Mechanism and products of alite hydration in the presence of minerals from the zeolite group

Cement production has a negative impact on the environment. On the one hand, this is related to the use of a huge amount of geological natural resources in the form of limestone, and, on the other hand, to the high energy consumption in the clinker burning process, and hence the emission of a large amount of CO_2 into the atmosphere. It is estimated that the cement industry emits 0.87 ~ 0.94 t CO_2 in the production of 1t of cement clinker, which is approximately 7-8% of global CO_2 emissions. Simply improving the cement manufacturing process is not enough, so it is so important for the environment to try to reduce its production at the expense of replacing it with pozzolanic materials. Additives are sought that can not only partially replace cement, but also contribute to giving the pastes the desired features shaping the microstructure of hardened grouts and pastes. Such additives can be synthetic zeolites obtained from by-products of coal combustion (fly ash).

The aim of this project is to use synthetic zeolites as a pozzolanic additive to alite (the main component of cement) and to identify the processes and products formed during the reaction of bonding the binder with water (hydration process). The research will be carried out on various types of zeolites (low-silicate, medium-silicate, high-silicate) and will take into account the influence of the maturation time of the pastes and the degree of replacement of alite by zeolite. The key task of the project will be the analysis of the solid - products resulting from the hydration of the alite-zeolite system. For this purpose, standard methods of phase analysis will be used, which will be extended with the use of synchrotron measurement techniques using diffraction and microscopic methods, which will allow to gain new knowledge about the course and products of the hydration process.

On the one hand, the results of the project will contribute to broadening the knowledge in the field of building materials engineering, with particular emphasis on the hydration process. On the other hand, they can contribute to the creation of materials with precisely defined properties, which in the future can be used in the production of environmentally safe cements.