Volume 13 – No.10 – 2004
REPRINT pp. 1036 - 1039

EFFECTS OF FOLIC ACID ON THE EFFICIENCY OF BIOLOGICAL WASTEWATER TREATMENT

Elvan Senorer - Hulusi Barlas

Angerstr. 12
85354 Freising - Germany
Phone: ++49 – (0) 8161-48420
Fax: ++49 - (0) 8161-484248
Email: parlar@psp-parlar.de
www.psp-parlar.de

EFFECTS OF FOLIC ACID ON THE EFFICIENCY OF BIOLOGICAL WASTEWATER TREATMENT

Elvan Senorer and Hulusi Barlas

Istanbul University, Engineering Faculty, Department of Environmental Engineering, 34320 Avcilar-Istanbul, Turkey

Presented at the 12th International Symposium on Environmental Pollution and its Impact on Life in the Mediterranean Region (MESAEP & SECOTOX), Antalya, Turkey, 04 – 08 Oct. 2003

SUMMARY

Efficiency losses occur in biological wastewater treatment systems due to various reasons and vitamin shortage was mentioned to be one of these reasons. Especially folic acid was found to stimulate biomass growth and metabolisms. Therefore, it is important how to adjust folic acid addition and to control its concentration in a biological wastewater treatment system.

In this study, the effects of folic acid application were studied for a domestic biological wastewater treatment system with a 300 m^3/day capacity. The rate of wastewater entering the system, its efficiency parameters in the inlet and outlet, and the values regarding biomass were monitored.

It was observed that treatment efficiency increased and values at the system`s outlet could be stabilized by continuous dosage of folic acid, whereas non-continuous dosage enormously decreased efficiency and caused remarkable variations of discharge parameters.

KEYWORDS: Biological wastewater treatment, folic acid, chemical oxygen demand, organic shock load.

INTRODUCTION

In biological wastewater treatment, systems collapse due to several reasons, such as toxic compounds, hydrolytic activities and organic shock loads, but also holidays or operational breaks. Then reaching the previous efficiency would be time-consuming and also causes economic losses.

Alternative methods, such as the application of adaptive bacterial cultures, addition of folic acid and active carbon (PAC-AS), were considered to be useful in optimization of existing systems, thus leading to the required efficiency [1].

It is very simple to add folic acid into a treatment system and neither new equipment has to be purchased nor radical revisions have to be made [2].

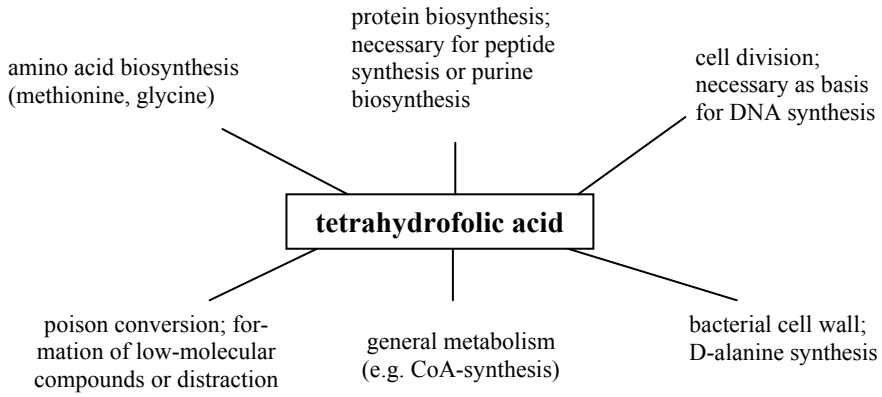

FIGURE 1
The importance of tetrahydrofolic acid for microorganisms [3, 4].

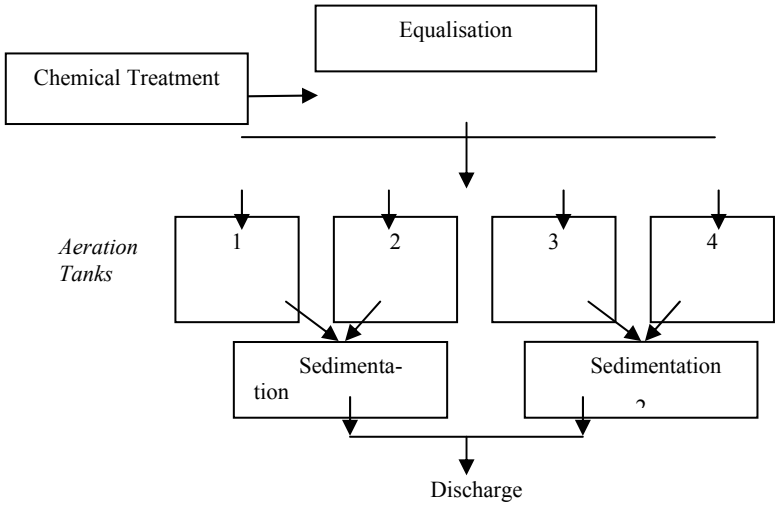

FIGURE 2
Flow diagram of domestic wastewater treatment system.

Importance of Folic Acid for Biological Wastewater Treatment Systems

Folic acid is a water-soluble vitamin, also called "Vitamin Bc". Natural sources are foods such as liver or spinach. Bacteria synthesizing folic acid are very rare in nature, but microorganisms synthesize tetrahydrofolic acid, an essential co-enzyme, from folic acid [5]. Therefore, the presence of folic acid in biological wastewater treatment and activated sludge systems is known to be the reason for their proper functioning [6]. The domestic wastewater treatment system studied throughout this research is illustrated in Figure 2. The system has a total wastewater treatment capacity of 300 m^3/day and wastewater is processed by means of chemical treatments. The system works as follows: wastewater is first fed into four aeration tanks with a 105 m^3 capacity after being processed in an equalisation tank. This extended aeration type wastewater treatment system was operated at the end of year 2000 by using a bacterial culture and enough seeding sludge. In the first month, only two aeration tanks (2 x 105 m^3) were operated. During this time period, the amount did not exceed the value of 150 m^3/day. This value increased to about 300 m^3/day within one year. With the addition of rain waters, it showed a peak value of 1200 m^3/day in the aeration tanks in January 2001.

The current work aims to investigate the effect of folic acid on the efficiency of this wastewater treatment system. For this purpose, folic acid dosage was applied to one of the aeration tanks in the studied domestic wastewater treatment system (see Figure 2) and the effect of this addition was investigated. During this study, the rate of wastewater entering the treatment system, the values of biological wastewater treatment efficiency parameters in the inlet and outlet of the biological system and the values regarding its biomass were monitored. The results and corresponding discussions were given in the latter part.

MATERIALS AND METHODS

In the experimental part, a liquid formulation of folic acid (Dosfolat XS, Alphachemie GmbH, Germany) was used. This form of folic acid is water-soluble and has a long-time effectiveness. Its specifications are given in Table 1.

TABLE 1
Folic acid formulation (Dosfolat XS) specifications.

Specific gravity	1.115 - 1.125 g/cm^3, at 20 ºC
Freezing point	approx. – 18 ºC
Flash Point	---
Evaporation Point	> 110 ºC (vapor)
pH value of 1% folic acid formulation in water	6.5

Folic acid dosage applied to the domestic wastewater treatment system was 0.2 ppm (0.2 g/m^3). This was implemented to obtain a 2 L-dosage of folic acid per 10,000 m^3/day domestic wastewater in the light of information provided in Ref. [2].

Folic acid was first mixed with soft water in the rates of 1/100 - 1/400 before feeding into the biological system in order to achieve a fast mixing of biomass. This mixture was then pumped into the sludge recycling line by means of a dosage pump.

The most convenient location for the dosage application is either the biological sludge recycling line where oxygen rate is low or the inlet of the aeration tank. By this way, a homogenous and effective interaction of bacteria with the folic acid is ensured. The most important point in dosing is to feed folic acid into the system continuously rather than rapidly.

Folic acid dosage described above was continued from 01.01.2001 – 24.02.2001. After a three-days break, 0.2 ppm folic acid dosage was continued for one day between the dates of 24.02.2001 – 29.04.2001.

COD, BOD_5, total soluble solids (TSS), sludge volume index (SVI, ml/g), SV_{30} (30 ml/ml), N, P and pH measurements were carried out according to standard methods during the experimental period.

RESULTS AND DISCUSSION

During the application of folic acid in domestic wastewater treatment between 01.01.2001 and 31.01.2001, the outlet COD values reached a maximum of 60 mg/L. The inlet COD values varied from 200 to 1400 mg/L, but very stable discharge values were observed. COD value reached 31 mg/L with the increase of folic acid formulation in the biological wastewater treatment system.

As a result of continuous folic acid dosage during February 2001, peak variations in the outlet COD values disappeared and average values of 30–35 mg/L could be reached ensuring an efficient and stable discharge.

After these positive results obtained in February, folic acid was fed continuously for one day periods with 3-4 days intervals. When stopping the continuous dosage, COD values of 70–112 mg/L were obtained. The maximum of 112 mg/L was reached in April 2001 (see Figure 3).

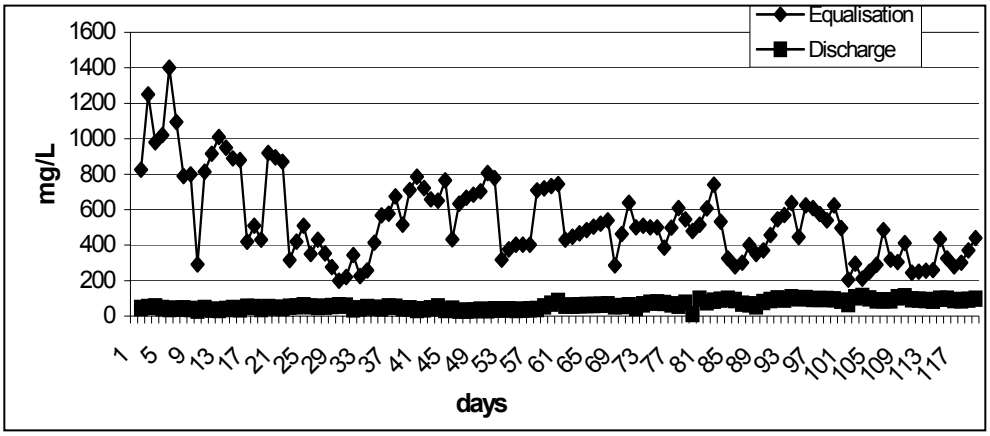

FIGURE 3
COD analysis values between January and April, 2001.

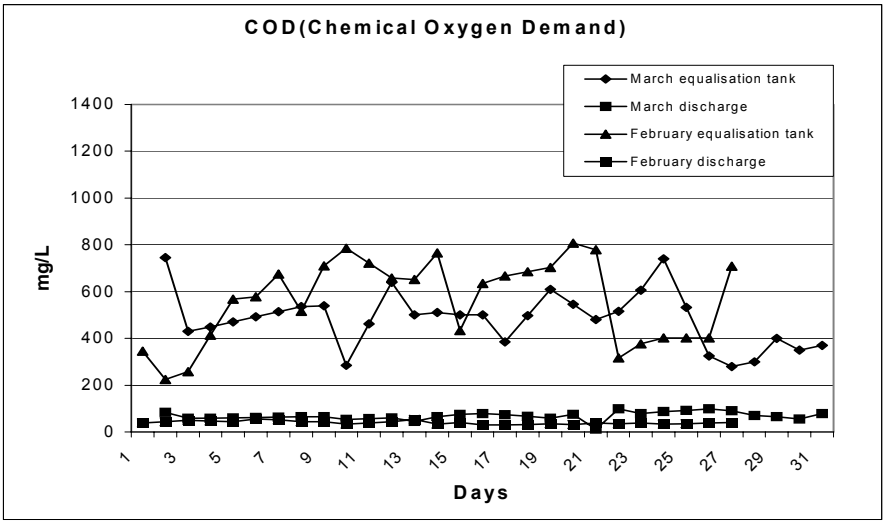

FIGURE 4
Comparison of equalisation and discharge COD values between February and March, 2001.

When folic acid was fed discontinuously, the outlet parameters became unstable. A decrease in efficiency of wastewater treatment process can clearly be seen from Figure 4. Strong deviations of COD parameter between February and March 2001 occurred as a result of changing continuous folic acid dosage to discontinuous feeding in the domestic wastewater treatment process (see Figure 4).

REFERENCES

[1] Aydin K. and Barlas H. (1996) Increase of biological waste water treatment efficiency in a glucose factory with folic acid. I.T.U. 5. Industrial Environmental Pollution Symposium '96, p. 402-410.

[2] http://www.dosfolat.de/

[3] Dohme M. (1987) The effect of folic acid on the metabolism rate of activated sludge plants as shown by the example of the Uelzen and Suderbrug sewage treatment works. Diploma Thesis, Fachhochschule Suderburg, Germany.

[4] Kazuoi I., Masamich I. and Shunochi F. (1977) Studies on the biosynthesis of folic acid compounds: Nutritional requirements for folate compounds and some enzyme activities involved in the folate biosynthesis. J. Nutr. Sci. Vitaminol, 23(2), p. 95-100.

[5] Senorer E. (2001) Determination of Efect of Folic Acid on Biological Treatment Efficiency, Msc. Thesis, Istanbul University, Institute of Science and Technology, Istanbul, Turkey.

[6] Rapold H. and Baher A. (1974) Bacterial degradation of folic acid. H. Hen. Microbiol., 89, p. 283-290.

Received: January 12, 2004
Revised: May 12, 2004; August 11, 2004
Accepted: September 10, 2004

CORRESPONDING AUTHOR

Hulusi Barlas
Istanbul University
Faculty of Engineering
Environmental Engineering Department
34320 Avcilar, Istanbul - TURKEY

e-mail: hbarlas@istanbul.edu.tr