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Satellite Elements Were Found In Technological Solutions In Uranium Deposits

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Abstract: This article analyzes the mineralogical state of molybdenum, one of the associated elements in the technological solutions found in uranium deposits, its forms in composition, and extraction technologies. The transition of molybdenum to the technological solution during the hydrometallurgical processing of uranium and the main methods of its separation - extraction, ion exchange, and sorption processes - are considered in detail. The economic and environmental significance of separating molybdenum as a by-product is also emphasized. The article serves to expand the possibilities of complex use of raw materials in the uranium mining industry.

Keywords: Uranium, molybdenum, associated elements, technological solution, extraction, sorption, ion exchange, molybdenite, hydrometallurgy, processing technology.

Introduction

Uranium deposits are of great importance not only as a source of nuclear fuel but also as an important source of various trace elements. In addition to radionuclides, they contain several economically important elements - molybdenum (Mo), vanadium (V), selenium (Se), rhenium (Re), etc. These elements appear in the process of uranium mining as a result of decomposition in technological solutions and can be isolated as a by-product.

Trace elements in uranium deposits

Trace elements in uranium deposits vary depending on various geochemical and mineralogical conditions. Below are some of the most common trace elements:

Molybdenum (Mo) is a widespread metal, found in uranium deposits in the form of MoS_2 (molybdenite).

Vanadium (V) is most often found in uranium-vanadium ore deposits.

Rhenium (Re) is rare but is present in minerals associated with molybdenum.

Selenium (Se) and tellurium (Te) are formed through deep thermohydrothermal processes. The extraction of these elements is not only economically beneficial but also important for environmental control.

Molybdenum (Mo) is an element with the atomic number 42, which is highly resistant to corrosion, has strong mechanical properties, and is used in many applications. The main areas of application of molybdenum are

As an additional metal (for example, in steelmaking),

As a catalyst,

In electronic equipment and nuclear technology.

Molybdenum extraction in uranium mines

Molybdenum is found in uranium mines in the form of the mineral molybdenite (MoS_2). Depending on geological conditions and the storage of molybdenum, it is present in the mineral but also in the form of adsorbed and colloidal forms and is transferred to technological solutions. The concentration of molybdenum in these solutions is usually around 1–50 mg/l, but in some deposits, it can reach up to 100 mg/l.

Molybdenum extraction technology

Various methods are used to extract molybdenum from technological solutions in the uranium mining industry. Below we will consider the 3 most effective and common methods:

1. Extraction method

In this method, molybdenum is extracted from the aqueous phase using organic solvents (for example: tributyl phosphate, amines). The process is carried out in the following stages:

Optimization of the RN level (5–7),

Mixing with the organic phase,

Recovery of molybdenum (stripping) - using acid or alkali.

Advantages: high efficiency, selectivity, can be operated on an industrial scale.

2. Ion exchange layers (ionites)

In this method, molybdenum is retained using ion exchange layers (cationites or anions).

Process:

What causes the solution to pass through the ion exchange column,

Molybdenum is collected in the ion exchange,

Subsequent regeneration and separation from the solution.

Advantages: environmentally friendly, recyclable.

3. Sorption method

Here, natural sorbents or modified sorbents (for example: activated carbon, zeolites) are used. The degree of sorption depends on the pH of the environment, each and other factors.

Additional processes and recovery

Molybdenum is separated, it is:

In the form of molybdate ions (MoO_4^{2-}),

Subsequent distillation and heating are obtained in the form of anhydrous molybdenum trioxide (MoO_3) or metallic molybdenum in ready-made form.

Uranium deposits are of particular importance not only as a source of uranium, which is a strategic nuclear fuel but also as an important reserve of highly valuable trace elements such as molybdenum. Molybdenum is a metal characterized by its strength and corrosion resistance, and its wide application in various industries - in particular, metallurgy, the oil and gas industry, nuclear power, and electronic technology - makes it a strategic metal.

During the hydrometallurgical processing of uranium, molybdenum enters the composition of technological solutions, and its separation from these solutions allows for complex processing of the raw material. The main directions of molybdenum separation are extraction, ion exchange methods, and sorption technologies, each of which is selected depending on the specific conditions and composition of the solution. These technologies allow for the effective and selective separation of molybdenum from the solution and its subsequent conversion into a metallic form or oxide form.

Studies show that molybdenum separation is not only economically feasible but also plays an important role in reducing environmental impact. Because molybdenum remaining in solutions, although not highly toxic, poses a risk of leaching into groundwater in the long term. Therefore, its separation from solutions is also important from the point of view of saving resources and environmental sustainability. In conclusion, the separation of associated elements such as molybdenum from technological solutions in uranium deposits allows for the complex processing of raw materials in the industry, reducing the amount of waste and generating additional economic income. In the future, deepening scientific research in this area, the creation of modern sorbents and selective extractants, and the introduction of automated technologies will further increase the efficiency of molybdenum separation.

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