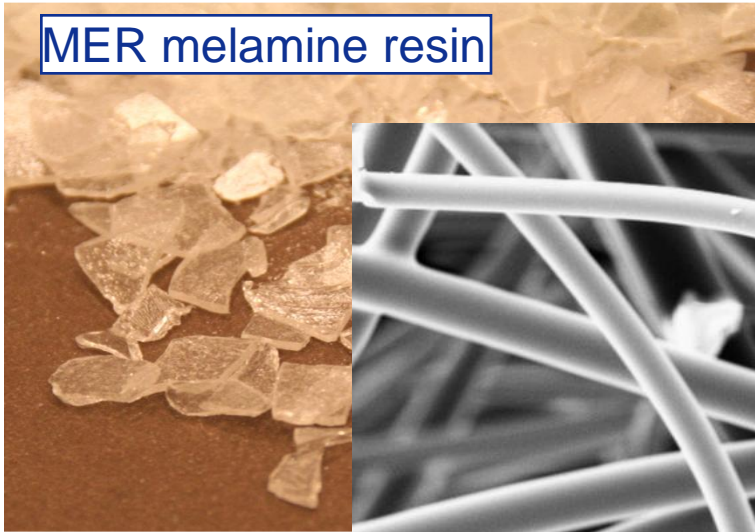
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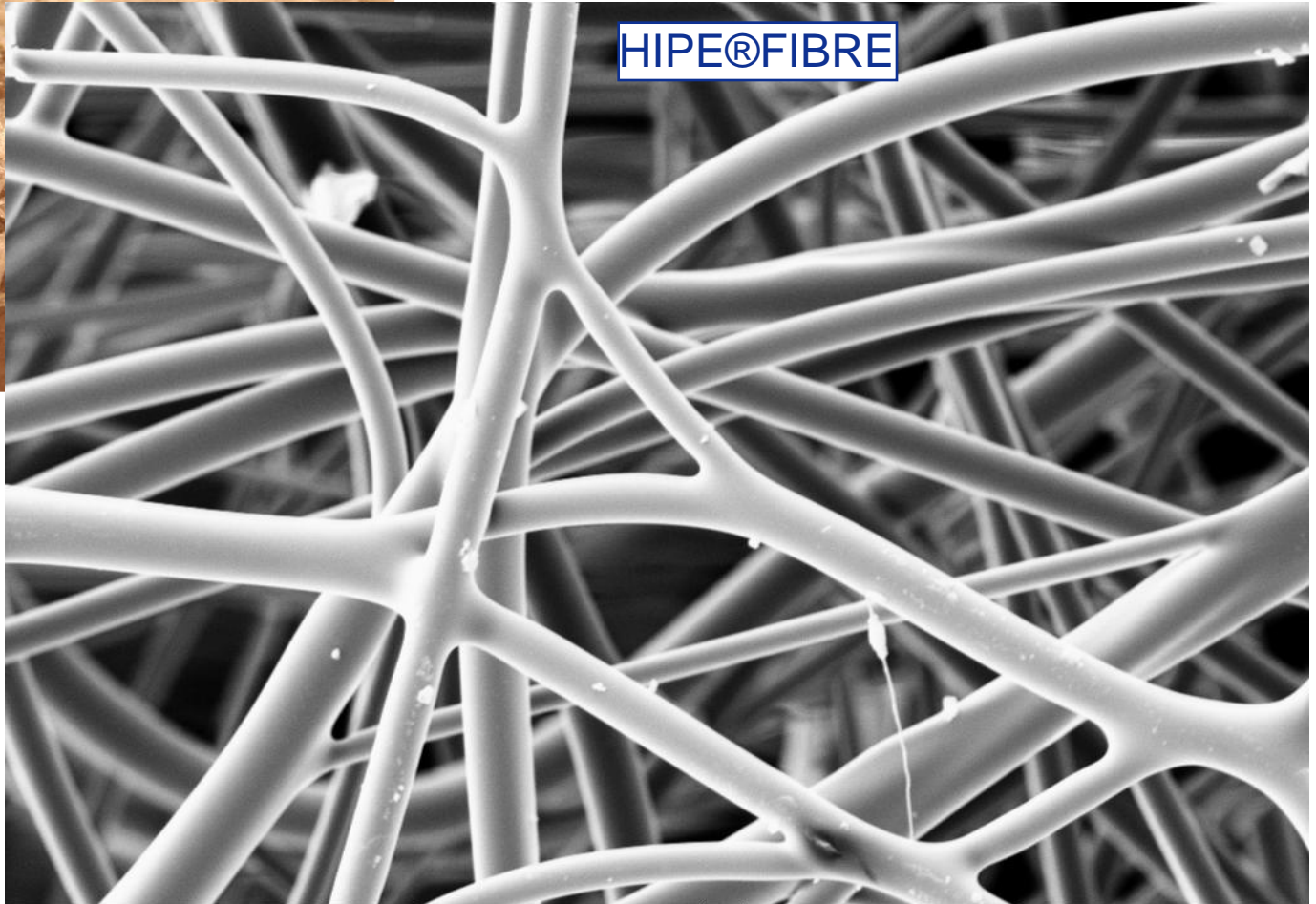
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MER melamine resin



HIPE®FIBRE



OMPG
Probe:27 MER-Vlies Nr. 3

10µm
HV=15.00 kV

Vergrößerung= 200 X
Arbeitsabstand= 8 mm

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HIPE®FIBRE Nonwovens: Key Properties

- Inherent flame resistance: High Limiting Oxygen Index (LOI = 32)
- Do not shrink, melt or drip when exposed to open flame
- High thermal & acoustic insulation
- Excellent heat dimensional stability
- Textile processability
- 3D meltblown nonwoven structure = self-bonded web
- Flame-resistant microfibres → high filtration efficiency
- Excellent alkali and organic chemical resistance / Fair acid resistance



Fits into market requirements & trends

Outstanding Characteristics & Performance →

Heat & flame resistant barrier layer for applications in

- **Filtration:** High-temp. / hot gas filters
Nonwoven dust and air filters
Engine & cabin filters
- **Protective clothing and apparels:** FR clothing & fire workers' apparel
- **Bedding, mattresses, upholstery:** Mattress tickings and covers // Waddings
- **Carpets / contractors & transportation:** Primary / secondary backing
- **Automotive industry:** Heat & acoustic insulation
- **... and much more**

Basic Product & Application Development

- Prove textile processability
- Give evidence of outstanding performance & product potential
- Identify & confirm preferred application areas
- Develop, prove & provide basic functional systems
(Case studies, samples)



Case Study: Protective Clothing (Fire Protection)

Essential standards & requirements:

- ✓ Fire fighters' apparel: DIN EN 469
- ✓ Industrial washing cycles: EN 26630; EN 3175-2
- ✓ Limited flame spreading: DIN EN ISO 15025
- ✓ Heat transfer – flame: DIN EN 367
- ✓ Heat transfer – radiation: EN ISO 6942
- ✓ Heat shrinkage: ISO 17439
- ✓ Penetration of liquid chemicals: EN ISO 6530

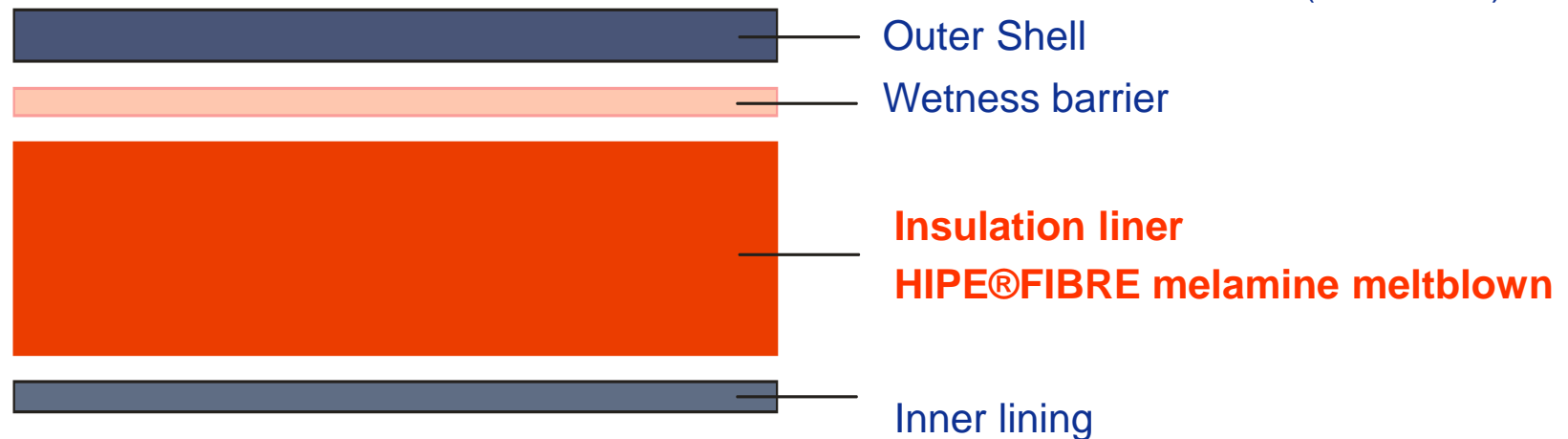
Fully fulfilled

Weight reduction potential

+ Ret

+ Rct

(Skin model)



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Case Study: Protective Clothing (Fire Protection)

- Limited flame spreading EN ISO 15025 -



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Case Study: Protective Clothing (Fire Protection)

- DIN EN ISO 15025 after 5 washing cycles-



LAYERS:

50/50 AR/CV FR

PU Membran

Melamine Meltblown

50/50 AR/CV FR

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Case Study: Filtration (Hot Gas Filtration)

HIPE®FIBRE melamine meltblown nonwoven offering

- Very low fibre diameters down to ~1 µm
- Self-bonded microporous meltblown structure
- Large surface-to-mass relation
- LOI 32, thermal decomposition ~ 400 °C, service temp. >200 °C



Improved retention of fine & ultra-fine particles



Higher requests
from legislation

Incineration plants, cement & iron / steel industry, power stations, ...



**Fine fibre layer =
HIPE®FIBRE melamine meltblown**

Needlepunched nonwoven

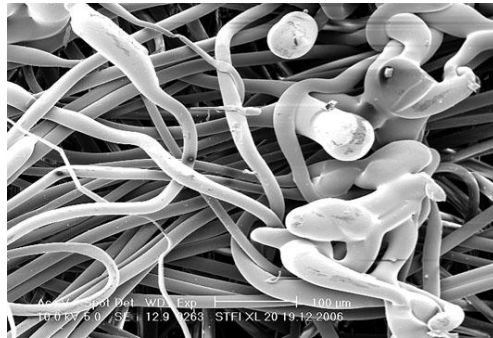
Scrim

Needlepunched nonwoven

Case Study: Filtration (Hot Gas Filtration)

- Fine fibre nonwovens vs. Membrans -

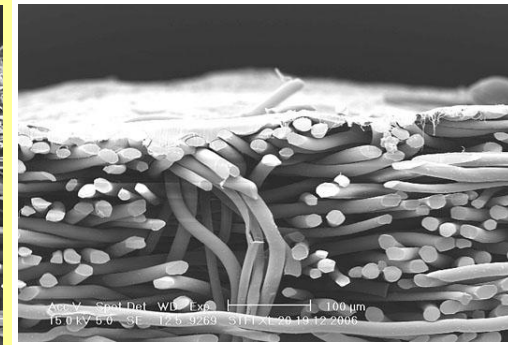
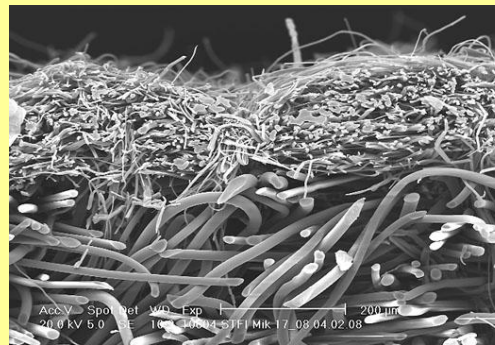
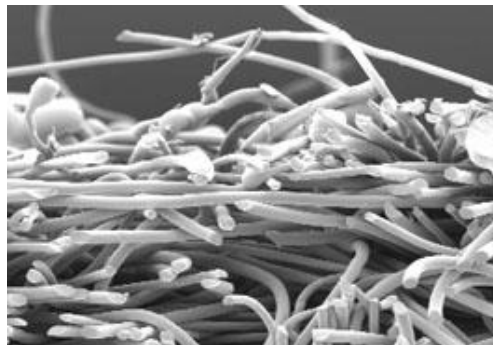
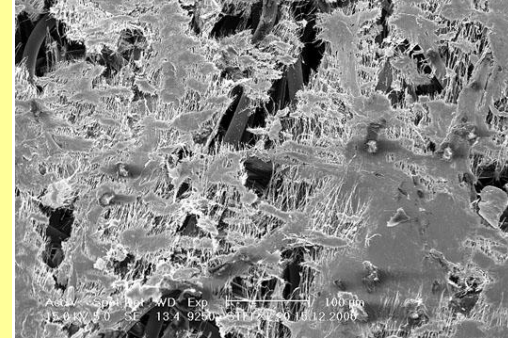
NPN singed



Meltblown



Membrane



AIR PERMEABILITY

FINE DUST SEPARATION

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Case Study: Filtration (Hot Gas Filtration)

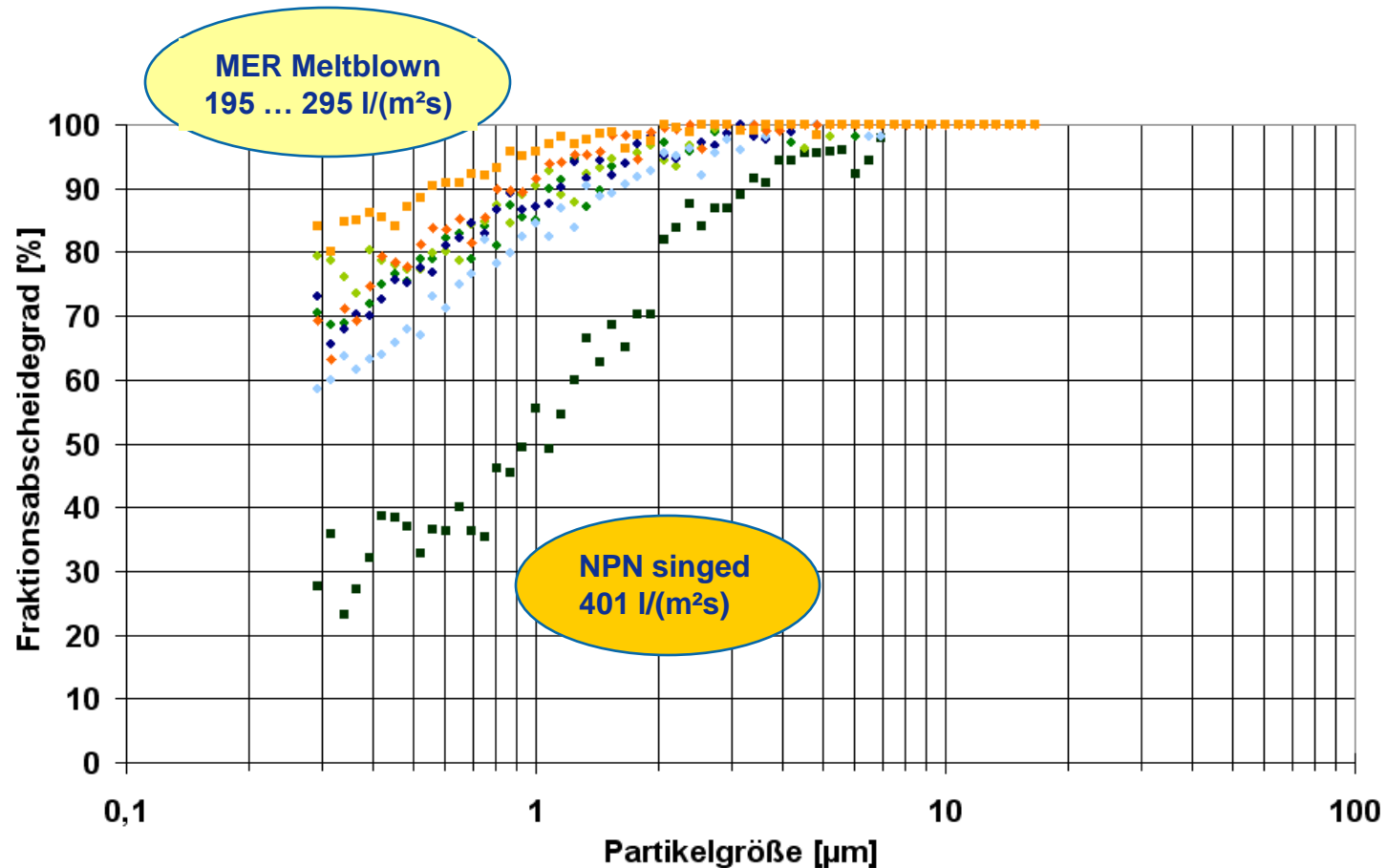
- Fractional efficiency -

PALAS® MFP-3000-S

Pural SB

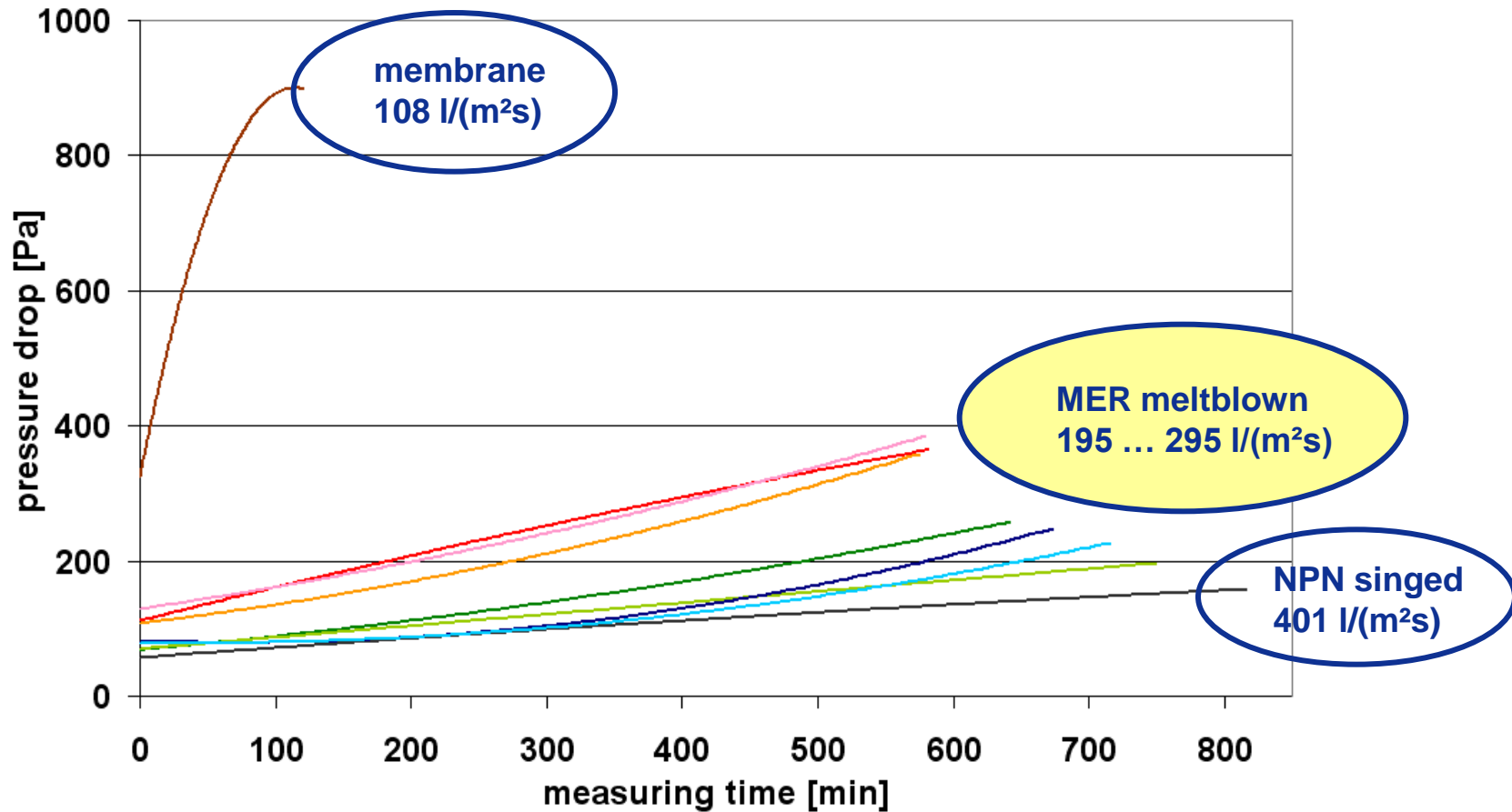
0,075 m/s

550 mg/m²



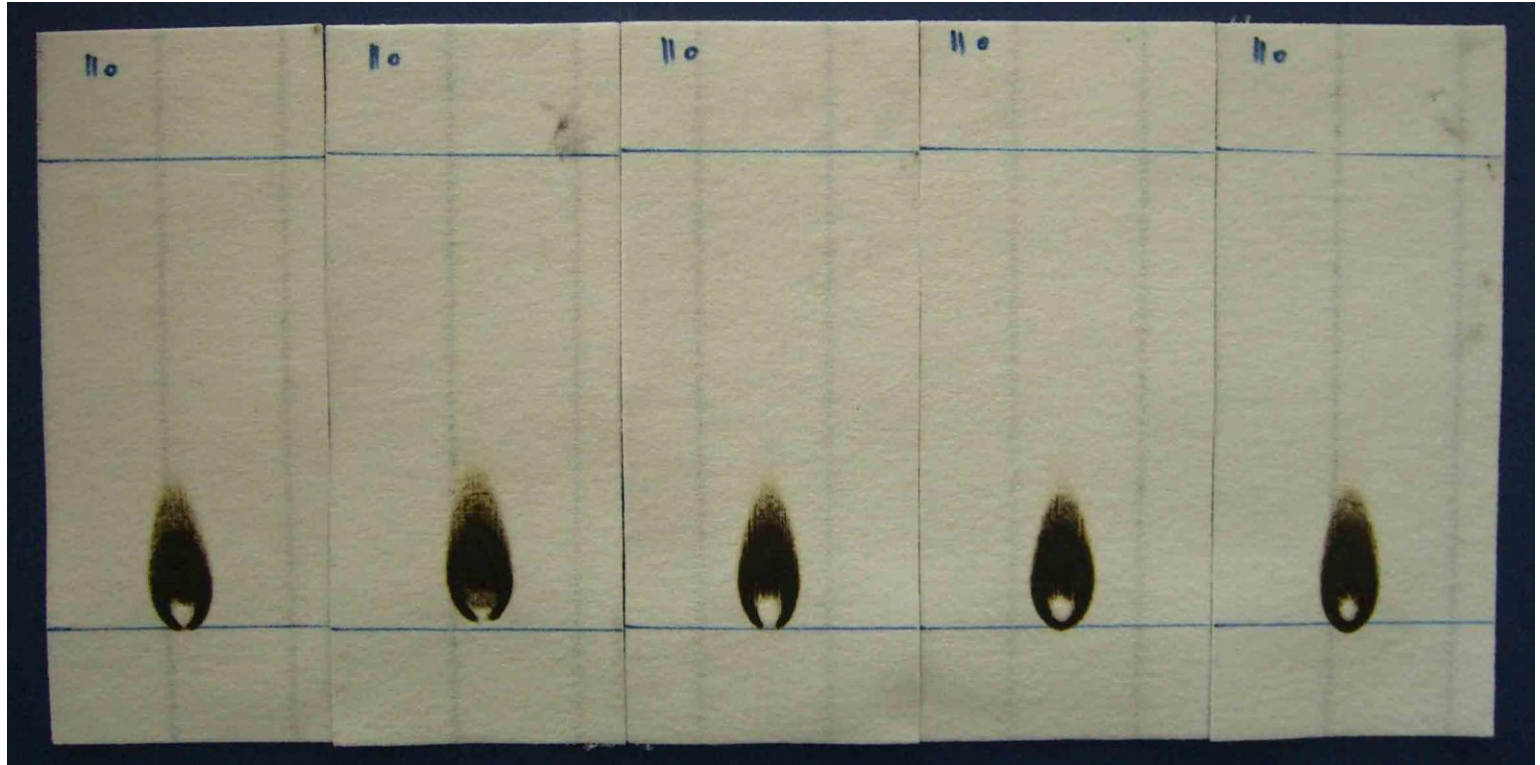
Case Study: Filtration (Hot Gas Filtration)

- Pressure drop & Air permeability -



Case Study: Filtration (Hot Gas Filtration)

- Surface flame impingement DIN 53 438-3 -



440 g/m² PES needle-punched nonwoven with inner scrim
85 g/m² HIPERFIBRE melamine nonwoven

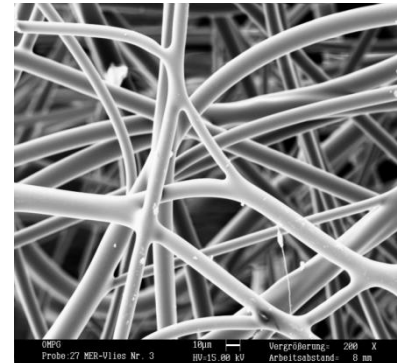
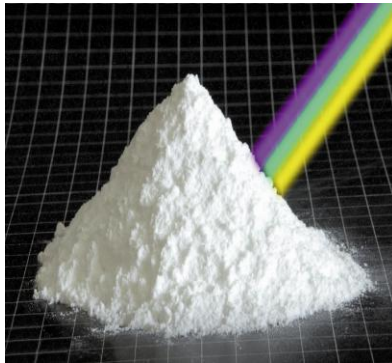
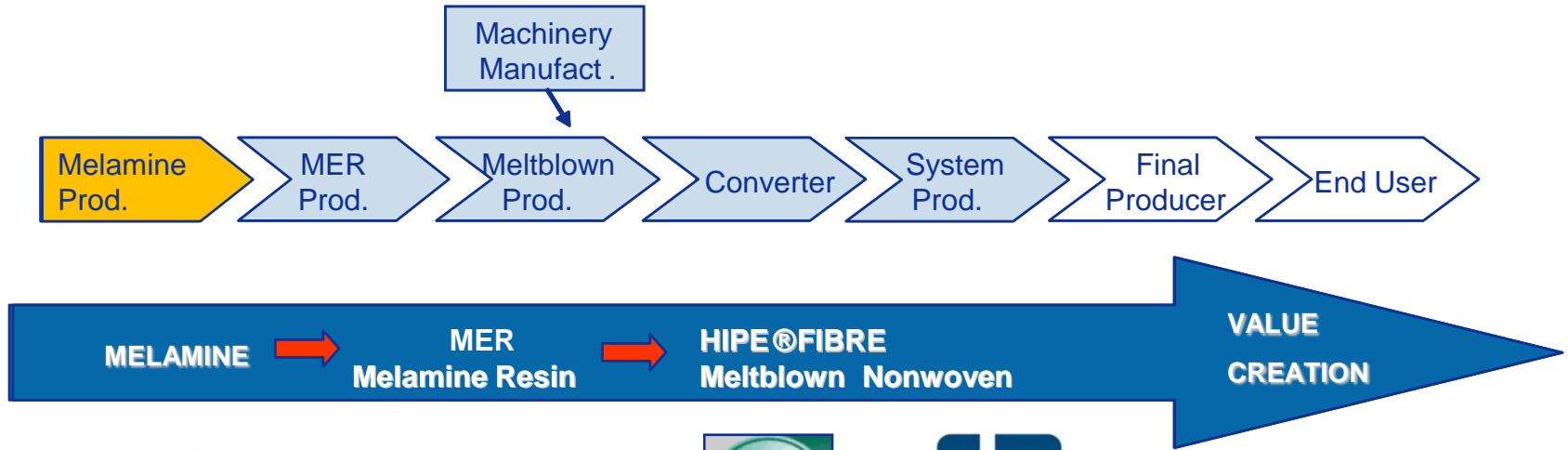
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Summary



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Summary

- Unique extrudable melamine resins developed & available: MER
- Modified meltblown technology for producing melamine-based HIPE®FIBRE nonwovens available (Basic Design / small-scale pilot line)
- Meltblown technology and equipment for manufacture of self-bonded meltblown webs: Proven & Ready for upscaling
- Recent status: Fibre diameters down to $\sim 1\mu\text{m}$ and grammage $>35\text{ g/m}^2$
- Outstanding performance of HIPE®FIBRE meltblown nonwovens, particularly high heat and inherent flame resistance
- Case studies for product and application development running

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Outlook: Innovation according to market needs

- Commitment to innovation & sustainable product, application and technology development
 - Melamine (Borealis Agrolinz Melamine)
 - Polyolefins (Borealis Polyolefins)
- Focus on customer-oriented solutions
- Case studies for evaluating HIPE®FIBRE product and market potential
- Market evaluation showed large interest in HIPE®FIBRE
- Upscaling and market introduction together with and by partners / customers:
 - ⇒ Borealis will not forward integrate into any fibre or nonwoven production !

Thank you for your kind attention !

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