



Acrodur©

Evolution of a sustainable Technology Platform

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 **BASF**

We create chemistry

BASF - Fiber Bonding

as integral part of BASF's polymer dispersions, resins and additives business



Architectural Coatings



Automotive and Industrial Coatings



Furniture and Flooring



Printing and Packaging



Construction



Adhesives



Fiber Bonding



Paper Coating

Selected Target Industries

for nonwoven and fiber bonding products



Automotive



Construction



Consumer

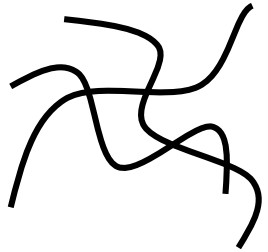


Furniture

Typical Binders and Fibers

for chemical bonding

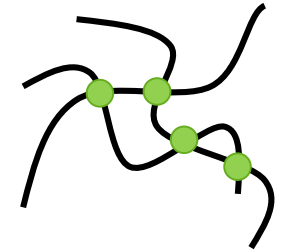
Fiber



Binder



Product



Natural fibers

- hemp, wood
- cellulosic

Man made fibers

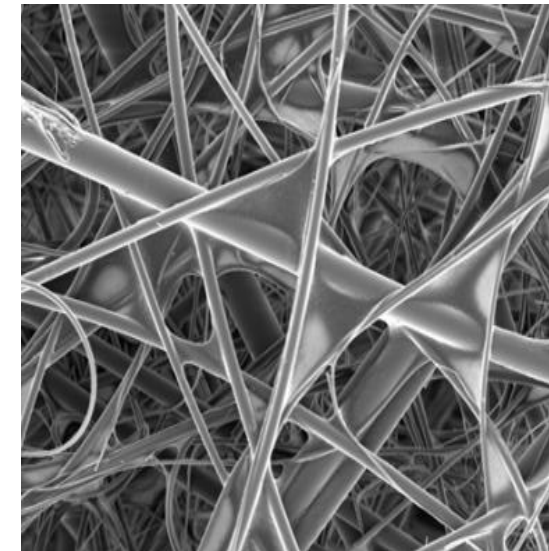
- synthetic (PET)
- glass
- carbon

Dispersions

- (styrene-) acrylic
- styrene-butadiene

Resins

- acrylics based
- formaldehyde based (UF/MF)



BASF Binder Portfolio

Various dispersion and resin technologies with dedicated additives available

Dispersion

(thermoplastic, soft, flexible)

(Styrene-)Acrylic
Acronal®

Styrene-Butadiene
Styrofan®

Polyurethane
Emuldur® / Luphen®

Resin

(thermoset, rigid, stable)

Acrylic
Acrodur®

Urea-Formaldehyde
Urecoll®

Melamine-Formaldehyde
Saduren®

Additives

Thickener, Surfactants, Pigment dispersants

Performance meets Sustainability

Our targets in product development



Improve performance



Save system costs



Reduce emissions



Renewables content

Introduction to Acrodur

Water-based binder for natural and man-made fibers

What Acrodur is:

- ▶ Water-based, thermoset, acrylic binder
- ▶ Formaldehyde-free
- ▶ Perfect fit for glass-, PET- and natural-fibers



Introduction to Acrodur

Water-based binder for natural and man-made fibers

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What Acrodur enables:

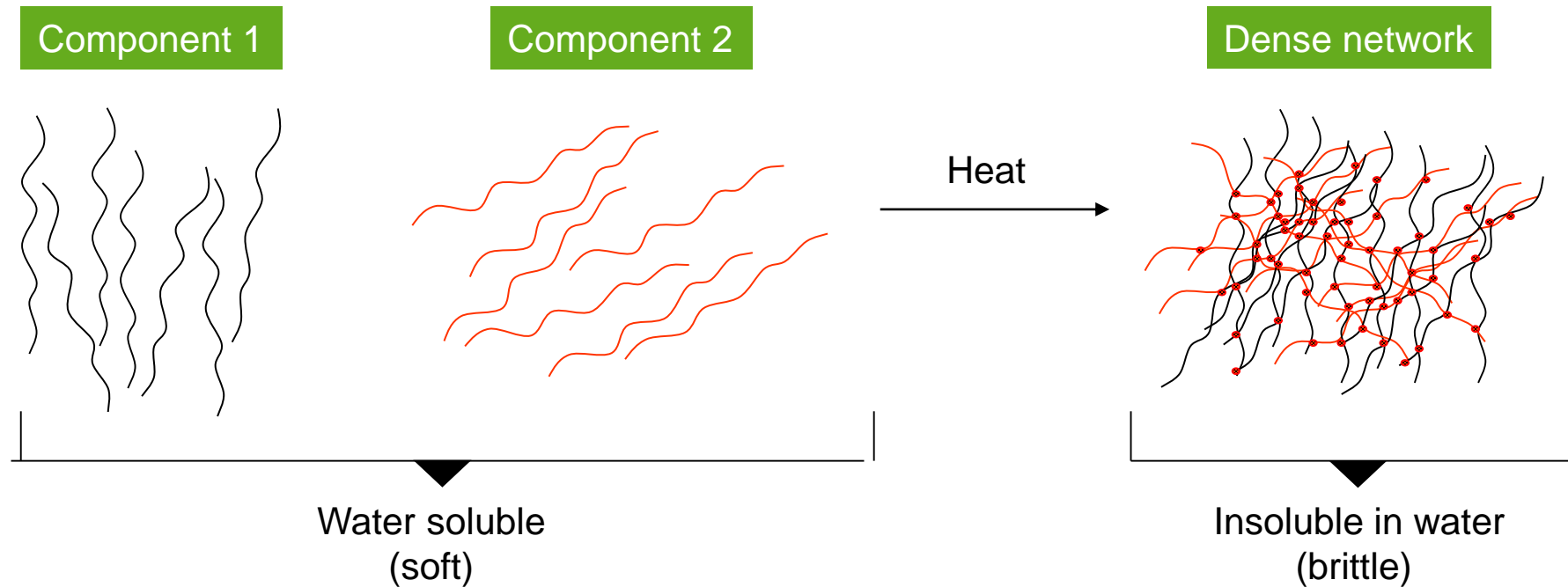
- ▶ Thermo-mechanical stability: up to 220 °C
- ▶ Applicable in critical and sensitive business fields
- ▶ Low expenses for workplace hygiene



What are Thermosets

and how do they archive their typical characteristic

Thermosets are forming a network by thermal curing of low-molecular components



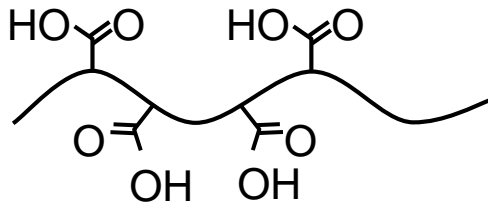
Typical thermosets: phenolic-, melamine-formaldehyde-, epoxy-resins.....and Acrodur®!

Acrodur Solutions – Formaldehyde-free, water-based Resin

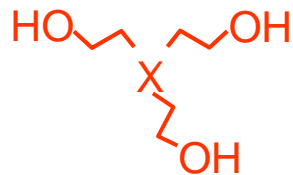
fulfilling requirements for high thermal resistance

Acrodur **solutions** consist of two components, dissolved in water

...a polycarboxylic acid:

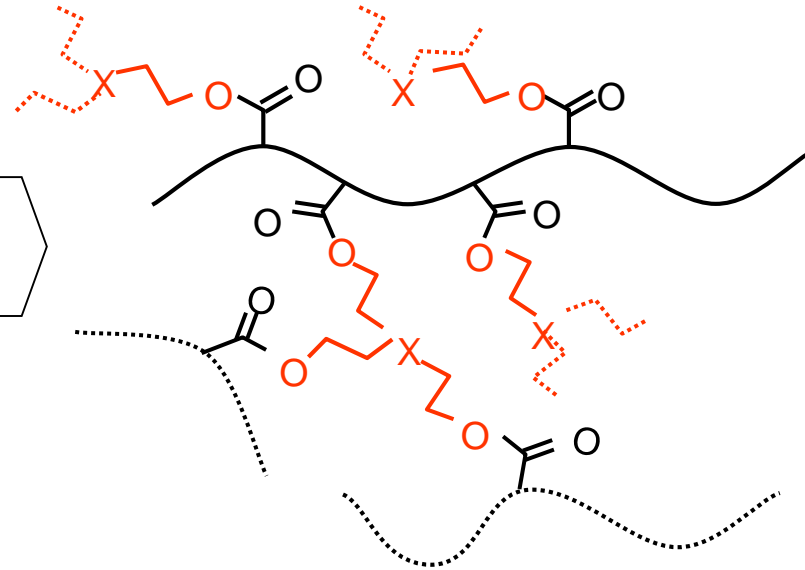


...and a polyalcohol:



Temp. > 130 °C

...to form a polyester

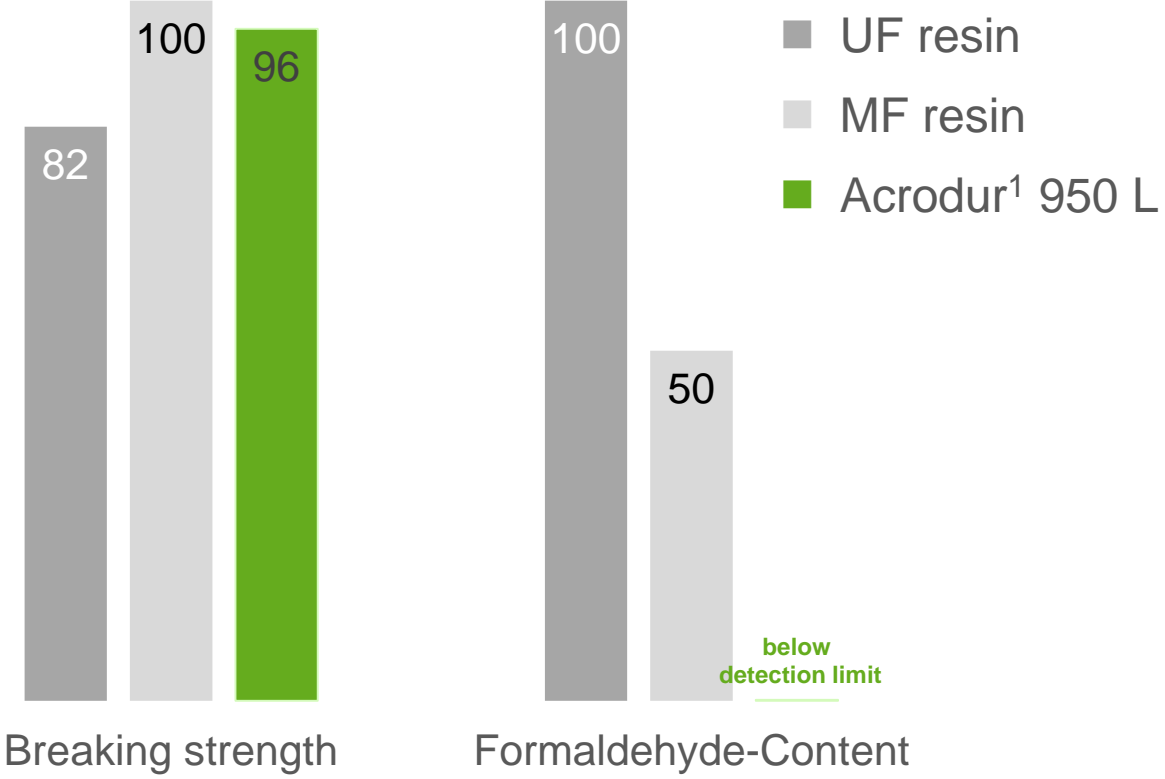


...and water

+ H₂O

Example for Construction Industry and In-house Application

Formaldehyde reduction with Acrodur on glass substrates

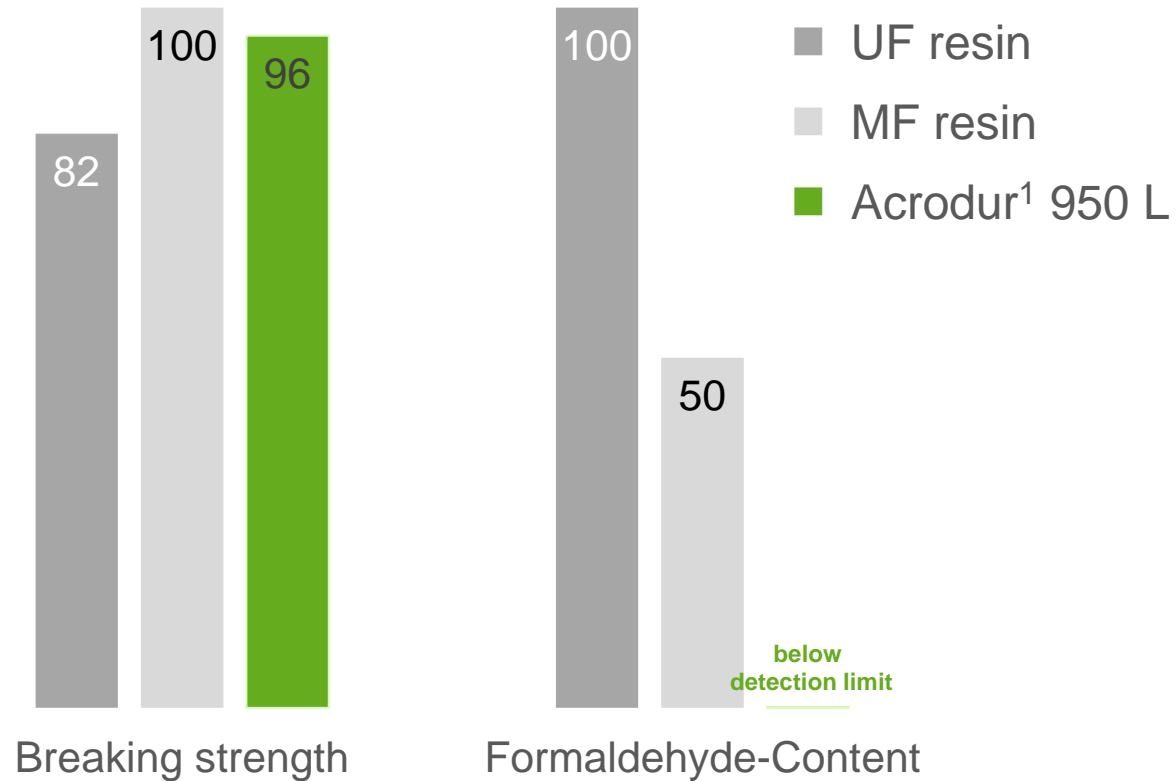


¹Formaldehyde not intentionally added

Performance indexed to 100
Lab-scale: 50 g/m² nonwoven, 20% binder, 3min 200°C

Example for Construction Industry and In-house Application

Formaldehyde reduction with Acrodur on glass substrates



Acrodur benefits

- Improved workplace hygiene
- No Formaldehyde¹, No air-treatment necessary
- Various eco-labeling options

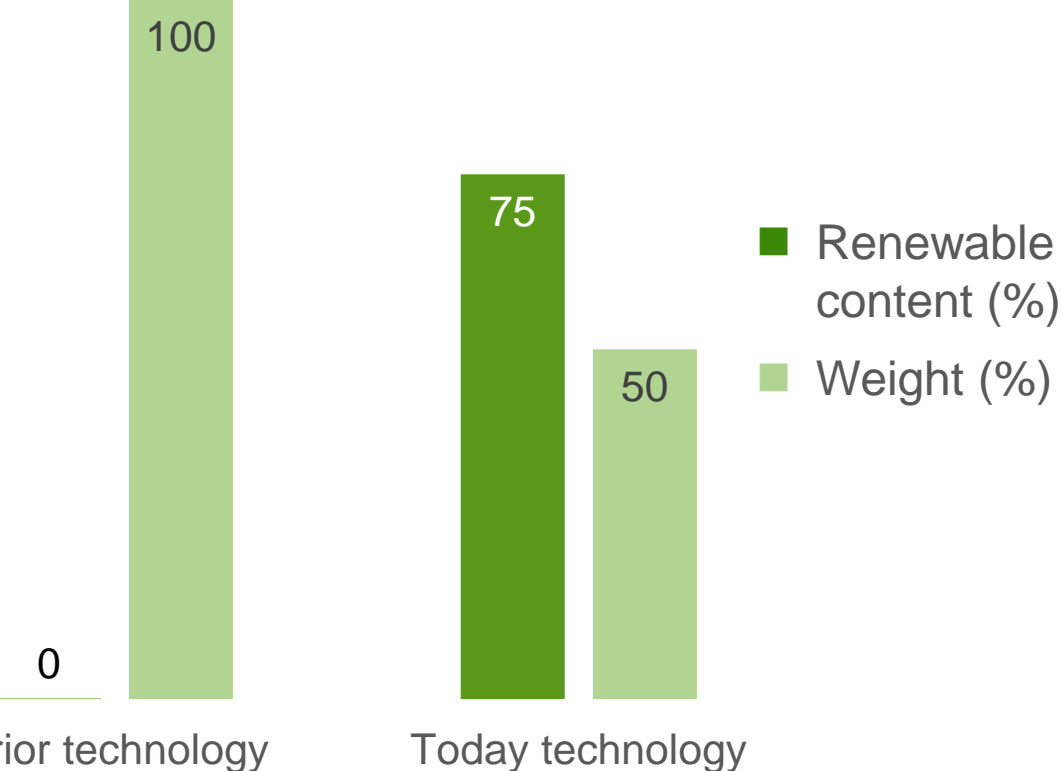
¹Formaldehyde not intentionally added

Performance indexed to 100

Lab-scale: 50 g/m² nonwoven, 20% binder, 3min 200°C

Example for Automotive: IAC FiberFrame with Acrodur® 950L

Worldwide first automotive roof frame made of natural fibers



Content / weight indexed to 100,
Hemp / Kenaf nonwoven + 30% binder



Example for Automotive: IAC FiberFrame with Acrodur® 950L

Worldwide first automotive roof frame made of natural fibers

IAC FiberFrame in Mercedes E-class

- ▶ Acrodur ensures necessary loading capacity and heat resistance of the lightweight component
- ▶ Composite weight reduction by 50% due to replacement of metal
- ▶ Time savings in composite production
- ▶ Improved workplace safety due to low emissions



Photo: Courtesy of IAC

Acrodur a sustainable Solution for our core Industries

due to high compatibility with nearly every fiber

Automotive



Construction



Consumer & In-house



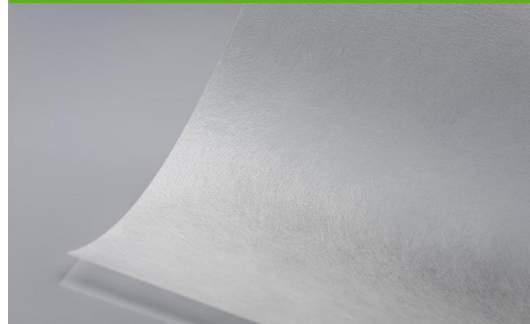
Industrial



Natural Fiber



Glass Fiber



PET Fiber



Polyamide Fiber



Challenging to meet various Industry and Process Requirements

with only “one” Acrodur grade

Acrodur Solutions

Product Name	Tg [°C]	Solids [%]	pH value	Viscosity [mPas-s]	Low VOC	FA free	Self x-linking	Product key properties
Acrodur 950 L	-	50	~3.5	~1300	■	■	■	Hard, brittle
Acrodur DS 3530	-	50	~3.5	~225	■	■	■	Hard, brittle

Potential requests

Processability

e.g. Reactivity, Foam-able, Spray-able, Thermoplastic moldable, etc.

Properties

e.g. Balanced Rigidity-Elasticity, Hydrophobicity, Color-fastness, etc.

Compatibility

e.g. Formulation Additives, other Binders, Fillers, Flame retardants, etc.

New Generations of Acrodur available or in development

Meet various industry needs with Acrodur dispersions, new Acrodur solutions & thermoplastic Acrodur

Generation

Acrodur Dispersions

New Acrodur Solutions

Thermoplastic Acrodur

Focused
Characteristics

- Increasing elasticity
- Higher hydrophobicity
- Affinity to dispersions & fillers

- Higher reactivity
- Tailored drying speed
- Less yellowing
- Affinity to (natural) binders

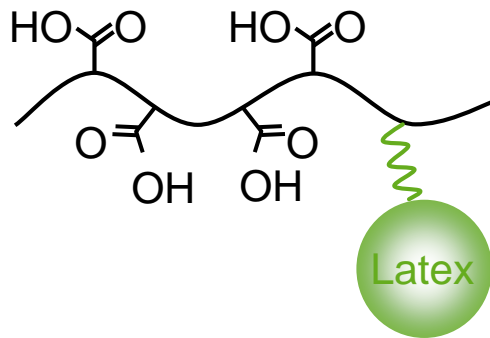
- Combined “Acrodur-typical” hardness with cold moldability

Acrodur Dispersions – Formaldehyde-free, water-based Binder

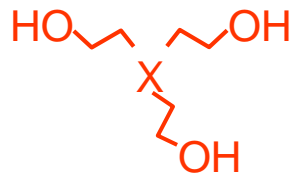
fulfilling the requirements for high thermal resistance and flexibility

Acrodur **solutions** consist of two components, dissolved in water

...a latex-modified, polycarboxylic acid:

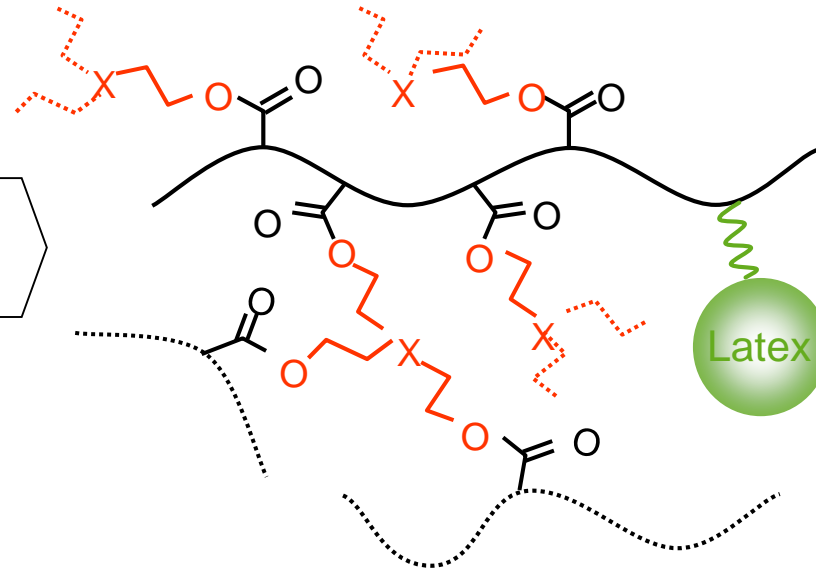


...and a polyalcohol:



Temp. > 130 °C

...to form a latex-modified polyester

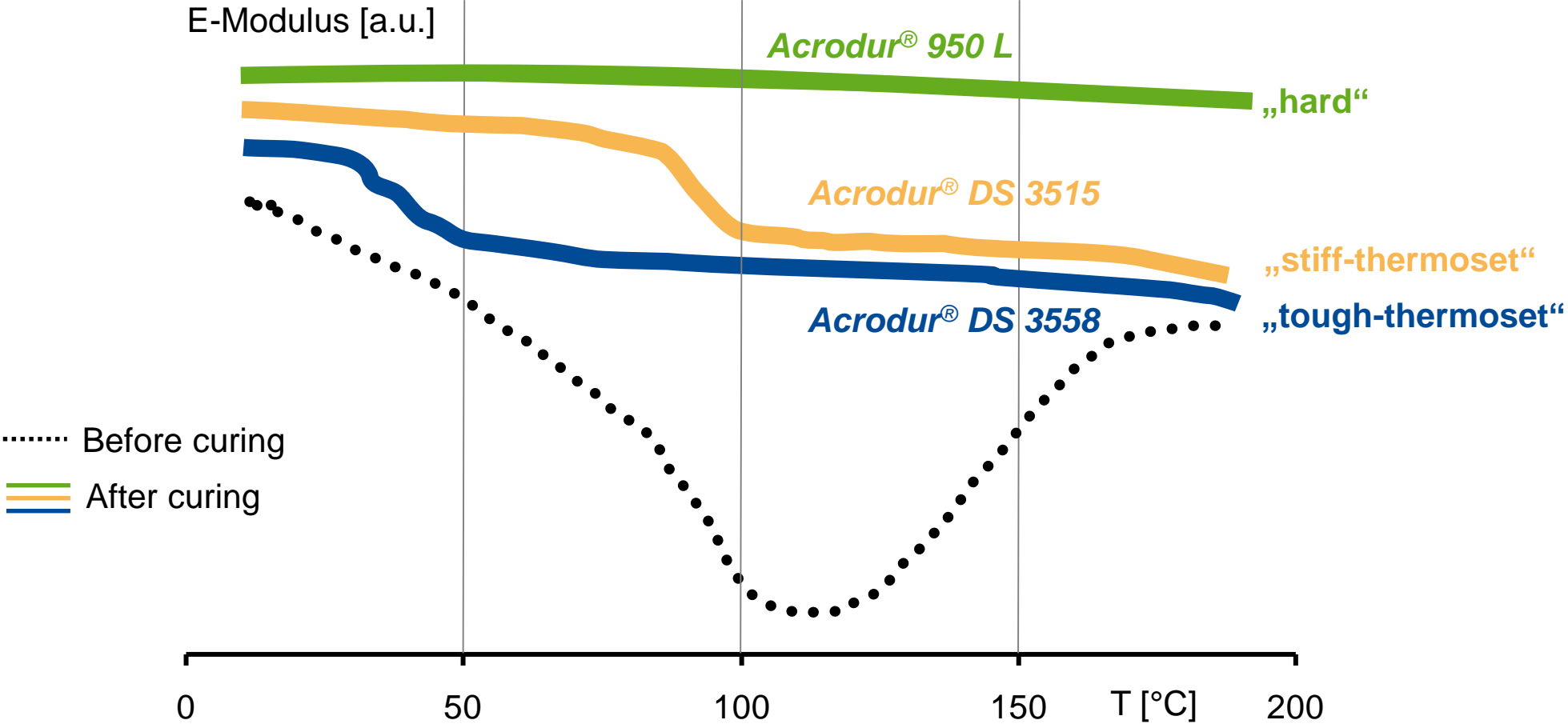


...and water

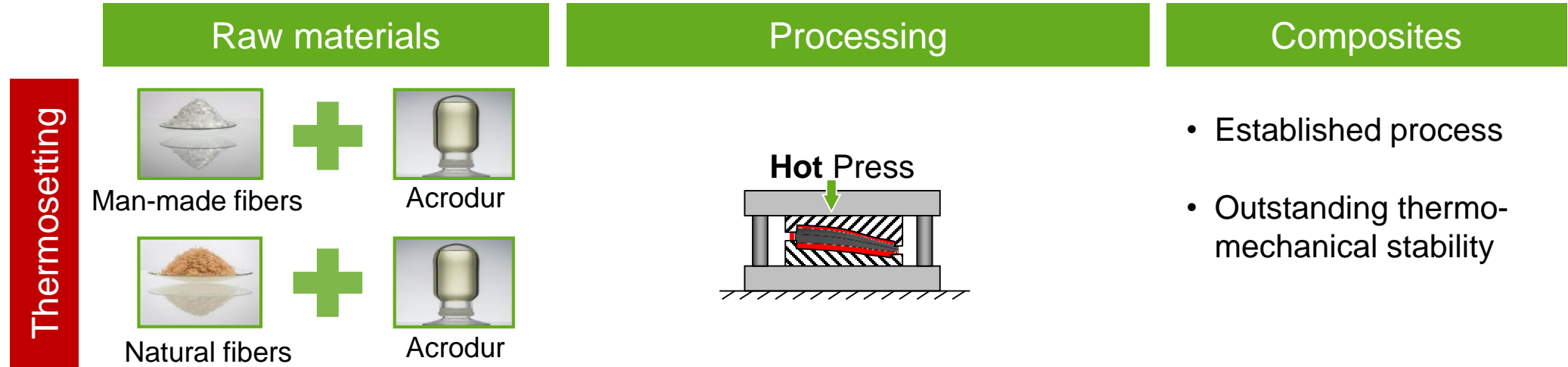
+ H₂O

E-Modulus of Acrodur Dispersions versus Acrodur 950 L

as example for an increase in flexibility and “slight” thermoplastic behavior



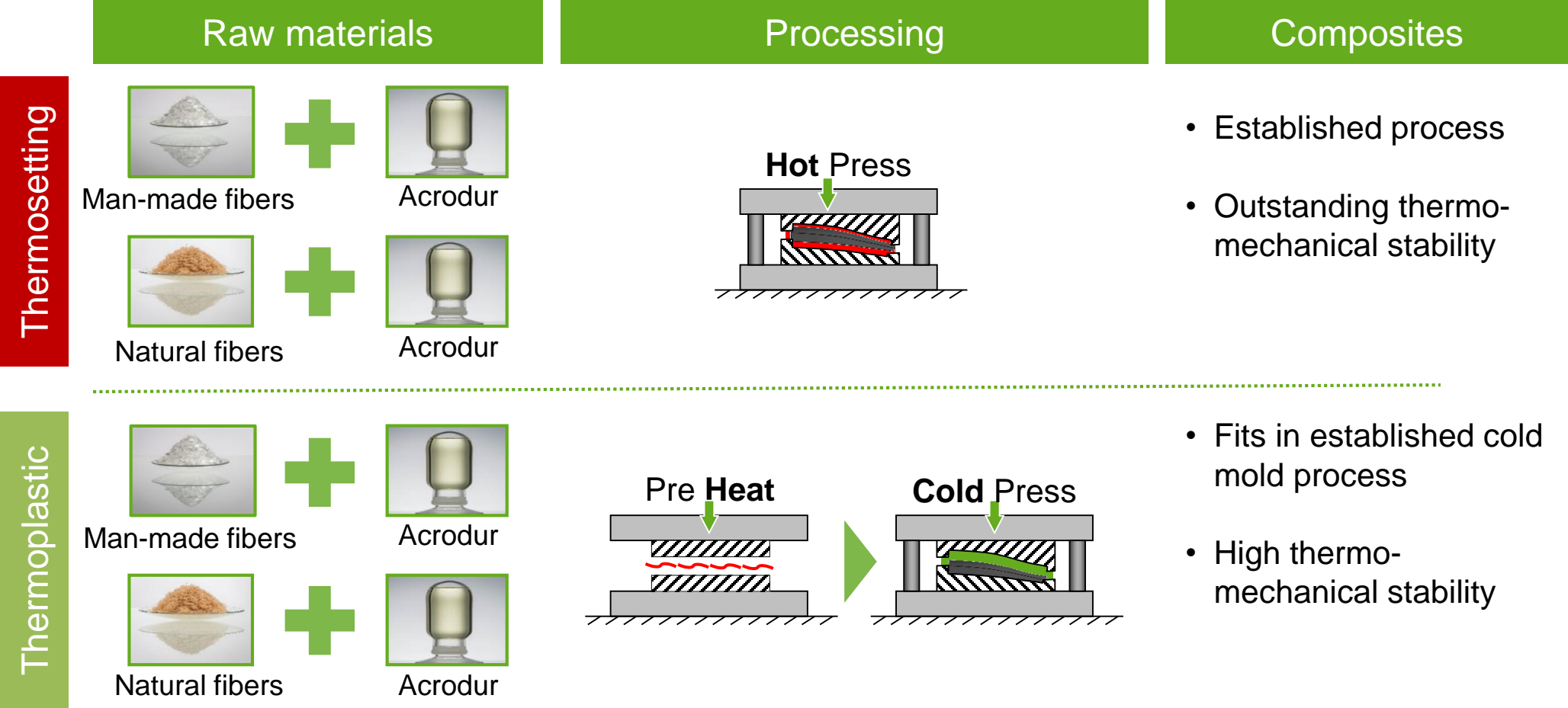
Thermoset Acrodur: Established hot molding processes, but no option for cold molding process



Need of thermoplastic Acrodur generation to offer binders for cold molding process!

New thermoplastic Acrodur generation,

to offer a processable Acrodur solutions for the whole molding value chain

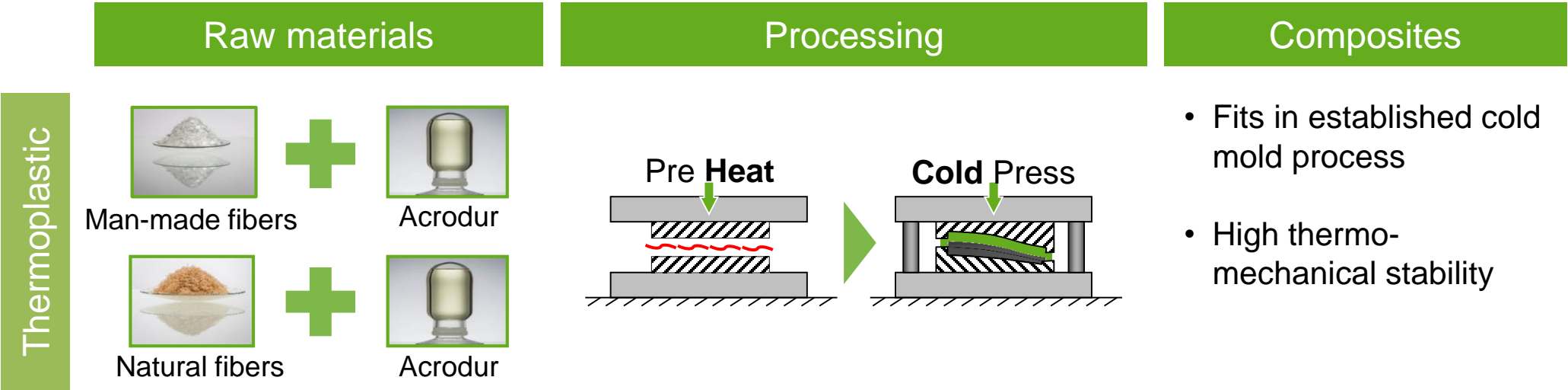


New thermoplastic Acrodur generation,

to offer a processable Acrodur solutions for the whole molding value chain

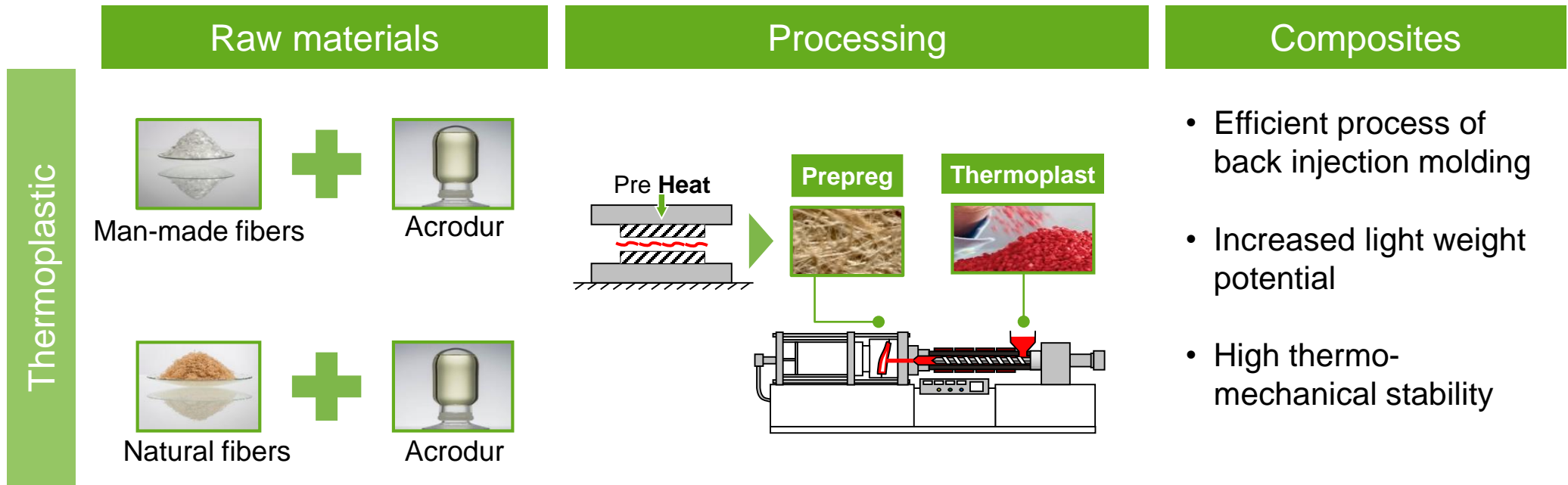
Product Name	Tg [°C]	Solids [%]	pH value	Viscosity [mPas-s]	Low VOC	FA free	Self x-linking	Product key properties
Acrodur Power 2750	95	50	~3.5	~200	■	■		Hard, visco-plastic
Acrodur Power 2850	105	50	~3.5	~200	■	■		Hard, visco-plastic

Resulting prepregs provide a high storage stability and allow thermoplastic processing. Flame retardants and pigments can easily be added to the binder.



Thinking one Step further, combining two Process-Steps into One

Thermoplastic Acrodur allows to combine compression and injection molding in one step.



Combination of Compression and Injection Molding

with thermoplastic Acrodur – natural fiber composite



acForm® - Acrodur spin-off Technology

for cost-efficient and sustainable production of 3D wood composites

acForm™ binder



- Water-based acrylic dispersion
- Non-added Formaldehyde & low-VOC
- Drop-in solution for fiberboard production process

3D moldable fiberboard (3MF)



- Thermoformable wood fiberboard
- Producible in large-scale production lines
- Moldable in standard hot presses

acForm enables cost-efficient production of 3D wood composites

Thermoformable 3MF fiberboards suitable for both moldable or structured parts

3MF fiberboard



Hot molding



3D molded wood composite



Structured wood composite



Advantages of 3MF technology

- Time- & cost-efficient process
- New design options & high surface quality for 3D wood fiber parts
- High degree of wood utilization
- Sustainable binder technology

acForm – Innovative Binder for the Woodworking Industry

offering new design options for furniture industry



Broad Acrodur Technology Portfolio

to meet various industry needs

Generation	Acrodur Dispersions	New Acrodur Solutions	Thermoplastic Acrodur
Name	Acrodur DS 3515 Acrodur DS 3558	Acrodur 950 L Acrodur DS 3530 i.a.	Acrodur Power 2750 Acrodur Power 2850
Focused Characteristics	<ul style="list-style-type: none">■ Increasing elasticity■ Higher hydrophobicity■ Affinity to dispersions & fillers	<ul style="list-style-type: none">■ Higher reactivity■ Tailored drying speed■ Less yellowing■ Affinity to (natural) binders	<ul style="list-style-type: none">■ Combined “Acrodur-typical” hardness with cold moldability

Questions, Remarks or Project Ideas ?

We have various lab opportunities to follow up your ideas

Impregnation



- Foulard
- Spray coating
- ...

Drying



- MATHIS dryer
- FLEISSNER air-through dryer

Sample Preparation



- VOGT hot press

Characterization



- Mechanical
e.g. tensile test
- Thermo-analytical
e.g. DSC, TGA
- Optical
e.g. microscopy

Let's talk!



We create chemistry