Electrokinetic desalination of sandstones for NaCl removal - DTU Orbit (06/10/2019)

Electrokinetic desalination of sandstones for NaCl removal: Test of different clay poultices at the electrodes

Salt induced decay is a serious threat to many historic stone and brick buildings and monuments. Further salt decay can be problematic in more recent buildings, as well, causing repeated plaster and paint peeling and increased hygroscopic moisture content. There is a need for development of reliable methods to remove the damaging salts in order to stop the decay. Electrokinetic desalination of fired clay bricks have previously shown efficient in laboratory scale and in the present work the method is tested for desalination of Cotta and Posta sandstones, which both have lower porosity than the bricks studied. The stones were contaminated with NaCl by submersion prior to the desalination experiments, where an electric DC field was applied to the stones from electrodes placed in clay poultice. Two poultice types were tested: calcareous clay used brick production and a mixture of kaolinite and calcite. Both poultice types neutralized efficiently the acid from electrolysis at the anode. Regardless poultice and stone type high initial concentrations of chloride (0.41 and 0.34wt%) were reduced to below the target value (0.03wt%) in less than 3 weeks with 10mA (corresponding to about 4A/m² of stone surface) applied. At the end of all desalination experiments the water content in the poultice at the cathode was higher than in the poultice at the anode, revealing electroosmotic water transport. The water profiles in the stones, however, did not indicate electroosmosis as they were quite uniform within each stone, but electroosmosis in the poultices may have caused suction/pressure over the interface between stone and poultice causing the differences in poultice water content. The transport numbers for Cl⁻ and Na⁺ differed in the two stones and were highest in the most porous Cotta sandstone in spite of similar high pore water concentrations and the same applied electric current. The hypotheses is that a layered structure of the sandstones could be the cause for this, as the electric current may preferentially flow in certain paths through the stone, which are thus desalinated first. After the desalination of the paths with lowest resistivity the major charge carrying ion here is then OH⁻ from electrolysis at the cathode slowing down the desalination of the remaining part of the stone.

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