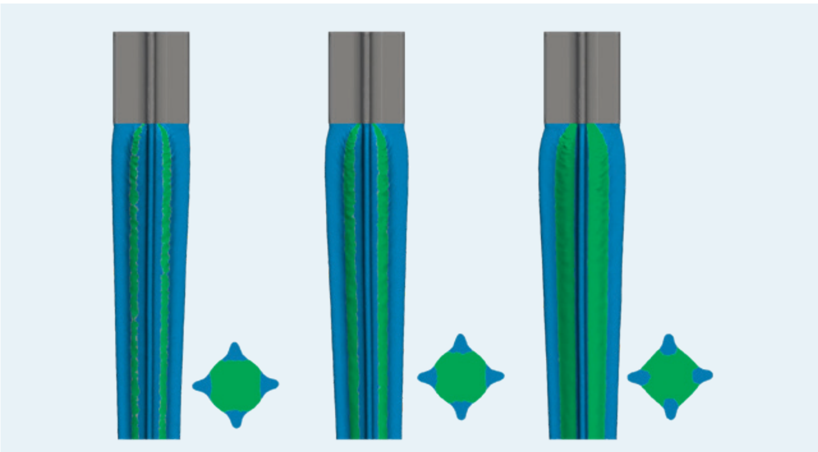
Extrusion Simulation of Bicomponent Synthetic Fibers

Not all fibers are round. But how do you make it run round anyway and spin a plastic fiber with a cloverleaf-shaped cross section, for example? A team from our department "Transport Processes" develops simulation methods for such complex tasks – our established software solutions MESHFREE and VISPI are used here.



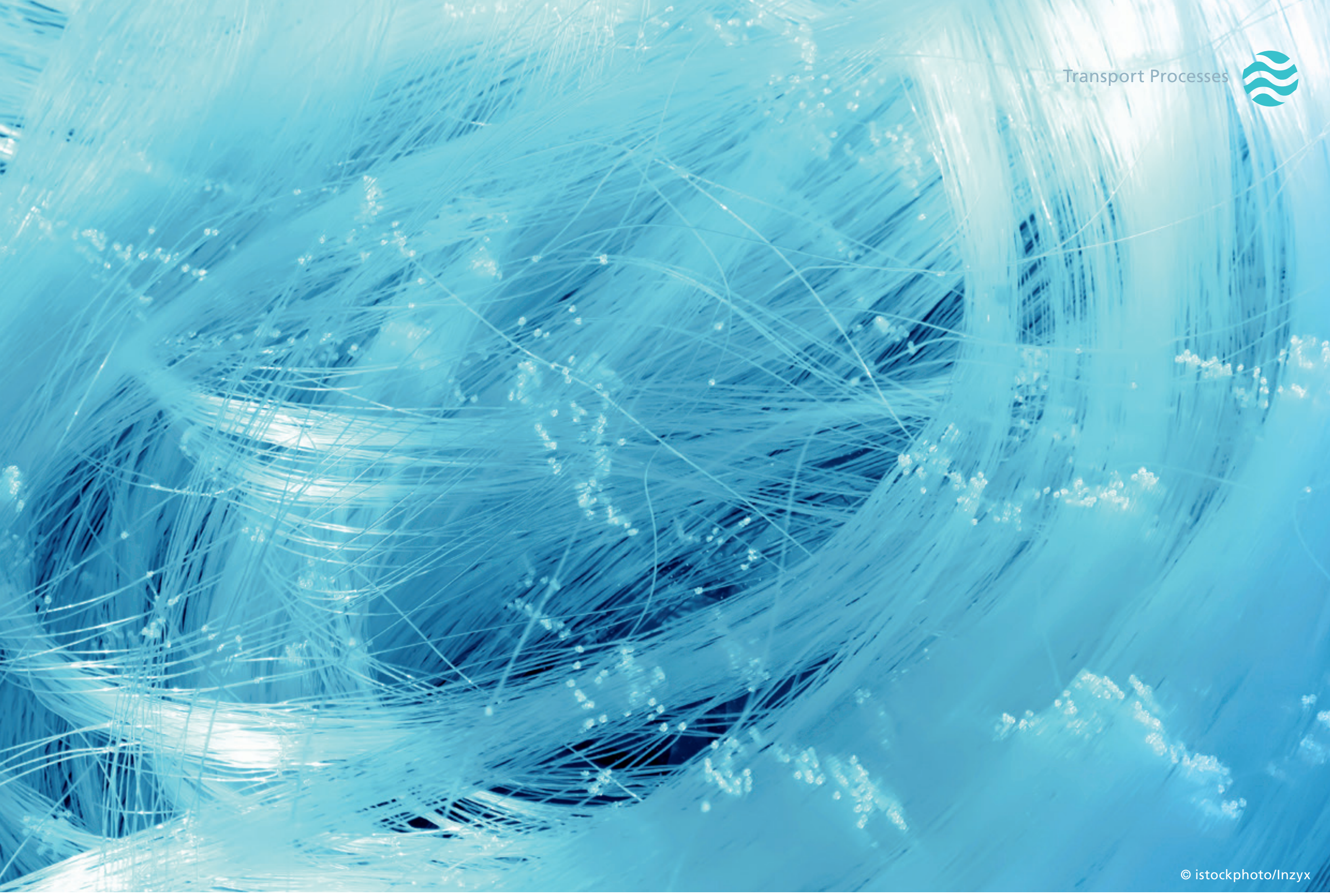
Three different BiGOFil fibers with different raw material properties: The graphic shows in each case the fiber spinning out of the die and the final fiber cross-section.

Today, everyday life without plastic fibers is unthinkable. We encounter them in almost all areas of life, whether in an oil filter or in a nonwoven medical face mask – and their composition varies depending on their function. In essence, however, they all depend on the fibers on a small scale and the production process on a large scale.

In spinning processes for the production of synthetic fibers, molten or dissolved mass is forced through fine nozzles and spun into fibers. These are usually passed through an air flow for curing. Known processes are melt spinning or dry spinning. What they all have in common is that it is always a demanding process in which all components must interact optimally. That is why our department "Transport Processes" has already developed software solutions that virtually map the spinning process as a digital twin. Such simulations save manufacturers cost- and time-intensive experiments, allow new insights and enable systematic parameter variations, which then support product design.

BiGOFil: Simulation of Plastic Fibers Using the Project Example

The work of the past decades has made our researchers world-leading experts in this field. Numerous projects have involved modeling, simulation and optimization. One example is the two-year BiGOFil project, which will be completed in 2022. Coalescence filters are used, for example, to filter fine oil droplets from an air flow. We are supporting our project partners in the development of special bicomponent fibers that are added to the filter to better drain off the collected oil. The shape of the fibers is particularly important for the



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functional properties, which we can influence by designing the fine capillaries of the spinneret.

"We use two of our established ITWM tools and thus achieve an unprecedented simulation depth," says Dr. Christian Leithäuser, project manager BiGOFil. "Our VISPI solution simulates the spinning process as a whole. In the next step, our software MESHFREE is then called upon. It takes over the mesh-free detail simulations of a single fiber. In the process, several areas and properties can be taken into virtual view at the same time. For example, the temperature curve influences the shape and properties of the finished fiber.« The researchers then reflect the findings from this micro view back to the macro level: What does the fiber look like in the simulation and how must the nozzle therefore be designed?

Outlook: New Challenges From Bio-Based Materials

The portfolio expansion of the ITWM team can not only be applied to plastic fibers for filters, but may also help in the production of bio-based plastics in the future. The majority of materials produced so far are based on petroleum. That is set to change.

"One alternative, for example, is materials that are partly made from renewable raw materials and/or are biodegradable. Here, the industry is constantly looking for ways to replace the classic raw materials. Processing these novel materials is a challenge. This also requires modified production processes." Processes that the team will certainly be able to support with digital twins in the future.

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