Researchers at the Fraunhofer Institute for Wood Research, Wilhelm-Klauditz-Institut WKI are now replacing carbon-fiber or glass-fiber fabrics with environmentally friendly natural fibers such as flax. Depending on the component requirements, the flax is supplemented through individual strands of polymer fiber and a mixed fabric is produced. In order to prevent the fabric from weathering, a high-performance concrete is implemented whose structural impermeability protects the fibers almost completely against harmful influences. In addition, the woven textile can be modified with natural resins.
**Manufacturing process**

The native natural fibers are further processed through spinning or weaving procedures. Through the implementation of natural fibers, the CO₂ balance of the concrete can be improved whilst maintaining the same level of performance, and the manufacturing costs can be reduced. The material mix is woven with the aid of a double-rapier weaving machine with Jacquard attachment, which is an integral part of the Fraunhofer WKI equipment. Innovative lightweight composite materials with complex, application-specific fabric structures and integrated functions can thereby be produced.

The flax textile, for example, is introduced into the respective component in layers. As the stiffness of the textile is adjustable, it can be inserted in the desired shape, for example curved forms such as domes or rounded wall elements. The liquid concrete is subsequently poured onto the textile. The concrete is an in-house development of the Center for Light and Environmentally-Friendly Structures (ZELUBA®) at the Fraunhofer WKI. During development, special emphasis was placed upon the use of only small amounts of primary raw materials in order to achieve environmental sustainability. The material mix consists of a very fine aggregate, water, concrete additives and concrete admixtures as well as the textile reinforcement made from flax.

**Composite material with a long service life**

Initial tests have shown that the combination of flax and concrete has proved to be a suitable composite material. The matrix is so dense that harmful substances cannot penetrate the building structure. Initial investigations indicate that a significantly longer service life of several decades can be expected. The available results regarding durability and load-bearing capacity of the novel, environmentally friendly textile-reinforced concrete are positive. The natural fiber interlocks very well with the building material. The specific surface of the textile can be configured.

**Outlook**

Future projects, in collaboration with industrial partners, will examine how textile-reinforced concrete made from renewable raw materials needs to be configured in order to be implemented in lightweight, slender constructions. The innovative building material should be permanently optimized; a building authority approval is still pending. Further applications outside the construction industry are also possible.