On the treatment of fish filleting waste water by means of rotating biological contactors

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Abstract

A simplified model for the removal of organic load from fish filleting waste water by means of rotating biological contactors (RBC) is presented. The model takes into account the surface area as representative of the active biomass. Information on the BOD-COD correlation for fisheries waste water is also presented. Finally, the evolution of the different forms of nitrogen during the biological treatment is discussed.

Introduction

The fish filleting industry in Mar del Plata is one of the main food processing industries. Some of the fisheries use only a simple settling tank as primary waste-water treatment. In view of increasing requirements of water pollution standards, a high interest exists in improving the removal of contaminants from waste water prior to its discharge to sewers. In this paper, I report on the biological treatment of fish filleting waste water by means of rotating biological contactors (RBC). These are fixed-film treatment systems which utilise corrugated plastic media. The media in turn rotate slowly while partially {usually 40 to 50%) immersed in the waste water.

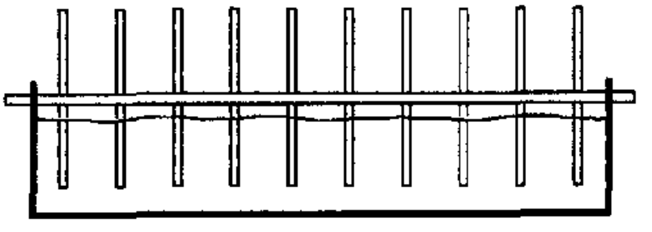

Figure 1
Schematics of a single stage of the RBC system

Materials and methods

The waste water was collected from fish filleting plants located at the harbor of Mar del Plata. In the laboratory, it was kept refrigerated at 4°C in a plastic vessel, which served also as primary settler. The waste water was then pumped to the RBC system using a peristaltic pump, with the following flow rates (in *Ifd):* 31; 40.7; 49.5 and 125. The system was operated at room temperature, between 18° and 22°C.

The analyses performed were: biochemical oxygen demand (BOD_5); chemical oxygen demand (COD); nitrite-nitrogen; nitrate-nitrogen and total Kjeldahl nitrogen according *ioStandardMethods* (1976). Ammonia-nitrogen was determined according to a method adapted in our laboratory (Gonzalez, 1984).

The RBC unit was custom-built in plastic material (PVC). It consisted of three stages, each of which had ten disks attached to an axis that rotated supported by bearings at the end of each stage and driven by a variable-speed motor. During operation, 40% of the surface of the disks was immersed in the waste water. A scheme of a single stage is shown in Fig. 1.

Kinetic model of substrate consumption

For the correct sizing of a waste-water treatment system, proper knowledge of the kinetic parameters for the removal of the contaminants is needed. The following simple model provides such kinetic parameters, based on the following assumptions for its development: the liquid in each stage is completely mixed; the concentration of oxygen in the liquid is not limiting. These are conditions that were satisfied by operating the system at its maximum rotating speed. A third assumption is that the substrate (contaminant) is consumed exclusively by the biomass adhered to the surface of the disks, which is equivalent to neglecting the substrate consumption by the small amount of biomass suspended in the liquid phase. This is generally true, because the amount of attached biomass is much larger than the amount of suspended biomass. Finally, the model is obtained from a substrate balance:

$$\left\{\begin{array}{c}\text{mass of substrate}\\ \text{that enters the}\\ \text{control volume}\end{array}\right\} = \left\{\begin{array}{c}\text{mass of substrate}\\ \text{that exits the}\\ \text{control volume}\end{array}\right\} + \left\{\begin{array}{c}\text{mass of substrate}\\ \text{that is consumed in}\\ \text{the control volume}\end{array}\right\}$$

that is:

$$\frac{F}{A} Si = \frac{F}{A} Se + \frac{dS}{A\,dt} \qquad (1)$$

where:

- F = flow rate (ud)
- Si = substrate concentration at the inlet of the stage *(g/l)*
- Se = substrate concentration at the exit of the stage *(g/l)*
- $\frac{dS}{A\,dt}$ = specific rate of substrate consumption (g/d-m^2)
- A = area over which the biomass is attached (m^2).

For the specific rate of substrate consumption several expressions have been proposed, most of which are modifications of the Monod expression for bacterial growth. The following fisheries waste-water treatment model is proposed:

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Received 6 December 1994; accepted in revised form 1 August 1995,