Start-up of a UASB effluent treatment plant on distillery wastewater

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Abstract

Distillery effluent is a contaminated stream with COD values of up to 30 000 mg/ℓ and low pH values of between 3 and 4. The anaerobic biological treatment of distillery effluents is widely applied as an effective step in removing more than 90% of the COD in the effluent stream. This paper reports on the seasonal operation of a UASB treatment plant treating a distillery wastewater stream with particular focus on seasonal start-up conditions after the first process commissioning. The start-up period was typically one week before process stability could be achieved. It is recommended that the loading rate to the plant be controlled between 4 and 8 kg COD/m^3·d until the process is stable and COD removal efficiencies remain, on average, higher than 90%. After the start-up period the loading rate applied (4 to 18 kg COD/m^3d) did not significantly affect the COD removal efficiency of the plant. High removal efficiencies of higher than 90% were achieved and stop-start operation of the UASB process posed no problem for treatment.

Introduction

A distillery in Wellington in South Africa uses grape wine feedstock (during the grape season) that is fermented and then distilled to separate the alcohol from the fermented liquid. The resulting effluent stream from the process is highly polluted with a Chemical Oxygen Demand (COD) of 20 000 to 30 000 mg/ℓ and a low pH of between 3 and 4. These values are comparable with other grape wine based distillery effluents with COD values of between 22 000 and 48 000 mg/ℓ reported by Driessen et al. (1994). Effluent from a wine distillery consists primarily of organic acids with a high soluble biodegradable COD fraction of 98% (Moosbrugger et al., 1993). In Table 1 the typical composition of a wine distillery waste with respect to organic acids is provided.

To pre-treat this effluent, the winery installed an upflow anaerobic sludge blanket (UASB) process in 1994 to reduce the COD concentration to acceptable levels for discharge to the municipal sewer.

TABLE 1
Organic acid composition of wine distillery effluent (Moosbrugger et al., 1993)

Tartaric acid	27%
Malic acid	8%
Lactic acid	29%
Succinic acid	26%
Acetic acid	10%

Anaerobic biological treatment of high-strength distillery effluent is a proven technology that has been widely applied (Rajeshwari et al., 2000). COD removal efficiencies of more than 90% and volumetric loading rates of up to 16 kg COD/m^3·d, and even higher, is possible. Rajeshwari et al. (2000) reported upper organic loading rates of 16 kg COD/m^3·d for sugar cane distillery effluent, while Driessen et al. (1994) recommended a maximum loading rate of 22 kg COD/m^3·d on a juice distillery effluent in a UASB reactor. A concern, is that biological treatment systems often do not perform well on campaigning industries and long start-up periods, in the order of one to two months, is being reported (Austermann-Haun et al. (1994)). When commissioning a reactor for the first time on a particular effluent stream, it is advantageous to utilise sludge from a reactor treating a similar waste. If this is not possible, the sludge will have to be acclimatised to the specific effluent (Hickey et al., 1991). Once the reactor has been commissioned, subsequent start-ups can be performed with the sludge already in the reactor.

In this paper, the results from the monitoring programme that was performed during the last three seasons of operation of the UASB plant will be reviewed. The suitability of UASB technology for campaigning industries and the start-up performance of the pant will be discussed.

Plant and methods

The full-scale plant was commissioned in 1996, and to ensure a faster start-up, the plant was seeded at a loading rate of 0.55kg COD/kg VSS with anaerobic granular sludge obtained from a UASB process treating brewery effluent in KwaZulu-Natal, South Africa. The results presented here were obtained from the monitoring performed during the 1998, 1999 and 2000 seasons only, as detailed information is not available prior to 1998. The distillery operated 24 h per day during the seasons and the treatment plant was run on a continuous basis while effluent was available. Each year, after the season was completed, the plant was shut down and allowed to stand with effluent and the granular sludge until the following season.

Plant layout

In Fig. 1, the process flow diagram of the effluent treatment plant is shown. The effluent from the distillery is collected in a balancing

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Received 22 December 2000; accepted in revised form 6 September 2001.