

Mining technologies

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CONCENTRATION

URANIUM CONCENTRATE: U3O8 / « YELLOW CAKE »



EXTRACTION: OPEN-PIT MINE, FOR SHALLOW DEPOSITS

To extract uranium from shallow deposits, the open-pit mining method is used.

The first step in open-pit mining is to strip away the rock that contains no uranium to get to the orebody, where the uranium is concentrated.

Explosives, generally in the form of a solution that can be pumped, are placed in holes drilled vertically into the rock according to a predefined pattern. The area is then cleared, and a slice of the deposit is blasted away.

The ore is then scooped up with power shovels and loaders and transported by truck to the mill. There the ore is processed mechanically and chemically to concentrate the uranium in the product that will be sold, called yellowcake.

EXTRACTION: CONVENTIONAL UNDERGROUND MINE, FOR DEEPER DEPOSITS

When the orebody lies deep beneath the surface, the ore is extracted with an underground mine. The mine is accessed by a shaft or incline, and horizontal galleries are dug with explosives to form its infrastructure.



Crushers and conveyor belts installed in the galleries are used to bring the ore to the surface.

Holes are mechanically drilled and the orebody is checked. Explosives are then placed in the holes, the area is cleared, and a slice of ore is blasted away.

Before the ore is loaded, the work area and all access tunnels are made secure, in particular by supporting the roof with metal rods called anchor bolts.

EXTRACTION: IN SITU RECOVERY (ISR)

The in situ recovery method can be used to mine uranium deposits when suitable geological conditions are present.

With this method, an acid or alkaline solution is pumped into the orebody through injection wells. The solution circulates through the ore, dissolving the uranium. The uranium-bearing solution is pumped to the surface through production wells and transferred to the processing plant. The uranium is extracted by loading it on ion exchange resins or solvents and then concentrated. The acidity or alkalinity of the uranium-free solution is adjusted, and the solution is reinjected into the wells.



The in situ recovery process takes place in a closed system.

This method, which is more suitable for low-grade deposits, is being used in Kazakhstan and may be applied in Mongolia.

EXTRACTION: JET BORING, A HYDRAULIC SYSTEM FOR MINING HIGH-GRADE DEPOSITS

There are several methods of extracting uranium remotely so that no workers need to come into direct contact with high-grade ore. One of these methods employed at Cigar Lake site is Jet Boring, a system that uses water under high pressure to remove the ore.

To safely mine the deposit, the zone around it is frozen by pumping brine chilled to -40°C from the surface and circulating it in pipes running through the rock for about one year.

A mining machine digs through the rock below the deposit to create a production tunnel, which is encased with rings of concrete blocks.

The jet boring system is then brought into the production tunnel. A pilot hole is drilled into the deposit. The drill head is then replaced with the jet boring nozzle. The system bores into the ore with a high-pressure water jet. The water jet rotates, creating a circular cavity.

During the boring, the slurry formed by the ore and water is recovered in the slurry car and transferred to the storage sump, where the excess water is drained off and recycled. The ore is then removed from the storage sump with a clamshell scoop.



After the ore is dumped from the clamshell, it is broken down to the consistency of fine sand and pumped to the surface.

The ore is then loaded in special containers for transport to the mill.

Two other non-entry mining methods have been used in Canada at the McArthur River mine: Raise Boring and Boxhole Boring.

Another jet boring technology is under development in the SABRE project: Surface Access Borehole Resource Extraction.