



Spectral induced polarization of concrete

Philippe Leroy (1), Stephane Gaboreau (1), Alexis Mainault (2), Andreas Hordt (3), Egon Zimmermann (4), Johan Alexander Huisman (4), and Francis Claret (1)

(1) BRGM, Orléans, France (p.leroy@brgm.fr), (2) UMR UPMC-CNRS-EPHE 7619 METIS, Paris, France. , (3) TU Braunschweig, Braunschweig, Germany., (4) Forschungszentrum, Jülich, Germany.

Concrete is a material of choice for the storage of nuclear wastes in deep geological formations because of its long durability, high specific surface area and resulting low permeability that confer it remarkable confining properties (Banthia and Mindess, 1989; Labbez et al., 2006). Nevertheless, concrete can be degraded in contact with a water unsaturated with it such as the pore water of clay at the clay/water interface (Marty et al., 2015). For that reason, there is a need for the use of non-invasive geoelectrical methods such as induced polarization to follow the stability of concrete in situ. In this work, spectral induced polarization (SIP) laboratory measurements were carried out on concrete and cement paste first in equilibrium conditions and then in contact with a perturbing saline solution. The measured spectra exhibit a high resistivity (> 10 kOhm m) and phase shift between injected current and measured voltage (superior to 40 mrad and above 100 mrad for frequencies > 100 Hz). These observations were described using the membrane polarization model of Bucker and Hordt (2013) considering cations repulsion from the nanopores due to the positive surface charge of calcium-silicate-hydrate (C-S-H) phase (Labbez et al., 2006). The high resistivity and phase shift were respectively explained by the presence of dead pores corresponding to the interlayer space of C-S-H and the strong cationic exclusion (Gaboreau et al., 2011). The sensitivity of IP to the electrochemical and microstructural properties of concrete proves that it is very promising to monitor its chemical reactivity and confining properties in situ.

References

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