EVALUATING A SUPER SATURATED AERATION SYSTEM FOR TREATMENT OF HIGHLY CONCENTRATED BLACKWATER

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The membrane bioreactor (MBR) technology has potential for application in the treatment of highly concentrated black water due to the ability to operate at high mixed liquor suspended solids (MLSS); however the oxygen transfer efficiency (OTE) of conventional fine bubble aerators significantly decreases in MLSS concentration above 10 g/L. The lab-scale Supersaturated Dissolved Oxygen (SDOX) delivery unit which uses pressurised system can successfully deliver 9.7mg/L O2 in MLSS concentration of 34.2 g/L under endogenous respiration.

This study evaluated the performance of the SDOX unit using activated sludge (MLSS) in exogenous respiration. The main aim of the study was to test whether oxygen utilisation rates (OUR) of biomass will increase with the increase in MLSS concentration under optimal SDOX aeration conditions. Furthermore, the SDOX unit was also compared with fine bubble diffuse aerators under the same operational conditions.

Activated sludge samples were collected between the aeration basin and secondary settling tanks of the local wastewater treatment works. The samples were thicken gravitationally and aerated overnight to endogenous respiration phase using diffuse aerators. Synthetic black waterwas then added into the 15L reactor thecontaining the endogenous activated sludge samples while aerated with the SDOX unit. The SDOX unit was operated at a pressure of 58 – 65 psi, with the influent process water flow rate ranging from 1585 mL/min to 1750 mL/min. The reactor contents were then pumped into an airtight completely mixed vessel wherein oxygen utilisation rates weremeasuredusing the biological oxygen meter (BOM). The experiments were performed at sludge concentrations±4, 7, and 13 g/L. The experiment was repeated at 4 g/L using fine bubble diffuse aerators and performance between aeration using the SDOX unit and diffuse aerators was compared.

It was found that the OUR increased with the increase in sludge concentration for sludge concentrations of up to 13 g/L while aerated with the SDOX unit. The average oxygen utilisation rates for the sludge concentrations 3.71g/L, 3.88 g/L, 7.07 and 13.6 g/L were 59, 58, 105 and 141 mg/L.hr, respectively(R²=0.94). This implies that microbial activity (in terms of OUR) was unaffected by the increase in sludge concentration, thus illustrating the prospects of the SDOX technology as the future aeration device for MBR application. The SDOX unit exhibited a superior performance (based on oxygen utilisation rates) over conventional fine bubble diffuse aerators. Further studies to determine the performance of the SDOX unit at MLSS concentration >13g/L are recommended. In addition, it is also recommended that the potential impact of the high pressure environment of the SDOX unit on microbial activity be investigated.

Keywords:Aeration technology, MBR aeration, Supersaturated dissolved oxygen (SDOX) delivery unit,