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Hybrid anaerobic reactor: Brewery wastewater and piggery effluent valorisation

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ABSTRACT: A hybrid anaerobic reactor (HAR) operated to digest brewery wastewater, complemented with piggery effluent (60% and 40% v/v, respectively), under three hydraulic retention times: HRT: 5.7, 3.0 and 1.0 d. Along the first phase, the biogas of 0.9 $LL^{-1}d^{-1}$ evolved to 1.2 $LL^{-1}d^{-1}$ with a methane content of 77–78%. The HRT reduction to 3 days promoted the production until 2.1 $LL^{-1}d^{-1}$, with methane proportions of 79.5%. The operation with an even lower HRT (1 d) allowed to obtain a higher biogas (2.9 $LL^{-1}d^{-1}$, 79.5% CH_4). HAR was successfully applied to the mixture digestion, even with a HRT as low as 1 day. Phenolic compounds with antioxidant capacity in effluent adds value, besides the supply of biogas/methane.

1 INTRODUCTION

The production of beer has an important impact on the economic sector in Portugal. In 2017, 744 million liters of beer were produced in Portugal (Eurostat 2018). However, the brewery industry generates large volumes of highly polluted water, about 3–10 L of waste effluent per L of beer produced are generated depending on the production and specific water usage (Simate et al. 2011). The high pollution potential of these effluents is due to their organic load (sugars, soluble starch, ethanol and volatile fatty acids), suspended solids content and the presence of phosphorus and nitrogen (Raposo et al. 2010). The present work aims to valorise the wastewaters from the breweries through anaerobic digestion process using a hybrid anaerobic reactor, with the addition of another waste flow used as a complementary substrate.

2 MATERIALS AND METHODS

2.1 *Substrates*

Brewery wastewater (BWW) was collected from the Sociedade Central de Cervejas e Bebidas (SCC) brewery (Vialonga, Portugal). Piggery effluent (PE) was collected in Valorgado Company (Salvaterra de Magos, Portugal). Both effluents were previously subjected to the removal of most of the solid fraction.

2.2 *Experimental set-up*

Anaerobic digestion was carried out in the hybrid anaerobic reactor (HAR, Figure 1), designed in LNEG and tested with different organic materials. It is equipped with a packed bed selected in previous studies (Marques 2001), which was placed in the upper section of the column and occupying only 1/3 of reactor height. No device separator of solid/liquid/gas was installed and no substrate recycling was provided. Hybrid with a total volume of 2 L (1.7 L working volume), was functioning in up-flow mode, under semi-continuous conditions, fed by means of a peristaltic pump. The operational temperature was maintained at 37°C using a water jacket.