BIOLOGICAL TREATABILITY OF DOMESTIC AND INDUSTRIAL WASTEWATERS IN A TREATMENT PLANT

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ABSTRACT

Urban development produces wastewaters with flow and/or concentration peaks which prejudice the well functioning of a wastewater treatment plant designed for influent categories characterized by certain domains of composition and concentration. This study aimed to investigate the conventional physical-chemical and biological treatability parameters of the influent and the removal efficiency of the treatment plant: high carbonic loading, chemical oxygen demand (COD), and low biodegradability as BOD_5/COD (biological oxygen demand/chemical oxygen demand) ratio. The improvement of the biological biodegradability parameters in order to obtain a proper activated sludge was achieved by optimal oxygen and nutrients addition. Molasses addition to correct the BOD_5/COD ratio to values ≥ 0.4, determines the increase up to 60-80% of biodegradable organic matter mineralization. COD efficiency removal increases by 10-20% vs. the results obtained for oxygen deficit and/or low biological treatability.

INTRODUCTION

Wastewaters overflowing into the sewage systems or natural streams must meet certain requirements prescribed by the legislative norms. These requirements are met by treating domestic, industrial and pluvial wastewaters. Several big cities with inappropriately dimensioned municipal wastewater treatment plants have been concerned to improve the wastewater treatment technology. Also, in the past, the industry was deficitary with respect to this, emphasizing just the economical growth and not a sustainable one. Among the methods of secondary treatment, a frequently used method is based on the activated sludge for the removal of wastewater organic matter. Empirical in the beginning, this method was then applied at large scale due to the advantages of high biodegradable organic matter removal efficiencies and possibility of monitoring the control parameters of the wastewater treatment plant. [1-2].

Biological and physical-chemical characterization of wastewaters is used for the control and optimization of the existent technological process, and also for the development and implementation of new processes [3]. An important parameter for treatment plant influent characterization is COD (chemical oxygen demand), considered as equivalent of the carbonic substrate of the organic matter. Part of this substrate is represented by the soluble matter, which diffuses rapidly through cellular membranes and is immediately used by the bacterial population in metabolic processes of heterotrophic decomposition. BOD_5/COD ratio renders the biological biodegradability, the activated sludge capacity to degrade organic substances. A BOD_5/COD ratio between 0.2-0.5 stands for a biodegradable wastewater but

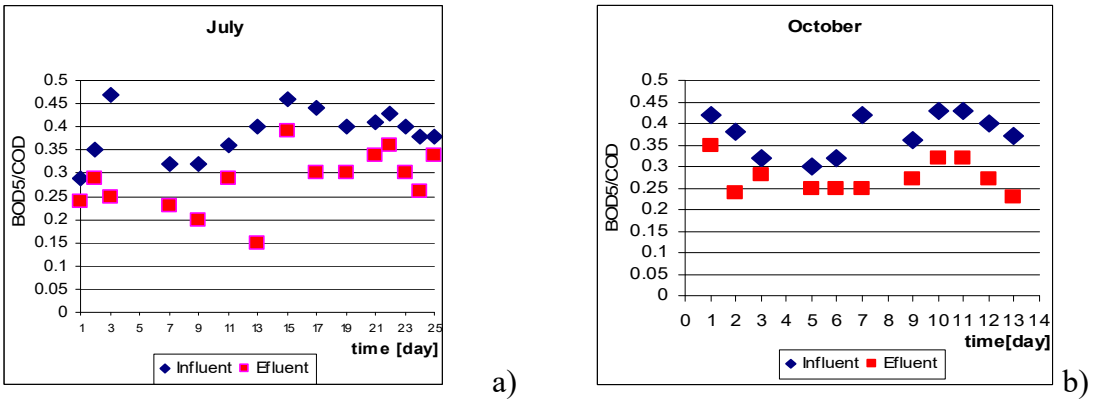
with relatively reduced biodegradability, and a ratio between 0.1-0.2 stands for a water with an elevated level of toxicity, respectively reduced biodegradation in the biological treatment stage [4]. Values of 0.09-0.5 for the BOD_5 /COD index for influent of mixed waters, domestic and industrial, have been reported [5-8]. This index is also used as the operational parameter for the biological treatment, which should be effective for the BOD_5 /COD index value of minimum 0.4 [9-10] The aim of this study is to investigate the conventional physical-chemical and biodegradability parameters of an influent of a wastewater treatment plant and improvement of performances of the biological treatment for wastewater characterized by high content of organic carbon and solid suspensions content and low biodegradability index.

MATERIALS AND METHODS

This study was performed on a wastewater treatment pilot plant characterized by constant flow. The experimental pilot is of the ORM 5 type and produced by S.C. EDWARDS S.A. Sweden. The pilot plant undertakes the wastewater collected from the sewage system of Timisoara city. Water intake occurred twice a day with a total quantity of 800L influent/day. Conventional parameters of pH, COD, BOD_5, were determined in according with the standard analysis methods. The biodegradability level of the organic matter from the wastewater was determined by an auxiliary quality parameter, the biodegradability index, expressed as the BOD_5/COD ratio. BOD_5/COD ratio determined for the effluent is used to estimate the decomposing level by bacterial action of the biodegradable organic matter from the wastewater [4]

RESULTS

Figures 1 show the evolution of BOD_5/COD index during the biological treatment in relation the influent characteristics The biodegradability index values ranged within the 0.29-0.47, indicating the presence of the necessity of biodegradable support to assure a good functioning of the biological stage and a minimum value of the index of 0.4 [9]. This support was assured by the addition of molasses. It must be noticed that BOD_5/COD index after the biological treatment decreased versus the influent, which denotes an effective biological treatment, indicating that a major part of the biodegradable organic matter was metabolized by the biocenosis.



a) b)

Figure 1. BOD_5/COD ratio for biological treatment influent and effluent: a) July; b) October.

Oxygen addition in excess led to the rebuilding of the activated sludge floc structure and, at the same time, greater process efficiencies. Oxygen treatment at a 6-7 mgO_2/L level was applied in similar situations of sludge swelling in July and October during the period shown in Figure 2 with positive results regarding the recovery of the sick activated sludge when the biocenosis shows species characteristic of a healthy sludge.

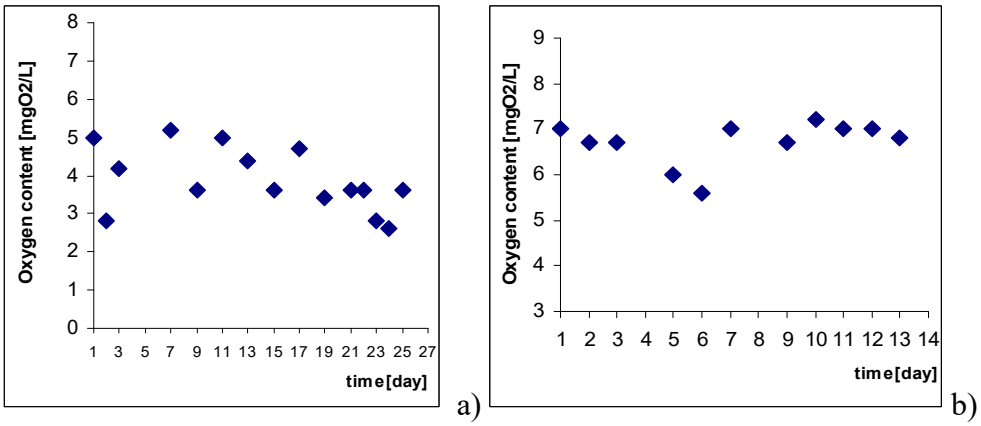


Figure 2. Oxygen concentration from the aeration basin: a) July; b) October.

Figure 3 shows comparatively the removal efficiencies for BOD_5 and COD parameters in relation to the literature data [11], that have been reported a reduction efficiency of at least 70% for BOD and at least 75% for COD by biological treatment.

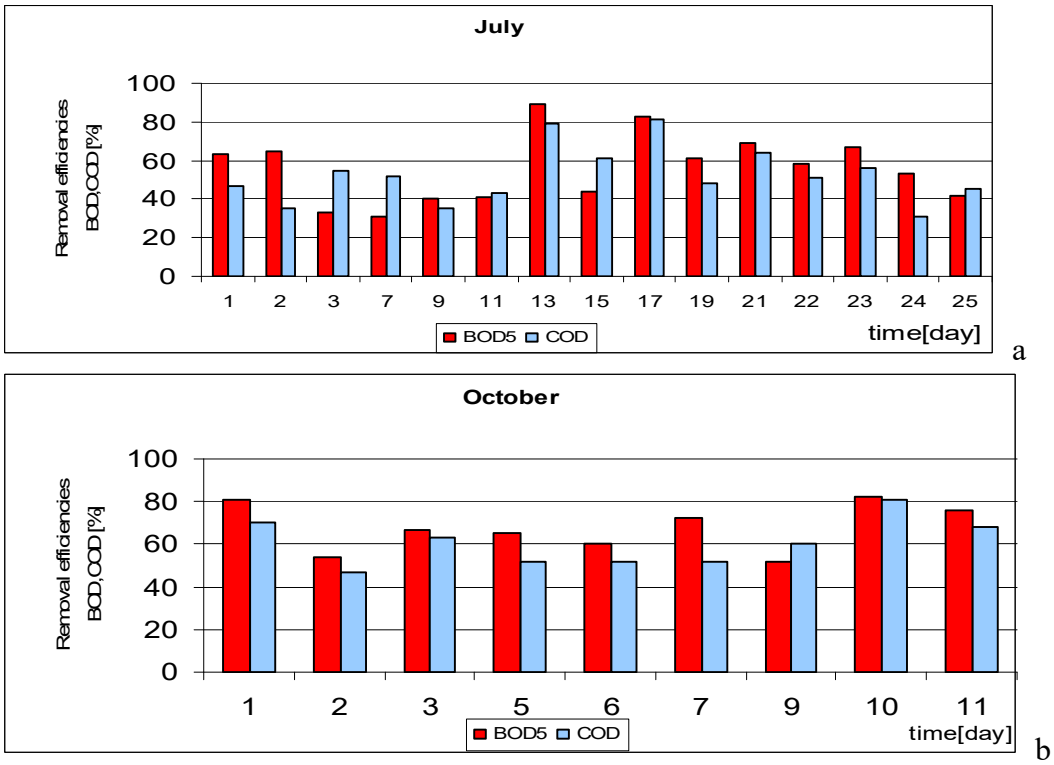


Figure 3. Removal efficiencies of the organic load in the biological treatment expressed by the conventional parameters BOD_5 and COD: a) July, b) October.

The reduction efficiency of the biodegradable organic load (BOD_5) was between 40-50% in the first decade of July and between 60-80% in the second and third decades of July and October. The reduction efficiency for the COD load is slightly reduced compared to

BOD_5 but follows the same trend as BOD_5. The organic matter expressed as COD is apparently formed of substances relatively difficult to remove from the studied waters.

CONCLUSIONS

The treatment applied to wastewaters from urban centers has at its core the biological treatment which, generally, determines the reduction yields of the organic matter in accordance with the parameters for which the plant is designed. Urban development brings an organic matter surplus recorded as concentration and composition peaks needing the alteration of some process factors, such as oxygen demand and the correction of biological treatability parameters in order to obtain a biocenosis in the activated sludge proper for the advanced reduction of soluble organic, finely suspended or colloidal matter.

Molasses addition and correction of the BOD_5/COD ratio to values ≥ 0.4 determine the increase by 60-80% of the biodegradable organic matter reduction. The reduction efficiency of COD is increased by 10-20% vs. the reduction efficiency obtained for oxygen and/or biodegradable organic matter deficit.

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