A COMPOSITE MATERIAL BASED ON RECYCLED TIRES

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The present study is devoted to the elaboration and investigation of a composite material based on mechanically grinded recycled tires and a polymer binder. The correlation between the content of the binder, some technological parameters, and material properties of the composite was clarified. The apparent density, the compressive stress at a 10% strain, the compressive elastic modulus in static and cyclic loadings, and the insulating properties (acoustic and thermal) were the parameters of special interest of the present investigation. It is found that a purposeful variation of material composition and some technological parameters leads to multifunctional composite materials with different and predictable mechanical and insulation properties.

Introduction

Scrap tires represent more than 1% of solid waste and require special disposal and reuse strategies because of their specific nature [1]. Therefore, the recycling of scrap tires also obtains importance from the aspect of unloading the environment from nondegradable waste. There are two generally accepted methods for the reuse of scrap tires — whole or processed [2, 3]. Scrap tires processed into various-sized particles can be used to fabricate, for example, floor mats, gaskets, insulation panels, etc. [4, 5]. Unfortunately, there are not accessible wide selections of published scientific reports regarding the investigation into the mechanical or insulation properties of pratically useable composite material based on recycled tires and a polymer-type binder, probably due to commercial reasons. Some reports [6, 7] reflect findings obtained in the context of specific scientific projects.

In the present study, the results of investigations into the mechanical and insulation properties of a composite material based on mechanically grinded scrap tires and a polymer binder are reported. A correlation between the composition and the properties of the composite material is demonstrated.

Materials and Investigation Methods

Scrap tires, freed from the cord and grinded mechanically at room temperature (particle size from 0.25 to 8.0 mm) and in liquid nitrogen (particle size from 0.25 to 3.0 mm), and a polyurethane-type binder were used. Samples of the composite material were prepared under specified conditions (T0, RH, molding pressure, etc.). The compressive stress σ10, the compressive elastic modulus E (EN 826) in static and cyclic loadings, the thermal conductivity λ10 (prEN 12667), and the stroke and sound
absorption (EN ISO 140-7 and the “Brüel and Kjaer” method) of the composite were investigated in relation to its apparent density \(AD\) (prEN1602).

**Results and Discussion**

Figure 1 shows the direct influence of content of the polymer binder on the apparent density \(V_p\) of the composite material. In all the samples prepared and investigated, rubber cuttings nonfractionated by particle size were used. The higher values of \(AD\) for the samples containing the cryogenically grinded rubber are explained by the more regular (close to spherical) shape of the particles, which allows for their more compact packing in the composite material.

The compressive stress \(\sigma_{10}\) at a 10% deformation, the compressive elastic modulus \(E\) in static and cyclic loadings, and the insulation properties (acoustic and thermal) were the parameters of special interest in view of the possible employment of the composite material in building industry.

A gradual increase in the compressive stress \(\sigma_{10}\) was observed for the samples with growing content of the polymer binder regardless of the type of grinded rubber (Fig. 2). A further increase in binder content (more than 50 wt. %) was not acceptable because the material became less homogeneous.

The influence of material composition on the compressive elastic modulus (at a 10% deformation) is shown in Fig. 3. The notable increase in \(V_p\) with content of the polymer binder can be explained by the growing integral stiffness of the composite.