BIOFILM REACTORS

SEPTEMBER 29 - OCTOBER 1st 1993

PARIS

LES RÉACTEURS À CULTURES FIXÉES

29 SEPTEMBRE - 1er OCTOBRE 1993

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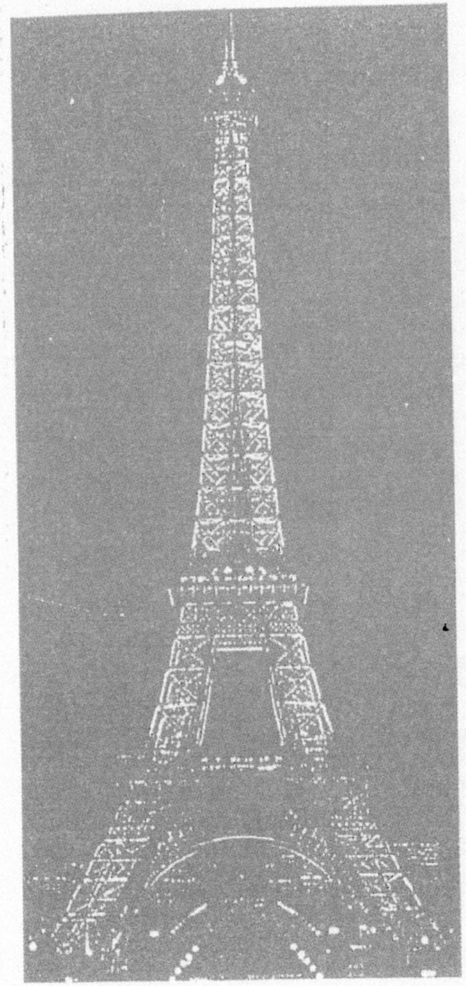

DEUXIÈME CONFÉRENCE INTERNATIONALE SPÉCIALISÉE SUR

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SECOND INTERNATIONAL SPECIALIZED CONFERENCE ON

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REMOVAL OF CARBONACEOUS ORGANIC MATTER BY A BIOFILM PROCESS WITH A PERMEABLE SUPPORT TO OXYGEN

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ABSTRACT

A permeable support biofilm reactor (PSBR), with complete mixing, was constructed. The support membranes had a pore size of 0,5 and 0,2 μm. Pure oxygen was supplied. The oxygen maximum flow allowed the bulk liquid to remain anoxic.

KEYWORDS

biofilm, permeable support, carbonaceous oxidation, nitrification, denitrification, oxygen, membrane

INTRODUCTION

Since the importance of nitrogen contamination was recognised, great efforts have been made to develop processes of control and elimination of this type of contamination. Many biological processes of wastewater purification are proposed to achieve (1) the elimination of soluble organic matter, (2) nitrification and (3) denitrification, either together or separatly. In the new technology called Permeable-Support Biofilm reactor-PSB- (Timberlake et al.,1988; Abdel-Warith et al.,1990), oxygen is supplied through a permeable membrane which completely consumes the gas in the biofilm and allows anoxia in the liquid bulk. This fact makes it possible to obtain specific characteristics in a biofilm which contains specific microorganisms for nitrification, heterotrophic oxidation, denitrification and anaerobic fermentation. In the present study an experimental reactor has been designed in which a biofilm on a support medium permeable to oxygen can be developed. High organic loads are fed so that the performance in the elimination of carbonaceous organic matter can be observed.

MATERIALS AND METHODS

The experiments have been developed in a laboratory scale complete hydraulic mixing reactor, which contains a volume of liquid of 10,7 l. The supports to the biofilm are PTFE-FHLP and PTFE-FGLP membranes (Millipore), with a surface area of 628.10^{-4} m², biologicaly inert, connected to a support frame of poliethylene, hydrophobic, and with bubble points of 0,49 and 0,91 bar. The reactor was fed with a constant flow of artificial wastewater, which consisted of a solution of glucose, ammonium chloride, potassium nitrate, phosphorus source and oligoelements. The pure oxygen is transfered from a pressurised receiving vessel, which has a reducing pressure valve and another flow control valve. The flow of oxygen to the system allows anoxic condition to be maintained in the liquid bulk. The reactor was seeded with aerobic microorganisms obtained from a prolonged aireation treatment works. The active sludge from this process contains about 5.000 ppm of volatile suspended solids. A certain adsorption on the support was observed after 2-3 hours. The experimental plan was designed based on four variables of the greatest importance: the maximum oxygen flow was limited, the support medium, the hydraulic retention time and the influent concentration of chemical oxygen demand (200 and 400 ppm). The combination of these two last parameters gives rise to influent organic loads of 146, 292 and 584 gCOD/m².d. A programme of 16

RESULTS AND DISCUSSION

The efficiency of COD removal was in the range 25-94%. In the relations obtained by means of the parametric analysis for the elaboration of results, the hypotheses (1) steady state (2) all the biomass inside the reactor is in contact with the same concentration of substrate, which is equal to the effluent concentration and (3) Monod 's equation is applicable, were kept in mind. The removed organic load has a relatively very narrow variation range, being larger than 90% for loads between 130-160 g COD.m^{-2}.d^{-1}. For these experiments, the biofilm thickness became larger than 3 mm., and the biofilm density was in the range 90-105 Kg.m^{-3}.

The nitrite and nitrate concentrations in the effluent were practically zero. The relation influent-effluent organic load (Fig. 1.) is shown. The PSBR function removing an practically constant organic load.

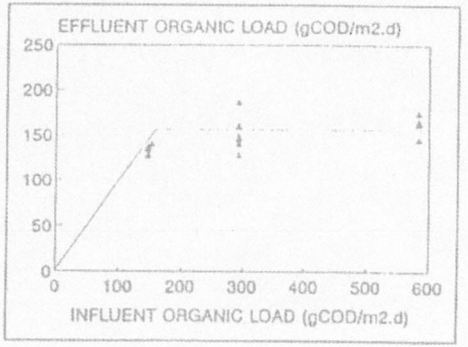

Fig. 1. Influent Vs. Effluent Organic Load

CONCLUSIONS

The two permeable-support membranes employed, have had no influence on the results. For high organic loads, the system works at its greatest capacity of removal of carbonaceous organic matter, independently of the loads.

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