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UTILIZATION OF MINE WATER AT THE MECSEK ORE MINING PLANT

The operational problems of the wastewaters treatment from an ore mining plant near Pécs, Hungary, have been discussed as well as the preventive measures which have been applied against the difficulties resulting from the fluctuations in uranium and radium concentrations and those caused by high contents of bicarbonates and iron.

Mining operations of the Mecsek Ore Mining Plant are performed in the neighbourhood of Pécs, which is one of the most densely populated towns of Hungary. For these reasons the water management of the plant involved neighbourhood of the town considered from several points of view.

The water pumped out from the mines contains different concentrations of radioactive pollutants, natural uranium and radium. This water has high concentrations of bicarbonates and sulphates and it is polluted with suspended solids. Thus, raw effluents of the mine water would result in serious environmental pollution.

The drinking-water of the municipal supply system of Pécs arose some doubts from point of view of its quality, therefore in the mid-sixties it was proposed to use the water for the drilling rather than for drinking purposes.

According to the requirements of national health authorities the water used for drillings in the mines should meet the quality of drinking water. Therefore the generally applied technologies of water treatment should be completed by another one, allowing radioactive pollutants removal from the mine water.

The home-made anion-exchange resin VARION AP proved to be the most suitable for the extraction of uranium from mine water. The skeleton of the resin VARION AP is a styrene-divinyl-benzol polymer, pyridine being its active group.

In the reactors filled with ion-exchange resin the mine water to be treated flows upward from the bottom to the top at the rate of 7 m/hour (fig. 1). The reactors are connected two by two in series. Resin circulates periodically in counter-current direction

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with respect to the water flow. The retained uranium load is removed from the resin in a separate column system by sodium chloride and sodium carbonate solution. The regenerated resin is reused for the next cycles of the removal of uranium. Uranium contained in the regenerating solution (about 10 kg/m^3) is supplied to the chemical plant for processing.

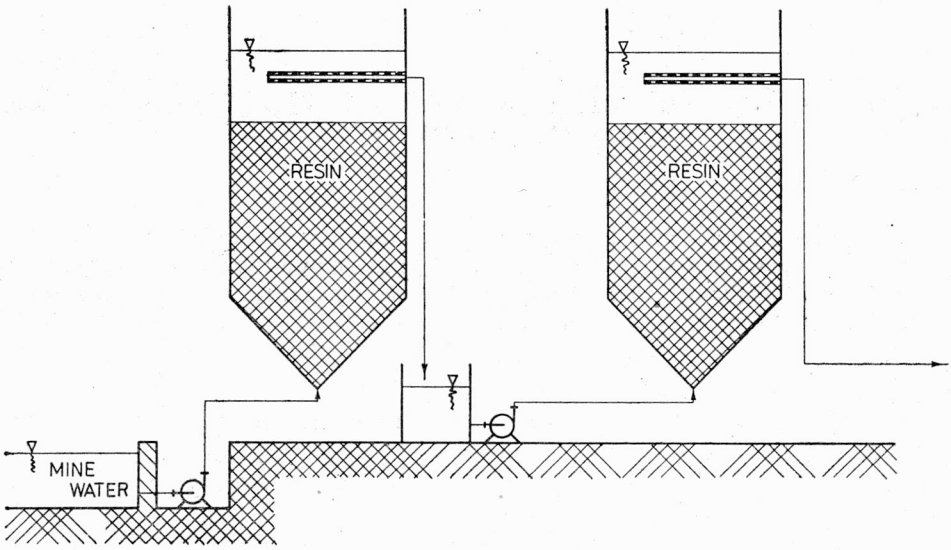

Fig. 1. Bond of ion-exchange reactors

Rys. 1. Złącze jonowymiennych reaktorów

After preliminary removal of uranium, the mine water is treated according to the scheme given in fig. 2. First it is treated with ferric chloride, and then filtered by sand of the DEVIG type. The filtrate is disinfected with sodium hypochlorite and pumped through a pipe system several kilometer long to the mining plants.

The mine waters to be treated come to the treatment plant from several places. The composition of water alters depending both on the place and time of uptake. The fluctuation of uranium concentration is the most symptomatic. Three years ago the composition of the water pumped out from the mines revealed sharp variations from one day to the next. Thereafter uranium concentration increased stepwise just as that of free carbonic acid and hardness.

Moreover, in some cases the iron concentration exceeded 20 mg/dm^3 which resulted in water turbidity and continuous deposition of brown precipitate. The precipitate consisted of ferric hydroxide and carbonates formed during the decomposition of hydrocarbonates. This fact was disadvantageous both for the equipment for uranium removal and filters; the capacity of the latter being significantly limited.

The uranium-exchange capacity of the ion-exchange resin has also decreased due to the deposition of the ferric hydroxide precipitate, preventing the resin—water contact. Consequently, the number of regeneration cycles and time consumption increased. Attempts are being made to solve serious operating problems due to the described phenomena occurring in the water being treated.

Waters of different origin are mixed in two retention basins which offer possibility of precipitate formation and deposition, thus insuring water quality before the water reaches ion-exchange bed. Thus, the process marked in fig. 2 as uranium removal may be interpreted as the parallel processing of waters of different quality, as well as the uranium removal from mixed water.

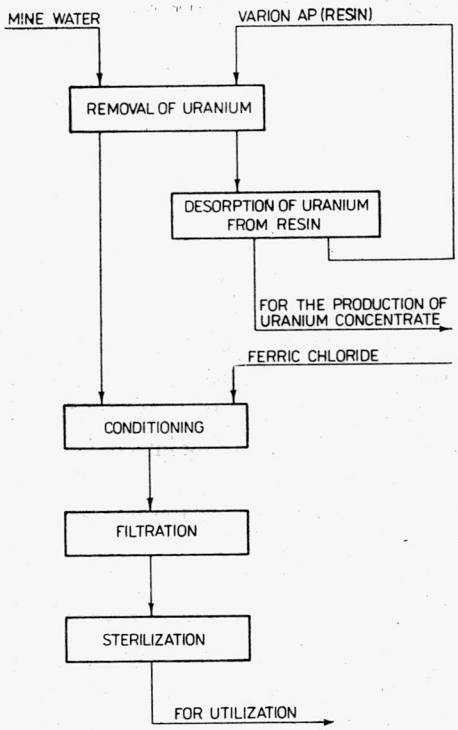

Fig. 2. Water purification

Rys. 2. Oczyszczanie wody

The process of the water treatment has risen some problems concerning the equipment in the case when the mine waters are of extraordinary hardness. In case of the Mecsek Mill the mine water pumped out from the depth of some hundred meters has the carbonate hardness of about 400—450 mg CaO/dm^3. The precipitate formation resulting from decomposition of bicarbonates affected the ion-exchange resin bed and sand rapid filters. The filters of DEVIG type were equipped originally with a filter-tube drainage system. The skeletons of the tubes were made of a perforated iron pipe on which an acid-proof

screening cloth was placed. After a half-year of operation the capacity of filters decreased significantly. After some time the filters could not be used any more. The detailed examination of the drainage system in the filters from which the sand bed had been removed revealed that the screening cloth was clogged by the precipitated carbonates. According to the producer's suggestion the iron tubes have been replaced by the perforated PVC tubes and instead of metal screening cloth the perlon cloth has been used. Since then the clogging problem did not occur in filter operation.

Actually radium concentrations of the mine water comply with the standard requirements. Considering that during mining operations new ore bodies will be exploited, it is possible that the radium concentration in the mine water will also increase. However, the adequate preventive measures are at disposal of the water treatment plant. In the past years the basic problems of the radium removal were solved by the use of barium chloride and cation-exchange resin. However, treatment of the precipitate formed in the ion-exchange bed and increasing radioactivity of the bed during the concentration of radium still remain unsolved.

The main task the research group working at the mine water treatment plant is to get an adaptable treatment technology which can be applied even at the changed quality and quantity of mine water and to achieve the product which can be reused in various unit processes of ore mill operation in order to cut down the drinking water consumption for industrial purposes.

The economic aspects of the water treatment is also of extreme importance. The mine water treatment plant is operated continuously during three shifts, with one operator in each shift. Uranium is extracted from more than 1500 m^3 of water/d from which nearly 1000 m^3 of industrial water/d is produced. Taking into consideration the cost of the drinking water consumed earlier for industrial operations, we can say that the present production cost of industrial water is only 80% of the earlier one, and the value of the recovered uranium is of millions forints.

WYKORZYSTANIE WÓD KOPALNIANYCH W KOPALNI RUDY „MECSEK"

Omówiono technologiczne zagadnienie oczyszczania ścieków z kopalni rudy koło Pécsu (Węgry) oraz przedstawiono działania zapobiegające zagrożeniom wynikającym zarówno z fluktuacji stężenia uranu i radu, jak również spowodowanym dużą zawartością dwuwęglanów i żelaza.

NUTZUNG DER GRUBENWÄSSER IM ERZBERGWERK „MECSEK"

Besprochen werden technologische Probleme der Abwasserreinigung in einem Erzbergwerk b. Pécs (Ungarn) sowie Maßnahmen zur Vorbeugung der Gefährdung die von Schwankungen der Uran- und Radiumkonzentrationen herkommen und die auch durch hohe Bikarbonat- und Eisengehalte verursacht werden können.

ИСПОЛЬЗОВАНИЕ РУДНИЧНЫХ ВОД В МЕТАЛЛИЧЕСКОМ РУДНИКЕ „МЭЦЧЕК"

Обсуждён технологический вопрос очистки сточных вод из металлического рудника вблизи Печ (Венгрия) и представлены действия, предотвращающие опасность, вызванную флуктуацией концентрации урана и радия, а также вызванные высоким содержанием бикарбонатов и железа.