POWER
Thermal shock resistance
Polymer cOating
Waste management
Environment
Recycled aggregate

Multi-scale evaluation of the effect of thermal shock on the properties of environmentally-friendly polymer-cement composites modified with recycled fine aggregates (POWER)

The layered systems made of polymer-cement composites used in construction have usually very good mechanical properties. However, they have generally very weak resistance to fast temperature changes, defined as thermal shock, caused e.g. by forcing the forklift drive wheel. This problem very seriously exists in civil engineering during construction, exploitation and renovation of layered systems made of polymer-cement composites. Nowadays, there is lack of studies focused on thermal shock resistance of layered system made of polymer-cement composites. Moreover, there is no scientific approach to examine this phenomena. Thus, it is still the challenge for civil engineering discipline to find the way to improve the thermal shock resistance of this kind of composites. The phenomena of low thermal shock resistance occurs in the production and warehouse buildings and is crucial for the composites with high area (e.g. floors).

Layered system made of the polymer coating modified with natural river sand was a subject of the preliminary research of wiping the floor surface with the spinning drive wheel. The tests showed that this kind of composites are not resistant to avoid thermal shock. The consequence of abrasions and burns on the composite is mostly the loss of its pull-off strength. Even, recent attempts to use natural fine aggregate do not solve this problem. Considering the above, to improve the pull-off strength of coating and as a result of it the thermal shock resistance, in the preliminary research the epoxy resin has been modified with recycled fine aggregate (RFA) from demolition wastes. Results shows that specimens with higher amount of RFA obtained better results of pull-off strength. The preliminary research test results prove that the success of the project can be obtain.

Will application of an alternative material instead of river sand help to avoid strength loss? Is the application RFA scientifically reasonable and possible in layered systems made of polymer-cement composites? How this layered system will behave during overheating? Hopefully, RFA added to the polymer can change the conduction of the heat in the coating what could have significant influence on thermal shock resistance of layered system. This phenomena was not investigated. Therefore, the main aim of the project is to answer for the following questions. The aim is especially to find a scientific relation between thermal shock and the properties of modified polymer-cement composites. Thus, in the project commonly used polymers will be modified by the RFA sourced from buildings demolition and coarse aggregate production (granite and marble). The various coatings thicknesses and compressive strengths of substrates will be also analyzed.

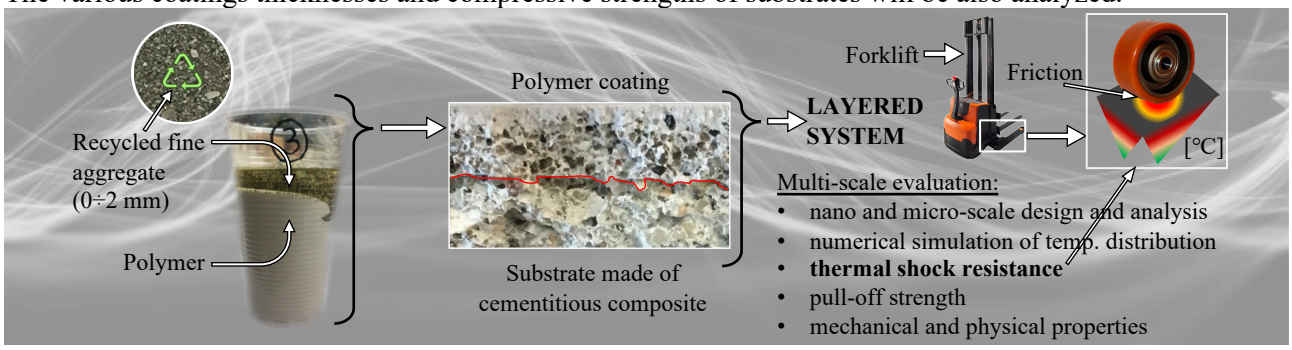

Fig. 1. Graphical abstract of the project.

For purpose of this project, multi-scale evaluation of the layered system made of polymer-cement is proposed to study the phenomena of thermal shock of layered systems. The most fundamental studies include evaluation of indentation modulus and hardness at different temperatures, analysis of scratch test, numerical simulations of the temperature, macro-scale investigation of the thermal shock resistance of layered system, its pull-off strength and chemical composition within the interface between coating and substrate. The last stage of the research related to the evaluation of nano-mechanical properties obtained from nanoindentation and Scanning Electron Microscopy (SEM) techniques will be analyzed.

The expected result of the project will be development of thermal shock resistance influence on polymer-cement layered system properties. Moreover, the best polymer-cement composite will be indicated based on performed studies. Presented project and investigation of novel phenomenon could have significant impact on environment and building industry in the field of polymer-cement composites.

The expected scientific achievements of the research will be published in scientific journals listed in Journal Citation Reports (JCR). About 5 papers listed in the JCR database, including Open Access publication are expected to be published. The journals with the high impact factor only will be selected. The PhD student will attend at several high-quality conferences in order to present the results. The PhD thesis will be prepared based on these publications. The Preludium Bis funds (if obtained) will play an important role in the development of the PhD student involved in the project.