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High Technologies of the Underground Extraction of Kazakhstan Fields

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ABSTRACT: In the underground extraction of ore deposits in Kazakhstan, full or partial backfill of the goaf is applied. In terms of market economics, goaf stowing is impractical. Thus, methods of synthetic roof fall of proof ores in mining have been designed.

1 INTRODUCTION

The method of synthetic slackening and roof falls of proof ores involves their deconsolidation by reactive solutions. For tins purpose, wells of 75 mm in diameter are bored in ragstones. Deconsolidating chemical solutions are forced under pressure into these wells.

Considerable deconsolidating and slackening of ore and barren sandstones have been obtained during experiments, and expenditure on explosives has been greatly reduced. This method will be tested and applied in one of the ore mines in Kazakhstan in 2001.

2 DOWN-HOLE MINING APPLICATION IN KAZAKHSTAN

It İs possible to develop a number of Kazakhstan friable ore fields, and also precious, non-ferrous and rare metals and uranium placer deposits applying know-how of hydraulic down-hole mining. Analytical investigations have been carried out and practical experience of hole know-how applied to the mining of different metal fields has been accumulated. Down-hole mining of friable leaden ores has resulted in a S-fold decrease in the production cost of 1 ton of ore in comparison to underground extraction.

Up to 45 % of Kazakhstan uranium field reserves are in composite geological conditions; therefore, these fields are developed applying down-hole know-how with the special methods of reservoir preparation for treatment and uranium leaching process intensification.

The engineering methods of fluid fracturing of soil parameter computation for the creation of synthetic aquicludes in uranium underground leaching, arguments the determination of intermediate shields, zones of permeability are designed. The processes of computation of physicochemical methods of underground leaching process intensification are introduced. Methods of calculus of optimal arguments of compound-structured reservoir exposure and development well construction are presented.

The special methods of uranium reservoir preparation and down-hole leaching intensification are designed on the basis of shield and hydrocurtain creation, colmatant injection, superwell construction, ultrasonic and electrical treatment of seams and screens, chemical decolmatation, effects of power surges, application of oxidants, magnetization, pulsating conditions, reversal of currents, etc.

The regularities of reagent current movement during filtering on bedding and crossing bedding of ore-bearing sandy and silty uranium reservoirs with different-granulated fractions and pore space, filled with clay formations grouted by montmorillomte and hydromicas are established. The links of seam protoxidation arguments with colmatauonal phenomena (gaseous, chemical) are recovered at different pH values of solution, overseaming head amount, and the availability of sulphate of calcium. The conditions of formation of aluminium and Ferri lactas hydroxides and the regularities of redepositions on the mobile geochemical barrier are determined.

The engineering methods (special and combined) of computation of opening up compound-structured uranium reservoirs to underground leaching are designed.

The idealized arguments of physics of the process of fluid fracturing of seams folded as friable sand-and-clay formations are given. The fluid fracturing

computation method is designed and machinery necessary for its realization is determined. When this İs applied in practice, the expected increase in uranium mined from 1 km" of reservoir floor space is 25-30 %, costs will be reduced 15-20 %, productivity will rise 20-30 %, and considerable savings of facilities, 60-80 million tenge, will be achieved annually. In addition, the ecological safety of e uranium mining will increase.

3 USE OF OLD MINES FOR VARIOUS PURPOSES IN KAZAKHSTAN

At several ore mines in Kazakhstan, there is practical expertise of using old mine workings for economic and manufacturing purposes. Analytical investigations of the use of old mines and ore mines for economically effective purposes are carried out.

Thus, capital investment is cut 1.2-1.5 times, and working costs are cut 1.5-1.8 times.

Methods of keeping long-lived old mine workings hot (for 50 years) and technologies of dumping parasitic wastes (uranium, mercury, arsenic) in old mine workings for infiltration into underground workings and mine waters are designed.

In the old mine workings of the "Youth" mine in the Karatau phosphorite basin and Belousovskii ore mine in eastern Kazakhstan, fungi, colours and vegetables are grown year round with large savings of facilities, particularly in winter time.

At mine .№ 39 in Zhezkazgan, old stops is used as stockyards and pigsties, and for beaver rearing and vegetable storage.

At one of the Zhezkazgan mines, there are plans to install machinery for copper dressing and discharge using a hydrometallurgical method in old underground mine workings. Thus, it is planned to increase the discharge of copper at the underground factory by 20 % m order to utilize solid washery waste for goaf stowing and to obtain a saving of about US$ 20 million annually.

Geotechnological methods of mining non-ferrous metals, both gold underground and heap leaching, are designed and tested practically in Kazakh ore mines. Experimental research is carried out and a project for mining zinc-lead ores by underground leaching is compounded in Tekeli ore mine. Thus, the withdrawal of zinc and lead compounds 80 % and considerable saving of facilities is obtained. In addition the necessity of keeping a large number of workers in underground conditions will be eliminated.

At Akchi-Spasskii opencast mine in Zhezkazgan, industrial trials of heap leaching of oxidated copper ores with large savings of facilities have been carried out. On the basis of the results of these operations, a heap leachmg lease of oxidated copper ores has been designed, with an annual output of 100 thousand tons of ore. Gold heap leaching from dressing tailings is developed at three ore mines in northern Kazakhstan - Aksu, Bestobe and Zholymbet. At Aksu ore mine, ladings from flotation occupy 90 ha floor space, where 7.3 million tons of tailings with 10.22 tons of gold and silver - 20.44 tons are stored; at Bestobe ore mme, these figures are 140.7 ha with 7.0 million tons of tailings containing 10.5 tons of gold and silver - 1.4 tons; and at Zholymbet ore mine - 88.5 ha, 9.0 million tons, 11.7 tons and 5.4 tons respectively.

For recovery of gold and silver from flotation tailings at Aksu, Bestobe and Zholymbet ore mines, dense alkaline cyanide leaching and sorbate concentration on highly alkaline anion exchanger, reactivation of gum and electrolysis of documentary reagents with precipitation of gold on the cathode are used. The technological system enables preliminary fine-grained tailings material pelletization (agglomeration) up to a fineness of aggregate of 15-30 mm with the use of 5 kg of cyanide and 2 kg of lime per ton of tailings. In order to maintain alkalinity at pH 10.5-11.5, CaO (0.6 kg per ton) is added when yarding tailings in stacks of heap leaching. As the resolvent, a mild solution of cyanide of sodium is applied. Cyanide solutions of such concentration dilute oxygen well and are fissile resolvents of gold. The desorption of gold is realized by eluting solution composed of thiourea and sulfuric acid in reverse-flow strings mixture. Electrolysis of the documentary reagent is done on carbonic-and-plumbago material by electrolytic cells witb. an output of 2 m per hour and 4% exit of gold on the current. Cathodic settling incineration is carried out by carbonic-and-plumbago fundamentals burning out at the temperature of 500-600°C. In the incinerated cathodic settling, the contents of gold compound 900-950 g per 1kg of the settling.

After leachmg the aqueous washing out of the heap leaching and tailings of leaching rendering stockpiles from cyanides up to the maximum allowable concentration by 25 % sulphite-bisulphite solution of ammonium is carried out.

In order to justify the building of a trial complex for the production of cathodic gold, a feasibility report on the development of gold heap leaching from tailings of flotation ores dressing at Aksu, Bestobe and Zholymbet ore mines was prepared by the D.A. Kunayev Institute of Mining. On the basis of the feasibility report, a detailed plan of production was prepared.

The resulting production is 1.6 tons of gold annually. The specific investments compound US$ 2.86 per gram of gold, and the cost price of the commodity output is 3.7 dollars per gram.

4 CONCLUSIONS

The modern technological possibilities and expenence gained allow 70-75 % recovery of gold from tailings dressing accumulated in the tailings storages of the Aksu, Bestobe and Zholymbet ore mines