

Hydrothermal Synthesis of Hydrosodalite by Using Ultrasounds

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Abstract : The use of ultrasounds in zeolization of fly ash can increase the efficiency of this process. The molar ratios of the reagents, as well as the time and temperature of the synthesis, are the main parameters determining the type and properties of the zeolite formed. The aim of the work was to create hydrosodalite in a short time (8h), with low NaOH concentration (3 M) and in low temperature (80°C). A zeolite material contained in fly ash from hard coal combustion in one of Polish Power Plant was subjected to hydrothermal alkaline synthesis. The phase composition of the ash consisted mainly of glass, mullite, quartz, and hematite. The dominant chemical components of the ash were SiO₂ (over 50%mas.) and Al₂O₃ (more than 28%mas.), whereas the contents of the remaining components, except Fe₂O₃ (6.34%mas.), did not exceed 4% mas. The hydrothermal synthesis of the zeolite material was carried out in the following conditions: 3M-solution of NaOH, synthesis time - 8 hours, 40 kHz-frequency ultrasounds during the first two hours of synthesis. The mineral components of the input ash as well as product after synthesis were identified in microscopic observations, in transmitted light, using X-ray diffraction (XRD) and electron scanning microscopy (SEM/EDS). The chemical composition of the input ash was identified by the method of X-ray fluorescence (XRF). The obtained material apart from phases found in the initial fly ash sample, also contained new phases, i.e., hydrosodalite and NaP-type zeolite. The chemical composition in micro areas of grains indicated their diversity: i) SiO₂ content was in the range 30-59%mas., ii) Al₂O₃ content was in the range 24-35%mas., iii) Na₂O content was in the range 6-15%mas. This clearly indicates that hydrosodalite forms hypertrophies with NaP type zeolite as well as relict grains of fly ash. A small amount of potassium in the examined grains is noteworthy, which may indicate the substitution of sodium with potassium. This is confirmed by the high value of the correlation coefficient between these two components.

Keywords : fly ash, hydrosodalite, ultrasounds, zeolite

Conference Title : ICAPC 2020 : International Conference on Applications of Porous Ceramics

Conference Location : Jerusalem, Israel

Conference Dates : April 27-28, 2020