EDUCATIONAL ASPECTS IN TEACHING WASTE WATER TREATMENT PROCEDURES

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Abstract. *Surface water pollution is mainly due to the direct discharge of domestic or industrial wastewater into outflows. Industrial wastewater and domestic wastewater are discharged into surface water, often without treatment, leading to water and environmental pollution. Organic surfaces in decomposing wastewater reduce the oxygen concentration in the receptor and affect wildlife. In the last decades, water pollution has increased in a time and an alarmingly high degree in those areas where industrialization has developed a lot and with it the population has grown, the problem being not taking measures to protect water quality, and the requirements of water being larger and larger. Under these conditions, measures must be taken to reduce the impact of anthropogenic activity on the quality of the emissary, through efficient treatment and environmentally safe discharge of water. The subject of the paper is, through its applicability, in pedagogical practice, aiming to raise awareness and sensitize high school students about the optimal use of water consumption, the need for wastewater treatment and ecological education to protect and prevent water pollution. The paper aims at both scientific aspects, its purpose being to determine the quality indicators of domestic and industrial wastewater in Arad and mechanical-chemical treatment processes, as well as aspects regarding the implementation of notions within the specialized modules for the specialization environment "Environmental technician and environmental quality protection" and a Student Assessment Test regarding the operation of collecting and conserving water samples, worksheets for laboratory determinations and 3 teaching projects. The research results have a high civic value, and can be disseminated by local authorities by informing residents about the prevention of water pollution and its waste in households and the improvement of pedagogical practice*

Keywords*: water pollution, wastewater treatment, pedagogical practice, water quality indicators*

INTRODUCTION

Water represents a pedestal for all living organisms, which may not exist without water. In surface waters, aquatic flora and fauna carry out their activity, that is why their biotope must be purified. In these conditions, the quality of the water is very important, and where it has been used for domestic, industrial, purposes, etc., the efficiency of wastewater treatment methods must be high so that at the time of its discharge into surface water it does not cause any imbalance to trophic chains and ecosystems (RADULOV et all., 2016).

Surface water pollution is a result of the direct discharge of domestic or industrial wastewater into emissaries. Industrial wastewater and domestic wastewater are discharged into surface water, often without any treatment, leading to water and environment pollution. Organic surfaces from wastewater, which are being in decomposition, reduce the oxygen concentration from the receiver and affect the fauna and flora (MARTONOS et all. 2017, HAMEED et all. 2010).

The quantity of organic substances existing in the water influences the oxidisability. Organic substances are formed after the decomposition of aquatic organisms, but most of the time they arise from wastewater.

Biochemical oxygen present in the water is the consumed amount of oxygen in five days, due to its involvement in biochemical decomposition reactions of organic substances from the water. A polluted water means that it has a large oxygen deficiency.

Water treatment is of several kinds: mechanical treatment, chemical treatment, biological treatment and advanced one. Mechanical treatment or "primary stage of treatment" means the first stage of the wastewater treatment process aimed at removing existing solids in wastewater. Chemical treatment applies to both suspended and dissolved pollutants. Biological treatment is done through constructions and plants of natural biological treatment and artificial biological treatment. Natural biological treatment is recommended when the water discharged into the emissary must be as clean as possible, the efficiency of the purification being of 95-98% (PĂUNA et all., 2018, ȘMULEAC et all 2018).

The importance and knowledge of water resources underline the fact that water is a particularly precious raw material for which there are no alternative solutions.

The purpose of this paper is to determine the indicators in the domestic and industrial wastewater in the city of Arad, in order to treat and discharge the water in environmentally safe conditions, as well as aspects regarding the implementation of the notions within the specialized modules for the specialization "Ecological Technician and Environmental Quality Protection" and a pupils evaluation Test (BĂCALU et all, 2021, PAȘCALĂU et all. 2021).

MATERIAL AND METHODS

For the present paper, the Sewage Treatment Plant in Arad has been chosen to present the results obtained from the monitored indicators'analysis. The following indicators have been chosen for the determination: biochemical oxygen consumption BOD5, chemical oxygen consumption of COD, pH, and total nitrogen. In order to make an interpretation, we chose a summer month (July) and an autumn month (November), months of 2019, due to the existing flow difference. The determinations were performed on water samples, both from the input and output of to the station.

The results of the water analyses were interpreted and compared with the main indicator parameters of the Normative on the conditions of wastewater discharge in the sewerage networks of the localities and directly in the treatment plants, NTPA-002/2002 from 28.02.2002 and updated according to the G. D. no. 352/2005. The purpose of this regulation is to establish the conditions under which the discharge of wastewater into the receivers is accepted, so as to ensure their protection and normal functioning, as well as to protect the environment from the adverse effects of wastewater discharges.

The methodical-didactic examples presented in the work optimally capitalize on the results of the research carried out, by presenting interactive forms and methods of training, describing the learning and evaluation methods.

RESULTS AND DISCUSSIONS

Bod5 Biological Oxygen Demand (BOD) is the primary design parameter for the biological system. If BOD5 influencer's concentrations are stable, a decrease in flow rate will reduce the organic load of the influence and increase the retention time in the tank, which can improve the efficiency of BOD5 removal (if the other operating conditions are favourable). However, activated sludge systems can adapt more efficiently to a higher organic load if the system's hydraulic is stable. In general, user flow adjustments should not be used to measure organic load over the overall balance of the system. Other process adjustments such as low sludge losses should be applied to adapt the increased organic load as long as effluent's quality is acceptable.

The permissible value of NTPA 002/2005, for BOD5 content in wastewater at the entrance into the station is of 300 mg/l. The allowed value according to the water management

authorization no. 2/08.01.2019, according to NTPA 001/2005, for the BOD5 content in the wastewater at the exit of the station is of 25 mg/l.

According to Figures 1 and 2 respectively, a substantial decrease in the BOD5 value from the entry of the wastewater into the station compared to that existing in the water at the exit of the station, which means that this process is effective.

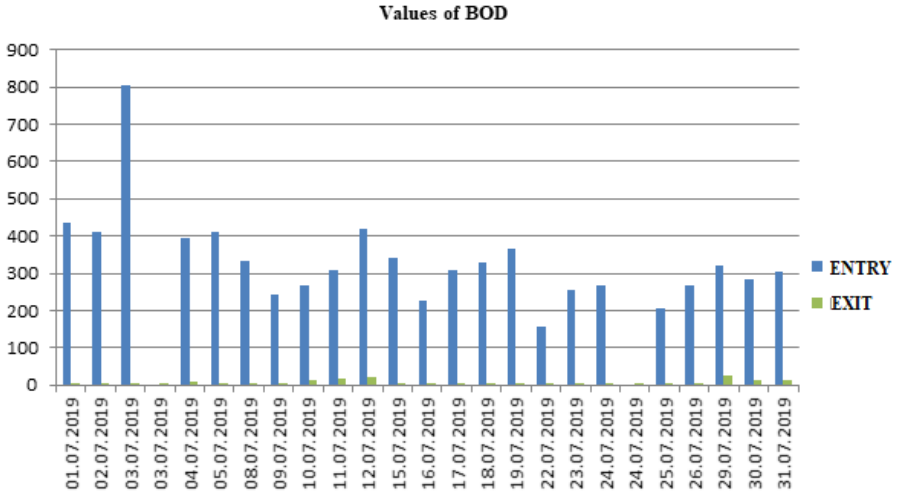

Fig. 1. Comparative BOD5 values from the entry-exit of the station-month of July 2019

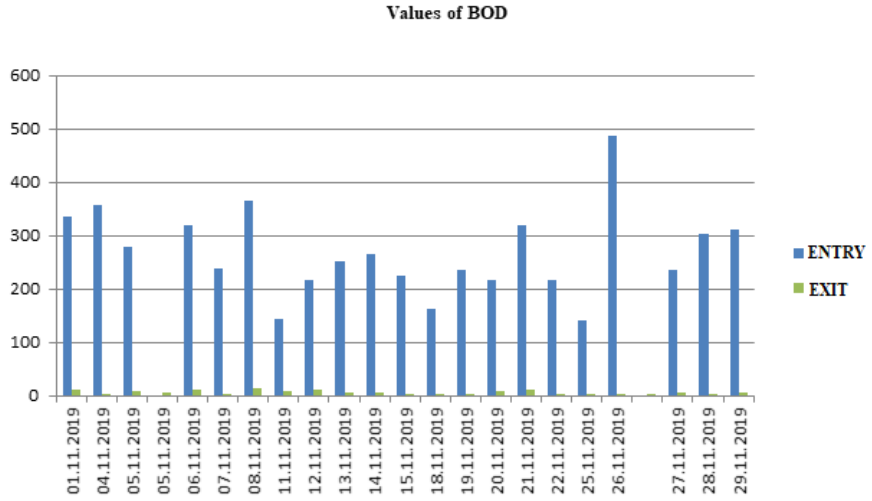

Fig. 2. Comparative BOD5 values from the entry-exit of the station-month November 2019

CCOCr (Chemical Oxygen Demand, COD) is the parameter related to the concentration of BOD, although their relationship is often difficult to predict for a specific operating period. Those conditions that promote the removal of BOD5 will generally optimize the removal of CCOCr. Monitoring data for CCOCr is used to predict the CBO5 discharged. Neither the projected capacity nor the permitted limits for CCOCr should be a limiting factor. The permissible value of NTPA 002/2005, for the content of CCOCr in wastewater at the entrance into the station is of 500 mg/l. The

allowed value according to the water management permit 2/08.01.2019, according to NTPA 001/2005, for the CCOCr content in the wastewater at the exit of the station is of 125 mg/l.

According to graphs 3 and 4, one may notice a substantial decrease in the CCOCr value from the entry of the wastewater into the station compared to the one existing in the water at the exit of the station, which means that this process is effective.

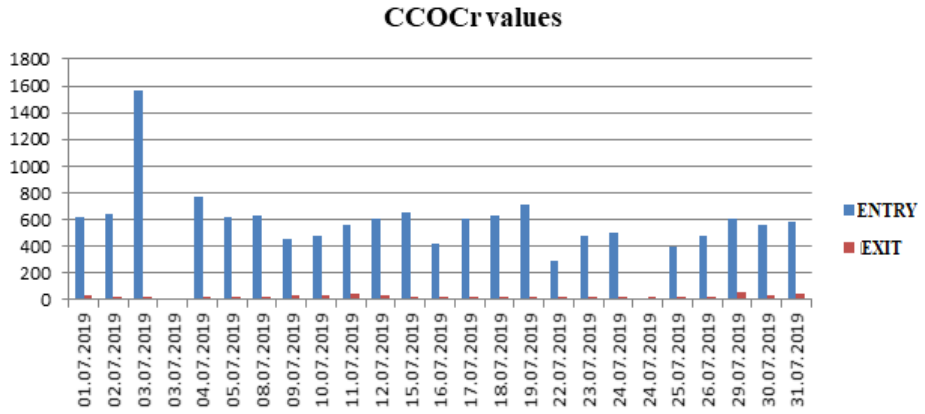

Fig. 3. Comparative CCOCr values from the entry-exit of the station-month July 2019

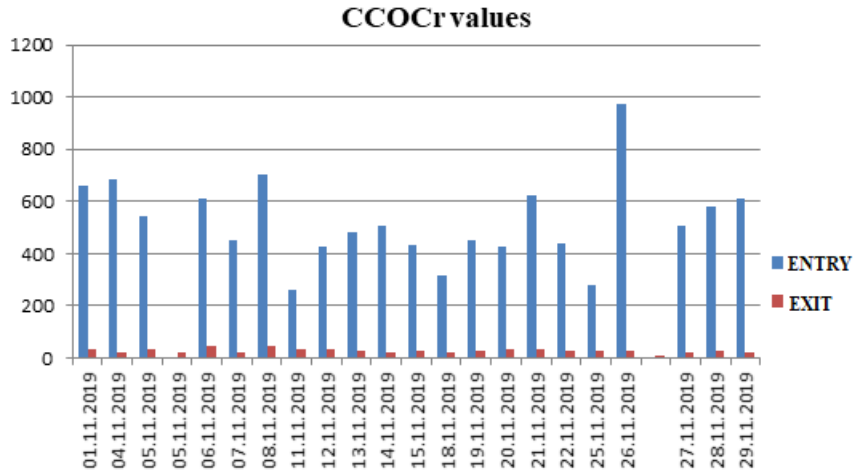

Fig. 4. Comparative CCOCr values from the entry-exit of the station-month November 2019

The pH of the wastewater must be verified so that the pH resulting from the tank is in the optimum *range*. The optimal pH range for the biochemical reaction is 6.5 – 8.5. The permissible value of NTPA 002/2005, for pH in wastewater at the entrance into the station is between 6.5-8.5 pH units. The allowed value according to the water management permit 2/08.01.2019, according to NTPA 001/2005, for Ph in wastewater at the exit of the station is between 6.5-8.5 pH units.

The pH values during the study were within normal limits in both July and November, both at the entrance and at the exit of the station.

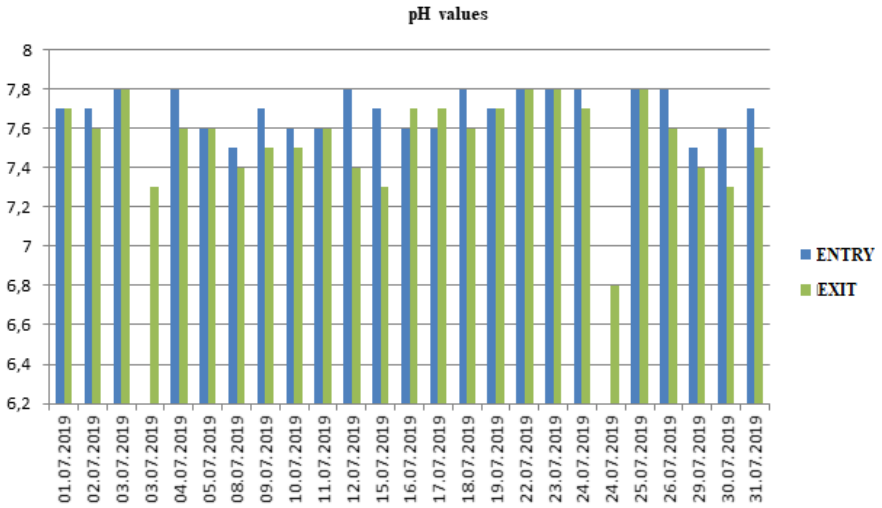

Fig. 5. Comparative pH values from the entry-exit of the station-month July 2019

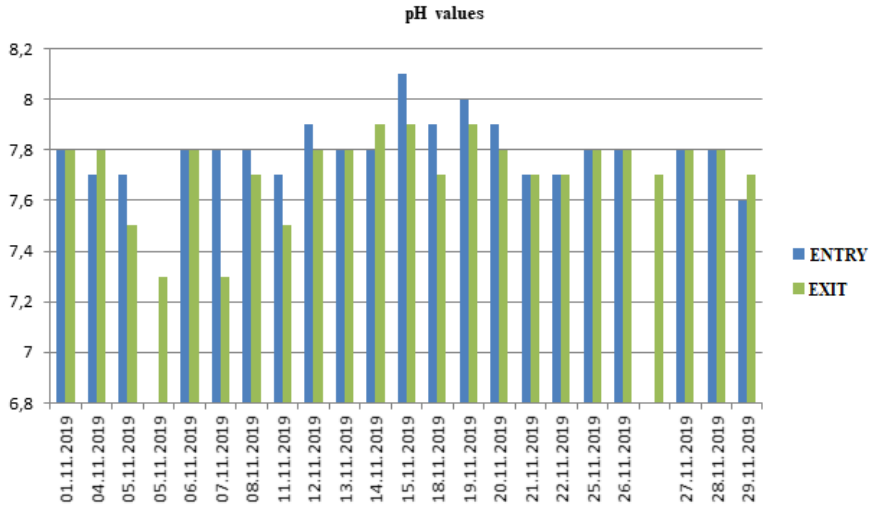

Fig. 6. Comparative pH values from the entry-exit of the station-month November 2019

Nitrogen compounds such as ammonium are used by biomass as a nutrient. The degradation of organic nitrogen can lead to an increase in the concentration of ammonium trough the biological treatment process. The ammonium removal percentages are directly related to the activity levels (BOD5 removal) in the activated sludge system. Ammonium discharge levels will decrease as the BOD5 load increases, assuming the ammonium load remains constant. The reduction of ammonium can be achieved by the nitrification process if the system is designed for it. The permissible value of NTPA 002/2005, for the total nitrogen present in the wastewater at the entrance to the station is of 30 mg/l. The permissible value according to the water

management permit no. 2/08.01.2019, according to NTPA 001/2005, for the total nitrogen present in the wastewater at the exit from the station is of 2(3) mg/l.

Ammonium values present in the wastewater at the entrance into the station, are well above the limit allowed in November compared to July. Regarding the purified water, at the exit of the station only on one day in July and November, respectively, the value of the ammonium exceeds the permissible limit (Figures 7, 8).

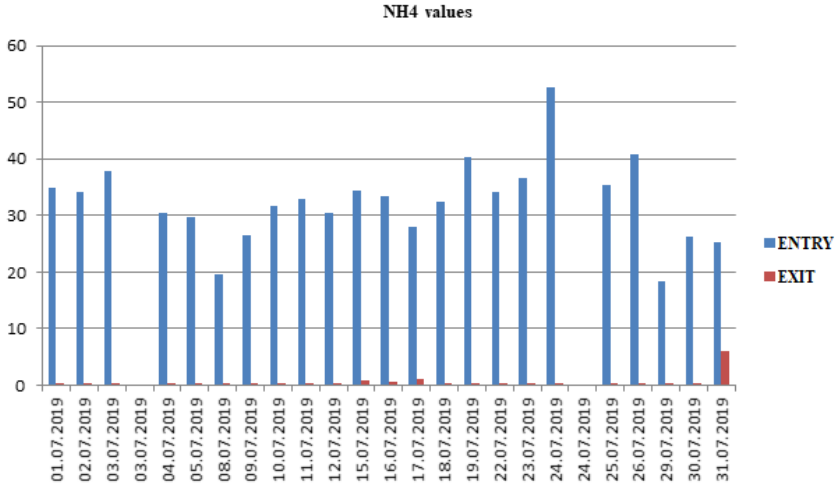

Fig. 7. Comparative NH4 values from the entry-exit of the station-month of July 2019

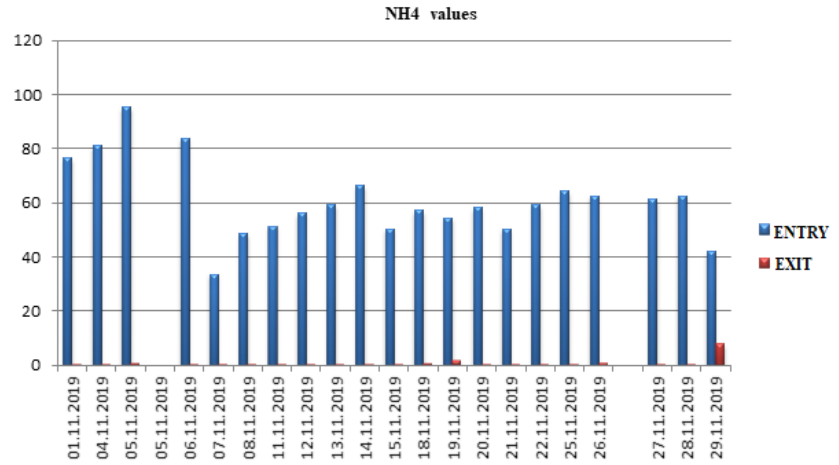

Fig. 8. Comparative NH4 values from the entry-exit of the station-month November 2019

Based on the observations and the obtained results, a Test for the evaluation of the students from the specialization "Environmental Technician and Environmental Quality Protection" entitled "Supervision and control of the quality of wastewater" was elaborated, containing a set of 5 grid questions, 4 true/false statements, 3 associative information distributed on the columns and a point at which to present the stages of mechano-biological wastewater treatment.

The worksheets consisted of the realizing a template of a city to be crossed by a river, from the materials offered, a drawing on an A4 paper with the theme "Dispersion of pollutants over the environment", Making different objects from the offered materials, and the projects had the following theme: "Volumetric determinations based on neutralization reactions", "Identification of water pollutants and dispersion mode" and "Biological treatment".

The topics addressed during the classes aim at raising awareness and raising awareness of students about the optimal use of water consumption, the need for wastewater treatment as well as the ecological education aimed at protecting and preventing water pollution

CONCLUSIONS

Water quality indicators were determined throughout 2019 and compared over July and November 2019 both at the entry of wastewater into the station and at the exit of treated water from the station.

It has been shown that the water flow is higher in July compared to November, due to the higher water consumption from the population and industrial activities in the city of Arad.

It was concluded that the BOD5 concentration in the wastewater from Arad is low with a low carbon content. If this is much lower than the value mentioned in this paper, there is a possibility that the existing level of carbon is not sufficient for the activities of denitrification and removal of biological phosphorus. In this case, a source of external carbon must be added, which may be methanol or acetic acid.

The purpose of the work was to present the results obtained from the analysis of the indicators pursued within the project, namely that the water which is passed through the mechano-chemical treatment process at the Wastewater Treatment Plant in Arad, has a good quality, according to the regulations admitted in the standards in force and can be discharged into the effluent safely.

Regarding the smell due to the fermentation of the sludge on its drying beds, one measure was planting around the station some trees called Paulonia, which overtake the smell and do not let it expand over large areas. The resulting excess sludge is used as a fertilizer on the agricultural lands from Arad County.

Finally, for the specialization "Ecologist and environmental quality protection technician " a test was issued for the evaluation of students regarding the operation of harvesting and preserving water samples, worksheets for laboratory determinations and 3 didactic projects that highlight the importance of environmental and water protection.

The results of the research have a high civic value, being able to be disseminated by the local authorities in the city of Arad by informing the inhabitants about the prevention of water pollution and its waste in households.

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