Advantageous material properties of natural fibres reinforced polymers

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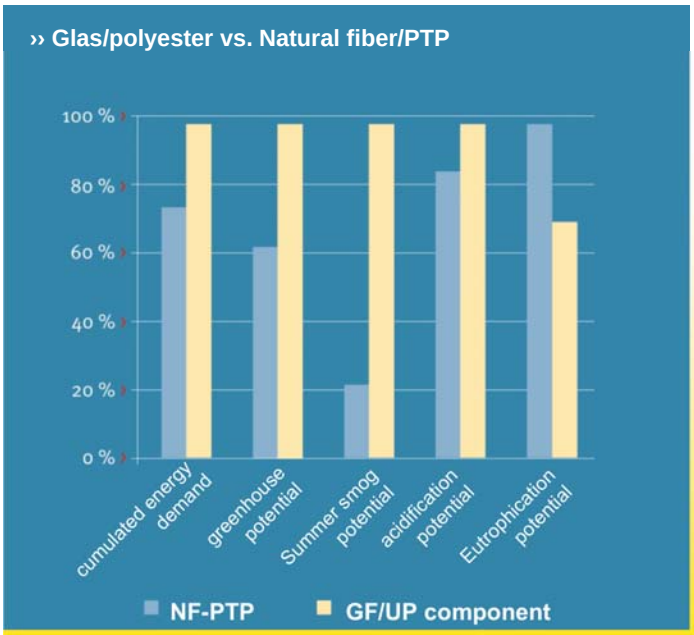
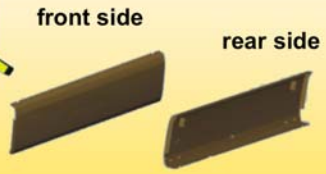
- **overview of nontechnical advantages**
- **material properties and technical advantages of natural fiber reinforced polymers**
- **Design with natural fiber reinforced polymers**

Content





Source: Faserinstitut Bremen

Ecological Advantages

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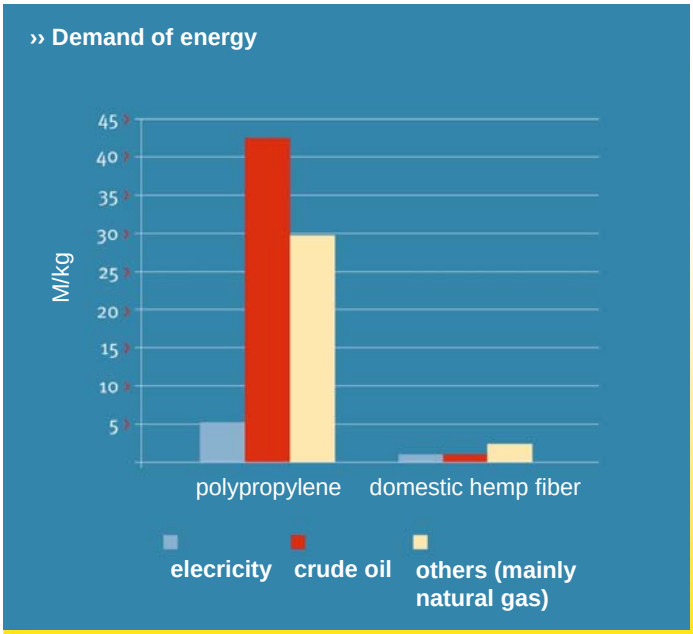
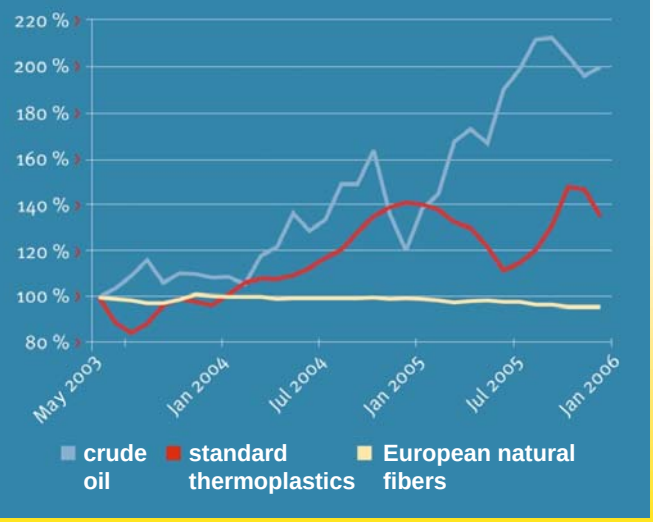


- The production of natural fiber is remarkably independent of the consumption of crude oil and natural gas.

Source: nova Institut

Increasing cost attractiveness

›› Price development of crude oil, standard thermoplastics and European natural fibers since 2003



Comparison of Natural Fiber Prices

Compared to crude oil and standard thermoplasts the level of European natural fiber prices is very even.

Source: nova Institut

Increasing cost attractiveness

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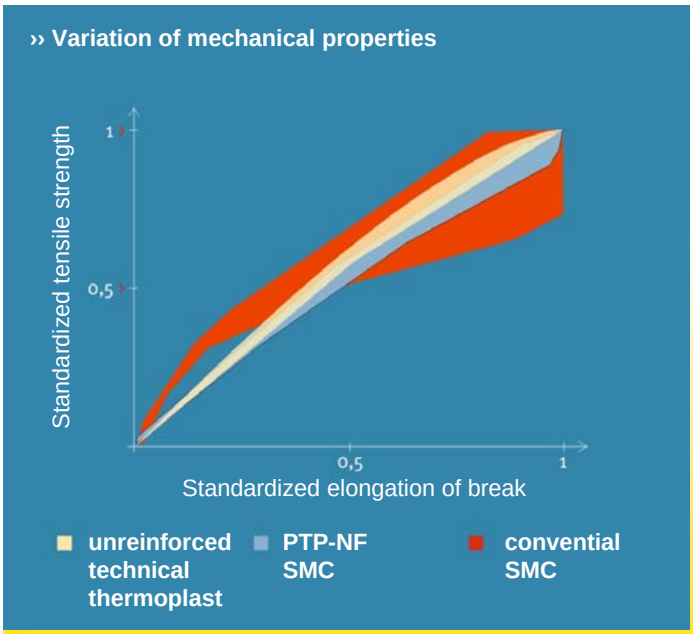
›› Worldwide bast and leaf fiber production

Bast and leaf fiber production above 1000 tons per year

Worldwide bast and leaf fiber production 5,4 m tons (according to FAO 2005)

- 2.860.000 t, jute
  mainly India, Bangladesch
- 931.000 t, coco
  mainly India, Vietnam, Sri Lanka
- 782.000 t, flax
  mainly China, Europe, Russia, White Russia
- 403.000 t, jute-like fibers
  mainly Indien, Bangladesch, China, Thailand
- 314.000 t, sisal
  mainly Brazil, East Africa
- 66.000 t, hemp
  mainly China, Europe

High Security of Supply



Homogeneous Mechanical Properties

- Natural fiber reinforced polymers are often blamed for the high variation of their properties. But a comparison with conventional materials shows that the variation does not exceed those of conventional materials.

Source: Faserinstitut Bremen

High Quality

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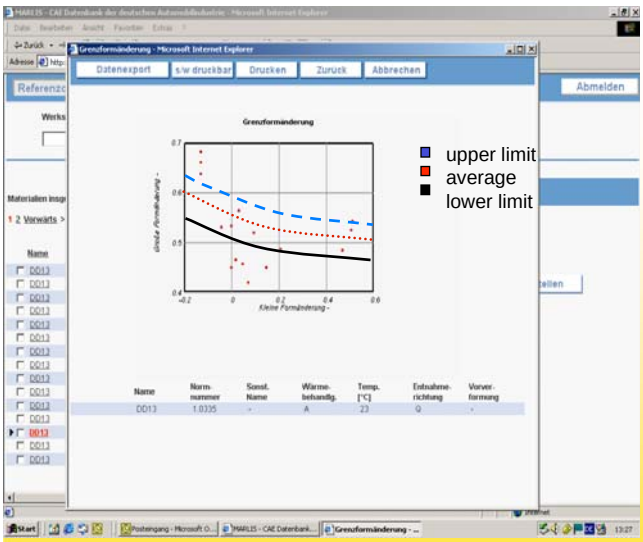

Homogeneous Mechanical Properties

- Non polymer conventional materials, i.e. steel show significant variation of mechanical properties, too.

Quality of conventional materials

- flexible grinding wheel with injection molded carrier of PP-NF
- good mechanical properties
- Advantages for safety at work
- Advantages for disposal

Advantage for occupational health

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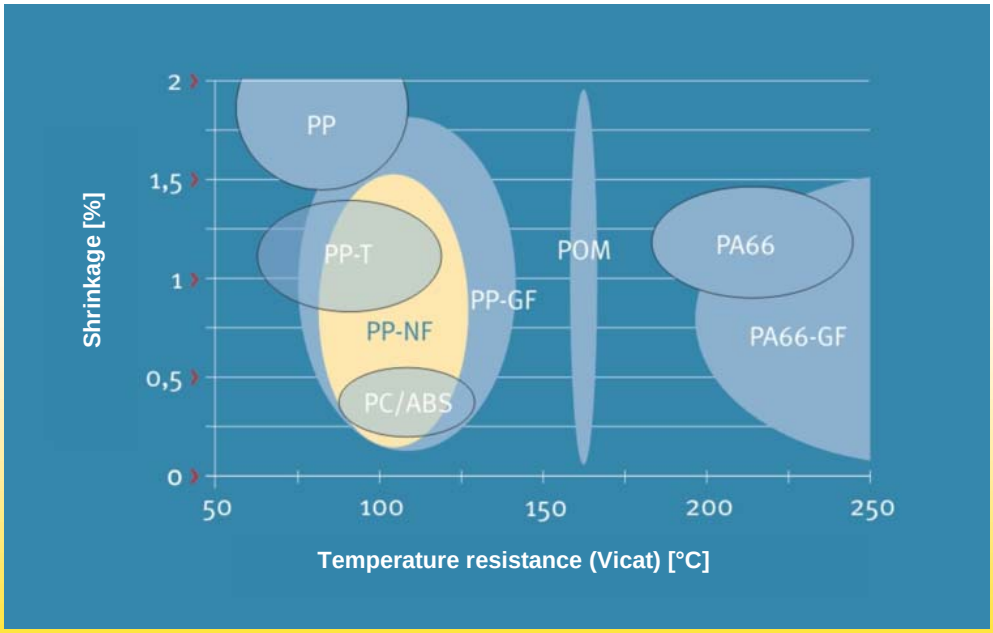
- technological Advantages
  - **dimensional stability**
  - **temperature resistance**
  - **mechanical properties**
  - **crash behaviour**



Shrinkage of PP-NF

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- good impact resistance (Charpy)
- good surface quality
- little shrinkage / warpage
- good thermal endurance

possible points of attack for PP-NF

Reasons for Using PC/ABS

- price
- processability
- no contact noise (squeak)

Benefits of PP-NF compared to PC/ABS

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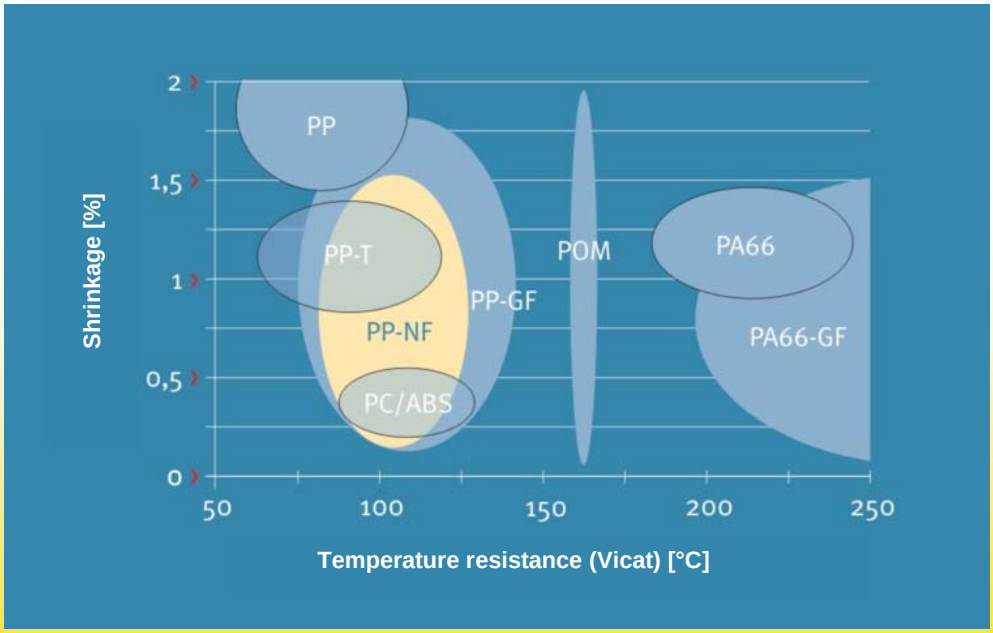
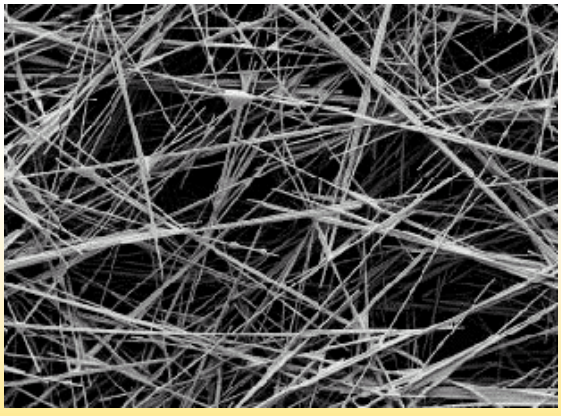


Shrinkage of PP-NF

Shrinkage = f(Material, Melt Temperature, Pressure, ...)

Due to the thermal sensitivity of natural fibers, PP-NF is optimized for the processing at low temperatures; high pressures are required for filling.
Both reduce the shrinkage of the part.

Factors Influencing Shrinkage
Processing



glass fibers

natural fibers

Factors Influencing Shrinkage/Fiber Orientation
Fiber Geometry

compound	volumetric fiber content[%]
PP-GF 30	14,5
PP-GF 50	28
PP-NF 20	15,5
PP-NF 30	23,5

Factors Influencing Shrinkage/Fiber Orientation
volumetric fiber content

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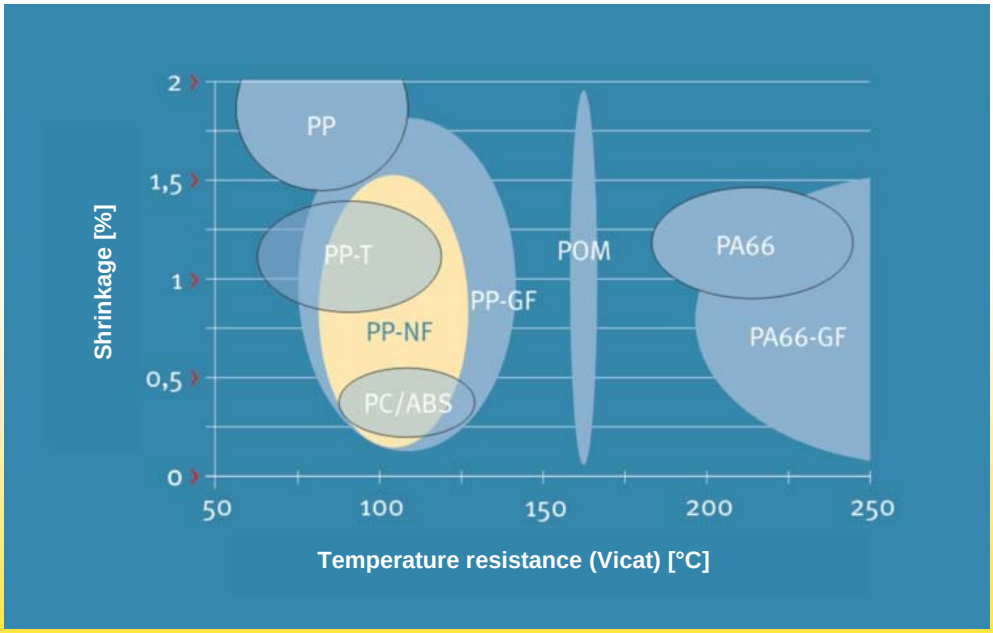
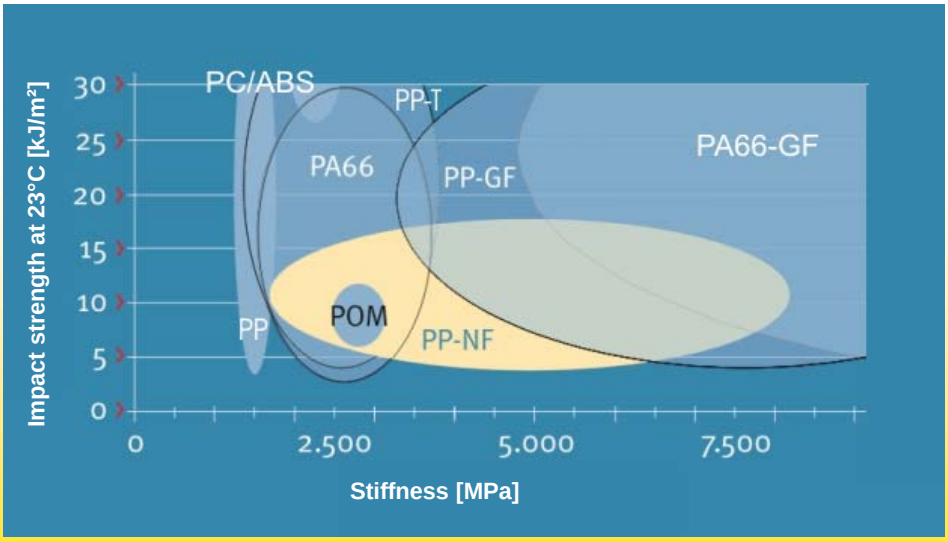


Temperature Resistance



mechanical properties

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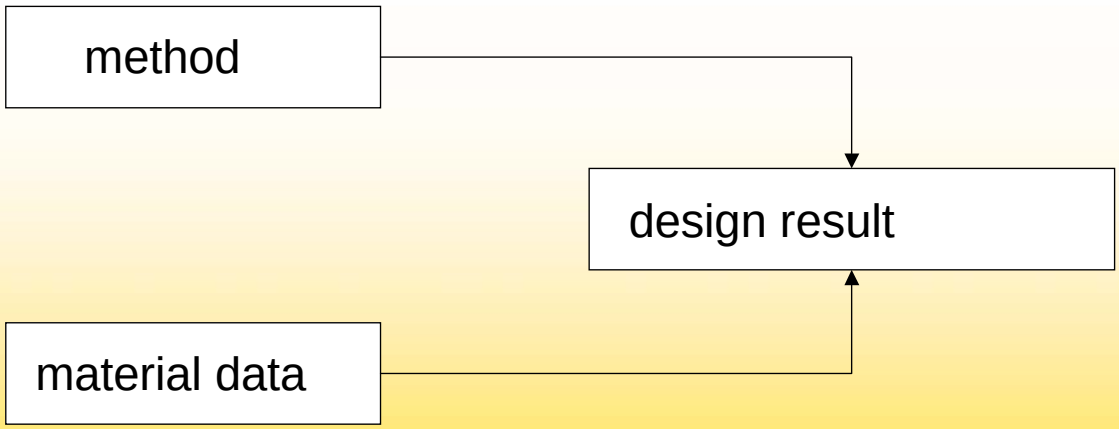
Although Charpy impact properties are quite poor, natural fiber reinforced polymers are known for their good crash behavior:

- they do not sliver
- they absorb a lot of energy

Maybe these advantages are restricted to textile based compression molded parts.

crash behaviour



Elements of Design

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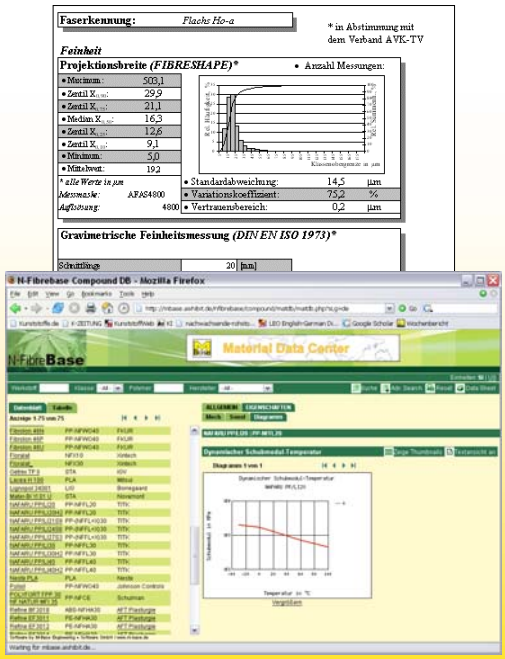
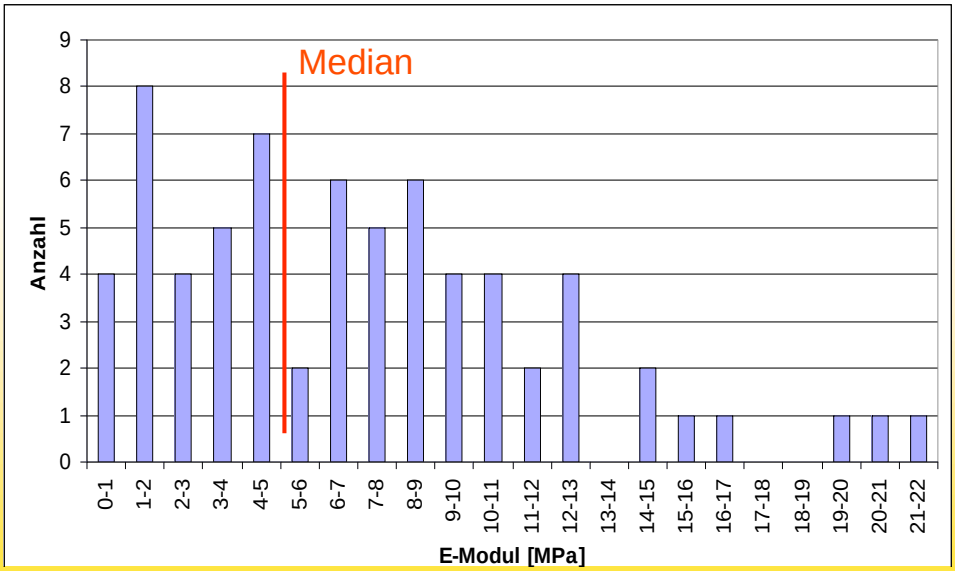
- **test recommendation**
  - reproducable, effective and comparable tests for fibers and compounds
- **internet portal**
  - data bases



Material Data?
www.N-FibreBase.net!



Determination of the Representative Elastic Modulus

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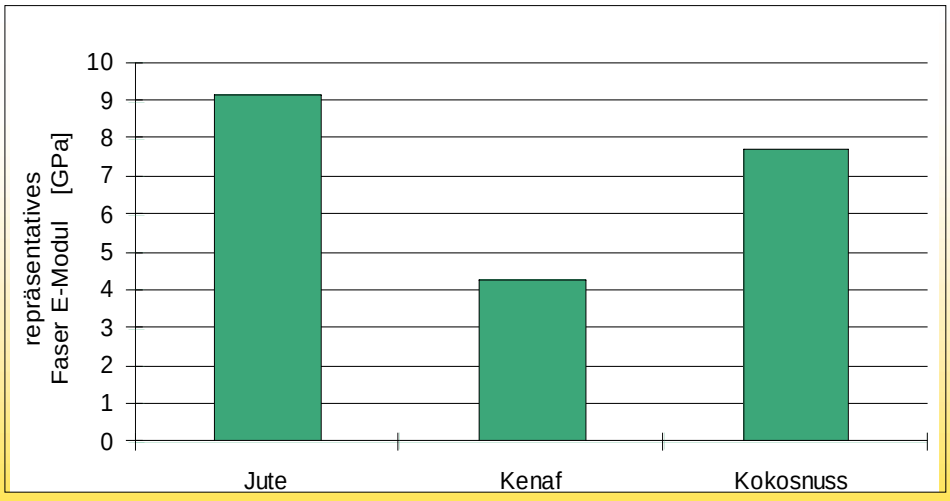
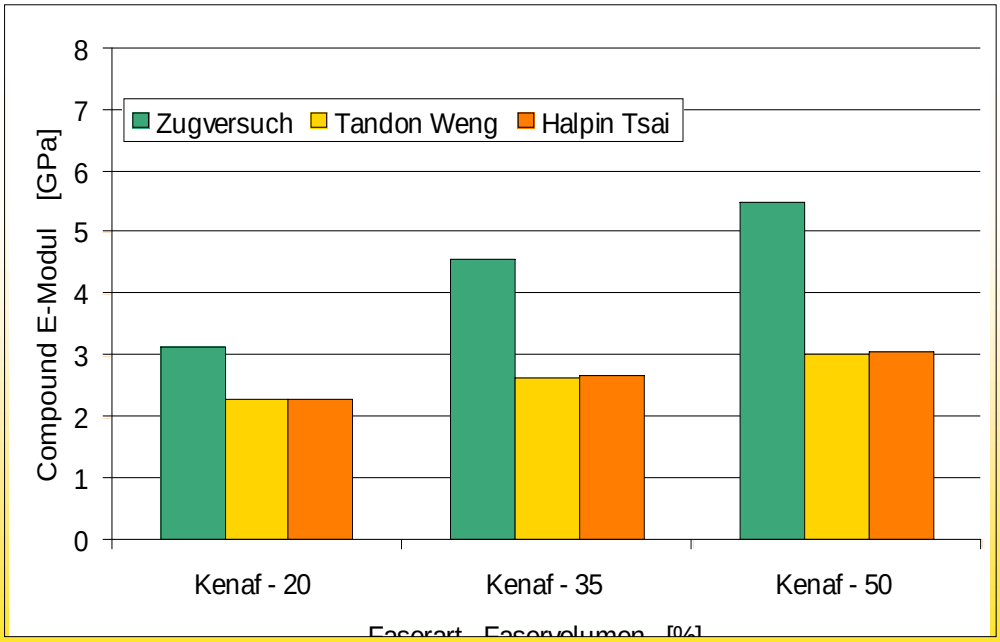


Test Results Fiber Modulus



Comparision of Calculated and Measured Compound Modulus

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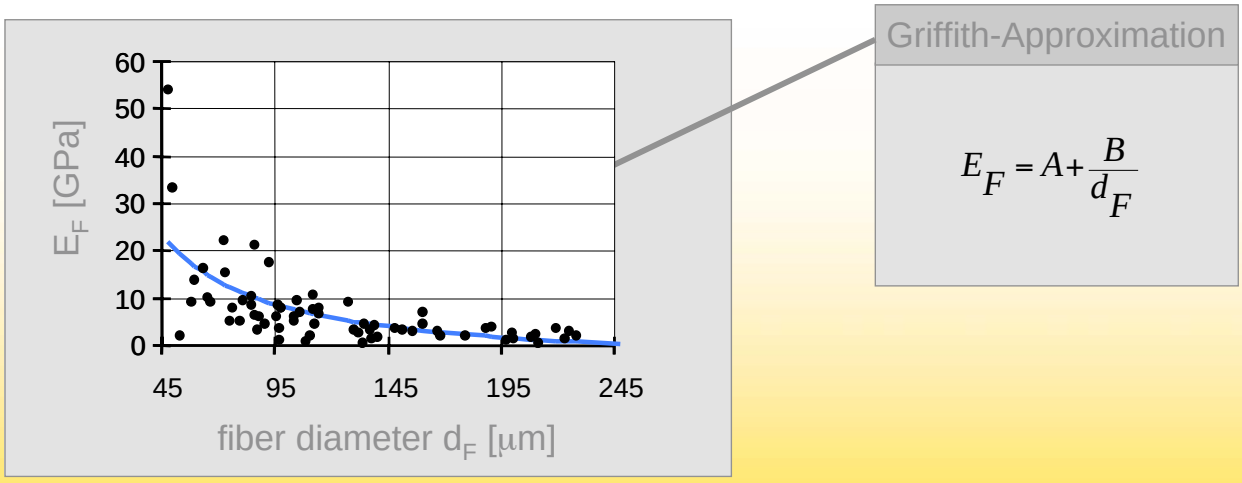
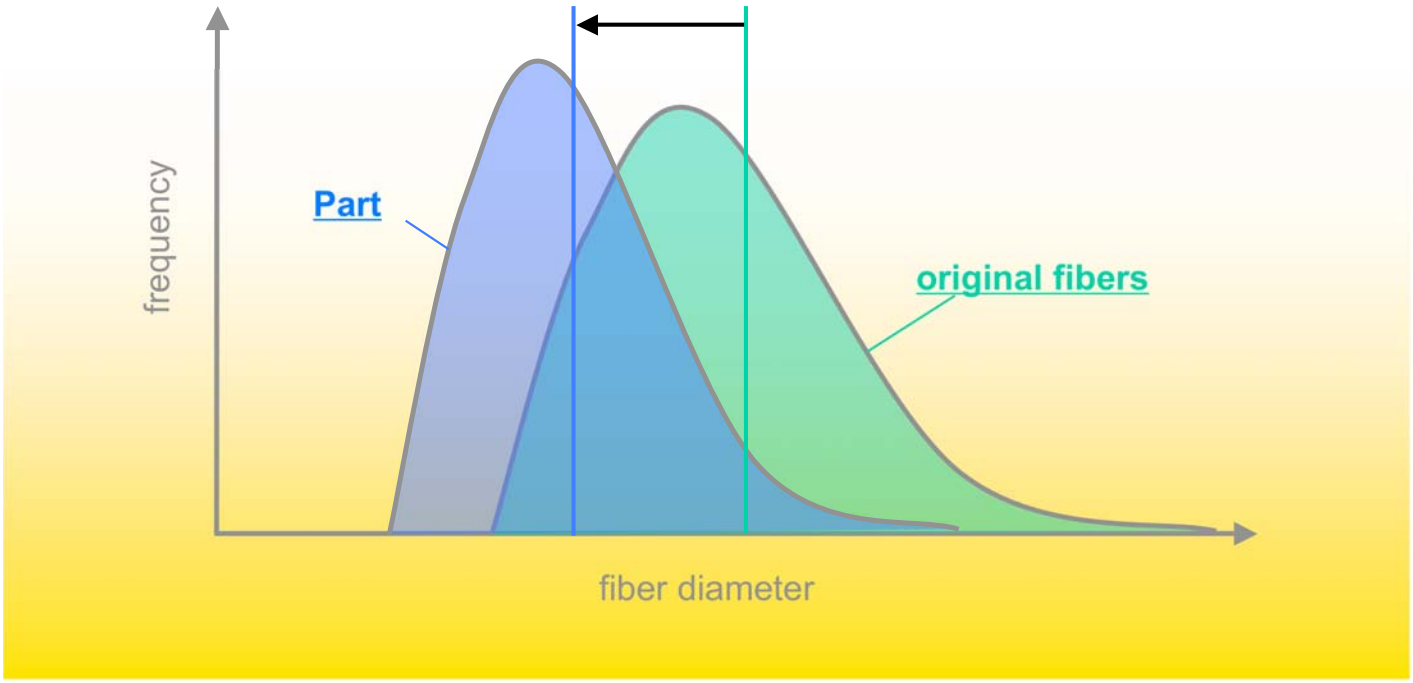


Dependency of Elastic Modulus from Fiber Geometry



Differences in Fiber Diameter Distribution Part – Original Fibers

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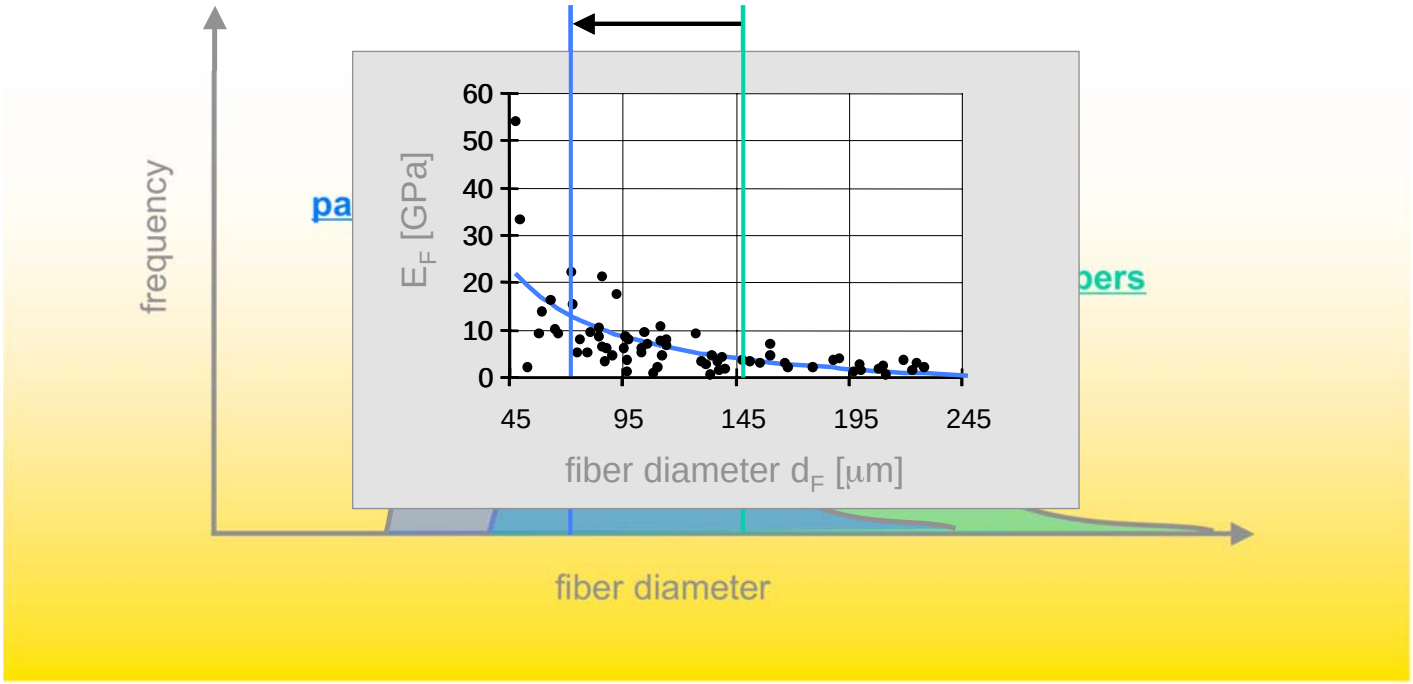

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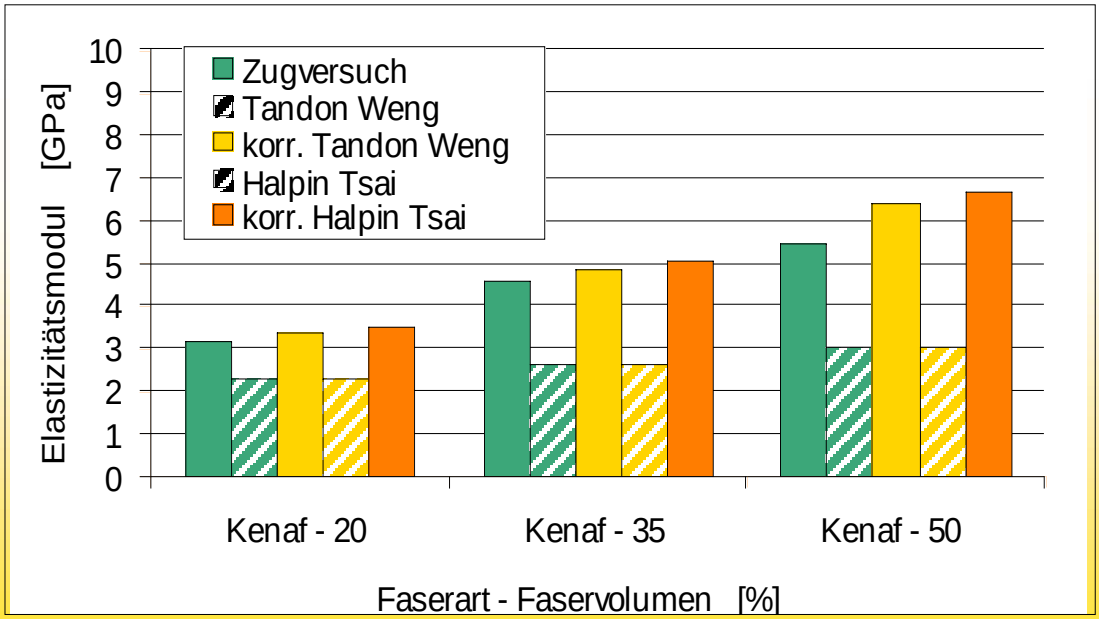

Comparision of Calculated and Measured Compound Modulus

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NF-GuideLines

Development of design guidelines for injection and compression molding of natural fiber reinfoced polymers

further information: www.n-fibrebase.net

Actual Project

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Faserinstitut Bremen e.V., (FIBRE)

Institut für Polymerwerkstoffe und Kunststofftechnik der TU-Clausthal, (PuK)

Faurecia Innenraum Systeme GmbH

Project Partner

- Natural fiber reinforced polymers provide a lot of interesting properties
- Substitution of several technical polymers is possible (PP, PP-T, PC/ABS, ...)
- Distribution of design knowlegde is a good marketing instrument

Resume

Advantageous material properties of natural fibres reinforced polymers

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