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Polyurethane filled with modified basalt fiber

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Abstract

The use of basalt fiber as a reinforcing filler is mainly used instead of glass fibers due to its unique properties. Basalt fiber in comparison with glass has a 10-22% greater modulus, higher absolute strength after exposure to 400 °C, superior to glass in alkali and especially acid resistance, approximately identical in water resistance, i.e. close in properties to high-modulus glass fibers. However, it is most often used as a filler for concrete and other building structures.

There is much less information about its use as a polymer reinforcing filler. The polymer matrix for creating polymer composite materials is most often epoxy resins, less often polyester.

At the same time, there is practically no data on polyurethanes that have a unique combination of high strength indicators with elasticity and hardness, resistance to solvents and aggressive media, abrasion resistance, etc. The use of basalt fiber as a filler that increases the strength characteristics of polyurethanes and gives them specific properties can significantly expand the scope of their application. In this regard, this study attempts to use crushed basalt fiber as a reinforcing filler for polyurethanes. In order to increase the adhesion of the polymer matrix – filler system, an adhesive based on water-based polyurethane dispersion is used.

Samples were obtained based on a polyurethane binder filled with basalt fiber in amounts up to 10.0 % by weight, treated with water-polyurethane dispersion with a concentration of 10 to 20 % by weight.

The best complex of strength properties is provided by polyurethanes filled with basalt fiber in the amount of 1.0% by weight, treated with 15 % by weight water-based polyurethane dispersion. At the same time, the tensile strength increased by 15% compared to the same filling without processing and by 50% compared to the unfilled analog and amounted to 33.7 MPa.

These changes are explained by a more uniform distribution of crushed basalt fiber in the polymer matrix and an increase in the adhesion interaction of fiber-adhesive-polymer matrix due to the biphilicity of the adhesive, as well as the same (polyurethane) nature of the adhesive and the matrix. The developed polymer composite materials have high hydrolytic resistance, as well as resistance to acetone and hexane. At the same time, the greatest degree of swelling did not exceed 0.9 % of the mass.

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