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Wastewater Quality Monitoring in a Biological Treatment Plant

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Abstract

The main objective of this study was monitoring of wastewater in a biological treatment plant from a petroleum refinery, during April 2009. The selected quality indicators were: pH, sulphides, suspended solids, phenol, chemical oxigen demand, biological oxigen demand, ammonium ion, nitrites, nitrates and phosphates. Water samples were collected from entering the physical-chemical stage and from entering and exit the biological stage. The evolution of the studied indicators is graphically presented.

Key words: *monitoring, wastewater, quality indicators, water treatment*

Introduction

Untreated wastewater contains high levels of organic material, pathogenic microorganisms, different nutrients and toxic compounds. [1-3]

Wastewater characterization represents an indispensable step yielding all the necessary information for a reliable modeling and design of treatment processes. Wastewater treatment plants located in industrial areas have to face a complex mixture of various organic and inorganic compounds. Comprehensive analytical strategies are required to study the wastewater quality and to identify a wide variety of compounds present in industrial wastes. Wastewater treatment technologies differ from each other in terms of their principles, scope of application and economy. Wastewater treatments begins with minimization of wastes as a primary measures and then it is followed by physical, chemical, electrical, thermal and biological treatments. [4,5]

Wastewater quality may be defined by its physical, chemical and biological characteristics. Chemical parameters associated with the organic content of wastewater include biochemical oxygen demand (CBO_5 or BOD), chemical oxygen demand (CCO-Cr or COD), total organic carbon (TOC) and total oxygen demand (TOD). Inorganic chemical parameters include: salinity, hardness, pH, acidity and alkalinity, as well as concentrations of metals such as iron and manganese and anions, such as chlorides, sulfates, sulfides, nitrates, nitrites and phosphates. Bacteriological parameters include specific pathogens and viruses. [5,6]

More rigorous treatment methods of wastewaters include the removal of specific contaminants as well as the removal and control of nutrients. Natural systems are also used for the treatment of wastewaters in land-based applications. Sludge resulting from wastewater treatment operations is treated by various methods, in order to reduce its water and organic content and to make it suitable for final disposal and reuse.[6-11]

The main objective of this work was monitoring of wastewater from a biological treatment plant of a petroleum refinery, during April 2009. Water samples were collected from various stages of the wastewater treatment plant: entering the physical-chemical stage, as well as entering and exit the biological stage.

Experimental part

The determination of quality indicators of wastewaters was achieved by using standardized analysis methods. Samples were collected in Pyrex borosilicate glass containers; quality physical-chemical indicators for studied wastewaters are presented. The supervised indicators were: pH, sulphides, CCO-Cr and $CBO_{5,}$ suspended solids, compounds extractable in petroleum ether and phenol.
The pH indicator was supervised at all important points of the wastewater plant and its correction was made to assure the necessary conditions of the biological treatment stage, to increase the efficiency of coagulation. The results obtained by monitoring this indicator during April 2009 showed a constant evolution and the values of pH were between 7-8 (fig. 1), respecting the admitted limits of the directive NTPA 001/2002.

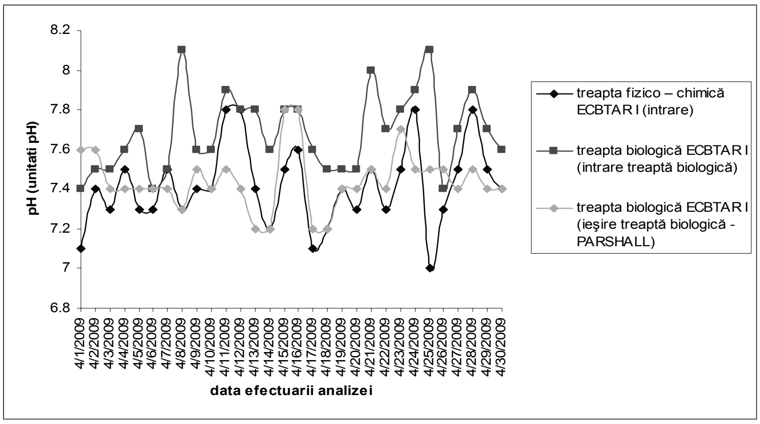

Fig. 1. pH control at various stages of a wastewater treatment plant

Oxygen demand is an important parameter for water quality, because it can assess the concentration of organic contaminants in water resources. This type of organic pollution in aqueous systems is generally assessed by using three main indexes: chemical oxygen demand, biological oxygen demand and total organic carbon. The determination of chemical oxygen demand gives information about the plant efficiency upon the sedimentation capacity of sludge.

Our studies showed that the content of dissolved oxygen was between 5-6 mg/L (for PARSHALL biological stage) and the aquatic fauna is not affected by these waters.

Biological oxygen demand represents the quantity of oxygen (mg/L) necessary for biological oxidation (under the action of microorganism) of the organic compounds from water. The determination of the biological oxygen demand for 5 days (CBO_5), corresponds to the oxygen consumption of a quantity of water from a closed tube at 20 ºC, at dark, for 5 days. Our study showed that the ratio CBO_5/CCO-Cr was greater than 0.3 (fig. 3), then it is considered that a wastewater is biodegradable.

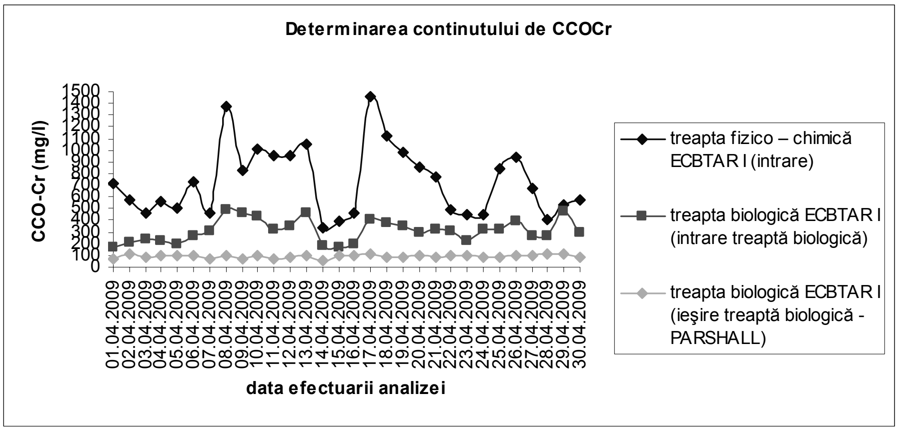

Fig. 2. The determination of CCO-Cr indicator at various stages of a wastewater treatment plant

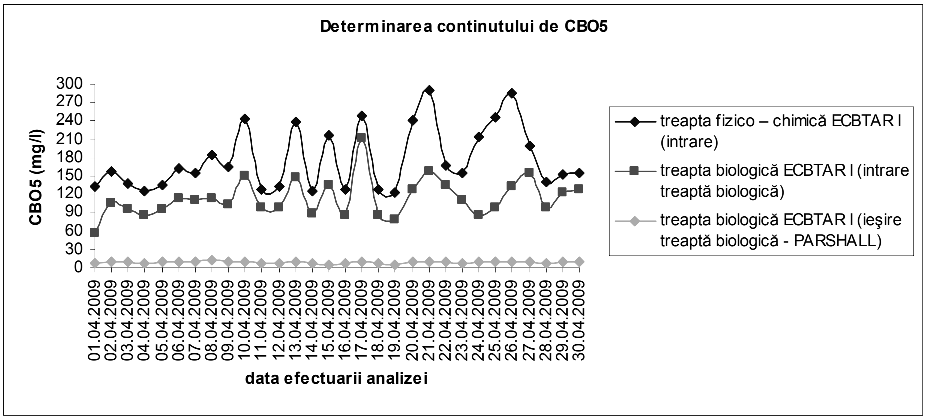

Fig. 3. The determination of CBO_5 indicator at various stages of a wastewater treatment plant

The concentration of phenols in the samples corresponding to the raw influent, from the first settlement-before biological treatment and from the effluent does not affect the aquatic fauna. (fig. 4)

Laboratory studies performed for four weeks demonstrated that wastewater entering the wastewater treatment plant with a concentration of 193 mg/L substances extractable in petroleum ether permit the formation of floculants after the physical-chemical stage. Petroleum ether extractable compounds from the wastewater enter the biological stage (ECBTAR I) with a concentration between 20- 30 mg/L, compared to the admitted limit of 100 mg/L and at the exit of the biological stage (PARSHALL) their concentration is less than 10 mg/L. (fig. 5).

Nitrogen compounds from refinery wastewaters present a nitrogen content less than 100 mg/L; after the biological stage nitrogen content is reduced to 5-10 mg/L, by two processes: nitrification and denitrification.

The monitoring of the three indicators: NH_4^+, NO_2^-, NO_3^- for one month demonstrated that their concentrations respect the directives of wastewaters treatment. (fig. 6, 7)

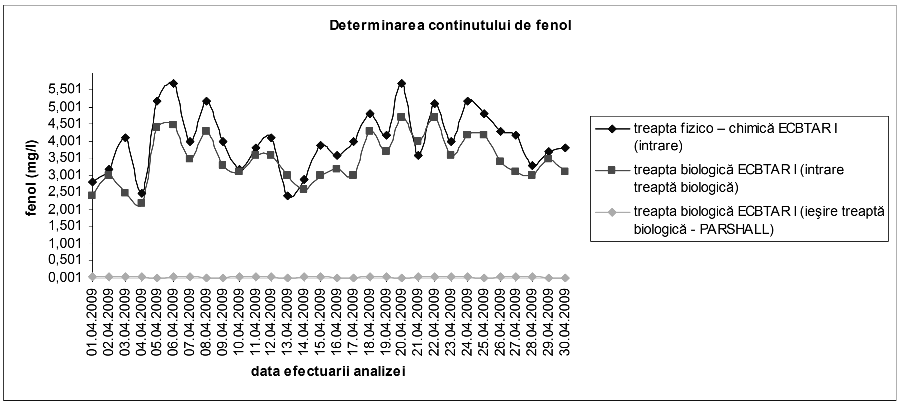

Fig. 4. The determination of phenol concentration(mg/l) at various stages of a wastewater treatment plant

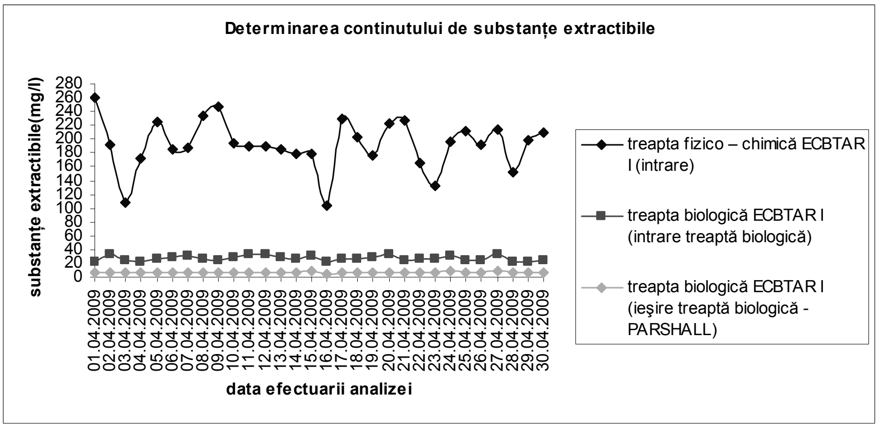

Fig. 5. The determination of concentration of substances extractable in petroleum ether (mg/L) at various stages of a wastewater treatment plant

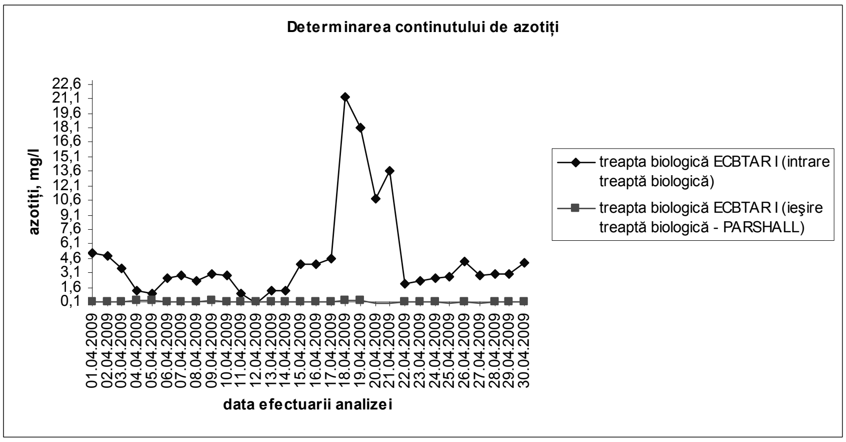

Fig. 6. The determination of NO_2^- concentration (mg/L) at various stages of a wastewater treatment plant

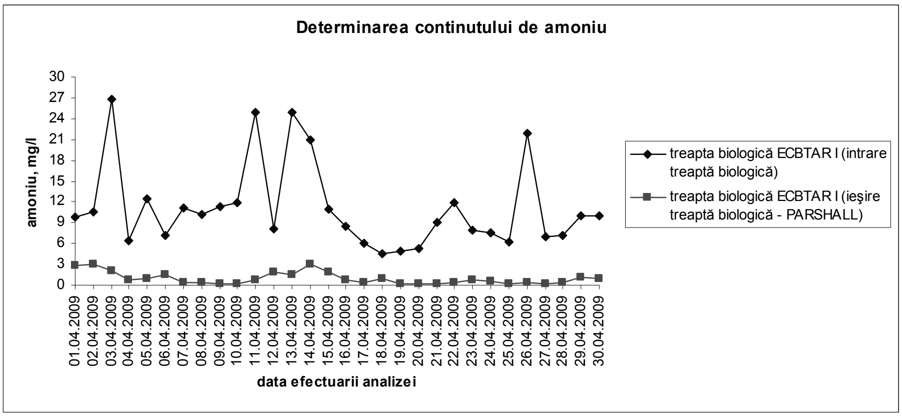

Fig. 7. The determination of NH_4^+ concentration (mg/L) at various stages of a wastewater treatment plant

Conclusions

Wastewater treatment presents a great importance regarding environmental and public health. Research activities in this field have led to significant improvement and diversification in the processes and methods used for wastewater treatment.

The efficiency of a wastewater treatment plant from a petroleum refinery was evaluated by collecting and analyzing samples at various stages of the water treatment process, for one month.

From the results presented in fig. 1-7 it is revealed that the specific wastewater indicators do not overtake the limits provided by the directives NTPA 001/2002 or by wastewater management.

This paper can provide an evaluation guideline of the toxicity of wastewater effluents.

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Monitorizarea calităţii apelor într-o staţie de epurare biologică

Rezumat

Obiectivul principal al acestei lucrari este monitorizarea calitatii apelor reziduale dintr-o statie de epurare biologica, aparţinând unei rafinării de petrol, pe parcursul lunii aprilie 2009. Indicatorii de calitate monitorizati au fost: pH-ul, sulfuri, materii în suspensie, fenol, consumul chimic de oxigen, consumul biochimic de oxigen, ionul amoniu, azotiţi, azotaţi şi fosfaţi. Probele de apă au fost recoltate la intrarea în treapta fizico-chimica, intrarea si ieşirea din treapta biologică. Evoluţia indicatorilor studiati este prezentata grafic.