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Evolution of pH induced by salt concentration change under flowthrough conditions

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Column experiments are more sensitive to surface reactions than batch studies due to the increased surface area to liquid volume ratio. Moreover, these dynamic set-ups allow for stringent tests concerning the validity of equilibrium models for surface protonation and adsorption of pollutants. In the present study, column experiments were carried out at constant pH, where the concentration of background electrolyte consisting of monovalent electrolytes like NaCl at the inlet were varied. Due to the charging phenomena caused by ionic-strength dependent acid-base reaction, the pH at the outlet of column varied. On a positively charged surface (such as alumina at pH 5.8) the increase in salt concentration at the inlet caused a transient increase in pH due to enhanced protonation of surface hydroxyls. On a negatively charged surface (PTFE at pH 5.8) the increase in salt concentration caused a decrease in pH at the column outlet due to enhanced uptake of hydroxide ions at higher salt concentrations. The charging behavior of both surfaces was independently determined by streaming potential measurements. For PTFE column experiments at different pH values were carried out to further relate them to the streaming potential data. Indeed below the isoelectric point, the trend of the pH-jump at the outlet of the column was inversed which suggests pH dependent charging of this inert surface due to protons and hydroxide ions.

Overall, the experiments show the high sensitivity of column experiments to changes in solution composition and the kind of experiments may allow for determining points of zero charge in an elegant way.