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MAJOR CONTAMINANTS IN INDUSTRIAL AND DOMESTIC WASTEWATER

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Abstract. This paper provides an overview on the type and concentration of the major contaminants in industrial and domestic wastewater. The present study was conducted to analyze and collect data on hazardous substances in wastewater from petrochemical plants, pulp and paper mills, electroplating industries, power plants, and municipal sources (households and small industries).

1. Introduction

In today's dynamic world, more and more attention is paid to the development of energy saving technologies [1]. The introduction of such technologies to manufacturing industry, as well as consumer responsible attitude to the problem of energy saving, allows reducing annual energy consumption in Europe and the United States. However, resource consumption per capita continues to increase due to the growth of Earth's human population (mainly in developing countries) and the rise of consumer aspirations in developed countries.

Nowadays, an increase in production capacity occurs in order to meet growing consumer demands. Such increase will inevitably entail significant anthropogenic impact on the environment. One of the negative impacts of human activity on our planet is wastewater discharges from manufacturing industries and municipal sources. It is worth noting that the composition of discharged wastewater varies considerably depending on the branch of industry, technology features in an industrial enterprise, population density, climate and even cultural and social traditions in a region.

All of the mentioned factors cause a need to develop new technologies and improve existing ones for industrial and domestic wastewater treatment. To achieve the best results in this process it is advisable to carry out theoretical and experimental research. In particular, it is necessary to conduct a detailed analysis on the composition and concentration of pollutants removed from water.

The aim of this paper is to analyze data on the type and concentration of contaminants in industrial and domestic wastewater.

2. Results and discussion

We conducted a detailed analysis of statistical data on the volume of wastewater discharged from different industrial plants and municipal sources in the territory of the Russian Federation. Recent reports have demonstrated that power plants are the major source of water pollution in Russia, where wastewater discharges from power plants constitute about 50% of all discharges [2]. Furthermore,

wastewater from power plants contains various waste contaminants, such as organic compounds and surfactants in domestic wastewater, or petroleum products with an average concentration 20÷30 mg/l.

The table below shows the major types of contaminants in wastewater from thermal power plants [3].

Table. The major types of contaminants in wastewater from thermal power plants.

Waste types	Contaminants and their concentrations
Water, polluted by petroleum products	Petroleum, fuel oil, and etc. with a concentration from 5 to 100 mg/l
Water from chemical plants	Calcium carbonates, magnesium carbonates, iron hydroxide, aluminum hydroxide, sand, organic compounds, salts of hydrochloric acid and sulfuric acid
Water after washing external heating surfaces	Ash, soot; sulfuric acid with a concentration from 0.5 to 1 %; vanadium salt with a concentration from 0.2 to 0.4 g/l; nickel – 0.05–0.08 g/l, iron – 5–7 g/l, copper – 0.01 g/l
Water after washing equipment and its preservation	Hydrazine, hydrochloric acid, citric acid, ammonia, fluorides, nitrites, methenamine, 2-mercaptobenzothiazole, and etc.
Water from hydraulic ash removal at coal-fired thermal power plants	Calcium sulfate, magnesium sulfate, sodium sulfate with a concentration to 2000 mg/l; calcium oxide, arsenic, vanadium, and etc.

The manufacturing industry is the second largest industry in the number of polluted water discharges [2]. Since this sector includes a wide variety of production, pollutants from each type of production are characterized by its specificity. However, chemical and petrochemical industries [4], pulp and paper mills [5], electroplating industries [6] may be indicated from all the variety of industrial plants in terms of water pollution.

For example, wastewater from petrochemical industries may contain about 20 types of harmful substances. It is possible to highlight the phenol, acetone, benzene, petroleum products, and nitrogen compounds among such substances [4]. The main waste contaminants in electroplating industries are the ions of heavy metals: Zn, Ca, Mg, Na, K [6]. Wastewater from pulp and paper mills contains different resin acids (such as abietic acid), and phenolic compounds [5].

Particularly, it should be highlighted wastewater discharges from oil and gas industries [7]. It is known that in petroleum industry water is injected into reservoirs to maintain the necessary pressure. What is more, water, polluted by petroleum products, is discharged from plants during the production of watered oil with its further settling. Besides that, the share of discharges from extractive industries constitutes about 10% of total wastewater discharges. The main pollutants of such wastewater are, naturally, petroleum products.

Nevertheless, the most diverse composition of pollutants is typical for domestic wastewater. Such wastewater contains all the above contaminants, such as petroleum products, or even heavy metals and corrosive inorganic acids in low concentrations. The predominant contaminants in domestic wastewater are organic substances and sulfide compounds [8].

It should be noted that some of wastewater treatment technologies are associated with heating and evaporation of liquid (chemical oxidation, distillation, and etc.). Many theoretical and experimental studies [9–14] demonstrate that the change in the concentration of contaminants (both chemical and mechanical) in water may affect significantly the characteristics and intensity of heat and mass transfer, and consequently, the efficiency of wastewater treatment.

3. Conclusion

This study has examined the type and concentration of contaminants in industrial and domestic wastewater. Results proved that it is necessary to develop and improve the methods of wastewater treatment.

The data presented in the review on the type and concentration of contaminants in wastewater can be used as reference data for the development of methods for theoretical and experimental studies, aimed at the development of new wastewater treatment technologies or their improvement.

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