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THE IMPACT OF THE INSUFFICIENTLY TREATED WASTE WATER DISCHARGE ON THE AQUATIC FAUNA OF AN OUTLET

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Abstract

The inadequate and insufficient treatment of the waste water into a treatment plant endowed with two stage (mechanical and biological, using a treated system with fixed biofilm and a system for treatment and sludge dewatering) and its discharging into a natural stream that supplies a fishing stock, determined an inappropriate aquatic life. The continuous discharge of the water which contains insufficiently oxidized organic and chemical substances (due to non-functionality of the treated biological stage) and the exceeding of the maximum concentration for the quality indicators: ammoniacal nitrogen, CCOCr, CBO_5 and detergents decreased the soluted oxygen from the water, the anaerobic biodegradation of the organic matters, ammonia intoxication and the generation of H_2S as the lapse of the atmospheric pressure during the precipitations. The effects of the water pollution were manifested in suffocation and mortality of the fishing fauna.

Key words*: aquatic fauna, domestic water, impact, pollution, spill.*

INTRODUCTION

The sewage-treatment plant in SC Apa CTTA Alba, branch Sebes has two sewage-treatment plants which are discharged in the town mains of Daia Romana. Each treatment plant is endowed with two stages (mechanical and biological) and a system for treatment and sludge dewatering in the bag unit. The treatment plant Daia Romana 1 is located at the entrance of the town and was designed for a maximum flow rate of 150 mc/day, but due to a malfunction, it was transformed in a pump plant (Figure 1).

Figure 1. The Treatment plant Daia Romana 1

The treatment plant Daia Romana 2 was working only with its mechanical stage, the biological one was not work since putting it into operation and being designed for a maximum flow rate of 1050 mc/day. At the same time with the pumping of the untreated water from the treatment plant 1, it is found that the designed treated flow rate of the treatment plant 2 was exceeded, given that this plant could not treat from the point of mechanical view either, because it exceeds the maximum capacity of the treatment plant 2 while operating at full capacity (1050 + 150 = 1200 mc/day) (Figure 2).

Figure 2. The Treatment plant Daia Romana 2

The Daia pond is part of a fishing stock of a company from the studied area and represents the first pool which is supplied with the water of the Valea Daii creek. This has a total area of 49.54 ha, the crystal surface being of 35.5 ha and a water depth at fishing level of 1.8 m.

Because, in the section of Valea Daii creek, between the treatment plant 2 and the fishing stock there is not a basin to allow a natural biological treatment of the waste waters, the biological untreated water from the treatment plant discharges directly into the first pool of the fishing stock, by Daia creek. Additionally, from a waterway mouth located at about 5 m of Daia creek, it is discharged the untreated water (Figure 3). Thus, the fishing stock is polluted with the discharged water from the two treatment plants, by Daia creek.

Figure 3. The discharging of the untreated water from a waterway mouth located by the Daia creek

The fishing stock's purpose is the production, the primary processing or the refrigeration of the products and the fish merchandising. The working time of the fishing stock is 24 hours/day, 365 days/year, and the production capacity is 120-140 t fish/year.

The large quantities of the inadequate and insufficient treatment of the waste water reached in the Daia pond of the fishing stock by Daia creek, resulted in the exceeding of the maximum concentration for the quality indicators of the waste water. Thus, the water that supplies the fishing stock is inappropriate to the aquatic life, changing the water characteristics of the Daia pond and causing the mortality of the fishing stock.

Fish is very sensitive to the inappropriate qualities of the waters, this could live just in a rich oxygen environment (the oxygen content > 3 mg/l) and free of toxic substances (pH = 6 - 8, ammonia nitrogen < 1 mg/l, phenols < 0.02 mg/l, CBO_5 < 5 mg/l, H_2S -free and detergents or surface-active chemical substances - free).

MATERIALS AND METHODS

To emphasize that the fishing mortality was caused exclusively by the systematic pollution of the Daia creek, that supplies the Daia pond of the fishing stock, due to the insufficient and inadequate treatment of the waste waters, in the sewage-treatment plants Daia Romana, it were sampled weekly/monthly/trimestral a number of 107 waste water samples from the treatment plant, during March 2016 - May 2018. The waste water samples were analysed by specific methods and were determinates the following quality indicators:

- pH (pH units) - potentiometric method.
- TP (total particulates) (mg/l) - gravimetric method, by filtering and oven-drying.
- Filterable residue (fixed), (mg/l) - gravimetric method, by oven-drying.
- CCOCr (mg O_2/l) - volumetric method, using the automatic system of overflowing back and volumetric titration with $K_2Cr_2O_7$.
- CBO_5 (mg O_2/l) - electro-chemical method of analyse, using the reading automatic system of the solute oxygen demand.
- Ammonium (mg/l) - spectre-photometric method.
- Retrievable substances (mg/l) - gravimetric method with solvents.
- Detergents (mg/l) - chromatographic method.

The obtained concentration values were compared with the maximum permissible limits, according to the monitoring frequency (weekly, monthly and trimestral), established by the water rights permits no. 64/March, 3rd 2016; 225/August, 8th 2017 and 264/September, 9th 2017 (Table 1).

Table 1. The maximum permissible limits for the quality indicators of the waste waters

Quality indicator	Maximum permissible limit
pH (pH units)	6.5-8.5
TP (particulates) (mg/l)	200/240
Filterable residue (fixed) (mg/l)	2000
CCOCr (mg O_2/l)	400
CBO5 (mg O_2/l)	215/240
Ammonium (mg/l)	30
Retrievable substances (mg/l)	20
Detergents (mg/l)	0.5

For each analysed quality indicator, the obtained concentration values were graph represented, using the water samples analysed from the point of view of each indicator, from the 107 waste water samples and there were identified the causes responsible for the fishing mortality.

RESULTS AND DISCUSSIONS

After the analyses of the waste water samples the following has been observed:

- The pH indicator falls into the regulated limits for the 106 analysed waste water samples, with the exception of the measurement done in November, 11th 2016, when the value of 9.3 pH units was recorded, namely an exceeding of 9.41% over the maximum permissible limit (Figure 4).

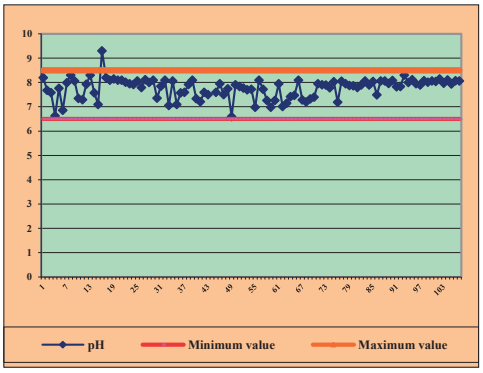

Figure 4. The fluctuation of the obtained values for the pH quality indicator determined in the waste water samples during March 2016 - May 2018

- MTS indicator (total particulates) recorded exceeding's for 23 of 100 measurements. The biggest value, 690 mg/l is registered in May, 5th 2016, 3.45 times bigger than the maximum permissible limit established for 200 mg/l (Figure 5).

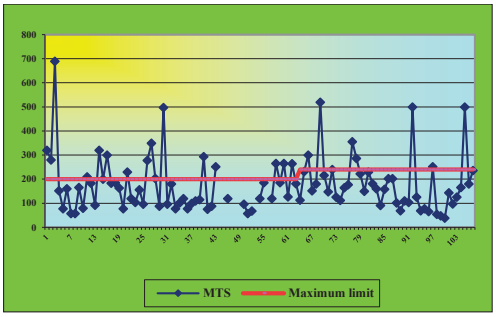

Figure 5. The fluctuation of the obtained values for the MTS quality indicator determined in the waste water samples during March 2016 - May 2018

- Filterable residue indicator (fixed) recorded exceeding's for 2 of 35 measurements, the biggest value being 3452 mg/l in June, 7th 2016, 1.72 times bigger than the maximum permissible limit (Figure 6).

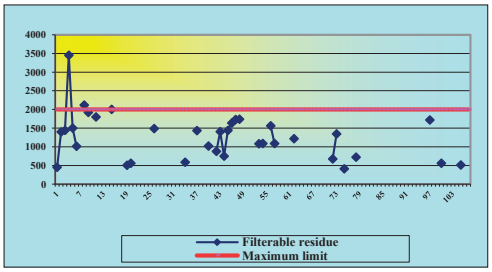

Figure 6. The fluctuation of the obtained values for the filterable residue indicator determined in the waste water samples during March 2016 - May 2018

- Chemical oxygen demand (CCOCr) recorded exceedings for 95 of 107 measurements, the biggest value being 1907.7 mg/l in September, 12th 2017, 4.76 times bigger than maximum permissible limit (Figure 7).

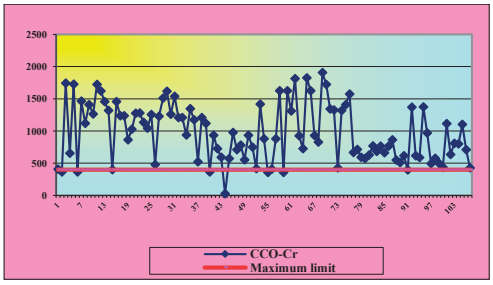

Figure 7. The fluctuation of the obtained values for the chemical oxygen demand indicator determined in the waste water samples during March 2016 - May 2018

- Biochemical oxygen demand (CBO_5) recorded exceeding's for 64 of 97 measurements, the biggest value being 1456 mg/l, recorded in November, 11th 2016. This being by 6.77 times bigger than the maximum permissible limit established for 215 mg O_2/l (Figure 8).

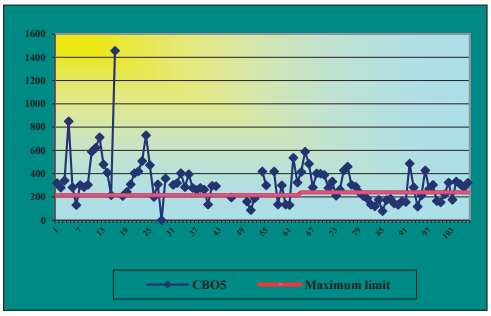

Figure 8. The fluctuation of the obtained values for the biochemical oxygen demand indicator determined in the waste water samples during March 2016 - May 2018

- Ammonium indicator recorded exceeding's for 103 of 107 measurements, the biggest value being 385.6 mg/l, recorded in May, 10th 2016, by 12.85 times bigger than maximum permissible limit established for 30 mg/l (Figure 9).

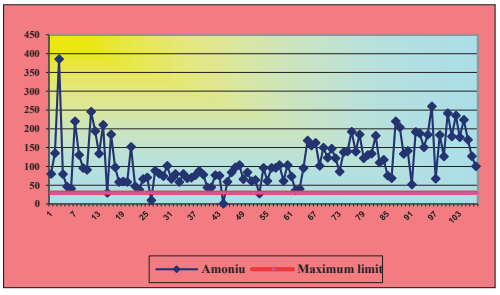

Figure 9. The fluctuation of the obtained values for the ammonium indicator determined in the waste water samples during March 2016 - May 2018

- Retrievable substances indicator recorded exceeding's for 2 of 14 measurements, the biggest value being of 72 mg/l, recorded in June, 7th 2016, by 3.6 times bigger than maximum permissible limit established for 20 mg/l (Figure 10).
- Detergents indicator recorded exceeding's for all three measurements, the biggest value being of 10.65 mg/l recorded in January, 3rd 2018, by 21.3 times bigger than maximum permissible limit of 0.5 mg/l (Figure 11).

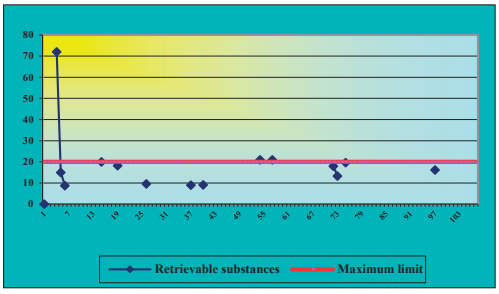

Figure 10. The fluctuation of the obtained values for the retrievable substances indicator determined in the waste water samples during March 2016 - May 2018

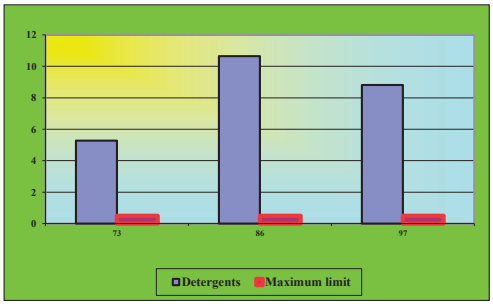

Figure 11. The fluctuation of the obtained values for the detergents indicator determined in the waste water samples during March 2016 - May 2018

The inadequate and insufficient treated waste water from the treatment plant Daia Romana reached using the Daia creek water in the first pond of the fishing stock. Due to the large area and to the volume of the creek water, the pollution effects on fishing fauna did not occur instantly.

The exceeding of the maximum permissible limit of the ammonium, CBO_5 and CCOCr indicators due to the non-operating of the biological treatment stage, demonstrates that the waste water of the treatment plant Daia had a high oxidable impurities insufficiently oxidized, which reaching the emissary Daia creek and in the Daia pond, led to the lower of the oxygen concentration dissolved into the Daia pond water, to the stopping of the oxidation aerobe processes of the insufficiently oxidized impurities and to the development of the biological anaerobic processes.

The high content of the detergents from the waste water led to the changement of the

superficial properties of the Daia creek and of the Daia pond, lowering the self-purification water capacity and to the reducing of the oxygen transfer into the water up to 70%.
Furthermore, due to the lowering of the air pressure, during the precipitations and to the anaerobic biodegradation of the organic matters, it occurred the development and the emission of the hydrogen from the accumulated sludge on the fishing pond bottom.
Technically, the sewage treatment plant had not the adequate treatment capacity, because:
- The screen auger was in open air and friable during the winter, being non-operating in the negative temperature periods;
- The sand filer or the fat collector was not endowed with the sand collecting pump and it was sealed off;
- The homogenizer basin was not endowed with mechanical mixing device or with airing system, enabling the piling of the dead sludge, an important source to generate the sulphurated hydrogen;
- The airing system of the basin enabled a low transfer of the oxygen into the waste water, unlowering the CBO_5 and CCOCr concentration from the waste water;
- The transfer rate of the water between basins were very high and did not allow the reducing of the nitrogen substances by nitrification/non-nitrification, enabling a high concentration of ammonium ligand into the waste water discharged into emissary;
- The sludge dewatering system was an empirical one and did not enable the high-speed discharging of the sludge water, unlowering the particulates concentration (TP) from the discharged water from the treatment plant into the emissary;
- The ammoniacal nitrogen and phosphor concentrations of the discharged water from the treatment plant were much higher than at the admission due to the entrainment of the dead sludge;
- Only 30% of the suspensions and the biochemical consumption of the oxygen were treated;
- The exceeding's of the quality indicator concentrations owed by using an inadequate treatment method with fixed biofilm treatment system.

These cumulated aspects led to the asphyxia of the fishing fauna, recording a mortality of 39.080 kg (Figure 12).

Figure 12. The asphyxia of the fishing fauna due to the pollution of the basin water

CONCLUSIONS

The treatment plants 1 and 2 from Daia Romana in Apa CTTA Alba, Sebes branch, did not work at the designed parameters because the biological stage and the sludge intendancy installations did not run and the mechanical stage of the treatment plant 2 was overstrained due to the taking of the untreated waste waters from the treatment plant 1.
The goal of the Daia pond is to stock fish in the polyculture.
Due to water samples and to the quality indicators were recorded exceeding's of the maximum limits established for the particulates (TP), the biochemical oxygen demand (CBO_5), the chemical oxygen demand (CCOCr), ammonium, retrievable substances and for detergents.
The fishing stock was polluted with discharged water from the treatment plant of the SC Apa CCTA Alba, the aquatic life being improper because the discharged water from the treatment plant was in a such quantity and concentration that changed the water characteristics from the ponds and put in danger the fishing stock.

The asphyxia and the fishing mortality from the Daia pond were caused by the waste water insufficiently treated and polluted with organic and chemical substances insufficiently oxidized, ammoniacal nitrogen and detergent that reached into Daia pond by Daia creek led to the lowering of the oxygen dissolved into water, the anaerobe biodegradation of the organic matters with the generation of the sulphurated hydrogen and with ammonium poisoning.

REFERENCES

Chiriac V. (1966). *Sewage-treatment plants*, State Comitee of Waters, Bucharest.

Environment license no. 29/March, 8th 2010 with further reviews.

Fact-finding note no. 88/12.06.2013 regarding the working of the treatment plants Daia Romana S.C. ECOTRUST AB S.R.L.

Ionescu T., Boltus M., Goruneanu S., Constantinescu S., Motoc M. (1964). *Industrial and waste wears*, Technical Publishing House, Bucharest.

Negulescu M. (1968). *The industrial effluents treatment*, Technical Publishing House, Bucharest.

Project P 700/1978, Fishing stock Valea Daia, Alba county.

Schiopu E. C. (2018). *Judicial technical valuation report*, Ecology and environment protection speciality.

Waste water analyzing reports discharged from the sewage - treatment plant Daia Romana.

Water rights permit no. 64/March, 9th 2016, no. 225/August, 7th 2017 and no. 264/September, 26th 2017.

Water law no. 107/1996 with further amendments.