INFLUENCE OF THE IONIC STRENGTH ON THE CLOGGING PHENOMENON AND TRANSPORT DYNAMIC OF MICROPARTICLES THROUGH SATURATED POROUS MEDIUM

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ABSTRACT

In natural subsurface and flow suspension, the nano as micro particles can present a grateful factor to contaminant porous saturated media. Indeed, they can act as a vehicle of organic and inorganic contaminant and heavy metals or instead became a barrier to the migration of these pollutants in the case of deposition and porous medium clogging. On the other hand, chemical characteristics of the suspension flow as ionic strength are among the major factors involved in the process of suspended particles retention or release. Authors have confirmed through the investigation of model system and numerical studies that increasing ionic strength enhances particles deposition rates under constant hydrodynamic factors at typical pH values ([1], [2], [3], [4], [5]).

At this aim, an experimental apparatus has been developed in our laboratory in order to characterize the influence of ionic strength on the behavior of silica micro particles (d_{50}=13µm) injected continuously through a saturated sand texture (0.1-0.5 mm) for short and long durations. At this scale we have both physicochemical and mechanic deposition phenomenon ([7]).

At first, the conducted experimental trials have allowed to apprehend the dynamics of particles in suspension over time for different ionic strength values adjusted by adding monovalent salt of sodium chloride (0, 5.13, 10.26 and 13.68 mM). Through these trials, the increase of the suspension ionic strength lead to a growth in the particles retention rate at micrometer scale for which the influence of hydrodynamic and shear forces still significant. Thus, this experimental study completes previous research where authors interested in studying the transport of nanoparticles through fine porous media ([1], [2], [4]). Moreover, the carried experimental tests for long duration injection revealed the presence of clogging phenomenon due to the successive deposition particles by filtration resulted in a decrease in permeability in the time. Therefore an increase in ionic strength increases leads to intensify the clogging of porous media; otherwise there is dominance of release phenomenon.

REFERENCES

[1] Compère, F., Porel, G., and Delay, F., "Transport and retention of clay particles in saturated porous media. Influence of ionic strength and pore velocity", *Journal of Contaminant Hydrology*, Vol. 49, n°1-2, p1-21, (2001).

[2] Elimelech, M., Gregory J., Jia, X. and Williams, R. A., "Particle Deposition and Aggregation : Measurement, Modeling, and Simulation", *Langmuir*, (1995).

[3] Grolimund, Daniel, Kurt Barmettle, et Michal Borkovec, "Colloid Facilitated Transport in Natural Porous Media: Fundamental Phenomena and Modelling", *Colloidal Transport in Porous Media*, vol. XII, 292 pp. 99, (2007).

[4] Khilar, K. C. and Fogler, H. S, "Migration of Fines in Porous Media", *Kluwer Academic Publishers*, (1998).

[5] Tiraferri, A., Tosco, T., and Sethi, A., "Transport and retention of microparticles in packed sand columns at low and intermediate ionic strengths experiments and mathematical modeling", *Environ Earth Science*, vol.63, n°4, p.847-859, (2011).

[6] Herzig, P.J., Leclerc, D. and Goff, P. Le., "Flow of suspensions through porous media. Application to deep filtration", *Industrial and engineering Chemistry*, vol. 62, n° 5, p.8-35, (1970).