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VII

ENGINEERING, ENVIRONMENT AND MATERIALS
IN PROCESS INDUSTRY
EEM2021

BOOK OF ABSTRACTS



JAHORINA
MARCH 17-19, 2021

REPUBLIC OF SRPSKA
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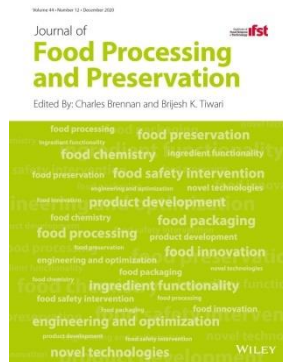


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REACTIVITY OF POLYPHOSPHATE GLASS IN DIFFERENT MEDIUM

Vladimir S. Topalović¹, Jelena D. Nikolić¹, Veljko V. Savić¹, Srđan D. Matijašević¹, Marija S. Đoščić¹, Sonja V. Smiljanić^{2,3}, Snežana R. Grujić²

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Abstract

Information about the dissolution process and ion release of phosphate glasses in different environments is important for a wide range of engineering applications, from biomaterial design to environmental technologies. The dissolution of glass is a complex phenomenon and the kinetics of this process depend on the glass properties (composition, structure, surface condition, etc.) and environment (the type of solvent, leaching solution volume, pH, temperature, etc.). The dissolution behavior of glass is determined by the reactions of the glass network and the release of different ions to the solution. Surface conditions and layer formation, saturation effects, and solution chemistry must also be taken into account when describing the dissolution processes. Mechanism of chemical reactivity of a polyphosphate glass (45P₂O₅·3SiO₂·25K₂O·15CaO·10MgO·1ZnO·1MnO (mol %)) in distilled water, an aqueous solution of 2% citric acid and SBF, under static and non-saturated conditions were presented. The leaching tests were performed with glass powder samples (0.3–0.65 mm) at T=37 °C for times up to 720 h. The mass loss of the samples, the changes of pH, the concentration of elements (P, K, Ca, Mg, Zn, and Mn) in solution, and the initial release rates (r_{0i}) and rate of glass hydrolysis (r_{hi}) were determined. The time dependence of the normalized concentration of ions in solution indicates that the dissolution of examined glass, for all investigated environments, occurs in three stages. For shorter times (stage I), the changes of the normalized concentration of ions in solution were linear with time, corresponding to the highest dissolution rates. During stage II, the changes of the normalized concentration of ions in solution with time were smaller due to lower dissolution rates. In stage III, the changes of the normalized concentration of ions in solution were very small and the dissolution rates were more than ten times lower compared to the initial rates. The initial release rates of cations were determined in the range of 0.17-12.92 g/m²h. The release rates of cations r_{hi} by hydrolysis were determined in the range of $0.13 \cdot 10^{-2}$ - $2.31 \cdot 10^{-2}$ g/m²h. The time dependence of the solutions' pH is not the same for all of the three solvents. pH value decreased in the initial stage and then remained constant in distilled water and SBF, while in the aqueous solution of 2% citric acid pH value increased in the initial stage and then remained constant.

Keywords: polyphosphate glass, dissolution, dissolution rate