Untreated wood fibers.
Pre-treated wood fibers.

With its Application Center HOFZET, the Fraunhofer WKI represents innovative, application-oriented research and expertise in the field of (bio-based hybrid) fiber composite materials (FRC). The main research focuses of the HOFZET include the development of application-specific optimized composite materials, project planning and the implementation of process chains for the production of novel (bio/hybrid) FRC for small and large-scale production, and the development and verification of effective material-specific surface modification methods for fibers.

In order to realize the maximum performance potential of the developed composites both successfully and cost-effectively, the experts optimize the interface quality between fibers and matrix. The optimal interface serves the effective transmission of force between the elements and ensures a high mechanical stability in the finished component. Components of a composite material, which differ greatly from one another as regards their chemical composition, structure, and morphology, therefore require an additional process step in order to improve their interaction at the interface.

The HOFZET employees develop and investigate component-specific wet-chemical approaches to the surface modification of fibers. The subject of the research is the development and practical implementation of methods for the (continuous) surface modification of short fibers, staple yarns, rovings and textile semi-finished products. The main research focuses include pre-treatments with polyelectrolytes, bonding agents, and the mercerization or application of special thermosetting coatings. In addition to the fiber-matrix bonding, the thermal, hygroscopic, optical and flame-retardant properties of fibers and composite materials can also be optimized through surface modification. Furthermore, the HOFZET is also investigating approaches to functional integration, such as electrical...
or thermal conductivity, on the basis of polyelectrolyte coating.

The elaborate analysis of the morphological and surface chemical properties enables the development of quality-assured, reproducible surface modification methods. Via the cooperation with the Institute for Bioplastics and Biocomposites IfBB at the Hannover University of Applied Sciences and Arts, the modified fibers are comprehensively characterized at the HOFZET.

**Expertise**

- Application or process-specific wet-chemical pre-treatment of short fibers, yarns, textiles
- A fully automated, purpose-built facility for the continuous wet-chemical and complex wet-chemical/physical surface modification of yarns, threads, filament yarns, rovings and textiles is currently being procured
- Desired product properties:
  - Optimized mechanical, thermal and morphological properties
  - Functionalization of the fiber surface
  - Improved flame-retardant properties
  - Fiber-matrix bonding
  - Fiber analysis of individual fibers and fiber bundles
  - Analysis of yarns and textile semi-finished products

**Fiber analytics – Technical equipment**

- Measuring system for length and width measurement of natural and synthetic fibers
  - Analysis of fibers/particles from approx. 7 um
  - Statistical evaluation of the size distribution (length, width, particle size)
  - Measurement of particles and fibers with complex structures
  - Measurement of dry or in liquid dispersed fibers
  - Dynamic contact angle measuring device and tensiometer
  - Determination of the contact angle for powders, fibers and fiber bundles
  - Investigation of the adsorption behavior
  - Analysis of the dynamic contact angle and the surface energy for prismatic and cylindrical test specimens
  - Determination of the static surface and interface tension of liquids
  - Investigation of the critical micelle formation concentration of surfactants (CMC)
  - Measurements at high temperature up to 250 °C
  - Determination of the density of liquids and solid objects
  - Characterization of sedimentation, penetration and adhesion
  - 3D digital microscope
  - Three-dimensional representation of samples with complex surface structures
  - Analysis of the scratch resistance of plastics

- Investigation of fracture surfaces and fiber-matrix systems
- Fiber/particle distribution on surfaces
- Volume and surface calculations for 3D bodies
- Incident light and transmitted light possibilities
- Up to 5000x magnification
- Adjustable angle
- Scanning electron microscope
  - Imaging and analysis of material surfaces and fractures
  - Three-dimensional representation of the morphology, corrosion and temperature resistance, and coating performance
- ATR infrared spectroscopy (FTIR-ATR)
  - Testing and identification of raw materials, foreign substances and mixtures
- Zeta potential measurement device
  - Analysis of the zeta potential of macroscopic solid object surfaces, such as fibers, textiles or powders by means of streaming potential-streaming current measurement
  - Adsorption processes on fibers
  - Stability of the fiber coating and size

3 Length distribution of wood fibers.
4 REM images of untreated and treated flax fibers.