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ADVANCED CERAMICS AND APPLICATION II
New Frontiers in Multifunctional Material Science and Processing

Serbian Ceramic Society
Institute of Chemistry Technology and Metallurgy
Institute for Technology of Nuclear and Other Raw Mineral Materials
Institute for Testing of Materials
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PROGRAM AND THE BOOK OF ABSTRACTS

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P1

Optimization of major oxides content and fired brick properties for various applications

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The optimal samples content of major oxides (SiO_2, Al_2O_3, Fe_2O_3, CaO, MgO, Na_2O, K_2O, MnO and TiO_2), firing temperature (800–1100 °C) and final properties of tiles, hollow blocks and solid cubes were chosen depending on a final usage of the raw material in heavy clay brick industry. Optimization procedure was performed using Fuzzy Synthetic Evaluation (FSE) algorithm on the basis of previously developed artificial neural networks models that predict compressive strength, water absorption, firing shrinkage, weight loss during firing and volume mass of laboratory products. Trapezoidal membership function is defined by experimentally obtained values and optimal ranges of tested properties. The objective function included all the fired products parameters with equal participation, and its maximum is determined the optimization results. Objective function gained values between 0.6 and 0.7. Solid bricks are proved to be producible of heavy clays containing the highest free SiO_2 and CaO content, by firing at high temperatures. Highly sinterable clays should be used for hollow bricks and the highest quality raw materials in roof tiles production, by firing at 900 °C at laboratory conditions.

P2

Lightweight construction ceramic composites based of pelletized fly ash aggregate

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As coal combustion byproduct fly ash represents a risk for environment: direct ash emission from open land-fills causes pollution of air, soil and water. The solution for this severe pollution problem is fly ash reapplication in various construction ceramic composite materials. Although pelletization of waste powdery material is a known technique in the production of artificial aggregates, it still has not been widely used in construction sector. Here investigated cold-bonded fly ash aggregate was produced in semi-industrial pelletizing device. The fly ash particles were bonded with water-glass (Sodium silicate - Na_2SiO_3) and used as substitution for aggregate in Portland cement based composite. Half of the produced lightweight aggregate was submitted to thermal treatment and afterwards applied in the construction composite in the same ration as in the case of cold-bonded pellets. The performance characteristics of two types of lightweight composites were mutually compared and afterwards correlated with characteristics of normal-weight concrete. Compressive

strength, modulus of elasticity and tensile strength were used as represents of the composites mechanical behavior. Mineral constituents of fly ash pellets were analyzed by means of X-ray diffraction analysis, differential thermal analysis was applied in crystalline phase investigation, and scanning electron microscopy in microstructural analysis. The leaching behavior and environmental impact of hazardous elements were also analyzed. It was concluded that content of potentially toxic elements found in leachate of fly-ash based composites was far below tolerance limit proposed by actual standards for the building materials, characterizing the fly ash non-harmful secondary raw material and enabling its reapplication in building materials industry. Utilizing fly ash to produce quality aggregates should yield significant environmental benefits.

P3

Establishing the model for predicting the moisture and velocity in the critical point during drying of green masonry products

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The aim of this study was to establish the model for predicting the moisture and velocity in the critical point during drying of green masonry products. The raw material was first dried at a temperature of 60°C, and then after cooling to room temperature, was milled down using perforated rolls mill. Milled material was identified and subject to further classical preparation, which precedes the formation on the vacuum presses. Thus prepared sample carried the name - sample A. The starting raw material was mechanically activated for 30 minutes. Thus prepared sample carried the name - sample B. Laboratory samples 120x50x14 mm were formed in a laboratory extruder under a vacuum of 0.8 bar. These samples were used in further experimental work. Drying process was monitored and all process parameters such as: temperature, relative humidity of the drying air, weight changes, linear shrinkage, temperature of the surface and in the centre of test samples were recorded continually.Two mathematical models, based on multi factorial experimental design technique, were set up. The first describes the moisture and the second one the velocity value of the samples B in the critical point as a function of temperature, relative humidity and the velocity of the drying medium.