

## USERS' PLATFORM

### Applications

# Carbon-fibre reinforced stone

Fibre-reinforced natural stone has been used for a long time for kitchen worktops, elevator carpeting or elegant bathrooms. TechnoCarbon Technologies has now developed a composite made of carbon fibre and stone that can be used in many more applications. The new material gives natural stone a new relevance as an environment-friendly material.

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**TechnoCarbon Technologies**

**F**ew people know that natural stone has the same specific weight as aluminium and is as pressure stable as construction steel - stonecutters have even been known to describe stone as being relatively flexible under certain conditions. German company TechnoCarbon Technologies (Munich) has utilized the above properties to allow compressing and preloading granite with the help of carbon fibres, to produce CarbonFibreStone (CFS), a highly durable method for stabilizing natural stone.

The carbon-fibre reinforcement protects the stone against breakage, thus creating new mechanical properties. Highly pressure-stable natural stone, such as granite, is combined with extremely tension-stable carbon fibre that consists of nearly 100% pure carbon. The materials can be bound with highly stable epoxy resins, for example. The carbon-fibre/stone bond is adjusted by hardening the epoxy resins with a specific preload, resulting in a composite material with a combination of completely new and formerly unknown properties. This constitutes a technologically sound way to replace (at least to some extent) metals, that are CO<sub>2</sub> emission intensive.

### Technical description

To develop its CarbonFibreStone, TechnoCarbon Technologies used patented technology to encapsulate the stone with carbon fibres, opening up the possibility to combine the following material properties:

- extreme pressure stability comparable to that of steel,
- extreme tensile strength,
- high elasticity combined with unmatched dynamic damping characteristics,
- high dimensional stability,
- minimal coefficient of thermal expansion (1-3),
- much lower specific weight than steel or iron (three times as low),
- a specific weight that, depending on the type of stone, is the same as or lower than aluminium,
- unlimited availability.

The new material can be used to produce construction elements and bearing structures that are lightweight, elastic but pressure-stable, torsionally stable, and vibration-damping. They are also resistant to fatigue, chemicals, and corrosion. In other words, they are in many ways superior to traditional materials like steel. Another advantage is that CFS construction elements can easily be processed and handled using conventional stone-industry methods and instruments like drilling, sawing, screwing, or gluing. TechnoCarbon Technologies is interested in working together with industrial partners and scientific institutions, and is currently

identifying partners for developing the multiplicity of potential technical applications.

### Natural stone slabs for kitchens

Another aspect of CFS technology involves coating one side of normally treated natural stone with thin films of carbon-fibre matrix in order to stabilize the stone so thoroughly that it becomes "flexible" and unbreakable. This is achieved by preloading as a function of the specific application. These sheets are more stable, yet about three times lighter than massive natural-stone coverings 3 or 4 cm thick. The carbon-fibre material stabilizes the worktop up to temperatures of 120°C and even higher, depending on the application. The coefficient of expansion of carbon fibre is negative, which keeps the stone from breaking over



Bulthaup kitchen top, 10-mm "Angola Blue" is covered with a CFS layer

a wide range of temperatures (-40°C to +120°C). The dilatation of the stone can also be forced to zero if necessary.

### Developing a ski with a heart of stone

Swiss company Zai AG worked with TechnoCarbonTechnologies to develop the Spada, the first ski ever made using natural stone. The new ski was presented to the market at Munich's International "ISPO 2007" trade fair for sports equipment and fashion. The composite material used consists of natural granitic gneiss from the Swiss Alps coated with a carbon-fibre laminate. Bonding these two ideally complementary materials together creates new mechanical –and engineering properties. The project turned into an exemplary demonstration

of the flexibility of CFS.

Because the natural stone used for the Spada ski has a lower specific weight than aluminium, and because of CFS's superior vibration-damping properties, the ski has incomparable handling properties. This means safer carving at higher speeds, simply because "the flutter" is better absorbed than with other materials. CFS opens up a new dimension in ski design, because it works with the other materials used to better distribute the absorbed vibrations.

### Wide-ranging future applications

By committing to the potential of CFS, manufacturers will soon come up with new ideas for applications. CFS beams could revolutionize architecture and bridge-building, and it could replace steel

reinforcements or, even better, reinforced concrete. Earthquake-resistant architecture or lightweight collapse-resistant hall roofs could be designed without having to resort to expensive vibration-compensating techniques. Even a top producer of photovoltaic equipment has shown interest, seeing the possibility for replacing aluminium and steel with a material that poses fewer problems.

In car bodies, the material could provide significant weight savings combined with higher crashworthiness. In boat-building, it could provide higher torsional stability with greater resistance to breakage. In machine construction, where vibration behaviour is often hard to control, CFS components could offer lightweight but highly stable and low-vibration constructions that are fatigue resistant. Applying CFS to wind-turbine rotor blades or airfoils is another possibility, here again due to the unique combination of properties such as high strength, vibration damping and fatigue resistance with elasticity and low weight.

And finally, CFS technology meets environmental requirements, which are close to its designer's heart. It can be used to manufacture raw materials that can be machined in an environment-friendly way with the possibility for recovery, and which consume much less energy than the production of steel, aluminium and concrete. ■

More information: [www.zai.com](http://www.zai.com)



Fig.2: The Spada stone ski, named for the Rhaeto-Romanic word for "sword"