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WASTEWATER TREATMENT CASE STUDY - SEAU BRĂILA

Lucica BALINT
"Dunarea de Jos" University of Galati, Faculty of Engineering, Romania
e-mail: lbalint@ugal.ro

ABSTRACT

The paper analyses the influent and effluent parameters, as well as the efficiency of the purification process. CBO_5 is found to be within the legal limits in terms of the amount of effluent suspensions of max 6.0 mg/L O_2. The efficiency of their removal from the influent was at least 94.8%. CCO is observed within the legal limits of the amount of effluent suspensions of max 20.2 mg/L O_2. The efficiency of their removal from the influent was at least 93.0%. Suspended matter shows that the effluent sludge was within the legal limits of max 10.9 mg/L, and the efficiency of their removal from the influent was at least 91.6%. Total nitrogen (N_{total}) and total phosphorus (P_{total}) are exceedances of the limits for sensitive areas subject to eutrophication. A downstream denitrification step is proposed downstream of the aerobic stage to eliminate total nitrogen, and a phase of chemical treatment or alternation of aerobic and anoxic steps is proposed for the removal of total phosphorus.

KEYWORDS: water treatment, wastewater, influent, effluent

1. Introduction

The current period is experiencing an accelerated development of urban settlements and especially of metropolises. Centralized water and wastewater/municipal water treatment systems are being developed and modernized in an accelerated manner. The systems cover distances of tens, hundreds of kilometers, serve tens of thousands, hundreds of thousands of inhabitants and operate 24 hours a day, provide wastewater treatment with increasingly complex techniques to meet quality standards.

Treatment technologies consist of processes or operations designed to reduce pollutants in wastewater to an acceptable level depending on the effluent destination.

Analyzes are performed by in-situ sensors in the laboratory to obtain data on the operation of a wastewater treatment plant in a timely manner with the possibility of rapid intervention of parameter adjustments and of historical trend setting.

Production reports based on these data are the source of the data needed to investigate the relationship between the input and output parameters of a wastewater treatment plants.

Effective treatment technology is a combination of processes or operations designed to reduce certain constituents in wastewater (reducing or removing organic, solid, nutrient, metals, microorganisms or other pollutants) to an acceptable level depending on the effluent destination. The purpose of wastewater treatment is to enable safe disposal of these waters without endangering public health and not pollute surface water, groundwater, or pollute the environment. a) Preliminary treatment aims to prevent damage in later stages of treatment as a result of the presence in the water of substances at concentrations and characteristics that do not allow the optimal development of physical, chemical or biological processes specific to the treatment technology. b) Primary treatment may be based on physical processes-based operations such as sedimentation, flotation and decantation. c) Secondary treatment is based on the decomposition of dissolved or colloidal organic matter in the decanted water by means of microorganisms. Secondary treatment can be done in one step at small organic loads or in two steps at high organic loads. d) Tertiary treatment will allow the elimination of non-biodegradable organic and mineral substances by filtration in granular media and generally applies to industrial wastewater. Dephosphating and denitrification are specific tertiary treatment operations that apply to wastewater treatment plants. e) In advanced treatment, residual solid suspensions and other wastewater constituents that could not be reduced by previous treatments are removed by combined application of unitary processes (reverse osmosis, electrodialysis, selective ion exchange, oxidation, detoxification, etc.) [1, 2].

2. Research and results

At the treatment plant, the influent and effluent parameters are followed, as well as the efficiency of the purification process to regulate the process. The most important data are given in Table 1 and Table 2.

***Table 1.** Influent / effluent monthly averages of parameters: temperature, pH, solids in suspension (SS), NH_4^+, NO_3^-*

Month	Temp. [°C]		pH		SS [mg/L]			NH_4 [mg/L]			NO_3 [mg/L]	
	Influent	Effluent	Influent	Effluent	Influent	Effluent	Efficiency	Influent	Effluent	Efficiency	Influent	Effluent
June	21.7	21.8	7.8	7.9	144.6	10.3	92.5	40.9	9.5	75.2	2.1	31.4
July	25.8	25.9	7.8	8.0	193.7	10.1	94.2	44.6	1.0	98.6	3.3	44.5
August	25.7	25.8	7.7	7.9	225.1	9.3	95.5	51.4	2.3	97.5	2.2	37.5
September	23.4	23.4	7.7	7.9	171.2	6.7	96.1	63.0	3.1	92.3	8.4	52.9
Octomber	21.1	20.6	7.6	7.6	265.5	10.9	95.7	58.1	1.5	95.5	3.4	47.5
November	17.3	17.1	7.5	7.4	213.5	8.1	96.0	50.2	1.2	97.8	2.5	57.4
December	11.9	11.5	7.6	7.4	131.2	10.2	91.6	51.8	3.1	94.1	4.3	42.7

***Table 2.** Monthly Influence / Influence Parameter Mediums: CBO_5, CCO-Cr, N_{total}, P_{total}*

Month	CBO5 [mgO_2/L]			CCO-Cr [mgO2/L]			Ntotal [mg/L]			Ptotal [mg/L]		
	Influent	Effluent	Efficiency	Influent	Effluent	Efficiency	Influent	Effluent	Efficiency	Influent	Effluent	Efficienta
June	172.2	8.1	94.8	353.5	20.3	94.1	48.5	13.7	71.7	7.9	4.2	45.6
July	187.9	8.6	95.2	379.7	24.4	93.1	41.8	13.2	67.9	4.9	1.8	63.2
August	215.9	8.7	95.6	458.3	24.7	94.1	41.9	14.9	68.7	4.6	1.6	67.2
September	173.3	7.6	95.6	384.1	21.6	94.3	43.1	13.0	69.8	5.5	2.9	41.8
Octomber	222.3	6.4	96.9	504.6	21.2	95.6	45.7	12.8	71.9	5.3	0.6	95.6
November	207.9	6.0	96.9	454.5	22.1	95.0	71.6	20.9	70.9	3.9	1.9	51.2
December	174.5	6.0	96.3	334.9	22.7	93.0	42.5	13.0	65.7	3.1	1.7	52.2

Concerning the suspended materials, a compliance with the legal limits is observed both in terms of the amount of effluent suspensions (< 40 mg/L) and the effluent removal efficiency (> 90%).

Regarding N_{total}, there are exceedances of the legal limits in the effluent (> 10 mg/L) and there is a low efficiency of its elimination from the influent. This can be corrected by future investments in the new capacity of the station. A de-nitrification step downstream of the aerobic stage can be achieved.

Regarding P_{total}, there are exceedances of the legal limits in the effluent (> 1%) and there is a low efficiency of its elimination from the influent. In this field, corrections can also be made through investments that may involve a chemical treatment or the successive alternation of aerobic and anoxic steps [3, 4].

It is a direct relationship between the evolution of the efficiency of the elimination of the chemical oxygen consumption and the efficiency of the elimination of the biochemical oxygen consumption. This is shown in Figure 1, in which variation of elimination efficiency of NH_4^+, CBO_5, CCO-Cr was represented in June-November. In June, due to a deficiency due to nonlinearities in the operation of the aeration system, there is a decrease in the efficiency of ammonium elimination in wastewater.

In aeration basin, where nitrification is carried out in an O_2-enriched environment, metabolic processes of multiplying the microorganisms responsible for this process occur. This organic substance increases the amount of sludge. The variation of the sludge quantity and volatile matter quantity in the months of June-November is shown in Figure 2. For plotting the graph, we used the data corresponding to the aeration basin, which worked without stopping during the entire period [5, 6].

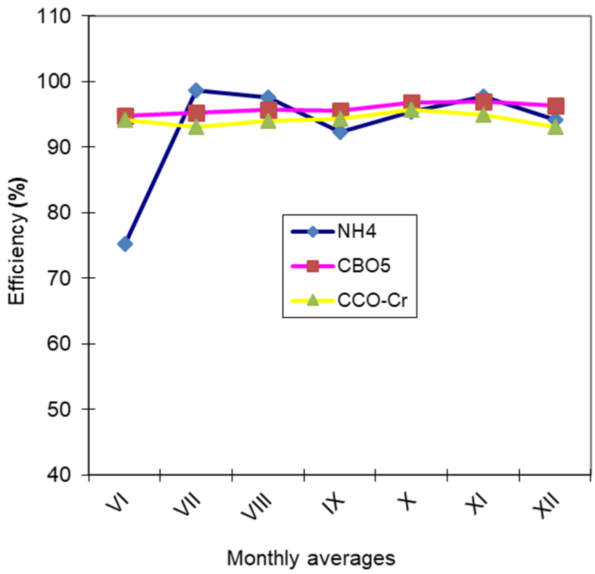

Fig. 1. *Variation of elimination efficiency of NH_4^+, CBO_5, CCO-Cr*

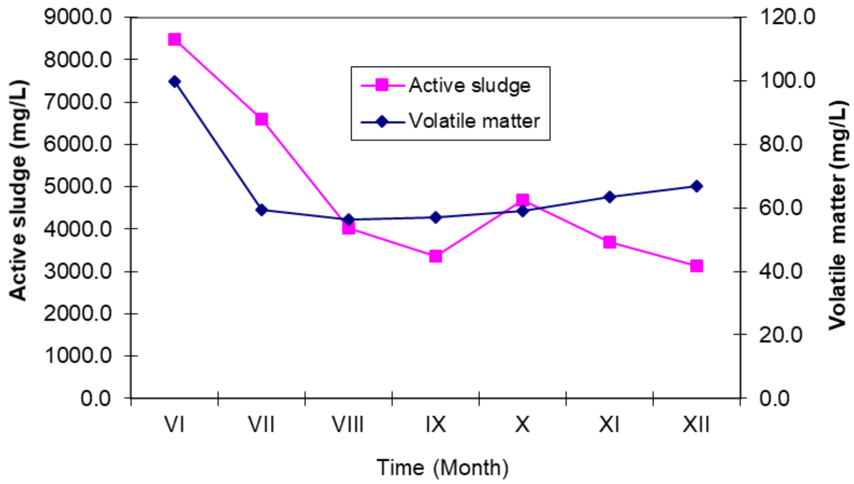

Fig. 2. *Variation of sludge and volatile content in the aeration tank in mg/L*

3. Conclusions

At SEAU Brăila, active sludge is used as the main treatment medium. The composition of wastewater determines both the size of the treatment plants and the quality of the surface water that may occur in the choice of process and treatment scheme.

At the base of the waste water treatment plant design, the current data on the equivalent population – 143,333, the CBO_5 load – 8,600 kg/day, the solid suspension load - 11,940 kg/day, and the forecast for 2026 (the equivalent population - 266,667, CBO_5 loading - 16,000 kg/day, solid loading suspension - 20,400 kg/day.

In the analysed period, the CBO_5 is within the legal limits both in terms of the amount of effluent suspensions of max 6 mg/L O_2 compared to the expected max. 25 mg/L O_2 and the efficiency of their elimination from the influent of 94.8% compared to 90% at least).

At CCO, a legal compliance is observed both in terms of the amount of effluent suspensions of max 20.2 mg/L O_2 compared to the maximum of 125 mg/L O_2 provided, as well as the efficiency of their elimination from with an influence of at least 93.0% compared to the expected 75%.

Suspended materials show compliance with the legal limits both in terms of the amount of effluent suspensions of max 10.9 mg/L compared to the predicted max. 35 mg/dm^3 and the efficiency of their elimination from the influence of minimum 91.6% versus at least 90% predicted.

At N_{total} and P_{total}, exceedances of the boundaries for sensitive areas subject to eutrophication are observed both in terms of the effluent concentration and the efficiency of its elimination from the influent. This deficiency can be corrected by a de-nitrification step downstream of the aerobic stage to eliminate N_{total}, and for P_{total} a chemical treatment step can be implemented, or successive alternating aerobic and anoxic steps can be employed.

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