Technical note

Evolution of operational parameters in a UASB wastewater plant

SMB Barbosa Correa[1]*, E Ruiz[2] and F Romero[2]

[1] *Pontificia Universidade Católica, PoVos de Caldas, Minas Gerais, Brazil*

[2] *Dpto. de Ingeniería Química y del Medio Ambiente, Escuela Superior de Ingenieros, Alameda de Urquijo s/n, 48013, Bilbao, Spain*

Abstract

The results reported here are based on data of the Nova Pampulha Wastewater Treatment Plant, in the metropolitan region of Belo Horizonte (Minas Gerais, Brazil) containing an upflow anaerobic sludge blanket (UASB) reactor. The objective of this research was to establish the operational parameters of the plant and evolution of elimination of pollutants. Influent and effluent parameters used for this research, were oils, volatile fatty acidity, alkalinity, ammonium, bacteria, flow, chlorides, BOD, detergents, COD, phosphates, total nitrogen, pH, settleable solids, suspended solids (total and volatile), sulphates, sulphides, temperature (air, influent, effluent and reactor) and hydraulic retention time (HRT). Weekly data were collected between January 1998 and June 2000, namely 124 weeks. Methods used for data included conventional statistics, graphical representations and multiple linear regression, applied with the program SPSS, licensed to UPV/EHU with the aim of obtaining equations for the estimation of%age elimination (or increase) of pollutants during anaerobic treatment. The analysis of operational data of the Nova Pampulha plant also includes the temporary and seasonal evolution of control parameters, made by a set of graphical representations for process parameters (flow, HRT, temperature and bacterial count), parameters associated with acid - base equilibrium (acidity, alkalinity and pH), organic constituents (BOD, COD, oils and detergents), inorganic constituents chlorides, phosphates, sulphates, sulphides and nitrogen compounds) and solids (settleable and suspended). By using multiple linear regression, equations could be obtained for estimating the elimination of constituent loads as functions of process parameters and constituent loads in the influents, as possible independent variables. Equations, statistically significant at a 95% confidence level, were obtained for all the eliminations. The calculation is presented in the form of regression equations and some comparative graphics between experimental and predicted data. Data variances were in the region of 20 and 87%. The observation of coefficients of equations for organic matter and suspended solids permits the establishment of parameters associated with elimination or increase of these constituents.

Keywords: wastewater, anaerobic treatment, UASB reactor, percentage elimination of pollutants

Introduction

Of the techniques used for the anaerobic treatment of wastewater, the UASB (upflow anaerobic sludge blanket) reactor is actually a technology adapted for a wide variety of industrial effluents and wastewater (Lettinga et al., 1997; Lópèz and Iza, 1998). Furthermore, it is very well suited to the climatic conditions of Brazil (Von Sperling, 1995; Van Haandel and Lettinga, 1994).

The efficiency of the system has been proved and the results obtained fulfil the objectives intended in well-designed and -operated plants. This type of reactor treats domestic wastewater with 500 mg/ℓ BOD eliminating 80% of the organic load in stations of Large Campina-Paraiba (Van Haandel et al., 1993) and São Paulo (Vieira et al., 1994).

In Brazil the number of cities and industries with wastewater treatment plants is very limited. Wastewater is collected in about 30% of the towns and villages, and treatment plants are found in only 10% of them (Chernicharo, 1997;Fundacao,2000). One of the factors that prevent a most effective development is the territorial expanse, as well as the population distribution (170 million inhabitants).

In this work real data from Nova Pampulha, a community of 6 600 inhabitants, located in Ribeirão das Neves, a residential area of the metropolitan region of Belo Horizon, was used. The wastewater treatment plant, owned by Companhia de Saneamento of Minas Gerais, COPASA–MG, uses a UASB reactor for biological treatment. Information obtained was used for the following purposes:

- to analyse the operational data of the plant, in order to determine the removal efficiency of pollutants, and its relation with process, temporal and seasonal parameters, and
- to obtain mathematical equations that allow the estimation of pollutant removal by the anaerobic digestion process used in the plant for different experimental conditions.

Experimental

Description of the plant

The water treatment plant in Nova Pampulha includes the following stages:

- Pumping of urban wastewater (maximum flow rate 43 m^3/h and 25 m of water column). The impulse pipe comprises 200 mm diameter PVC tubes and leads to a channel.
- Screening by 12.5 mm back racks with manual cleaning.
- Grit removal in a 5.0 m settling tank.

* To whom all correspondence should be addressed.
☎09 34946014109; fax:09 34946014179; e-mail: iapruroe@bi.ehu.es
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