Concrete-like polymer composites modified with waste and designed using experimental planning methods

• Concrete-like polymer composites: classification, definitions, properties, possibilities of application.
• Waste material problem.
• Possibilities of modification of resin composites with waste materials.

Polymer concretes belong to the group of composites whose basic composition is: synthetic resin, hardener, and aggregate. Additionally, various types of modifiers can be used, which should positively influence selected properties of the composite. Introducing waste material as a modifier in the form of a substitute for the binder or aggregate is justified both ecologically and economically, especially in the case of resin substitution, which is the most expensive component of mortar. The selection and appropriate combination of these substrates has a decisive impact on the unique properties of the finished product, including very high mechanical strength, excellent adhesion to many other materials, low water absorption, or excellent chemical resistance, which results in specific application possibilities, e.g. in construction infrastructure, the elements of which are subjected to mechanical and chemical loads. Incorporating waste into polymer composites could provide a new way to source raw materials and define an effective approach to designing materials suitable for engineering applications, based on the assumptions of the circular economy. The use of such materials as polymer concrete obtained with the use of waste is an interesting combination of care for the condition of the natural environment and reduction of carbon dioxide emissions, and also ensures obtaining favourable parameters of final products.

• Methods for planning an experiment, a tool helpful in the process of designing, obtaining, and analyzing building materials.

Nowadays, all technical innovations that bring profits develop largely on the basis of scientific research. In turn, scientific research is a combination of theory and experiment, with experiments generating disproportionately high costs compared to theoretical works. To obtain the necessary experimental scientific information as quickly and cheaply as possible,

the theory of the experiment should be used. The model of experience described by means of specific processes and real systems from various fields (e.g., technology) can be defined by one universal concept of the so-called test object. In the case of the process of obtaining new materials, this material that will be the object of research and its model will characterize the input quantities (raw materials and technologies) and output (building material with the desired properties).

To obtain the fullest information on the factors affecting the process of obtaining new material, it would be best to make measurements for every possible, experimentally justified combination of values of input quantities. In practise, however, this is almost never possible due to the high costs and time-consuming nature of such a solution. Measurements carried out for too few samples may in turn make it impossible to fit the appropriate model. The choice of model parameters is a computationally complex process. The experiment planning module in the STATISTICA programme supports computer-based practical application of experimental theory. The programme also has implemented algorithms necessary to analyse the results obtained during the practical implementation of the planned experience.