Laminate strength of basalt fibers in polyester resin

The industry is always striving to find new and better materials to manufacture new or improved products. With this context, energy conservation, corrosion, sustainability and other environmental issues are important factors in product development.

The objective of this project carried out at Reykjavik University Structural Research and Composite Center, (SEL), was to examine whether a composite material made of polyester resin reinforced with basalt fibers, could be used for engineering structures. Basalt fibers are natural material produced from the igneous rock which can provide high strength relative to weight.

Specimens made of basalt fibers in polyester resin were constructed and tested according to the ASTM standards. Three types of test were done: Uniaxial tensile test, compression test, and in-plane shear test. Two types of thin plates built by using the Vacuum Infusion process, using the same reinforcement biaxial fabric type BAS BI 600, supplied by Basaltex, and the matrix polyester resins POLYLITE 506-647, supplied by Reichhold. The plates are made of six pieces of fabric where each fabric was 0.5 mm thick and covered two layers with a weight of each layer 298.5 g/m2.

The standard ASTM D3171 Constituent Content of Composite Materials was used to ascertain the composite density and the fiber volume ratio. Method II in the standard was used because the basalt fabric areal weight was known. The fiber volume ratio measured 50.7%, and composite density measured 1.841g/cm3.

Uniaxial static tensile tests were carried out according to ASTM D3039 Tensile Properties of Polymer Matrix Composite Materials. Uniaxial static compression tests were carried out according to a combination of ASTM D695 Compressive Properties of Rigid Plastics and ASTM D3410 Compressive Properties of Polymer Matrix Composite Materials with Unsupported Gage Section by Shear Loading.

Uniaxial in-plane shear tests were carried out according to ASTM D3518 In-plane Shear Response of Polymer Matrix Composite Materials by Tensile Test of a ±45° Laminate.

The results were then compared to E-glass fabrics in epoxy resin. The sum of the ultimate tensile strength of both directions (longitudinal 0° and transverse 90° direction) became 19.3% stronger in basalt fabric than the E-glass fabric. The ultimate tensile strain in the basalt fabric became more than 50% higher than in the E-glass fabric.

The results of the experiments in this research indicate that continuous basalt fibers, as reinforcement material in a polyester resin, can be used as a composite material for structural design. The static uniaxial tensile test showed that basalt fiber was stronger than E-glass fiber and basalt fiber could be used instead of these types of fibers.