The influence of Mg^{2+} and Ca^{2+} ions on the glass corrosion

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The rate of glass corrosion is supposed to be influenced by the back precipitation of Me^{2+} silicates on the glass surface. In order the verify the model assumptions considering the protective function of such layers, the corrosion of the model glasses of the systems Na_2O-CaO-SiO_2 and Na_2O-MgO-SiO_2 was studied. The rates of dissolution and the diffusion coefficients of Mg^{2+} and Ca^{2+} were evaluated using mathematical model derived earlier. In contrary to the lower solubility of magnesium silicates, both SiO_2 matrix dissolution rate and leaching of moveable glass components was higher in the case of MgO containing glass. In order to explain this difference, the back precipitation was simulated by interaction between silica glass and concentrated aqueous solutions. Three different solutions were used: solution with increased SiO_2 concentration and solutions containing SiO_2 and Ca^{2+} or Mg^{2+} ions. The existence of secondary precipitated layer was confirmed using Secondary Neutral Mass Spectroscopy (SNMS). After leaching of silica glass in solutions containing Me^{2+} ions, the increased concentration of Mg or Ca ions was found on the glass surface. In agreement with the lower solubility of magnesium silicates, the glass surface concentration of Mg was considerably higher then the one of Ca. Despite of this fact, if Me^{2+} ions were present in the solution, the dissolution rate was approximately the same, independent of the nature of Me^{2+} ion. In the solution without Me^{2+} ions, glass was dissolved 3.5 times faster. It seems that although the transport through the precipitated layer influences the total dissolution rate in the same scale, the rate of the surface reaction is higher in the case of MgO containing glass.