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Technical Report

Particulate basalt–polymer composites characteristics investigation

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ABSTRACT

Basalt has remarkable physical and mechanical characteristics. However, its use and further processing is limited due to mechanical characteristics, e.g., density, hardness, fraying resistance, etc. The basalt–polymer composite enable maintains of physical and mechanical characteristics, further processing, and broader basalt application in various industries. Consequently, composites characterization, and production process technological parameters influence on the composites properties need to be appraised.

Basalt from locality Vrelo, on the eastern hillsides of the Kopaonik Mountain in Serbia was used for evaluation with 18 samples applied for each test. Samples of basalt-polymer composite with various ratios of basalts, polymeric matrixes and additives, and with different basalt particles composite grain size are synthesized to be tested. The results elucidate the composite mechanical properties dependence on the before mentioned parameters. Thus, it is possible to ascertain the most suitable composite with respect to basalt/polymer proportion.

Results demonstrate the practicability of the technological procedure development that would result in basalt-polymer composite, an inexpensive material with outstanding characteristics. This composite might be used in the first period for construction, and later for use in industry – especially machine and car industry. Presented data can be of importance for the development of new composite materials (composite basalt stones) which certainly will have significant application in the future.

1. Introduction

As a construction material, basalt has exceptionally good physical and mechanical properties, specifically high hardness, high strength, good wear resistance, color and shine. Properties of jointed basaltic rock masses and its limits on strength and deformation were evaluated by Schultz [1]. However, it's shaping and processing is very difficult due to before mentioned mechanical characteristics, and its extensive application is limited. Basalt processing into more complex forms while retaining its mechanical and physical characteristics is feasible only if the basalt particles are mixed with polymeric resins. As a result, particulate composite, suitable for cold casting process manufacturing of different geometric forms is generated.

1.1. Literature review

Divers studies have investigated various basalt composite combinations. Several authors in their studies evaluated a series of commercial-grade polypropylenes (PP) filled with different short basalt fibers quantity. Storage modulus increase with expand of the fiber content, based on dynamic mechanical thermal analysis accomplished by Botev et al. [2]. Matkó et al. [3] in their study discovered the improvement in mechanical properties as a result of the interface modification with low concentration of additives. Further, Kadykova et al. [4] evaluated comparative characteristics of polymer composites based on carbon, glass, and basalt fibers. The analyses indicate that the strength and physicochemical characteristics of polycondensation-filled composites generated by modification exceeds the corresponding properties of unmodified specimens. Thus, the method is justified given the associated cost reduction, working characteristics improvement, and the production time decrease. Basalt-based glass–ceramic coatings structural characterization is explored by Yilmaz et al. [5]. Their main conclusion is that crystalline phases enlarge as a result of the crystallization temperature increase; while lower temperature and longer treatment time generate harder coating layer. Other authors have based their research on the effect of fiber arrangement in 3D

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