UDC 628.543

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Cleaning of mineralized water

Today, significant factors of pollution are coal industies, fuel industries, electric power, non-ferrous metallurgy, ferrous metallurgy, chemical and petro chemical industries and machine building. Annually coal mines discharge a huge amount of mine water contaminated with mineral salt, suspended substances and bacterial impurities. It should be noted that coal industry accounts for more than half of all effluents. Shaft waters are characterized by a high content of suspended solids, increased mineralization, which causes large amounts of mineral salts to be discharged into reservoirs and rivers every year. As a result, in the industrial regions there is a short age of water for domestic and industrial needs, as well as a dangerous level of pollution of natural water sources. An urgent problem of pollution of water sources by coal enterprises comes up as unprofitable mines close down. When the mines are closed, their water course is more often redistributed to working mines.

In connection with the foregoing, the problem of demineralization of water during its purification from sulfates and softening is very urgent.

A reagent method based on coprecipitation of calcium sulphate with calcium aluminate can be noted [1, 2] among promising methods that are used to extract sulfates from wate,. The advantage of the method over ionex change, baromembrane processes, distillation, electrodialysis is that it allows the removal of sulfates from water in the form of a sparingly soluble precipitate, while in other cases waste is formed in the form of salt solutions.

The usage of lime does not allow to reduce the concentration of sulfates by less than 1500 mg/dm^3, which is due to the solubility of gypsum. Precipitation of sulfate ions with barium reagents is complicated by their toxicity and high cost, as well as the possibility of hydrogen sulphide release using barium sulphide. The sulphoaluminate method is simple, does not require complex equipment, but at the same time it does not allow achieving the values of MPC. At this stage of the development of the method, the most effective aluminum-containing reagent is selected for all indices. To precipitate calcium hydroxo-sulphoaluminates, it is advisable to use various aluminum coagulants along with lime. Processes of water treatment with lime and aluminum-containing coagulants based on the precipitation of calcium hydroxo-sulphoaluminate.

In addition to the purification efficiency, reagents should also have an economic feasibility. Therefore, it is important to determine the minimum amount of reagents while ensuring a high water purification effect.

It is noted in [3] that hydroxychlorides have the following technological and economic advantages: they are quickly and completely hydrolyzed; have a high polymerization capacity, which accelerates the formation of flakes and their precipitation; the precipitate formed is more dense and occupies smaller volume; have a wide range of optimal doses.

Therefore, 5/6 aluminum hydroxychloride was used as an aluminum coagulant to study the processes of purification of mineralized waters with an increased sulfate content. The conditions for effective softening of the solution and purification from sulphates in the complex treatment with lime are determined in the work.

As can be seen from Fig. 1, the use of Al2(OH)5Cl is to purify the solution ([SO42–] = 26,0 mg-equivalents/dm3; Stiffness = 16,0 mg-equivalents/dm3; [Ca2+] = 1,6 mg-equivalents/dm3; [Mg2+] = 14,4 mg-equivalents/dm3; [Cl–] = 2,3 mg-equivalents/dm3; Alkalinity = 16,0 mg-equivalents/dm3) provides high sulphate recovery efficiency.

The effectiveness of sulfate recovery increases insignificantly with an increase in the coagulant dose. However, an increase in the consumption of lime does not provide a significant improvement in the purification efficiency of the sulfate solution. Increase in the dose of lime from 82.2 to 108.2 mg-equivalents/dm^3 is practically unaffected on the effectiveness of softening the solution (Fig. 2). It should be noted that with the increase of the coagulant dose, the efficiency of waters often ingincreases, while the residual alkalinity of water also decreases substantially.

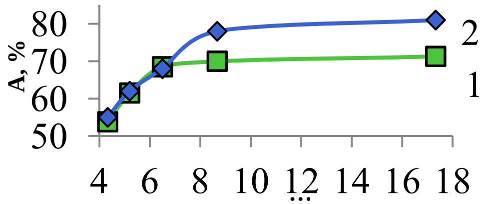

Figure 1 – Dependence of the removal efficiency of sulfate ions from the model solution on the flowrate of 5/6 aluminumhydroxochloride (lime dose mg-equivalents/dm^3: 82.2 (1), 123.8 (2))

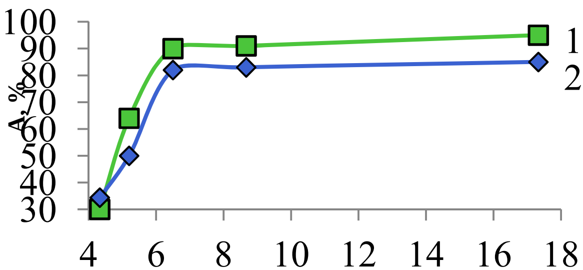

Figure 2 - Dependence of the softening efficiency of the model solution on the consumption of 5/6 aluminum hydroxochloride (lime dose mg-equivalents/dm^3: 82.2 (1), 123.8 (2))

Conclusion

Analysis of the presented graphs shows that the experimental points that were used in calculating the regression equation are on the constructed solution plane, which indicates the adequacy of the equation used. Using these regression equations, it is fairly easy to calculate the dosage of reagents for the recovery of sulfates and hardness ions using aluminum hydroxochloride as an aluminum coagulant. This makes it possible to efficiently desalinate water at permissible concentrations of chlorides in water.

References

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