DOI: 10.25515/PMI.2018.3.317

UDC 621.671.22

# A METHOD FOR CONTROLLING SILTATION OF WATER CATCHMENTS OF DISTRICT DRAINAGE SYSTEMS OF KIMBERLITE MINES

**Nikolai P. OVCHINNIKOV**
*North-Eastern Federal University named after M.K.Ammosov, Yakutsk, Russia*

High contamination of mine water leads to intensive siltation of water catchments of district water drainage installations of kimberlite mines in Russia, because of which their pumping equipment periodically works in non-stationary regimes. At present, a number of known methods are used to limit the operation of pumping equipment in non-stationary modes: equipping the pump with a hand hoist to regulate the depth of lowering its suction pipeline into the sinkhole; preliminary dismantling of one of the two screen filters, mounted in the suction pipeline of the pump, which has smaller cells. Experience in the operation of water-drainage farms of kimberlite mines shows that these two methods allow to prevent the operation of pumping equipment in non-stationary modes only for a short period of time.

A mine drainage installation is proposed, the technical result of which is the effective struggle against the silting of the water catchments of the district drainage systems of the kimberlite mines of the country.

***Key words*:** mechanical impurities, silting, water collector, mine, pumping equipment, destruction, drainage installation

***How to cite this article:*** Ovchinnikov N.P. A Method for Controlling Siltation of Water Catchments of District Drainage Systems of Kimberlite Mines. Journal of Mining Institute. 2018. Vol. 231, p. 317-320. DOI: 10.25515/PMI.2018.3.317

**Introduction.** In the presence of mechanical impurities in the mine water for a certain period of time leads to siltation of the water-collecting basins of the drainage farms of the mines and mines, which, in turn, leads to the operation of their pumping equipment in non-stationary modes. Under the operation of pumping equipment in non-stationary modes it is necessary to understand pumping of mine water with reduced hydraulic parameters [10-12]. Operation with reduced hydraulic parameters has a particularly negative effect on the durability of sectional pumps, since when working with such parameters, an increase in the axial force is observed, increasing it to critical values usually leads to active friction between the rotor and body parts of the pump.

The result of this tribocontact is extensive destruction of the rotor parts, primarily the impellers (Fig.1) [1, 4, 8, 9, 13-16].

Thus, it can be seen that the development of effective ways to combat siltation of water-collection reservoirs of mines and mines is an actual scientific and practical task, since its solution will improve the durability of section pumps, which are the most common type of centrifugal pumps engaged in the underground development of useful deposits fossils, in particular, kimberlite ores [13, 16].

**Statement of the problem and method of investigation.** Currently, the most common way to struggle siltation of water catchments is their mechanized cleaning with the use of self-propelled machinery. At the same time, this method is a very labor-intensive and capital-intensive process.

Experience in the operation of water-drainage farms in Russia's kimberlite mines, managed by the city-forming enterprise of the north-east of the country – ALROSA (the Company), shows that cleaning of the water

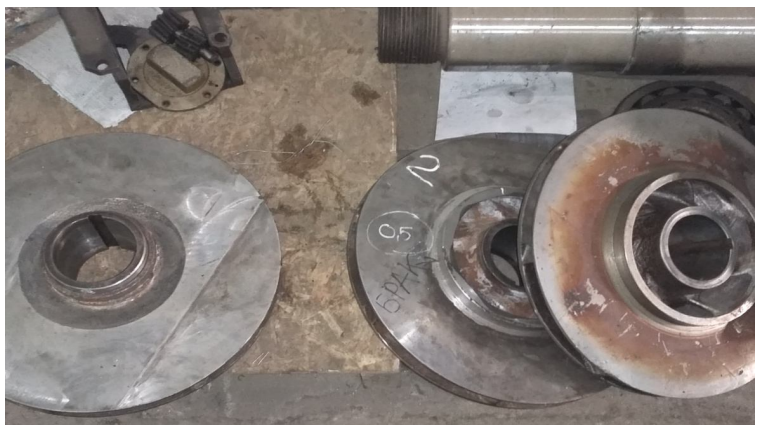


Fig.1. Consequences of the operation of the sectional pump model NCS (K) 400-660 in the non-stationary mode (Mirninsky OMPE, DC «ALROSA»)

DOI: 10.25515/PMI.2018.3.317



Fig.2. Sectional pump model CNS 180-200, pumping station UNS-380 (kimberlite mine «Mir», DC «ALROSA»)

catchments of the main drainage systems from mechanical impurities is much more frequent (usually 7-30 days.) than the cleaning of the catchments of the district drainage systems, because, unlike them, the main water drainage units are responsible for pumping out the total mine water inflow, and the deterioration of their functioning may whose consequences are catastrophic.

Due to the current situation, a number of known methods are used to limit the operation of section pumps of the company's kimberlite mines in non-stationary modes district drainage systems, namely: equipping the pump with a hand hoist in order to regulate the depth of lowering its suction pipeline into the silt sump (Fig.2); preliminary dismantling of one of the two screen filters, mounted in the suction pipeline of the pump, which has smaller cells.

Practice shows that these two methods allow preventing operation of pumping equipment in non-stationary modes only for a short period of time. Thus, it can be seen that for the company's management research is currently in demand devoted to the development of technical solutions for the effective control of siltation of water catchments of district water drainage installations.

The author's analysis of literary sources showed that a number of works by Russian scientists have been devoted to the development of technical solutions to combat siltation of water catchments of district water drainage installations [2, 6, 7]. Despite the indisputable merits of these technical solutions, their introduction into the system of district dewatering of the kimberlite mines of the company will face a number of specific problems.

The installation described in [2] can be embedded into mines, where the technology of laying the worked-out space is realized. However, not all of the company's mines implement the above technology. In addition, the hose (peristaltic pump), which is an important link in the considered technical solution, is not intended for pumping chemically active natural liquids with a temperature of 0 °C or lower (the temperature of the mine water pumped from the Company's kimberlite mines may be negative and reach – 5 °C).

A clear drawback to the practical application of the technical solution [6] in the Company's kimberlite mines is the fact that, in the sequential operation of sectional pumps, their individual suction side components (eg sealing elements) are under pressure above the critical value (more than 0.2 MPa), which in the future will necessarily lead to unscheduled failures of these structural elements.

In the technical solution [7] the evacuation of setting sludge (silt) is realized by means of its preliminary stirring. Practical experience at the kimberlite mine «Udachny» showed that the preliminary stirring, in addition to pluses, has a significant disadvantage. As it turned out, preliminary stirring of settled slime leads to more intensive hydroabrasive wear of the flowing part of pumping equipment, which adversely affects its durability.

**Technical solution.** For more effective control of siltation of water catchments of district water-pumping installations of kimberlite mines of the Company by employees of the Mining Institute of the Northeastern Federal University named after M.K.Ammosov developed a mine drainage installation (Fig. 3), the device of which is protected by a patent for a utility model [5].

DOI: 10.25515/PMI.2018.3.317

The device works as follows. The submersible pump 10 fixed to the stand picks up the sludge throughout the entire area of the header by moving it with a crane beam 6 moving along rails 8 fixed along the sides of the sump with which it is rigidly fixed through the rod 7. Sludge deposits from the suction pipeline 5 of the submersible of the pump 10 are fed to its pressure line 9, which is a flexible hose whose tip has a conical shape and is embedded in the elbow of the pipe of the common pressure header 3, which extends to the overlying horizon, with w lamella is evacuated from the sump bypassing the centrifugal section pump 2, whose pressure line 4 is mounted in the common pressure head 3.

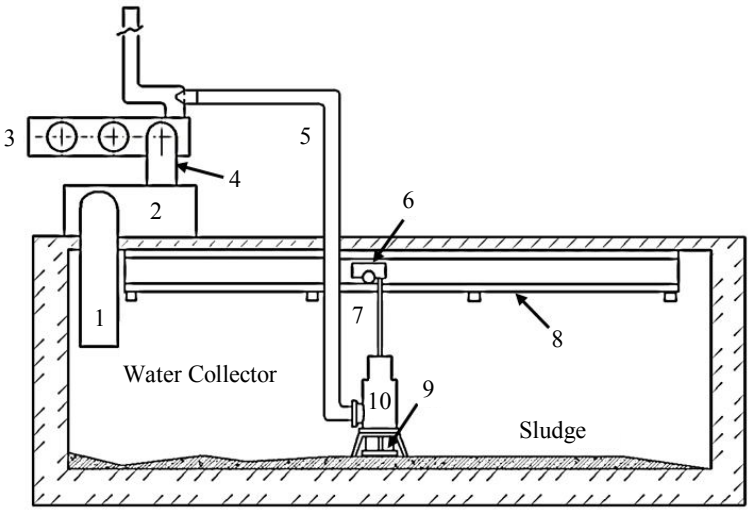



Fig.3. Mine drainage installation according [5]
1, 4 – suction and pressure pipelines of the centrifugal section pump;
2 – centrifugal sectional pump; 3 – the general pressure head collector;
5, 9 – suction and pressure pipelines of the submersible pump;
6 – a crane-beam; 7 – the rod; 8 – rails; 10 – submersible pump with stand



Fig.4. Submersible pump of the firm «Flyght»
(kimberlite mine «Udachny», DC «ALROSA»)

**Area of the technical solution.** In the conditions of the Kimberlite mines of the Company, the mine dewatering unit currently under consideration can now be introduced to the horizons – 650 m of the «Udachny» mine and the 0 m of the «Aikhal» mine, which is explained by the following. Due to the high aggressiveness of the mine water [13] pumped out of the mine workings of the company's kimberlite mines, it is recommended to use a pressure fire hose as the flexible hose of the developed device, whose maximum working pressure reaches 1.6 MPa [3]. Currently, at the company's kimberlite mines, pumping equipment with a pressure of less than 160 meters of water column is mounted precisely on the above horizons.

As a submersible pump in the developed technical solution (Fig.3), it is recommended to use the «Flyght» pump of the BIBO 2400 series, whose maximum hydraulic drop reaches 180 meters of water column the choice of the «Flyght» pump is explained by the fact that these submersible pumps have already proved themselves well in the company, in particular, at the «Udachny» mine (Fig.4).

**Conclusions.** Based on the results of the scientific research, a mine drainage system was developed that allows pumping setting sludge from the bottom of the water basin, bypassing the impellers of pumping equipment, thereby increasing its durability. Introduction of this technical solution will effectively combat siltation of water catchments of district water drainage systems of the company's kimberlite mines, which will ultimately have a positive impact on the company's technical and economic performance.

**DOI:** *10.25515/PMI.2018.3.317*

**REFERENCES**

1. Dolganov A.V., Eslent'ev A.O., Cherakov E.O., Toropov E.Yu. Analysis of the efficiency of unloading devices for shaft centrifugal section pumps. *Izvestiya Ural'skogo gosudarstvennogo gornogo universiteta*. 2014. N 2(34), p. 31-35 (in Russian).

2. Gorelkin I.M. Hydromechanized complex of equipment for water purification in mine drainage systems. *Zapiski Gornogo instituta*. 2014. Vol. 209, p. 170-172 (in Russian).

3. Elfimova M.V. Maintenance of fire hoses. *Vestnik Vostochno-Sibirskogo instituta MVD Rossii*. 2010. N 3(54), p. 55-61 (in Russian).

4. Timukhin S.A., Dolganov A.V., Popov Yu.V., Cherakov E.O., Eslent'ev A.O., Toropov E.Yu. Of the development of shaft centrifugal sectional two-flow pumps. *Izvestiya Ural'skogo gosudarstvennogo gornogo universiteta*. 2014. N 2(34), p. 41-44 (in Russian).

5. Ovchinnikov N.P., Vikulov M.A., Dovidenko G.D., Bochkarev Yu.S. Patent N 154173 RF. Mine drainage installation. Opubl. 20.08.2015. Byul. N 23 (in Russian).

6. Timukhin S.A., Ugol'nikov A.V., Petrovykh L.V., Stozhkov D.S., Lubinskii A.Yu. Patent N 2472971 RF. Mine dewatering plant. Opubl. 20.01.2013. Byul. N 2 (in Russian).

7. Popov V.M. Mine drainage systems. Moscow: Nedra, 1983, p. 304 (in Russian).

8. Styuflyaev S.S., Shipulin O.G. Comparative analysis of a multi-stage pump of the CNS type with an opposing arrangement of impellers and a hydrotreated. *Molodoi uchenyi*. 2017. N 3, p. 165-171 (in Russian).

9. Amolkumar D.L., Anurag V.K. Optimization and FEA of centrifugal pump shaft. *International Journal for Scientific Research & Development*. 2016. Vol. 4. N 5, p. 18-19.

10. Arun M. Cavitation Modelling and Characteristic Study of a Centrifugal Pump Impeller. *International Journal of Innovative Research in Advanced Engineering*. 2014. Vol. 1. N 10, p. 268-273.

11. Kesler R. Considerations is selecting a positive displacement slurry pump. *Mining World*. 2016. Vol. 13 (4), p. 34-37.

12. Kranzler T., Arola R. Improwing pump materials for harsh environments. *Sulzer Technical Review*. 2013. Vol. 2, p. 10-12.

13. Ovchinnikov N.P., Portnyagina V.V., Sobakina M.P. Dependence of the mean time failure a hydraulic balancing machine unit on different factors for sectional pumps of the Alrosa JSC. *AIP Conference Proceedings*. 2017. Vol. 1915, UNSP. 040043. DOI: 10.1063/1.5017391

14. Patsera S., Protsiv V., Kosmin V. Feasible ways to improve the durability of the pumps' parts operating with hydroabrasive mixtures. *Mechanics, Materials Science & Engineering*. 2015. Vol. 1, p. 133-137.

15. Pramod J., Bachche R., Tayade M. Finite element analysis of shaft of centrifugal pump. *IOSR Journal of Mechanical and Civil Engineering*. 2013. Vol. 7. N 3, p. 37-42.

16. Vikulov M.A., Ovchinnikov N.P., Makhno D.E. Measurements of section pump of rotor axial position at Udachny mine. *Advances in Engineering Research*. 2017. Vol. 133, p. 884-891. DOI:10.2991/aime-17.2017.143

***Author*** **Nikolai P. Ovchinnikov,** *Candidate of Engineering Sciences*, *Associate Professor*, *ovchinnlar1986@mail.ru* (*North-Eastern Federal University named after M.K.Ammosov*, *Yakutsk*, *Russia*).

*The article was received on 6 January, 2018.*
*The paper was accepted for publication on 18 February, 2018.*