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Treatment of vinasses by electrocoagulation–electroflotation using the Taguchi method

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ABSTRACT

Taguchi method has been applied in the treatment of vinasse from distillery for assess the performance of the process of electrocoagulation–electroflotation in the removal of total solids, turbidity and total organic carbon (TOC). The variables of study were initial pH, current density, concentration of hydrogen peroxide and material of the electrodes.

We obtained removals of 50%, 89% and 25% for total solids, turbidity and total organic content, respectively, and 61% removal of chemical oxygen demand (COD). Fourier Transform Infrared (FTIR) has been used to identify possible compounds that are formed on the electrodes.

1. Introduction

One of the most recent studies, is the electrochemical treatment of vinasse after of a conventional process of coagulation–flocculation, using Ti/RuPb(40%)O_x as anode and Ti/PtPd(10%)O_x as cathode, with oxidation reactions to achieve removals above 90% in COD, color and turbidity [1].

In another study [2], the vinasse was treated by electrocoagulation, the electrolyte support and hydrogen peroxide concentrations modified significantly the removal of total organic carbon (TOC), reaching values above 80%.

A study used electrocoagulation with and without Activated Areca Catechu nut carbon (AAC), where the removal efficiency of chlorides, sulfates, BOD and COD on the vinasse, reaching removals above 80% [3].

To reduce the crystallization and precipitation in evaporator tubes during the concentration of vinasse, the concentration of salts decrease using electrodialysis with the help of cation exchange membranes [4].

The use of Taguchi method in the treatment of wastewater is very common [5,6], in this case was used in the process of electrocoagulation–electroflotation of vinasse from distillery to remove the contents of BOD, TOC, COD, and turbidity.

Fig. 1. Vinasse untreated (right) and treated (left).

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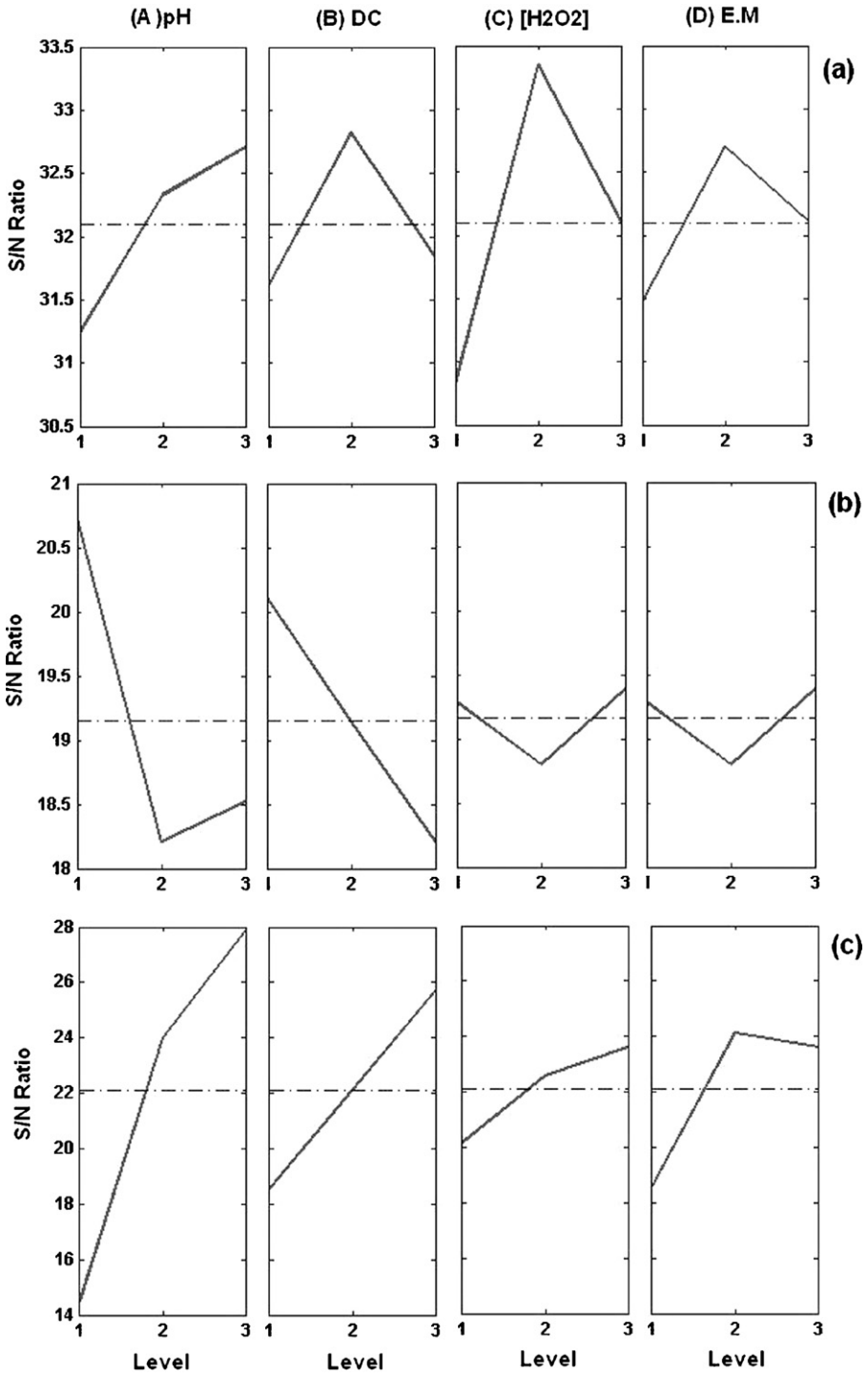

Fig. 2. (a) S/N ratios for total solids, (b) S/N ratios for turbidity and (c) S/N ratios for total organic content (TOC). —- is the mean and — is the S/N ratio.

2. Materials and methods

2.1. Experimental design

A $L_9(3^4)$ design was used, nine experiments with four variables with three levels each, the proposed design is an orthogonal array, for which each pair of the columns have all the possible combinations of levels. Table 1 shows the factors and their levels and Table 2 shows values used for this design.

2.2. Experimental equipment

An electrochemical cell of 500 ml with a speed of agitation of 110 rpm with electrodes in monopolar arrangement connected to a power source GPS-S Series INSTEK type analogous digital was used to carry out the experimental measurements. The electrodes provide an area of 32 cm^2 they are separated by 1 cm.

The pH of the foam and clarified and the conductivity were measured after the operation and the removal percentage of total