# A Photo Membrane Bioreactor with a Self-forming Catalytic Layer for Nutrient and Pharmaceutical Removal from Municipal Wastewater

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**Abstract:**

Wastewater reuse for potable purposes is imminent in South Africa. This is largely due to the ongoing freshwater scarcity and poor water quality. In addition, the performance of current wastewater treatment facilities has become a growing concern and pollution of freshwater sources by insufficiently treated wastewater effluent poses a serious threat to the availability of good quality potable water. Wastewater composition has evolved over the years and is characterized by increased concentrations of organic compounds and the presence emerging contaminants such as personal care products, pharmaceuticals, and micro and nano plastics. As such, there is an urgent need to develop sustainable and efficient integrated wastewater treatment technologies for reuse purposes. This paper report on the development and evaluation of a bioremediation-membrane filtration hybrid system for wastewater treatment and nutrient reclamation.

Municipal wastewater samples were collected from several selected plants in the Gauteng province. *Chlorella vulgaris, Artrospira patensis* and a naturally occurring species were used as representatives of microalgae. The common nutrients that are responsible for eutrophication nitrogen and phosphorous) were monitored in the reactor effluent in the form of total nitrogen, nitrates, ammonium, phosphates in addition to conductivity, total dissolved solutes (TDS), turbidity, and dissolved organic carbon (DOC). The reactor effluent recorded a 92, 88 and 97 % decline in total nitrogen, nitrates, and phosphates, respectively. Turbidity was reduced from 167 ± 4.22 NTU to 16 ± 3.02 NTU, whilst conductivity was reduced by 63 %. The antibiotic norfloxacin was the targeted pharmaceutical representative and its removal reached 76.0%. Removal of dissolved organic matter was a function of size exclusion, charge interactions, and microbial degradation.

Extracellular polymeric substances (EPS) and organic compounds were the most dominant foulants. Backwashing using 0.01 M Sodium Chloride at high cross-flow velocity was the most efficient fouling reversibility method.

**Keywords**: Bioreactor, Micro-algae, Pharmaceuticals, Ultrafiltration, Wastewater