Hydraulic characteristics analysis of an up-flow anaerobic sludge blanket fixed film (UASB-FF) using tracer experiments

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ABSTRACT

The hydraulic characteristic of an up-flow anaerobic sludge blanket fixed film (UASB-FF) were studied by changing two important hydraulic factors that can impact significantly on the hydraulic regime of the UASB-FF bioreactor: the Up-flow velocity ($V_{up}$) and biogas production rate ($Q_g$). The analysis of the reactor hydraulic performance was performed by studying hydraulic residence time distributions (RTD) obtained from tracer (Rhodamine B) experiments. The region of exploration for the process was taken as the area enclosed by $V_{up}$ (0.5 and 3.0 m/h) and $Q_g$ (14.87 and 7.96 l/d). Three dependent parameters viz. deviation from ideal retention time ($\Delta t$), dead volume percentage and Morrill dispersion index (MDI) were computed as response. The maximum $\Delta t$ and dead volume percentage were 33.58 min and 26 % at $V_{up}$ of 0.5 m/h and $Q_g$ of 14.87 l/d, respectively. While, the minimum responses (4.15 min and 19.3 %) were obtained at $V_{up}$ of 3.0 m/h and $Q_g$ of 7.96 l/d, respectively. The values of MDI computed at the minimum and maximum $V_{up}$ and $Q_g$ are identified as 11.33 and 10, respectively, showing that the hydraulic regime in UASB-FF bioreactor is a semi-complete mixing.

1. Introduction

The hydraulic behavior in biological reactors is of fundamental importance for the efficiency of the wastewater treatment processes. Examples of hydraulic phenomena with adverse impacts on the bioreactor performance include short-circuiting streams and dead

reactors. Hydraulic characterization is performed by retention time distribution (RTD) curve (Mansouri et al. 2012; Newell et al. 1998; Williams et al. 1998; Chen et al. 2010; Martin, 2000). However, there is not any tracer study done on the hydraulic characteristics of the UASB-FF bioreactor. Nonetheless, a few quantitative models have been proposed.