Clogging mechanisms on uranium in situ leaching exploitation

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The production by in situ leaching (also known as ISR, in situ recovery) became the first recovery process for uranium production in the world. This technique is less expensive than classical recovery processes like underground or open pit mining. Exploited deposits are usually low content per cubic meter but on a huge surface.

ISR is based on the injection of attack solution, which can be alkaline or acid. This solution allows the dissolution of the target mineral, uranium. Uranium is dissolved in solution, extracted by producer wells and treated in a plant. After chemical treatment and an adjustment of reagents concentrations, the fluids are recirculated back through injectors.

Wells clogging is a serious challenge for the uranium exploitation in Kazakhstan. The permeability decrease does not permit the fluid flow towards producers, leading to a decrease of produced flow and a clogging of producers. Several actions are performed on site in order to recover good produced flow. These actions are mechanical (jetting, swabbing, air lift) or chemical, using the producer as injector with chemical reagents.

In this case, mechanical and chemical clogging are considered as the main mechanisms. In fact, chemical deposits have been observed on screen and in column experiments at the lab scale. Deposits have been chemically characterized as hydroxyl alumino-sulfate. In literature a mechanical clogging in unconsolidated reservoirs is common, by mobilization of fine particles from the reservoir. So, mechanical clogging will occur with the transportation of colloidal and suspended particles, through the reservoir, which would depose/agglomerate at interfaces between the reservoir and the gravel pack, or the gravel pack and the screen.

The aim of this study, sponsored by the ANR industrial chair “ISR-U” (ANR, Orano, MINES ParisTech), is to understand chemical and mechanical clogging mechanisms, to localize agglomeration and precipitation related to the well distance. Thanks to the understanding of these mechanisms, we hope to propose mitigation strategies to avoid clogging, or optimization solutions for well recovery.

To reach these goals, a study of wells behavior is conducted in collaboration with Katco and Orano, as well as mass balance computations and reactive transport simulations with Hytec. A first result of mass balance calculations on aluminum, calcium and sulfate has been obtained, based on data of a block in production. Clogging occurs in the well vicinity, which concurs with observations on the field.