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ORIGINAL PAPER

Effect of organic loading rate on the performance of aerobic SBR treating anaerobically digested distillery wastewater

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Abstract The influence of organic loading rate (OLR) on the performance of aerobic sequencing batch reactor (SBR) treating anaerobically digested distillery wastewater (ANDW) was investigated in this study. The SBR is operated with four different OLRs of 1.8, 3.6, 5.4 and 9.0 kg COD/(m^3 day) by varying the influent COD concentration of 3600, 9000, 12000 and 17300 mg/L, respectively, and the hydraulic retention time was kept constant at 24 h. From the experimental investigation, it was found that the reactor performance decreases when OLRs increases. The COD and BOD removal efficiency is 74 and 96 % at 3.6 kg COD/(m^3 day), and with increase in the OLR to 9.0 kg COD/(m^3 day) results in the decrease in COD and BOD removal efficiency to 43 and 84 %, respectively. TKN removal efficiency also drops from 99 to 66 % when OLRs was increased to 9.0 kg COD/(m^3 day). Higher OLRs of 5.4 and 9.0 kg COD/(m^3 day) results in accumulation of inorganics in the reactor causing destabilization of the reactor and process failure, and thereby significantly affect the reactor performance in terms of organic removal. The OLR of 3.6 kg COD/(m^3 day) was found to be optimum for SBR for the effective treatment of ANDW combined with domestic wastewater.

Keywords Distillery wastewater · SBR · OLR · Biological treatment

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Introduction

Distillery industry is one of the most highly polluting and growth oriented industries in India based on the quantity of wastewater generated. Molasses from sugarcane industry is the common raw material used in ethanol production due to its easy availability and low cost (Kalavathi et al. 2001). Distillery industry has shown fast rising trend in recent years as alcohol is used as an industrial solvent, and in beverages as well as in ethanol blended gasoline (gasohol) for automobiles. At present, there are 319 distilleries in India with an annual alcohol production of 2.3 billion litres (Tewari et al. 2007) and approximately 40 billion litres of spent wash are generated annually (Ghosh et al. 2002).

Distillery wastewater is well known for its tremendous pollution potential due to high organic and inorganic loading, low pH and dark colour (Santal et al. 2011; Dikshit and Chakraborty 2006). The biochemical oxygen demand (BOD) and chemical oxygen demand (COD) are an index of its polluting character, typically range between 35,000–50,000 and 80,000–1,00,00 mg/L, respectively (CPCB 2003). Apart from high organic content, distillery wastewater also contains nutrients in the form of nitrogen, phosphorus and potassium that can lead to eutrophication of water bodies (Rajasundari and Murugesan 2011). Spent wash disposal even after conventional treatment is hazardous and has a high pollution potential due to the accumulation of non-biodegradable recalcitrant compounds, which are mostly coloured and in a highly complex state. The dark brown colour of the treated spent wash is mainly due to melanoidin that remain in the effluent undegraded even after conventional treatment. The Population equivalent of distillery waste based on BOD has been reported to be as high as 6.2 billion, which means that the contribution of distillery waste in India to organic pollution is

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