OPTIMIZING ACTIVATED SLUDGE BIOCENOSIS

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ABSTRACT

The predominant organisms of the sludge determined the efficiency of the biological treatment with a high organic load in the plant. The alteration of activated sludge health determined the destruction of granular flocks and the forming of filamentous structures because of the filamentous bacteria or some fungi multiplication. The filamentous structure determines the swelling of the sludge and reduction of its capacity to decompose organic matter. Swelling of the sludge is determined by the dominance of bacteria belongings Zooglea genus which secretes abundant extracellular material with high degree of hydration. The most practical solution to revive the activated sludge is an excess aeration, which leads to a higher oxygen content. To stimulate the microbial activity the biodegradable organic carbon compounds were supplemented. Molasses addition provides a high input of biodegradable organic carbon, which is necessary when BOD_5 is low and the ammonium quantity is high.

INTRODUCTION

The lack of pretreatment plants leads to an input of substances from industry to municipal wastewater plant influent which is very toxic to microorganisms, greatly hampering the treatment processes. Secondary treatment (biological stage) is the common treatment stage to remove the organic load from urban wastewater resulted from urban agglomeration greater than 10,000 p.e. (population equivalent) [1]. Urban development often determines the production of wastewaters with concentration peaks prejudicing the well functioning of the wastewater treatment plant designed for certain categories of composition and concentration. [2]. The other part of organic matter is comprised of the fine and colloidal matter, which is first adsorbed on the membrane surfaces where it is enzymatically solubilised and then taken through diffusion by bacteria and decomposed [3-4]. Only a part of the total organic matter can be biodegraded by the bacterial population, which is the biodegradable organic matter. Urban treatment plant influent generally contains a mixture of organic substances which may influence directly the water biodegradability level. Synergism or antagonism phenomenon due to organic matter composition and concentration from the wastewater confer it a great complexity reflected in their removal efficiency. For proper biocenosis development, preliminary stages adequate to the wastewater type are recommended, by which substance toxicity is reduced, for example ozonation, filtration etc., or even an addition of biodegradable carbonic substrate, such as methanol, acetic acid, glucose etc. [5-6]. Analyzing the activated sludge of municipal wastewater, a great number of microorganisms are found:

Micrococcus spp., Pseudomonas spp., Achromobacterspp,, Enterococcus spp., Acinetobacter spp., Alcaligenes spp., Arthrobacterspp., Escherichia spp., Salmonellaspp., Proteus spp., etc., Predominant organisms determined in the periods of sludge swelling: a) *Leptomitus spp., Geotrichum spp., Penicillium spp., Cladosporium spp., Mucor spp.,* etc. [7].
This paper provides results related to the improvement of the biological treatment of the municipal wastewater by oxygen adding and biodegradable carbonic substrate, molasses. The exploitation of the biological treatment process for a critical wastewater composition correlated with the sludge quality assessment allowed the enhancement of the removal of organic pollutants expressed as biocenosis elements.

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 SS and ammonium 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 biocenosis elements [4]. The control of qualitative studies of the activated sludge biocenosis was done using an Olympus CHBS Microscope, New York Microscope Company, Inc. The used molasses is a syrup-like liquid left from the sugar factory after concentrating the beet juice – Sugar Factory S.C. ZAHARUL ORADEA S.A. Specific characteristics of molasses are: brown-black color; viscous liquid; good solubility in water; saccharose 50%; used quantity 0.2% wt.

RESULTS and DISCUSSION

Wastewaters are a mixture of domestic, industrial and pluvial waters. It can be noticed that the mean values of the conventional parameters characteristic to the general influent, SS<100mg/L, $N\text{-}NH_4$ < 12mg N/L, correspond to the wastewaters with low loading [8]. However, for the entire studied range, there are several periods in which the conventional parameter values of the pilot plant influent exceeded the characteristic domains for a wastewater of low loading. Under these conditions, the influent characteristics correspond to the wastewaters with moderate loading.
Figure 1 shows the predominant organisms determined in the periods of sludge swelling.

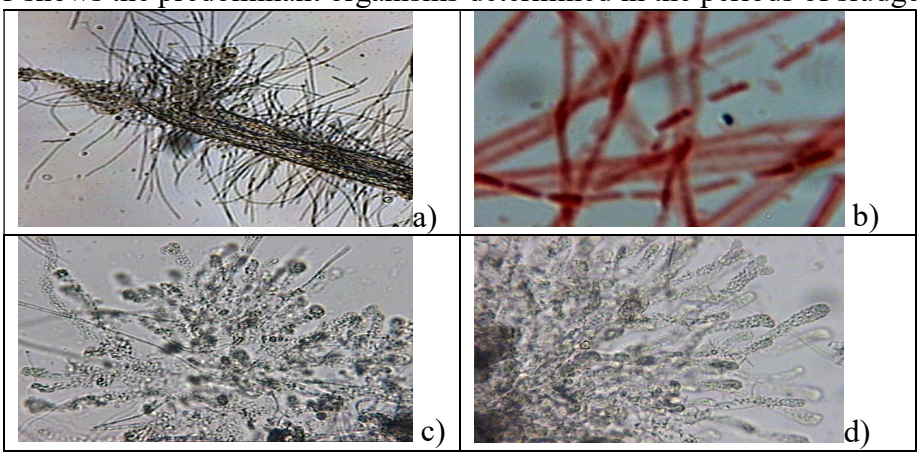

Figure 1. Predominant organisms determined in the periods of sludge swelling: a) Filamentous bacteria, objective 10x, ocular 10 x; b) Gram negative, filamentous bacteria , objective 100 x, ocular 10 x, c), d) Zoogloea genus , objective 10 x, ocular 10 x.

In according with the literature [4,7], the most practical solution to revive the activated sludge is an excess aeration and molasses adition, which lead to a higher oxygen content. An important parameter taken into consideration is oxygen content maintained within the indicated domain of 2.2-4.5 mgO_2/L, for which the sludge was swelled. This shock phenomenon occurred because of a high organic load in the biological treatment station that determined the destruction of granular flocks and forming of filamentous structures because of the filamentous bacteria or some fungi multiplication, e.g., *Leptomitus* spp*., Geotrichum* spp., *Penicillium* spp*., Cladosporium* spp*., Mucor* spp. The filamentous structure determines the swelling of the sludge and reduction of its capacity to decompose organic matter. Swelling of the sludge is determined by the dominance of bacteria belongings Zooglea genus which secrete abundant extracellular material with high degree of hydration.

To stimulate the microbial activity, biodegradable organic carbon compounds were supplemented. Molasses addition provides a high input of biodegradable organic carbon, which was necessary when BOD_5 is low and the ammonium quantity is high. Figure 2 shows the predominant organisms determined in the biocenosis of the healthy sludge.

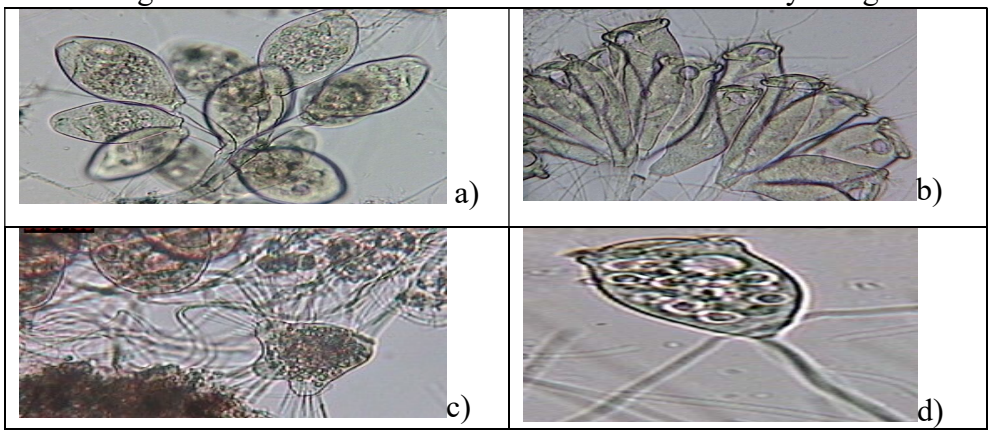

Figure 2. Predominant organisms determined in the flocs of the activated sludge, characteristic to the biological treatment of the wastewaters of Timisoara city. (obiectiv 10x, ocular 10x) *a)Opercularia spp., b) Epistylis spp.,c) Acineta spp., d)Vorticella spp.*

Figure 3 shows the removal efficiencies of solid suspensions and ammonium. In general, the suspension removal efficiencies ranged between 50- 80%. A possible explanation is the presence of the fine suspensions in the effluent due to deficitary sedimentation in the secondary settling tank. Also, Figure 3 shows that the ammonium present in high quantities in the biological treatment station influent is reduced by 30-60% in most of the studied cases. The removal efficiency of ammonium nitrogen reaches 90% in July. Nevertheless, the biological treatment during the periods of maximal load of the domestic and industrial wastewaters does not allow the obtaining of an effluent according to the requirements of quality concerning the control parameters. Efforts to maintain a biologically healthy activated sludge by supplementing oxygen and/or adding biodegradable material based on soluble organic carbon are not sufficient to determine an increase of the removal capacity or organic matter in the influent. The presence in the effluent of a greater quantity of nitrogen compounds, as well as of a remanent biodegradable organic material necessitates the implementation of a tertiary treatment stage in order to obtain a proper effluent in accordance with the quality requirements stipulated by NTPA. [9].

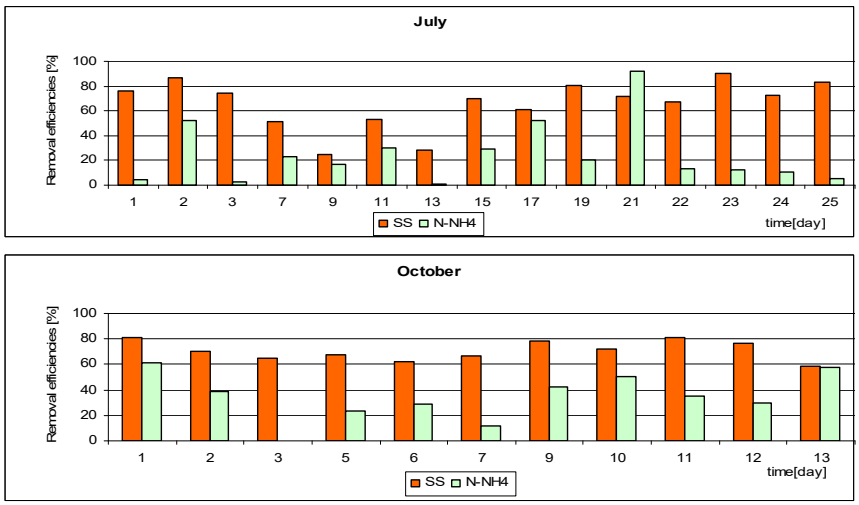

Figure 3. Removal efficiencies of the solid suspensions and ammonium nitrogen in the aerobic treatment stage: a) July; b) October.

CONCLUSIONS

Efforts to maintain a biologically healthy activated sludge by supplementing oxygen and/or adding biodegradable material based on soluble organic carbon are not sufficient to determine an increased removal capacity of organic matter present in the influent. The presence in the effluent of a great quantity of nitrogen compounds, as well as of a remanent biodegradable organic material necessitates the implementation of a tertiary treatment stage in order to obtain a proper effluent in accordance with the quality requirements stipulated by NTPA 002/2002.

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