E.S. Gogina, I.A. Gul'shin

THE POSSIBILITY OF APPLYING THE SINGLE-SLUDGE DENITRI-NITRIFICATION SYSTEM IN RECONSTRUCTION OF WASTEWATER TREATMENT PLANTS IN THE RUSSIAN FEDERATION

In Russia the standards for wastewater discharge have increased in the nineties of the twentieth century, and the main question was the removal of nutrients. In recent years there have been many studies in order to develop new methods of wastewater treatment, and to adopt Western technologies in Russian treatment plants. But the main problem now is that most of the plants in Russia were built more than thirty years ago. And now they need reconstruction. It requires great financial investments, but the possibilities are limited. Therefore it is necessary to reconstruct with minimal expenses, maximum usage of existing tanks and equipment, and the quality of wastewater treatment satisfying the standards.

In Moscow State University of Civil Engineering (MGSU) extensive researches are carried out in the field of biological wastewater treatment, including the removal of nutrients. The results of the researches were used for constructions and reconstructions of treatment plants in Russia.

Technological Scheme «Deep biological wastewater treatment system with ammonium-nitrogen removal», which was developed and patented in MGSU, treats wastewater biologically in the aeration tank, which is divided into a sequence of alternating anoxic and aerobic zones. The reconstruction of biological treatment plants under this Scheme is possible at minimal cost, and the quality of treatment satisfies the modern standards.

Nowadays, in the Russian Federation there are about sixty two percent of plants with aeration tanks, thirty three percent of biofiltration plants, and five percent of the plants with only mechanical treatment. The main task of the present research was to investigate the possibility of applying single-sludge denitri-nitrification system in the reconstruction of wastewater treatment plants in the Russian Federation. Only plants with aeration tanks were studied, because only they can be reconstructed with the use of the Scheme.

The research includes fifty three treatment plants of different Russian cities. According to the questionnaires the data for each treatment plant has been received. The date concerns influents and effluents, the features of a construction and operation of the structures at a station and the data about the cost of aeration in the aeration tanks and so on. The location of the studied treatment plants can be found on the map present in the article.

From the initial data the basic parameters of the aeration tanks were calculated, including the amount of air required for denitrification and nitrification. The calculation of the required air amount has been carried out using the method developed in MGSU. This method includes both normative calculations and practical experience of operating procedure of the aeration tanks (working with the single-sludge denitri-nitrification scheme). The results of the calculations were compiled for further analysis.

According to the analysis, sixty five percent of the studied wastewater treatment plants may be reconstructed according to the single-sludge denitri-nitrification scheme. It will lead to a serious improvement of wastewater treatment quality.

It is important to note, that the calculations were made on the basis of air amount produced by the existing station`s blowers. Therefore reconstructions don`t require replacement of blowers and can be done stage-by-stage.

Key words: wastewater, ecology, treatment plants reconstruction, deep biological wastewater treatment, nitrification, denitrification, single-sludge scheme.

References

1. Ponamoreva L.S. Rekomendatsii po primeneniyu «Metodiki razrabotki normativov dopustimykh sbrosov veshchestv i mikroorganizmov v vodnye ob"ekty dlya vodopol'zovateley» [Recommendations for Applying the Methods of Development of the Standards of Admissible Substances and Microorganisms Discharge into Water Objects for Water Users]. *Vodosnabzhenie i sanitarnaya tekhnika* [Water Supply and Sanitary Technique]. 2009, no. 2, pp. 4—15.

2. Salomeev V.P., Gogina E.S., Makisha N.A. Reshenie voprosov udaleniya biogennykh elementov iz bytovykh stochnykh vod [The Solution of the Problem of Nutrient Removal from Wastewater]. *Vodosnabzhenie i kanalizatsiya* [Water Supply and Sewerage]. 2011, vol. 2, no. 3, pp. 44—53.

3. Gogina E.S., Kulakov A.A. Razrabotka tekhnologii modernizatsii iskusstvennoy biologicheskoy ochistki stochnykh vod [Development of the Technology for the Modernization of Artificial Biological Wastewater Treatment]. *Vestnik MGSU* [Proceedings of Moscow State University of Civil Engineering]. 2012, no. 11, pp. 204—209.

4. Gao Shun Qiu, Ling Feng Qiu, Jian Zhang, Yi Ming Chen. Research on Intensive Nutrients Removal of the Low C/N Sewage. Advanced Materials Research. 2012, no. 550— 553, pp. 2142—2145.

5. Lawrence K. Wang, Nazih K. Shammas. Single-Sludge Biological Systems for Nutrients Removal. Handbook of Environmental Engineering. 2009, no. 9, pp. 209—270.

6. Cherlys Infantea, Ivan Leonb, July Florezb, Ana Zarateb, Freddy Barriosa, Cindy Zapataa. Removal of ammonium and phosphate ions from wastewater samples by immobilized Chlorella sp. International Journal of Environmental Studies. 2013, vol. 7, no. 1, pp. 1—7.

7. Kozlov M.N., Khar'kina O.V., Pakhomov A.N., Strel'tsov S.A., Khamidov M.G., Ershov B.A., Belov N.A. Opyt ekspluatatsii sooruzheniy biologicheskoy ochistki stochnykh vod ot so-edineniy azota i fosfora [Operating Experience of Biological Treatment of Wastewater from the Nutrients]. *Vodosnabzhenie i sanitarnaya tekhnika* [Water Supply and Sanitary Technique]. 2010, no. 10, ch. 1, pp. 35—41.

8. Salomeev V.P., Gogina E.S. Primenenie odnoilovoy sistemy denitrifikatsii dlya rekonstruktsii biologicheskikh ochistnykh sooruzheniy [The Usage of the Single-sludge Denitrification System for Reconstruction of Biological Wastewater Treatment Plants]. *Vestnik MGSU* [Proceedings of Moscow State University of Civil Engineering]. 2009, no. 3, pp. 129—135.

About the authors: **Gogina Elena Sergeevna** — Candidate of Technical Sciences, Professor, Department of Waste Water Treatment and Water Ecology, Vice Rector for Teaching and Studies, **Moscow State University of Civil Engineering (MGSU)**, 26 Yaroslavskoe shosse, Moscow, 129337, Russian Federation; GoginaES@mgsu.ru;

Gulshin Igor Alekseevich — student, Senior Assistant, **Moscow State University of Civil Engineering (MGSU)**, 26 Yaroslavskoye shosse, Moscow, 129337, Russian Federation; gulshin-dii@yandex.ru.

For citation: Gogina E.S., Gul'shin I.A. Issledovanie printsipial'noy vozmozhnosti primeneniya odnoilovoy skhemy denitri-nitrifikatsii pri rekonstruktsii ochistnykh sooruzheniy Rossiyskoy Federatsii [The Possibility of Applying the Single-sludge Denitri-nitrification System in Reconstruction of Wastewater Treatment Plants in the Russian Federation]. *Vestnik MGSU* [Proceedings of Moscow State University of Civil Engineering]. 2013, no. 10, pp. 166—174.