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Method of production and physical and functional properties composite lightweight aggregates

Summary

This dissertation describes conducting process of experiments and research connected with development of production technology lightweight composite aggregates created from materials with different properties and origin from different waste streams

In the initial phase, a pilot station for the production of artificial aggregate based on the assumed materials in repeatable and controlled conditions was developed. The next step was to analyze influence of process production conditions (time, temperature) and proportion of used ingredients for basic properties aggregates. In the course of the research, a technology for the production of lightweight artificial aggregates was developed using thermal treatment of a mixture of post-consumer waste from the thermoplastic polymer PET (polyethylene terephthalate) and by-products.

As a result of further improvements in the process, a manufacturing method that allowed to obtain lightweight ultracomposite aggregates with a characteristic, porous structure of a single grain resembling pumice in its own structure was developed**.**

In this work a particular attention was paid to the application tests prepared aggregates as a key to confirm useable that material in concrete ingredient function. The analysis of the conducted tests results on the basic properties of cement composites made with the use of the produced composite aggregates was also used for subsequent modifications of the manufacturing process and technology.

Additionally for the made concretes, including different types of composite aggregates created with the same method but from different mineral waste materials, durability research, relevant to the exploitation of the concrete structure, were performed. The focus was also on the analysis of potential problems related to the durability of the PET polymer in the alkaline environment of cement concrete. The results obtained from the conducted, additional long-term studies, e.g. microstructures, confirmed that such a risk practically does not exist for the developed grain structure proposal.

The subject matter and scope of the work required an interdisciplinary approach to research and description of the issue for the proposed way of managing waste combined into one useful product - construction aggregate.

Key words: circular economy, PET, anthropogenic raw materials, recycling, concrete, cement composities, composite lightweight aggregates