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PRODUCTION OF A FILTER TO SOFTEN THE CIRCULATING WATER OF THE COMPRESSOR COOLING SYSTEM

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Abstract: Today, a number of significant shortcomings of the cooling system have been identified in the use of mining compressor devices all over the world, which are caused by the specific features of their working principle. Thus, not cooling the air in reciprocating compressors every 5-6℃ increases the electricity consumption for air compression by 1%, and the efficiency decreases by 8-10%, causing a significant economic loss in the production of compressed air.
Most of the waters used in technological processes of industrial enterprises have high hardness, which creates a number of difficulties. In this regard, there is a need to study the effect of the cooling quality of the compressed air on the efficiency of the compressor device, to improve the cooling system, to develop a device for softening the supply water, to develop the scientific basis for increasing the efficiency of mining compressor devices.
This article deals with the issue of improvement and filtration of the softening device of the circulating water of the cooling system of the compressor.
Keywords: compressor, cooling system, compressed air, heat transfer, intercooler, water softening, coal sorbent, air cooler.

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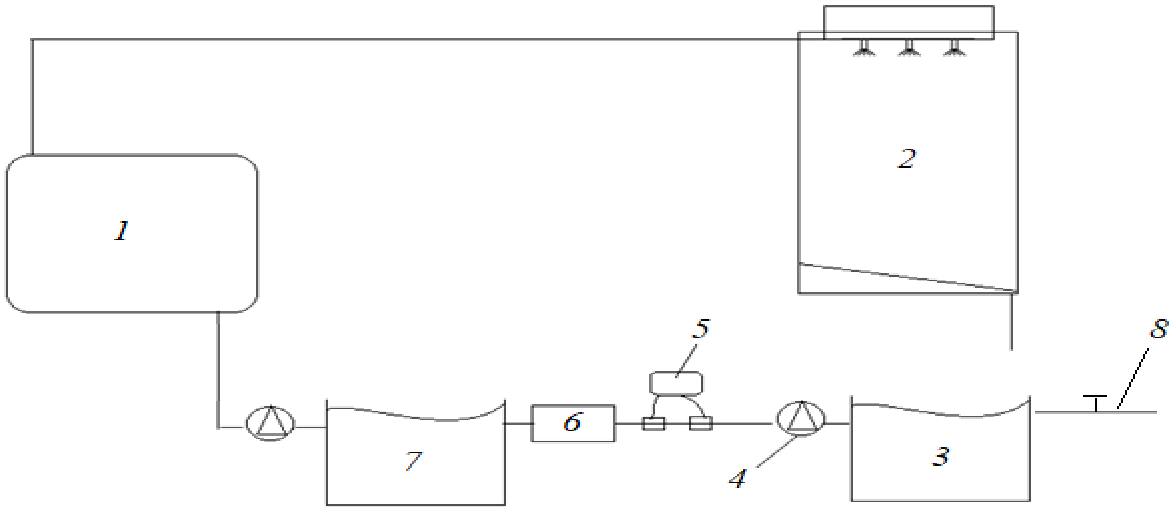
Today, the depletion of fresh water resources is becoming a global problem, by 2025 there will be a shortage of fresh water in about half of the world's countries. Circulating water is also used in the cooling system of the compressor equipment used in the mining enterprises of our country, the high hardness of the water, the high concentration of a number of salts such as calcium and magnesium in it creates soot-like layers on the heat exchange surfaces of the compressor equipment.

Water in the cooling system of the mine compressor equipment cools the intermediate and final coolers of the compressor, the compressor cylinder, after the temperature rises, mainly in the coolers or splash ponds. Due to the hot climate of Uzbekistan, the cooling system of the compressors used in industrial enterprises is equipped with coolers. Water with a reduced temperature in the radiator cooler is transferred to special water collecting containers and cooled, and its losses are replaced by additional water and sent back to the compressor through pumps. After that, the continuous circulation of the cooling water continues.

In order to effectively clean the salts contained in the cooling water sent to the intermediate and final air coolers of the compressor, it is suggested to filter the water coming out of the cooler and reduce its hardness and then transfer it to the air coolers. In this case, it is assumed that the water that is cooled in the cooler and then transferred to the water collection tank will be transferred to the additional water collection tank, and the water will be filtered between the transition from the first water collection tank to the second water collection tank. The filter used for water filtration (Fig. 1) is regenerated and cleaned during each shift change.

Figure 1 below shows a schematic view of the proposed filtering method.



1. Compressor, 2. Cooler, 3. First water collection tank, 4. Pump, 5. Electromagnetic processing equipment, 6. Main filter, 7. Second water collection tank, 8. Additional water pipe (pad).

Figure 1. Schematic view of the circulating water filtering device of the compressor cooling system.

The device works as follows: cooling water from the compressor (1) is sent to the radiator (2), cooled in the radiator and transferred to the first water collecting tank (3). Water is pumped from the collecting tank (4) to the main filter (6), the electromagnetic treatment equipment (5) is installed in the pipe between the filter and the pump, and then it is transferred to the second water collecting tank (7). and again transferred to the compressor. In Gradirnya, the amount of water reduced due to evaporation and losses is replenished with the help of an additional water pipe (8).

The efficiency of the circulating water filtering device of the compressor cooling system proposed in Fig. 1 depends on the operation of the filter that traps salt compounds in it. That is, the waves generated by the electromagnetic processing equipment accelerate the combination of calcium (Ca) and magnesium (Mg) elements in the water, the volume of the salts formed by the combination increases and retention in the filter is improved.

Today, a number of filters are used to soften the circulating water used in the technological processes of industrial enterprises. However, the efficiency of these filters is not enough, for example, when filtering large volumes of industrial water, filters installed in water pipes resist the flow of water, which in turn reduces the fields of application of such filters. The main thing is that due to the high pollution of water, the filters quickly clog, and as a result, time, labor and financial costs are incurred for their cleaning and restoration.

The use of filters to soften circulating water in the cooling system of compressor equipment is limited due to the fact that the filters quickly clog due to high water pollution. In order to solve this problem, the water softening filter can be regenerated many times without disassembly and assembly work. construction was developed.

The developed filter structure includes a porous filter material and an idol sorbent. The porous filter consists of the following ammonium bicarbonate ($NH5CO3$), polyorganosiloxane ($r2SiO$), acrylic emulsion, copolymers and vinyl chloride. Coal sorbent is made from brown coal and bentonite mixtures.

Figures 2-3 below show the construction and overview of this designed filter.

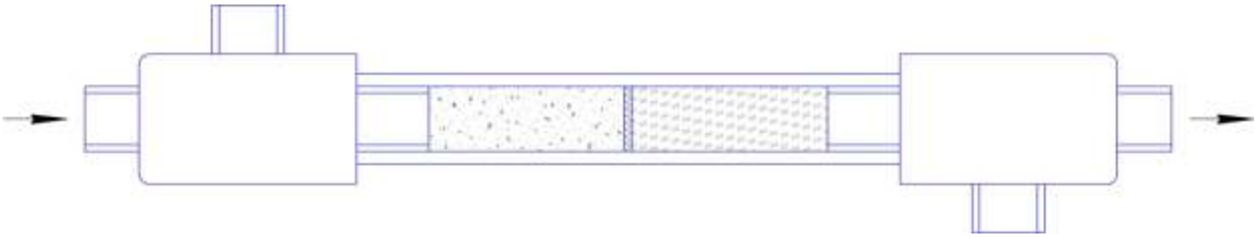


Figure 2. Constructive view of the water softening filter.

Figure 3. Overview of the water softener filter.

The unique aspect of the proposed water softening filter is that its construction includes both coarse cleaning (grubaya ochistka) and fine cleaning (tonkaya ochistka) filter materials.

Also, this filter structure can be regenerated after one shift of the compressor, and the regenerated and cleaned filter device maintains the softening efficiency of the water due to its non-clogging during the next compressor shifts.

In order to determine the effectiveness of the circulating water filtering device of the compressor cooling system proposed above, the physical model of this device was developed and tested in laboratory conditions.

The following main tasks were performed during the experimental work:

- assembly of the design of the circulating water filtering device of the compressor cooling system in laboratory conditions;

- to determine the developed water softening filter (Fig. 3), the ability to filter water;

- to determine the final performance of the designed filter after regeneration;

- to determine the optimal sizes of electromagnetic waves affecting the aggregation of salts in water.

The filter designed to soften the circulating water of the cooling system of the compressor was tested, during the experimental tests, the structure of the filtering device of the circulating water of the compressor cooling system was assembled in laboratory conditions, the electromagnetic water treatment equipment was made and tested.

The initial objective of the experiments was to determine the performance of the developed water softening filter. In this case, the hardness index is 0.15; Waters equal to 0.21 and 0.27 J mg-eq/l were passed through the filter, the results of experimental work are shown in the form of a histogram in Figure 4.

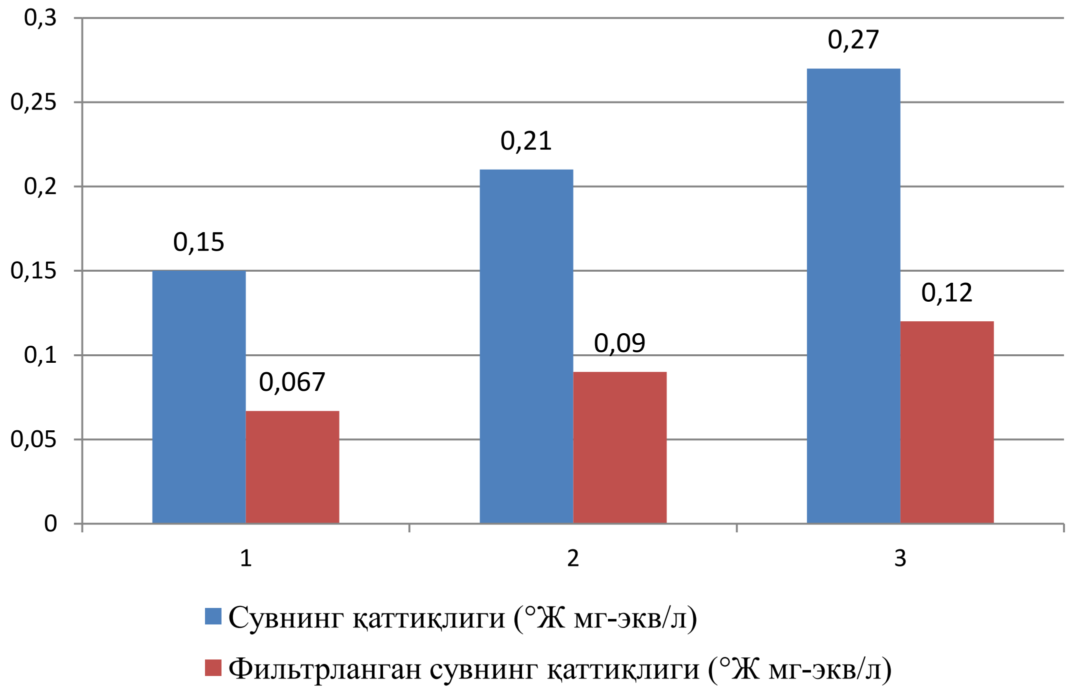


Figure 4. Results of experimental tests of a filter designed to soften the circulating water of the compressor cooling system.

After filtering water with a hardness of 0.15 J mg-eq/l, it was found that its hardness decreased to 0.067 J mg-eq/l on average. Also, when the hardness index is increased to 0.21 J mg-eq/l, the average hardness of filtered water is up to 0.09 J mg-eq/l, and when the water hardness is 0.27 J mg-eq/l, it was found that the hardness of the filtered water decreased to 0.12 J mg-eq/l.

The results of the experimental work showed that the tested filter can reduce the hardness of water by 55-60%.

To date, we know from the results of research on reducing water hardness using electromagnetic water treatment devices that when electromagnetic waves are applied to water, they prevent the formation of calcium (Ca) and magnesium (Mg) salts in the water. and eliminates their adhesion to pipe surfaces. Also, in some cases, electromagnetic waves are used to break up the structure layer formed on the pipe surfaces.

We thought that when electromagnetic waves of certain magnitudes are applied to water, they can bind calcium (Ca) and magnesium (Mg) salts in water, rather than separate them. Aggregation of calcium (Ca) and magnesium (Mg) salts increases their size and thereby ensures their effective retention in the filter. Experiments were carried out in order to confirm these ideas in practice.

During testing, the hardness index is 0.15; Water samples with concentrations of 0.21 and 0.27 °J mg-eq/l were exposed to electromagnetic waves from 2 kHz to 20 kHz in increments of 2 kHz. After exposure to each magnitude of electromagnetic waves, the filtered water was sampled and its hardness was determined. The results of the experimental work are presented graphically in Figures 5, 6 and 7.

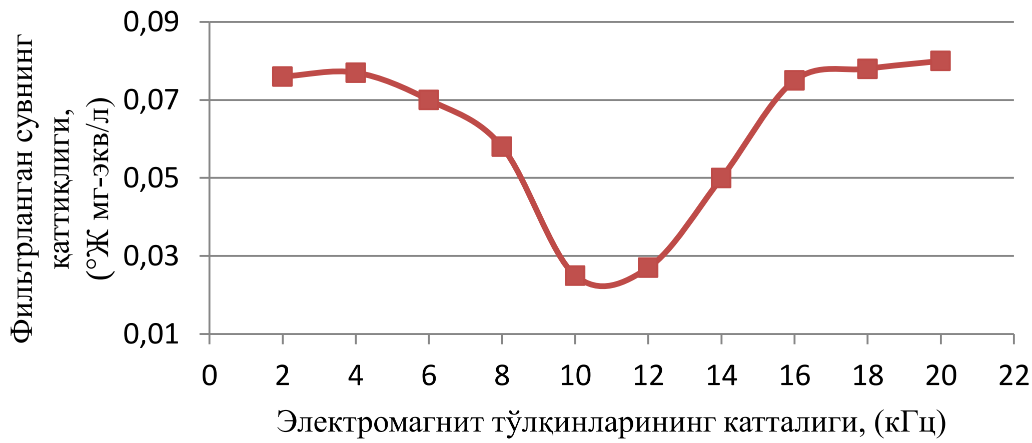


Figure 5. The effect of electromagnetic waves on reducing the hardness of filtered water when the water hardness is 0.15 °J mg-eq/l.

Figure 6. The effect of electromagnetic waves on reducing the hardness of filtered water when the water hardness is 0.21 °J mg-eq/l.

Figure 7. The effect of electromagnetic waves on reducing the hardness of filtered water when the water hardness is 0.27 °J mg-eq/l.

When water with a hardness index of 0.15 °J mg-eq/l was exposed to electromagnetic waves of 2 kHz, the hardness level of filtered water did not decrease, that is, the hardness of water was 0.076 ° J was mg-eq/l. No significant change in the hardness of the filtered water was observed even when the electromagnetic waves were increased to 4 kGs and then to 6 kGs. When the magnitude of electromagnetic waves was increased to 8 kHz, the hardness level of filtered water was 0.058 °J mg-eq/l, it can be seen that the hardness level of filtered water decreased to 0.018 °J mg-eq/l.

When the electromagnetic waves were increased to 10 kGs and 12 kGs, the hardness of the filtered water was 0.025-0.027 °J mg-eq/l, where we can see that the water hardness decreased to 85-90%. It was found that the hardness of filtered water increased to 0.05 °J mg-eq/l when we waited for electromagnetic waves at 14 kHz, and when we increased it to 16, 18 and 20 kHz, the hardness of filtered water increased to 0.08.

In the later stages of the experimental work, when the hardness index was 0.21 and 0.27 °J mg-eq/l water, the same results were repeated, that is, in all three cases, an electromagnetic field of 10 and 12 kG was applied to the filtered water. It was found that the hardness of filtered water decreased by 90% when exposed to waves.

As a result of the experiments, it was found that the filter device developed for softening the water reduced the formation of soot on the heat exchange surfaces of the intermediate and final coolers of the compressor by 85-95%.

Analyzing the results of the experimental work carried out above, the following conclusion can be drawn: exposure of filtered water to electromagnetic waves with a magnitude of 10-12 kGs causes the calcium (Ca) and magnesium (Mg) salts in the water to bind together. provides, as a result of the increase in the volume of the salts formed by the mutual compound, retention in the filter device is improved, thereby achieving effective softening of water.

BOOKS:

[1] Stapel A.G. Wege zu einer bessezen Qualitat der Druckluft. // Klepzig Fachderichte, 1972. #3 g. 145-146

[2] Externalities of Energy. Vol. 2 – Methodology. European Commission for Science Research. Brussels - Luxemburg, 1995. 125 p.

[3] Khatamova D.N., Abduazizov N.A., Djuraev R.U. Sovershenstvovanie sistemy okhlajdeniya rudnichnyx porshnevyx kompressornyx ustanovok // Innovative technologies. - QarMII, - No. 1. 2021. – S. 55-61

[4] Djuraev R.U., Merkulov M.V., Kosyanov V.A., Limitovskiy A.M. // Gorny magazine. - Izd. "Ruda i metally". - Moscow, 2020. - No. 12. P. 71-73. DOI: 10.17580/gzh.2020.12.16

[5] Merkulov M.V., Djuraev R.U., Leontyeva O.B., Makarova G.Y., Tarasova Y.B. Simulation of thermal power on bottomhole on the basis of experimental studies of drilling tool operation // International Journal of Emerging Trends in Engineering Research. Volume 8, No. 8, 2020. – pp. 4383-4389.

[6] Khatamova D.N., Abduazizov N.A., Djuraev R.U. Razrabotka tehnicheskikh resheniy, sinayushchikh obrazovanie otlozhenii na teploexchangemennyx poverkhnostyakh holodilnikov rudnichnyx kompressornyx ustanovok // Gornyy Vestnik Uzbekistana. - Navoi, 2021. - #4. - S. 91-94.

[7] Ergashovich Y. H., Narmuratovna Kh. D. THE INFLUENCE OF COMPOUNDS ON HEAT EXCHANGE SURFACES OF INTERMEDIATE AND FINAL COOLERS ON COMPRESSOR COOLING EFFICIENCY // Educational devotees. - 2022. - T. 17. – no. 4. – S. 43-46.

[8] Ergashovich Y. H., Narmuratovna Kh. D. STUDY OF THE INFLUENCE OF HIGH AIR TEMPERATURE ENTERING THE COMPRESSOR ON THE EFFICIENCY OF THE COMPRESSOR //Education devotees. - 2022. - T. 17. – no. 4. – S. 40-42.

[9] Muratov G. G. i dr. Sovremennye vnedreniya dlya predokhranenia uzlov conveyor v shakhte AO "Uzbekkumir" //Nauchnye issledovaniya i razrabotki 2018. – 2018. – S. 524-525.

[10] Khatamova D. N. i dr. DEVELOPMENT OF A DEVICE FOR SOFTENING THE CIRCULATING WATER OF THE COOLING SYSTEM OF STATIONARY

MINE COMPRESSOR DEVICES //Innovative technologies. - 2022. - T. 2. – no. 2 (46). - S. 72-77.

[11] Dzurayev R. U., Yuldoshov Kh. E., Khatamova D. N. Improving the efficiency of mine compressor units by improving their cooling systems.\\ Scientific and technical journal of the development of science and technology. 2022 - year 3 - issue, pages 156-160

[12] Ergashovich Y. H., Abdujabbor oglu A. A. STUDY OF THE INFLUENCE OF THE QUALITY OF COMPRESSED AIR COOLING ON THE EFFICIENCY OF THE COMPRESSOR INSTALLATION //Education devotees. - 2022. - T. 21. – no. 6. - S. 25-28.

[13] Khodyrev A.I. Povyshenie nadejnosti raboty porshnevyx kompressorov putem isparitelnogo okhlajdeniya sjimaemogo gas // Avtoref. dis. sugar tech science - Moscow, 1984. - 25 p.

[14] Bublikov I.A. Strukturnye osobennosti i teplofizicheskie svoystva vnutritrubnyx otlozhenii na teploobm