Middle-East Journal of Scientific Research 21 (8): 1276-1279, 2014
ISSN 1990-9233

DOI: 10.5829/idosi.mejsr.2014.21.08.21674

The Problem Solving of Highly Concentrated Sewage Treatment by Technological Complex of Sewage Treatment Developed by Ojsc "NIPIEP", Orenburg

[1]Evgeniy Vladimirovitch Levin, [1]Ramil Fargatovitch Sagitov,
[2]Svetlana Petrovna Vasilevskaya and [3]Ildar Dinarovitch Aliyamov

[1]Scientific Research and Design Institute of Environmental Problems,
Karavannaya st. 6a, 460000, Orenburg, Russia
[2]Orenburg State University, Pobedy pr. 13, 460018, Orenburg, Russia
[3]Orengurg State Agrarian University, Chelyuskincev, st. 18, 460014, Orengurg, Russia

Abstract: Currently in Russia there is the poor state of water supply, wastewater and sewage treatment. The Russian Federation is not being cleaned 7 % of the wastewater. Of wastewater undergoing purification to regulations is brought at least half (46 %). The situation in the Orenburg region in this area is quite complex. The main contaminant of water bodies in the area is housing and utilities. More than half the area of water treatment facilities do not provide a clean design mode, there is no post-treatment of wastewater. In the area of water bodies dumped annually about 120 million m3 of inadequately treated sewage, of which about 103 million m3 (85%) are in the Ural River. Currently used in the vast majority of treatment facilities Orenburg outdated technology of cleaning and disinfection of wastewater does not allow the execution of modern sanitary standards. To this end, JSC "NIPIEP" was developed complex wastewater (indirect) hardware type modular design that combines a balance of economic, technological and aesthetic parameters. The main purpose of the development and use of indirect - cleaning highly wastewater BOD and 5000 mg/l and higher water quality standards to fish for household purposes at relatively low capital and operating costs. Causeway is located on a prepared site and represents a building block of full factory readiness or ready – to - assemble components and assemblies. As a result, developed processes and designs, provide cost price indices of treatment facilities (with the use of new materials with a high degree of automation), comparable with the usual older versions. While direct operating costs was reduced to 0.4 - 0.6 kW/h ●3 drains. The result achieved against the backdrop of escalating tariffs for sanitation services in Russia for the first time allowed a new approach to wastewater treatment - technological and economic. The developed technology is attractive for private investment. Investments in the construction of sewage treatment plants, depending on the volume of wastewater and tariffs can pay from 3 to 7 years, remaining at the end of the payback period a stable source of income.

Key words: Drainage · Water s upply · Sewage treatment · Housing and utilities · Sump bionositel · Anaerobic section · Bioreactor · Aerators · Biological treatment · Post-treatment of sorption · Ultrafialet decontamination

INTRODUCTION

The poor state of water supply, wastewater and sewage treatment is observed in Russia, that is caused by insufficient industry funding.

So in the Russian Federation 7 % of wastewater are not cleaned. Less than half of wastewater undergoing purification is brought to regulations at (46 %).

In this regard, a perspective direction in the reform of water supply, wastewater and sewage treatment is to launch new economic, organizational and legal mechanisms to develop competitive business, to attract private investments and advanced technologies in water supply and the expansion of public-private partnership [1]. The constraint of fundamental changes in the brunch may be explained by the deficit of its own equipment and

Corresponding Author: Evgeniy Vladimirovitch Levin, Scientific Research and Design Institute of Environmental Problems, Karavannaya st. 6a, 460000, Orenburg, Russia.

reagents production, which are necessary for the modern technologies provision of water preparation and water treatment.

The Orenburg region is not an exception, here the state of water supply, wastewater and sewage treatment are influenced by the powerful industrial complex.

Many industrial giants of the Orenburg region were built in the middle of the last century, many of them use the outdated technological processes and are concerned as sources of negative impacts on water resources. The situation is aggravated by the absence of sewer systems in some towns and large regional centers and treatment facilities and sewers are morally and technically outdated, the wear of the material- technical base is also observed [2].

The main contaminant of water bodies in the region is housing and communal services. More than half of treatment facilities do not provide a planning procedure of treatment, there is no pre-treatment of wastewater. About 120 million m3 of inadequately treated sewage are annually discharged in the region water bodies, about 103 million m3 (85 %) of which are discharged in the Ural River. [3]

There are no facilities for sewage treatment in the regional centers: Dombarovka, Quarkeno, Svetliy, Tashla, Sharlyk. It is necessary to carry out the reconstruction of treatment facilities in order to bring up to modern standards for the extents of the purity and sewage disinfection methods with full channeling of the settlements, including such towns as Buguruslan, Sorochinsk, Abdulino, Gay, Kuvandyk, Mednogorsk, Novotroitck, Orsk, Sol-Iletck, Yasniy and also regional centers – Akbulak, Tyulgan [4].

The outdated technology of sewage treatment and disinfection which is currently used in the vast majority of treatment facilities of the Orenburg region does not allow providing the execution of the modern sanitary standards.

The problem solving is complex and is possible only under the concentration of financial, technical and scientific resources.

According to this aim, OJSC "NIPIEP" developed a complex of sewage treatment (CST) of apparatus type with block-modular design that combines a balance of economic, technological and aesthetic parameters [5].

The main purpose of CST development and usage is a highly concentrated sewage treatment from Biochemical Oxygen Demand (BOD) to 5000 mg/l and higher, according to water quality standards of fishery purposes at relatively low capital and operating costs. CST is located on a prepared site and represents a block building of full factory readiness or ready-to-assemble components and assemblies [6].

The technological and engineering developments of "NIPIEP" company became the basis for the technology and apparatus design of treatment facilities, domestic and industrial sewerage. Most of the developments are supported by the industrial patents.

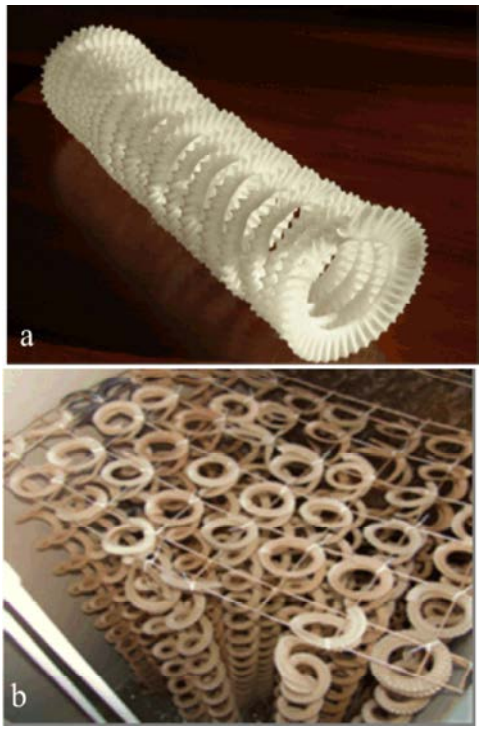
The integrated approach is realized here, where all processes (design, technology, manufacturing, installation and commissioning) are concentrated in one organization. That is why the responsibility for the final result falls entirely on the company - developer staff (OJSC "NIPIEP") [6, p.42].

The proposed equipment is fundamentally changing not only the technological process, using modern high-effective technical solutions, but also the concept of technical equipment and process control.

The proposed solutions are based on the experience of treatment facilities operation, the practice of modern technological approaches of sewage treatment, as well as the market analysis of modern equipment from leading manufacturers.[7]

The New Approach Involves:

- A complete rejection of traditional outdated technology;
- The use of the latest technological solutions with the level of 1-5 years patentable novelty inventive for each technological step ;
- A fundamentally new level of treatment facilities (TF) quality because of refusing to use the technological constructions, manufactured in a building way and to use the technological constructions of mechanical engineering way and the production level;
- The process optimization according to the economic parameters - the TF cost at operating of modern equipment does not exceed the TF cost of traditional type, the operating costs are reduced by more than a half;
- High adaptability of the equipment to sewage of different composition and to different requirements for treatment quality;
- High performance adaptability - the ability to increase and reduce productivity (up to the complete dismantling and moving to another place of operation).



a) BSP - 1 biocarrier, b) cassette with BSP - 1 biocarrier

Fig. 1: - BSP -1 biocarrier and cassette with BSP -1biocarrier

The complex of sewage treatment works in the following way. [8] The sewage enters the pressure absorber, where there are decrease and alignment of the flow rate and the initial deposition of large particulate matter and then water flows to the primary settling tank and thin-layer settling tank for water deep clarification. The clarified effluent flows by gravity from the primary settling tank into the intermediate container and then are served in the polarized filters, developed by specialists of "NIPIEP" company for pre-treatment [9]. Here, the concentration of organic contaminants is reduced to values that are acceptable for biological treatment technology (BOD is about 400 mg).

After pre-treatment the effluents enter the anaerobic section of the bioreactor, in which there is the destruction of hard-oxidized organics on the biocarrier by immobilized and free-floating microorganisms and then the effluents flow to the aerobic part of the bioreactor.

Each container of the bioreactor is divided by partitions into two sections. In each section there are cassettes with BSP-1 biocarrier (industrial patent ¹ 2369564) to secure the activated sludge particles (Figure 1) [5, p.24].

Fig. 2: The aerator of sintered titanium powders [3, p.120]

In order to intensify the treatment in the aerobic zone of the bioreactor compressed air is supplied through the system of the air distribution pipes and aerators that are made from sintered powders of titanium (Figure 2).

The Main Advantages of Titanium Aerators:

- Lower resistivity;
- Air consumption is less than 30-50%;
- Lower energy consumption for aeration;
- Less susceptible to bacterial growth than ceramic and polymer, it greatly increases the service life before regeneration.

In the aerational part of CST there is a complete mineralization of the activated sludge in the last phase of the biological treatment [10].

To remove the excess sludge after bioreactor the secondary clarifier with thin-layer modules is installed. The process of a thin-layer settling tank is known for a time, but the high price parameters for the design of thin-layer blocks hinder their mass application. Mechanical engineering level of OJSC "NIPIEP" production allows using such products serially during sewage treatment [11].

The technical result - increasing the efficiency of sewage treatment from suspended solids. BOD reduction efficiency at thin-layer clarifying reaches 60 %.

For more complete removal of phosphorus compounds and sludge deposition the secondary settling tank is provided with the supply of the coagulant solution. In working concentrations the coagulant has no harmful effects on the environment.

The filters block of mechanical and sorptional pre-treatment is used for thin pre-treatment. The filter operation is automatic [12].

The disinfection of treated water takes place on the units of the ultraviolet disinfection. They allow to destroy bacteria, viruses and other microorganisms due to exposure of UV - radiation with 254 n●m wavelength.

Germicidal ultraviolet selectively acts only on the microorganisms without affecting the chemical composition of the medium that occurs at chemical disinfectants using. The water disinfection is produced before releasing into the pond. UV-light inactivates microorganisms resistant to chlorination. In contrast to the chlorination and the ozonation there are no harmful organic compounds in water after UV exposure even in the case of numerous exceeding of the required doses. UV radiation does not affect the organoleptic properties of water (odor, taste). The disinfection time at UV-irradiation is 1.10 seconds in the continuous mode, so there is no need to establish the contact tanks.

The lower operating costs are typical for UV-radiation disinfection than at chlorinating and especially at ozonizing. This is due to the relatively low cost of electricity (10-30 W per 1 m3 water to be treated).

Advantages of Water UV-Disinfection:

- High efficiency of sewage disinfection;
- Absence of side effects typical for chlorinating;
- Does not require the usage of reagents and disinfectants;
- Low operating costs;
- Compactness, safety.

Treated to maximum permissible concentration (MPC) standards and disinfected water is drained into the bleed manifold and then is piped to bioponds.

The solid from settling tanks is fed to the block of solid dewatering. The resulting waste refers to V hazard class, which allows removing it on the landfill for the municipal solid waste (MSW).

As a result of 20-years quest the technological processes and structures were developed to ensure the cost price indices of treatment facilities (with the usage of new materials, with a high value of automation), comparable with the usual old versions. Also the direct operating costs were reduced to 0.4 - 0.6 kW ● ч/м^3 of drains.

For the first time in Russia the achieved result allowed to realize a new approach to wastewater treatment (technological and economic) against the backdrop of increasing tariffs for sanitation services.

The developed technology is attractive for private investments. The investments in the construction of treatment facilities can be paid from 3 to 7 years, depending on the volume of wastewater and tariffs and remain a stable source of income at the end of the payback period.

REFERENCES

1. Law of the Russian Federation “About the federal target program "Clean Water"” of 22 December, 2010 Volume 1092.
2. Law of the Russian Federation “About the State and Environmental Protection of the Orenburg region in 2012” of 2012.
3. Rao, D.G., R. Senthilkumar, J.A. Byrne and S. Feroz, 2013. Wastewater Treatment: Advanced Processes and Technologies. IWA Publishing, CRC Press Taylor and Francis Group, pp: 153.
4. Singh, V.P. and R.N. Yadava, 2003. Wastewater Treatment and Waste Management. Allied Publishers Private, pp: 241.
5. Waste-water Filtration Complex (NIPIEP). Date Views 10 December 2013 nipiep.ru/oborudovanie/clean/.
6. Levin, E.V., R.F. Sagitov, S.V. Antimonov, S.V Shabanovà and I.D. Alyamov, 2014. New innovative approach to solving the problem of purifying highly concentrated sewage by technological complex wastewater (indirect) development of "NIPIEP" Orenburg. 4(76): 40-45.
7. Tillman, G.M., 1996. Wastewater Treatment: Troubleshooting and Problem Solving. CRC Press, Aug, 1, pp: 216.
8. Drinan, J., J.E. Drinan and F. Spellman, 2000. Water and Wastewater Treatment: A Guide for the Nonengineering Professional. CRC Press, pp: 336.
9. Hlavinek, P., I. Winkler, J. Marsalek and I. Mahrikova, 2011. Advanced Water Supply and Wastewater Treatment: A Road to Safer Society and Environment. Springer, pp: 353.
10. Matsuo, T., K. Hanaki, S. Takizawa and H. Satoh, 2001. Advances in Water and Wastewater Treatment Technology: Molecular Technology, Nutrient Removal, Sludge Reduction and Environmental Health. Elsevier, pp: 336.
11. DeTombe, D.J., 1999. Complex Problem Solving: Methodological Support for Societal Policy Making. Rainer Hampp Verlag, pp: 163.
12. Lewandowski, G.A. and L.J. De Filippi, 1998. Biological treatment of hazardous wastes. Wiley, pp: 401.