
Corrosion of sodium silicate glasses: the influence of concentration effects

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Abstract

Sodium water glass can be produced by dissolving sodium silicate glasses at elevated temperatures. To contribute to the understanding of the dissolution process, studies on sodium silicate glasses having the composition $\text{Na}_2\text{O} \times x \text{SiO}_2$ ($x = 2.0, 2.5$ and 3.3) were performed. The glasses were dissolved in different neutral to alkaline corrosion media (H_2O , H_2O containing different concentrations of dissolved SiO_2 , concentration series of sodium water glasses having nearly identical molar $\text{SiO}_2:\text{Na}_2\text{O}$ ratios with SiO_2 contents up to 27 wt. %) at moderate to elevated temperatures in static as well as dynamic corrosion tests. Dynamic corrosion tests were only applicable as long as the viscosity of the leachants were low enough for pumping them through the corrosion containers. Depending on leachant composition and resulting pH, reaction layers were observed and investigated. Some kinds of saturation effects were observed in dynamic corrosion tests with silica enriched H_2O as leachant. Static as well as some dynamic corrosion test results with diluted sodium water glasses as leachant depend on glass composition. For $\text{Na}_2\text{O} \times 2 \text{SiO}_2$ the corrosion rates declined with increasing water glass concentration, whereas for $\text{Na}_2\text{O} \times 3.3 \text{SiO}_2$ the corrosion rate increased with increasing water glass concentration. To test this behavior an intermediate composition $\text{Na}_2\text{O} \times 2.5 \text{SiO}_2$ was tested. Here, corrosion rates first increase and then decline with water glass concentration. An explanation of these concentration dependencies on the basis of leachate pH and reaction layer formation will be discussed.

Keywords: sodium silicate, chemical durability, glass corrosion

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