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20.08.2021

Project title: Malleable pre-impregnated textile reinforcement structures for curing in concrete – FreshOnFresh

Duration: 01.11.2018 – 30.04.2021

Funding Agency: BMWi-IGF (AiF, project number 20296 N)

Mission Statement

In the construction sector, a trend towards lighter, resource-efficient components has emerged in recent decades, which textile-reinforced concrete (TRC) can serve. However, the lack of flexibility of current reinforcements, the high price due to the high material input required and the complex approval procedure still prevent broad economic application.

The FreshOnFresh project is therefore developing a process for producing malleable textile concrete reinforcements made of carbon, which only harden after insertion into the component. For this purpose, the concept of prepreg processing from fibre composite plastic technology is adapted to grid-like textile reinforcements for textile concrete. The aim is to reduce the carbon fibre requirement for reinforcement by approx. 30 % (cost reduction at component level of 20 %), cf. Figure 1.

This will increase TRC's competitiveness and open up new markets in which it has not yet been used for cost reasons. The central approach is to increase the flexural strength of formable reinforcements in concrete composites to 30 MPa with the help of a new prepreg reinforcement, which corresponds to the properties of rigid, EP-coated reinforcements. Compared to malleable, SBR-coated reinforcements, this represents an improvement of approximately 50%.

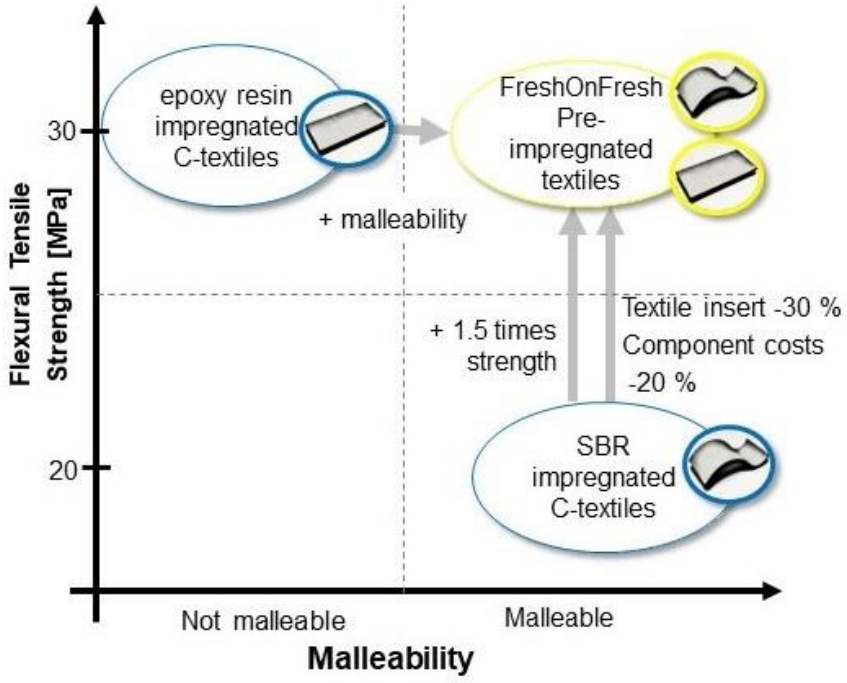


Figure 1: Goal and approach of the project Fresh on Fresh

Approach

From commercially available polymer systems, candidates are pre-selected that are suitable both for integration into TRC and can be processed in the coating process and stored partially cured. In this respect, the necessary process window for the coating is discontinuously investigated and determined depending on the preselected polymers. Subsequently, basic manufacturing processes are evaluated according to the fresh-on-fresh method:

1. Thermal activation: Crosslinking of the prepreg by hydration heat or thermal post-treatment
2. Chemical activation: Crosslinking of the prepreg by chemical compounds in fresh concrete, e.g. alkaline compounds.

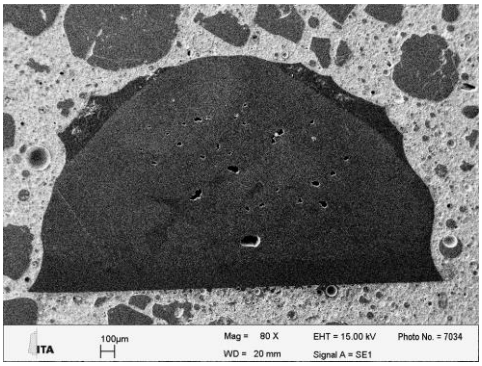
Based on tests on textile and concrete composite specimens, the polymers and their processing methods will be given state-of-the-art suitability. For at least two suitable polymers, the procedures are scaled up to continuous processes. This takes place both at the level of the coating process and at the level of the component manufacturing process in the form of a functional sample. In the latter case, the effects of the limited shelf life and the transport of prepregs that may have to be cooled are considered.

Results

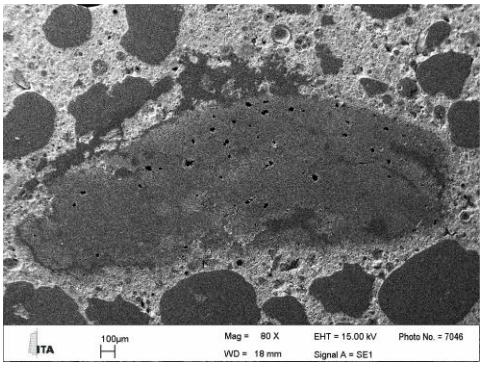
In the research project, various polymers were investigated for their suitability for curing in concrete. Some polymers showed an improvement of the fiber pull-out strength as well as the mechanical activation of the concrete bond. The background for this is an improvement in the bonding of the textile to the concrete, as shown in Figure 2.

In addition, suitable impregnation parameters (gap size, contact pressure, etc.) were determined for the selected polymers and qualified in discontinuous and continuous impregnation tests on grid-like reinforcement textiles. The component manufacturing process using the new Fresh-on-Fresh method was investigated and its general suitability was demonstrated by means of a functional demonstrator.

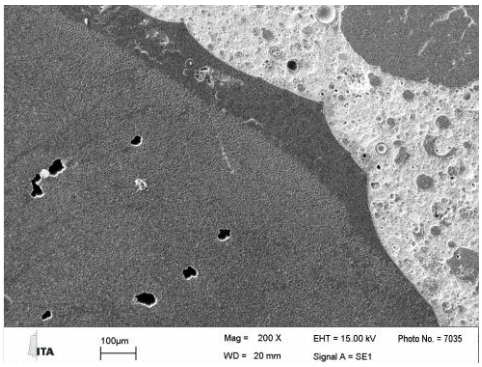
The results obtained are of great benefit to specialized small and medium-sized companies in the textile concrete sector. These companies can acquire the necessary know-how to manufacture freely formed concrete components using the fresh-on-fresh method or to supply components for this production (e.g. textiles). Follow-up research projects are planned to transfer the method into application.



SEM-picture of the
Hard-on-Fresh-method
(Top: Overview, Bottom: Detail)



SEM-picture of the
Fresh-on-Fresh-method
(Top: Overview, Bottom: Detail)



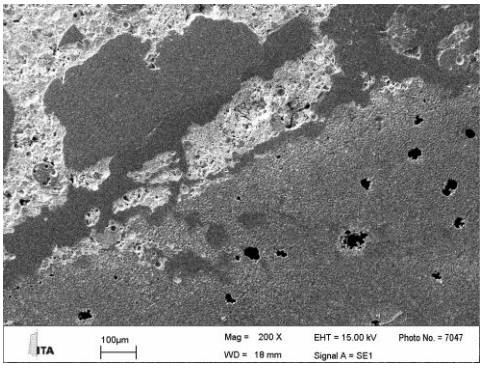


Figure 2: SEM-pictures of the Fresh-on-Fresh-method

Acknowledgement

The IGF project 20296 N of the Research Association Forschungskuratorium Textil e.V., Reinhardtstraße 14-16, 10117 Berlin was funded by the Federal Ministry for Economic Affairs and Energy via the AiF within the framework of the program for the promotion of joint industrial research IGF on the basis of a resolution of the German Bundestag.

We thank the AiF and the Federal Ministry for Economic Affairs and Energy for funding the research project.

Gefördert durch:

Bundesministerium für Wirtschaft und Energie

aufgrund eines Beschlusses des Deutschen Bundestages

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