DESCRIPTION FOR THE GENERAL PUBLIC (IN ENGLISH)

Composites are a group of materials increasingly used in the technique, due to their favorable mechanical properties and the ability to manipulate these properties to a certain extent, e.g. by choosing the right amount of filler. The continuous development of production processes and the increasing use of these materials causes the need to develop a methodology to determine the real properties: mechanical, thermal and other. Therefore, it becomes necessary to build constitutive models of composites and their numerical implementation, enabling simulations of the behavior of designed structural elements.

The goal of this project is to create a mathematical model that will allow to estimate the mechanical properties of any composite, based on the knowledge of the mechanical properties and geometrical configuration of its constituents. The mathematical model will be used to carry out numerical simulations using the finite element method. The obtained simulations will allow for verification of the validity of the developed model in the elastic-plastic range and also when regarding the micro-damage development. In the experimental part of the project, mechanical properties of composites will be determined using standard mechanical tests in accordance with the generally accepted standards. These tests will mainly concern the elastic field. Verification tests will be carried out on different types of composites to confirm the universality of the model. They will apply to both the simplest case of an isotropic composite, reinforced with short fibers arranged in a chaotic manner, as well as more complicated cases, taking into account the chosen groups of the material symmetry. For each tested composite, tests for samples with different percentages of filler will be carried out. This will allow for a precise analysis of the change in the mechanical properties of the composites depending on the modification of this parameter. The use of different composites to verify the results will allow for in-depth understanding of the relationship between the mechanical properties of composite materials and the properties and configuration of their components.

Detailed analysis and understanding of the key issues determining the effective mechanical properties of composites will have a significant impact on the development of constitutive modeling of these materials. In addition, it will allow for a significant acceleration in determining the mechanical properties of composites by limiting the need to perform a number of empirical tests required to determine them.