ABSTRACT

Water demand from the world for subsistence, technological advances and economic progress has outstripped the natural ability for hydrologic cycles to replenish adequate supplies of freshwater in many parts of the world. It has been projected that significant parts of the world will be affected by water scarcity in the near future, particularly aggravated from the impact of climate change. Water reuse, hence, has become an attractive alternative water source to supplement our thirst for this precious resource. The current key technology that is paramount for achieving water reuse is membrane processes, and it will remain so in the future.

One of the potential membrane technologies for water reuse is the anaerobic membrane bioreactor (AnMBR). AnMBR is a combination of anaerobic processes with membrane for solid separation to produce high quality water, which can be reuse, for example in agriculture. The performance of the lab-scale AnMBR was investigated using ceramic membranes with different pore sizes to elucidate membrane fouling mechanisms. For the treatment of domestic wastewater, chemical oxygen demand removal efficiencies achieved by the AnMBRs were about 88.6±9.0%, producing an effluent with COD and ammonium concentration of 35.8±26.8 and 40.2±2.3 mg/L, respectively, which can be potentially used for agricultural irrigation. Long-term fouling rates were higher with bigger pore size due to pore blockages by dissolved organic matters, particularly proteins with size around 117 kDa. The application of biocarriers in the AnMBR reduced membrane fouling rates due to enhanced physically scouring of membrane surfaces.

AnMBR was further explored for the treatment of high saline and organic strength pharmaceutical wastewater. Two AnMBRs with two different type of innoculants - conventional anaerobic digested sludge and halophic microorganisms from intertidal wetland sediment were compared. The results showed that halophic microorganisms from intertidal wetland sediment could achieve much superior organic removal efficiency than that of the anaerobic digested sludge at 71.4±3.7 and 32.3±6.1%, respectively. Fluorescent-in-situ-hybridization analysis confirmed the presence of a higher relative abundance of methanogenic populations and 16S rRNA gene pyrosequencing found several microbial groups related with degradation of hardly biodegradable compounds (PAHs, n-alkenes, aliphatic hydrocarbons, alkanes, etc.) in the AnMBR inoculated with halophic microorganisms.

ABOUT THE SPEAKER

Dr. Ng is a Professor, Deputy Head (Administration) of the Department of Civil and Environmental Engineering and Director of the Sembcorp-NUS Corporate Laboratory at the National University of Singapore (NUS). His current research focus is on biological processes, membrane processes and microbial fuel cell for water reuse and energy recovery. He had contributed to more than 300 publications in referred international journals and conference papers.

Dr. Ng is a Fellow of the International Water Association (IWA) and serves as an Associate Editor of Water Research, an Editor of the Journal of Water Reuse and Desalination and a Topical Editor of Drinking Water Engineering and Science. In recognition of his academic excellence, Dr. Ng received the 2016 National University of Singapore Engineering Researcher Award, the 2014 IWA Asia Pacific Regional Project Innovation Awards (Applied Research – Honour Award), the 2009 National University of Singapore Young Researcher Award, the 2008 Singapore Youth Award, the 2007 Singapore Young Scientist Award and the 2006 IWA Young Professionals Award.