Streaming potential measurement at high Reynolds number

Tohru Watanabe[1]

[1] Dept. Earth Sciences, Toyama Univ.

The streaming potential is one of electrokinetic phenomena caused by the ionic motion in the electric double layer. Helmholtz-Smoluchovski equation (HS equation, hereafter) is used to estimate the zeta potential. However, this relation was derived by assuming the laminar flow through pores. Although it has been reported that HS equation broke down at a large flow velocity (e.g., Lorne et al., 1997), the cause of breaking down has been poorly understood.

Watanabe (2004) made streaming potential measurements on brine-saturated glass-beads samples, and reported that HS equation is valid at Reynolds number below 100 although the inertial resistance is not negligible. This validity of HS equation is explained that the fluid flow in the electrical double layer is still laminar when the flow becomes turbulent in the central part of pores.

We will report streaming potential measurements at higher Reynolds numbers. Experiments employs brine-saturated glass-beads samples (D=19mm, L=40mm). The mean diameter of beads is varied as 200, 400 and 800 microns. The porosity is around 0.35 for all samples. The concentration of NaCl aqueous solution is 1e-5~1e-3 mol/l. Silver-silver chloride electrodes were used. In order to obtain high Reynolds numbers, we used the high pressure N2 gas (Max: 1MPa) to drive the fluid flow.