
Conférence Invitée : ISR: a key mining technique for Uranium worldwide production - Focus on Orano ISR modelling workflow and operational cases

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Résumé

The In Situ Recovery technique (ISR or In Situ Leaching ISL) is a uranium extraction technique suitable for large, low grade, medium depth deposits in sedimentary environments. It was developed in the 60's both in USA and former USSR. It is nowadays a significant contributor to the worldwide uranium production, close to 50% in 2017 according to the AIEA red book.

Unlike in conventional underground or open-pit mining, in the ISR technique, the metal in place is dissolved thanks to the circulation of injected chemical solutions through a network of injector and producer wells connected to the mineralized reservoir and covering the deposit. Two main technologies are available: acid or alkaline leaching. The choice depends on local regulations, geological settings and economic factors. In Kazakhstan most of the extraction by ISR (if not all) is conducted by acid leaching (H₂SO₄).

In support to feasibility studies and mine production, Orano Mining developed a modeling workflow able to forecast production and run sensitivity analysis. The main steps of this modeling approach are:

To build a geological model describing porosity & permeability, reduced & oxidized domains and the mineralization

To define and calibrate a geochemical model describing the main interactions between the rock and the leaching solution

To simulate the reactive transport

This modeling workflow has been used in several studies at Orano Mining for mining projects where no production occurred yet, it helps to "size" the project and build the mining plan. It is also used for more local purposes like production optimization. Three examples will be presented:

The pilot cells in Mongolia

The mining plan for a new deposit in Kazakhstan

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The optimization on a local zone in Kazakhstan