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The Impact of Glass Additives on the Functional and Microstructural Properties of Sand-Lime Bricks

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Abstract : The paper presents the results of research on modifications of sand-lime bricks, especially using glass additives (glass fiber and glass sand) and other additives (e.g.:basalt&barite aggregate, lithium silicate and microsilica) as well. The main goal of this paper is to answer the question 'How to use glass additives in the sand-lime mass and get a better bricks?' The article contains information on modification of sand-lime bricks using glass fiber, glass sand, microsilica (different structure of silica). It also presents the results of the conducted compression tests, which were focused on compressive strength, water absorption, bulk density, and their microstructure. The Scanning Electron Microscope, spectrum EDS, X-ray diffractometry and DTA analysis helped to define the microstructural changes of modified products. The interpretation of the products structure revealed the existence of diversified phases i.e.the C-S-H and tobermorite. CaO-SiO2-H2O system is the object of intensive research due to its meaning in chemistry and technologies of mineral binding materials. Because the blocks are the autoclaving materials, the temperature of hydrothermal treatment of the products is around 200°C, the pressure - 1,6-1,8 MPa and the time - up to 8hours (it means: 1h heating + 6h autoclaving + 1h cooling). The microstructure of the products consists mostly of hydrated calcium silicates with a different level of structural arrangement. The X-ray diffraction indicated that the type of used sand is an important factor in the manufacturing of sand-lime elements. Quartz sand of a high hardness is also a substrate hardly reacting with other possible modifiers, which may cause deterioration of certain physical and mechanical properties. TG and DTA curves show the changes in the weight loss of the sand-lime bricks specimen against time as well as the endo- and exothermic reactions that took place. The endothermic effect with the maximum at T=573°C is related to isomorphic transformation of quartz. This effect is not accompanied by a change of the specimen weight. The next endothermic effect with the maximum at T=730-760°C is related to the decomposition of the calcium carbonates. The bulk density of the brick it is 1,73kg/dm3, the presence of xonotlite in the microstructure and significant weight loss during DTA and TG tests (around 0,6% after 70 minutes) have been noticed. Silicate elements were assessed on the basis of their compressive property. Orthogonal compositional plan type 3k (with k=2), i.e.full two-factor experiment was applied in order to carry out the experiments both, in the compression strength test and bulk density test. Some modification (e.g.products with barite and basalt aggregate) have improved the compressive strength around 41.3 MPa and water absorption due to capillary raising have been limited to 12%. The next modification was adding glass fiber to sand-lime mass, then glass sand. The results show that the compressive strength was higher than in the case of traditional bricks, while modified bricks were lighter.

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