

Research About the Corrosive Effects of FeCl_3 in the Aeration Wastewater Basin

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Abstract: Biological aeration of industrial wastewater is a very impressive process in the treatment of wastewater. The involvement of chemical reagents in this process, however, implies the intensification of the corrosion processes due to both pollutants in the wastewater and the chemical reactions that occur when the coagulation / flocculation reagents are added. This paper explores the action of ferric chloride (FeCl_3) on metallic parts in the aeration basin. The most affected structures are metal. At the classical basins the aeration systems were made of P295GH materials. The corrosion produced is uneven. The analysis of the high degree of corrosion was done according to the national and international standards. Finally, the paper supports the replacement of the existing aeration system with an anticorrosive material.

Keywords: wastewater, biological aeration system, corrosive effects, FeCl_3

1. Introduction

The need for proper operation of the wastewater aeration system is an important desideratum [1,2]. Therefore, stopping the corrosion process must be effective. In this regard, finding suitable materials from which to build this system is a permanent concern of specialists in this field.

The accomplishment of the aerobic treatment process is an important wastewater in the industrial wastewater treatment plant [3,4,5]. The need for the addition of ferric chloride (FeCl_3) to this stage leads to the corrosion process of the system that carries out this process. Ferric chloride is added to increase sedimentation speed and uniformly develop active mud flocs. Due to the fact that FeCl_3 is highly corrosive, in the biological stage the corrosion phenomena lead to additional costs reflected in the cost price of the purified water [6,7,8]. This paper was based on monitoring the corrosion process in the aeration basin and finding a solution for the construction of a new aeration system.

2. Experimental part

The flow rate at the entrance to the treatment plant and at the exit from the biological treatment step was measured with an inductive electromagnetic flowmeter. The corrosion process is decisively influenced by the cathodic reaction. Because the temperature in the aeration basin is 32°C , the initial



oxidation rate is high [9-14]. The technological parameters that influence the corrosion process are: pH, temperature, amount of added FeCl_3 .

Oxygen was continuously measured with dissolved oxygen traductor and through the automation system the quantity is adjusted by the air introduced into the aeration tank and the period of denitrification.

The aeration basin was divided into four areas for a proper monitoring of physicochemical parameters (Figure 1). The anoxic zones have been alternated with the oxic zones. The monitoring period was 12 months.

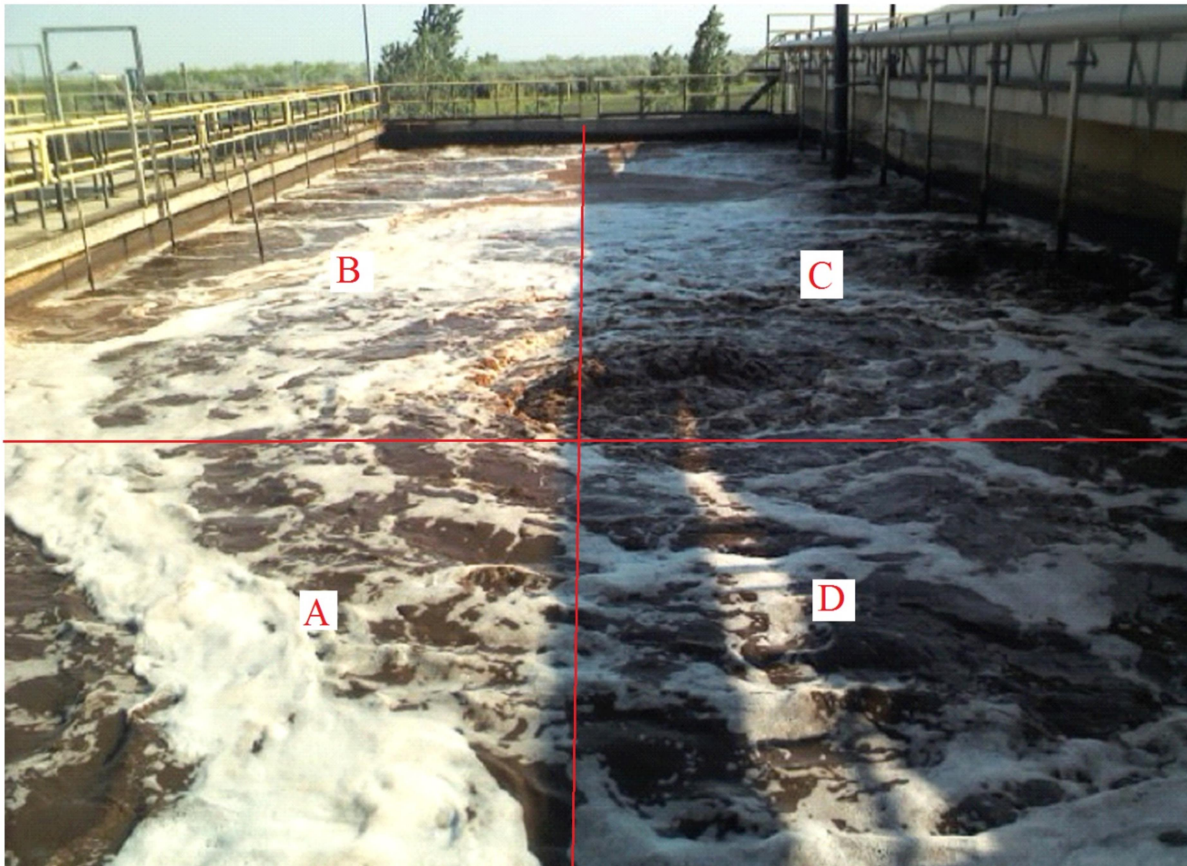


Figure 1. Aeration stage basin with four area

3. Results and discussion

The recorded flows at the entrance wastewater treatment plant and for effluent of the biological treatment stage are shown in the figure 2. It can be seen that it varies between the 405 l/s and 460 l/s.

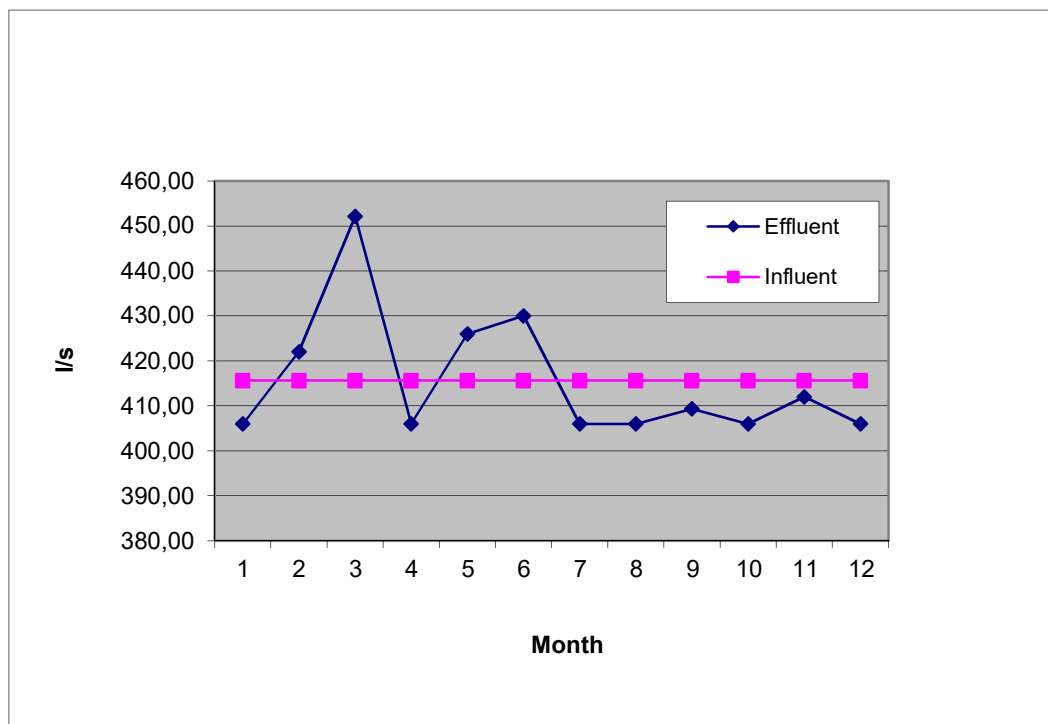


Figure 2. Flows recorded at the entrance wastewater treatment plant and for effluent of the biological treatment stage

The pH value recorded in the aeration tank is shown in the figure 3. The monitoring was performed over a period of 12 months. The pH was measured in all four areas of the aeration basin. The influence of pH is decisive in the aeration process. Addition of ferric chloride does not greatly influence the pH value, but the corrosion process is directly proportional to it. Value of pH acid can lead to the corrosion process occurring and intensifying. The minimum recorded value of pH in the aeration basin was 7.3 and the maximum value was 7.8.

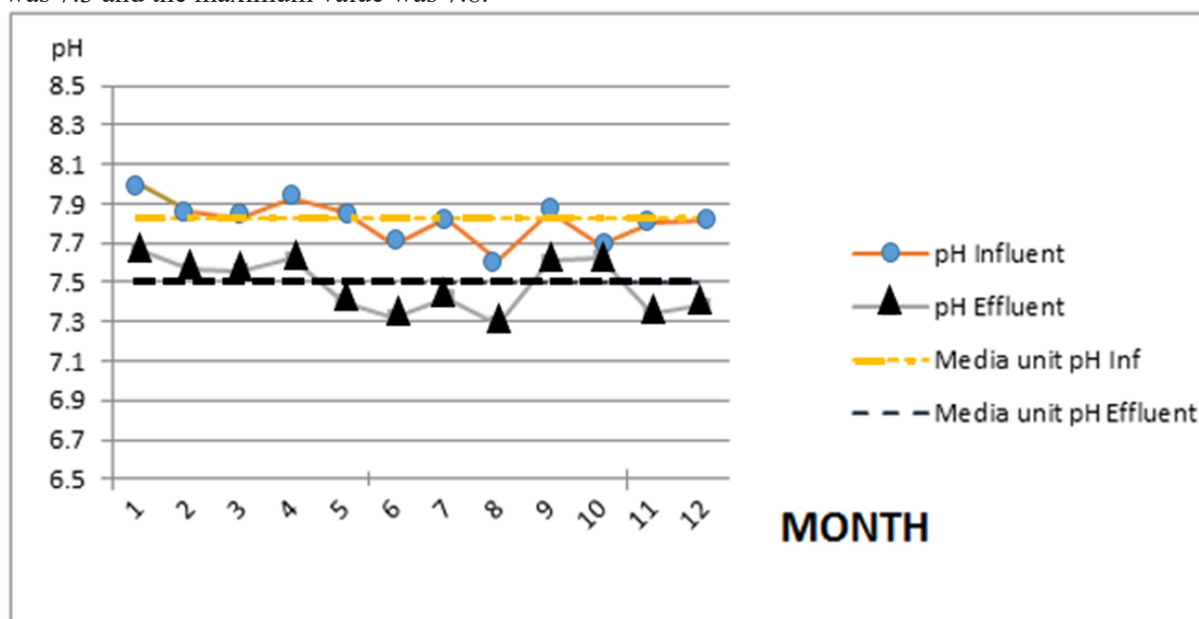


Figure 3. Value of pH monitoring 12 month

The temperature in the aeration basin depends on the temperature of the wastewater coming from the primary stage. Following the monitoring, the temperature was found to be in the range of 27°C-32°C.

The working temperature in the aeration tank depends on the temperature of the process water coming from the primary stage.

On the metallic surface of the aeration systems deposits take place. Thus, the material from which this system is built must resist corrosion phenomena.

At the classical basins the aeration systems were made of P295GH materials. The properties of this materials are presented in the Table 1.

Table 1. The chemical composition of P295GH[1]

Grade	The Element Max (%)						
	C	Si	Mn	P	S	Al(min)	N
<u>P295GH</u>	0.08-0.20	0.40	0.80-1.50	0.025	0.015	0.020	0.012
	Cr	Cu	Mo	Nb	Ni	Ti	V
	0.30	0.30	0.08	0.020	0.30	0.03	0.02

The corrosion produced is uneven. Its aspects of the aeration system are shown in the figure 4. The analysis of the high degree of corrosion was done according to the national and international standards. Finally, the paper supports the replacement of the existing aeration system with an anticorrosive material.



Figure 4. Corrosive effect of FeCl_3 about aeration system

The aeration system provides oxygen for the biological treatment process. Damage to the aeration system by swelling and peeling has led to the propagation of cracks along the entire length of the air supply. Crack propagation occurred longitudinally and transversely.

The adhesion of the oxidation layer to the surface of the system causes it to suffer damage and lead to significant oxygen losses

The main parameters used to assess the oxygen transfer performance are the oxygen transfer efficiency, global oxygen transfer coefficient, and the standard oxygen transfer rate in water. The distribution of gas bubble size depending on the surface velocity is very important in the aeration process. These determine the mass transfer coefficients and decrease or increase the efficiency of the aeration process. As a result of the corrosion phenomenon, the aeration becomes uneven and the amount of suspended matter increases. Thus, it is necessary to add additional amounts of ferric chloride which maintain an acceptable value of the sedimentation rate. The average concentrations of chlorides and FeCl_3 in the aeration basin, monitored for 12 months, are shown in figure 5.

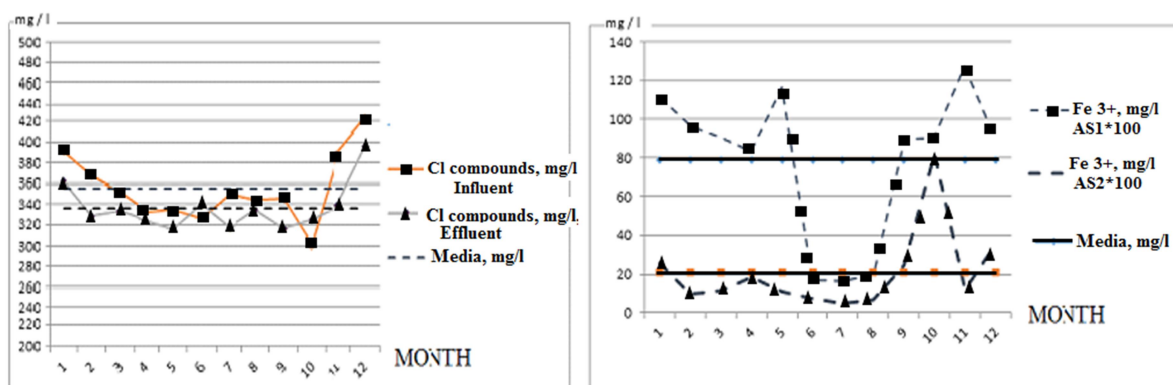


Figure 5. The average concentrations of chlorides and FeCl_3 in the aeration basin

At the most advanced stage of the corrosion of the operating system, metal specimens were introduced into the aeration basin for 4000 h. The corrosion rates recorded were the following:

- S 235JR: $k_g = 0.047\text{--}0.049 \text{ g/m}^2\text{h}$
- Al CuZn28Sn1: $k_g = 0.032\text{--}0.044 \text{ g/m}^2\text{h}$
- AISI Type 304L stainless steel: $k_g = 0.0020\text{--}0.0024 \text{ g/m}^2\text{h}$

Corrosion rates were relatively high. On the surface of the specimens appeared local forms of corrosion due to the pearl chloride. There were also in-depth cracks in the Magna flow method. Damage to aeration systems by swelling (blisters) and peeling has led to the propagation of cracks along the entire length of the air supply to the bottom of the aeration tank. The crack propagation occurred transversally and longitudinally. In anaerobic areas of the pool, corrosion is more reduced in relation to aerobic areas where the phenomenon is more intense. In aerobic areas the corrosion rate is higher. Oxygen introduced into the stage also has a uniform mixing role. The dysfunctions resulting from the corrosion process cause the temperature to be uneven, resulting in higher temperature gradients. They favour the intensification of the local corrosion process.

4. Conclusions

The paper was based on a study of corrosion processes in the aeration basin of a wastewater treatment plant. The analysis of the high degree of corrosion was done according to the national and international standards. After this study appear the necessity to replacement of the existing aeration system with an anticorrosive material

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