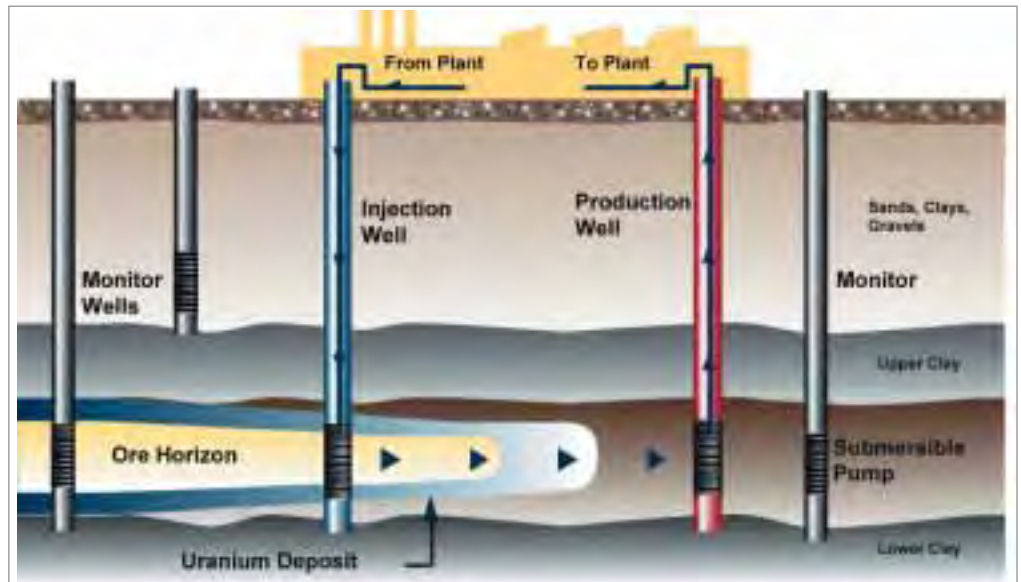


# To leach or not to leach?

In situ leaching is a process that produces little surface disturbance and has no tailings or waste rock. It is particularly useful in uranium projects where tailings and, in particular, tailings disposal is of great concern. *IM* examines the process, looking at some operations where it is currently in use

In-situ leaching (ISL) or in-situ recovery was developed in the mid 1970s as a method for extracting uranium from typical roll-front type deposits located in water saturated permeable rocks that were not suitable for conventional mining. It was conceived independently in both the (former) USSR and the USA using similar approaches in engineering and technology. The difference came in the fact that the Soviets used an acid leach system, whereas the Americans went to the other end of the pH scale with an alkaline, primarily carbonate-based system. The chosen approach is dependent upon deposit geology and groundwater conditions, with carbonate based leaching used where significant amounts of calcium is present around the ore. Since its original development the method has progressed into something that is efficient, environmentally safe and often cost effective.

Uranium One has much experience in ISL, with many projects in development using the process. This includes the Akdala mine in Kazakhstan, the Dominion project in South Africa and the Honeymoon project in South Australia. At Akdala a wellfield process is ongoing. The wellfield is created by pumping liquids down through injection wells placed on one side of the deposit of uranium, through the deposit, and up through recovery wells on the opposing side of the deposit - recovering ore by leaching. Wellfield patterns are typically configured as hexagons and sometimes as parallel linear rows. At Akdala the spacing between injection and production wells are in a hexagon pattern about 45 to 50 m apart. The spacing between rows in a linear pattern is 60 m, with 30 m spacing between wells in each row. A series of monitor wells are situated around each mineralised zone to detect any movement of mining fluids outside the mining area, and give early warning of any potential environmental concerns. The wells are also cased to ensure that liquors only flow to and from the ore zone and do not affect any overlying aquifers.



Schematic of in-situ leaching of uranium

Uranium production can differ from country to country. In Kazakhstan and Australia they use acid leaching of the crushed ore; whereas ISL in other countries generally uses alkaline leaching agents such as a combination of sodium bicarbonate and carbon dioxide. In South Australia the process is acid leaching with weak sulphuric acid plus oxygen, with the solution at a pH of between 2.5 and 3. As previously stated, this is dependent on the geology of the deposit and the groundwater.

Once the pregnant solution has been released from the production wells it is pumped to the treatment plant where the uranium is recovered in a resin ion exchange (IX) or solvent extraction (SX) system. The choice between either method is determined largely by the salinity of the groundwater with SX suiting high salinity, such as Uranium One's Honeymoon project and IX for low salinity groundwater. The uranium is then stripped from the resin, and precipitated chemically, usually with hydrogen peroxide. The uranium slurry is then dewatered and dried to give hydrated uranium peroxide product. Before the remaining process solution is re-injected to the wellfield, it is oxygenated and, if needed, recharged with sulphuric acid to maintain the desired pH. A small amount of solution is bled off to preserve a pressure

gradient in the wellfield and this, along with some solutions from surface processing, is treated as waste.

The environmental factors that have, historically, hindered the process have been countered by a series of processes that are carried out once the wellfields have been in use. These include:

- After ISL mining is complete, the quality of the remaining groundwater must be restored to a baseline standard that was determined before the operation start so that prior use can be resumed
- Upon decommissioning, wells are sealed or capped, process facilities removed, any evaporation pond revegetated and the land reverted to previous use
- The usual radiation safeguards are applied to ISL mining operations
- Employees are constantly monitored for alpha radiation contamination and personal dosimeters are worn to measure exposure to gamma radiation
- Routine monitoring of air, dust and surface contamination are constantly undertaken.

These measures have made ISL a successful component of uranium mining and have also allowed the method to be used for other permeable metals such as copper, achieved through stope leaching in America, and gold on a smaller scale. *IM*