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Recycling of biological secondary effluents in petrochemical industry using submerged microfiltration and reverse osmosis — pilot study and economic evaluation

Chen-Hua Ni[a], Yu-Chung Lin[b], Chia-Yuan Chang[c], Justin Chun-Te Lin[d,*]

[a]*Eco-Digital Technology Inc., Taipei City 10483, Taiwan*
[b]*EigenGreen International Inc., Taipei City 10483, Taiwan*
[c]*Department of Environmental Engineering and Science, Chia Nan University of Pharmacy and Science, Tainan 71710, Taiwan*
[d]*Department of Environmental Engineering and Science, Feng Chia University, Taichung City 40724, Taiwan, Tel. +886-4-24517250 Ext. 5216; Fax: +886-4-24517686; email: jlin0623@gmail.com*

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ABSTRACT

Two critical issues determining success of a wastewater reclamation project from petrochemical biological secondary effluents (BSE) were technical feasibility and cost-effectiveness. The former required qualified effluents for capable using in desired recycling purposes, and needed to demonstrate stability of the proposed system under extreme conditions. A mobile pilot plant composed of submerged microfiltration (sMF) and reverse osmosis (RO) membranes was applied to commit aforementioned issues in recycling BSE on site. Even an emergent shutdown caused by typhoon (shock chemical oxygen demand was more than three times, 210 mg·L^{-1}, of normal BSE, 85.7 mg·L^{-1}), excellent water quality still fulfilled requirements for cooling water make-up or process water in petrochemical manufacturing. Stability of the integrated membrane system (IMS) was therefore proved, average flow rates of sMF and RO were, respectively, 10.40 ± 0.29 and 4.47 ± 0.41 L min^{-1}, as well as effective membrane fouling control was implemented. Economic attractive of the proposed IMS was presented by evaluating capital (CAPEX) and operational expenditures (OPEX) of the sMF-one pass RO (0.45 USD·m^{-3} for OPEX and 0.28 USD·m^{-3} for CAPEX) and further upgrading to sMF-two pass RO (0.52 and 0.32 USD·m^{-3}, respectively) for full-scale reclamation project.

Keywords: Petrochemical wastewater recycling; Biological secondary effluents; Submerged microfiltration; Reverse osmosis; Integrated membrane system; Economic evaluation (CAPEX and OPEX)

* Corresponding author.

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