Towards Smart Textiles for Civil Engineering Application

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Integration of sensors or any other diagnostic technology directly into a material or structure is a way to increase the safety level of the construction and provide other features as online diagnostics, predictive maintenance or a functionality of early warning in case of component failure. Many of the available embedded sensor technologies suffer from limited lifetime or necessity to have a battery power, or influence the structure integrity. Technologies with lower impact on the structure, as integration of Fiber Bragg Grattings sensors [1], require expensive sensitive equipment to evaluate signals. Application of sensitive coatings on the textiles for reinforcement purpose is a novel and innovative approach [2], [3]. Using textile for the reinforcement of concrete and composites allows to build subtile and still high-performance structures. The textile itself can be used as substrate for layers providing sensing functionality to measure moisture, strain, load or to detect cracks in the material. The main advantage is the direct contact of these additional layers with the measured material, in-situ measurement, as well as protection of the sensitive textile against ambient environmental conditions.

This paper will introduce flax textile reinforcement, as sustainable alternative to synthetic reinforcement material, coated with carbon filled epoxy resin. The carbon provides conductivity properties to the textile. Graphite and bio-carbon will be studied in this work. A detailed study of textile conductivity properties with respect to the carbon concentration in epoxy will be presented in full paper. The promising results obtained with textile coated by epoxy filled with graphite shows suitable conductivity levels for embedded strain/load measurement in civil engineering. The results of epoxy-graphite and epoxy bio-carbon mixtures will be shown together with the coated textile conductivity study. The potential for applications in moisture detection in timber constructions such as CLT or GLT will be discussed in the full paper as well.

**Keywords:** Smart textile, embedded sensing, renewable materials

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REFERENCES

1. Kristýna Čápová, Lukáš Velebil, Jan Včelák, Jaroslav Demuth, Field Testing of FBG Based Deformation Sensors Embedded in Concrete Bridge Structure, CETRA 2018, https://doi.org/10.5592/CO/cetra.2018.694
2. P. Heysea, G. Buylea, B. Walendyb, P. Beccarellic, G. Lorigad, D. Zanganid, A. Tempesti, MULTITEXCO - High Performance Smart Multifunctional Technical Textiles for the Construction Sector, 1st International Conference on Structural Integrity, Procedia Engineering 114 ( 2015 ) 11 – 17, 2015
3. W. Rehnby, M. Gustafsson, M. Skrifvars, Coating of Textile Fabrics with Conductive Polymers for Smart Textile Applications, Ambience'08, At Borås, Sweden, 2008