Flame-resistant Meltblown Nonwovens made from Melamine Resins
- Manufacture and Potential Applications

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Summary and Outlook
Conventional Spunlaid / Meltblown Processing

- Economic 1-step process
- Very fine fibres
- Self-bonded structure
- Combinations: SMS
- Hygienic applications dominate

**Diagram:**
- Extruder
- Spinning bar
- Thermoplastic (PP, PES)
- Air
- Meltblow fibre stream
- Meltblown Nonwoven (Thermoplastic)
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
New Extrudable Melamine Resins: Key Properties

- Thermoplastic processing window -

• Crosslinking shifted to higher temperatures
• Very low crosslinking rate at 130 °C
New Extrudable Melamine Resins: Key Properties

- Thermal process stability -

**New Extrudable Melamine Resins:**
- **Key Properties**
  - Thermal process stability >>1h

**Graph:**
- MF resin
- MER resin
- Isothermal DMA at 120°C
- Measurement stopped

**Notes:**
- Thermal stability >>1h
Meltblown Processing: 1-step process for fine nonwovens

Thermoplast (PP, PES)

Extruder

Spinning bar

AIR

Meltblow fibre stream

Meltblown Nonwoven (Thermoplast)
Innovative Meltblown Process: Modified MB Technology

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Innovative Meltblown Process: Basic Process Steps

- Conventional Spunlaid / Meltblown \(^1\) -

**SPINNING**
- Feed-in of granulate
- Plastification
- Melt distribution
- Filament formation

**DRAWING & WEB FORMATION**
- Drawing
- Web formation & web transport

**WEB FORMATION**
- Bonding
- Rolling-up

\(^1\) „Nonwoven Fabrics“ by Albrecht, Fuchs, Kittelmann
Innovative Meltblown Process: Basic Process Steps

- HIPE®FIBRE Meltblown -

**SPINNING**
- Feed-in of granulate
- Plastification
- Melt distribution & conditioning
  - *Compulsory melt conveying for each die*
- Filament formation

**DRAWING & WEB FORMATION**
- Drawing
- Web formation & web transport

**CATALYST SORPTION & NEUTRALIZATION**

**CURING & TEMPERING**

**WEB FORMATION**
- Bonding
- Rolling-up

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MP / Dr. Ulf Panzer
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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MER melamine resin

HIPE®FIBRE

MER melamine resin
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 $\rightarrow$ 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

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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)

PROTECTIVE CLOTHING

FILTRATION

BEDDING & UPHOLSTERY

ACOUSTICS → AUTOMOTIVE & TRANSPORTATION
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)

Outer Shell
Wetness barrier
Insulation liner
HIPE®FIBRE melamine meltblown
Inner lining

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Case Study: Protective Clothing (Fire Protection)

- Limited flame spreading EN ISO 15025 -

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[Images showing front and back samples of protective clothing materials: HIPE® FIBRE and VISCOSE]
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

![Diagram of nonwoven materials]

- Improved retention of fine & ultra-fine particles
- Higher requests from legislation

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

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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

MER Meltblown
195 ... 295 l/(m²s)

NPN singed
401 l/(m²s)

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Case Study: Filtration (Hot Gas Filtration)

- Pressure drop & Air permeability -

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- Membrane: 108 l/(m²s)
- MER meltblown: 195 ... 295 l/(m²s)
- NPN singed: 401 l/(m²s)
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

Machinery Manufact.


VALUE CREATION

MELAMINE → MER Melamine Resin → HIPE®FIBRE Meltblown Nonwoven

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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 ~1µm and grammage >35 g/m²
- Outstanding performance of HIPE®FIBRE meltblown nonwovens, particularly high heat and inherent flame resistance
- Case studies for product and application development running
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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