Decentralized Membrane Bioreactor (MBR) Wastewater Treatment System for use by Fish Processing Industries in Urban and Peri-Urban Settlements in Kenya

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Introduction

Management of wastewater in urban and peri-urban settlements in developing countries is a challenge as lagoons and maturation ponds with low performance and large land requirement are used for treatment. Improper wastewater management is a cause of severe pollution problems such as:

- Eutrophication and pollution of water bodies
- Growth of aquatic weed eg water hyacinth
- Fish kills and low productivity
- Environmental degradation, fish kills, low Productivity and loss of economic value



Plate. 1 Eutrophication & invasion of water hyacinth plant along shores of Lake Victoria

In view of the ever increasing land price, scarcity in urban settlements, and with more stringent effluent quality standards, lagoons and stabilization ponds are no longer viable options. There is a growing need to introduce wastewater treatment systems that are efficient, cost-effective and of low foot print. MBR is a wastewater treatment system with low foot print, that allows treatment and reuse of highly clarified effluent. Introduction of this technology will provide a solution to the management of wastewater in fish industries in Kenya and mitigate pollution and eutrophication problem.

Objective

The main objective of this work is to investigate a potential application of MBR technology for treatment of fish processing wastewater by fish industries in urban and peri-urban centers in Kenya.

Results

- **An optimized proces was achieved using PES commercial membranes, with over 67%, 81% and 96% removal efficiency for phosphates, N-compounds and COD respectively**
- **A low fouling PBM-coated membrane was successfully developed with improved ability for foulant rejection**
- **Critical flux of PES module observed at 7.3L/m2*h with TMP of 230 mbar. Above this point was a decrease in flux and the onset of fouling**
- **No critical flux achieved at TMP of up to 340mbar for PBM module**

Experimental procedure

Materials: Lab-scale MBR & membrane modules

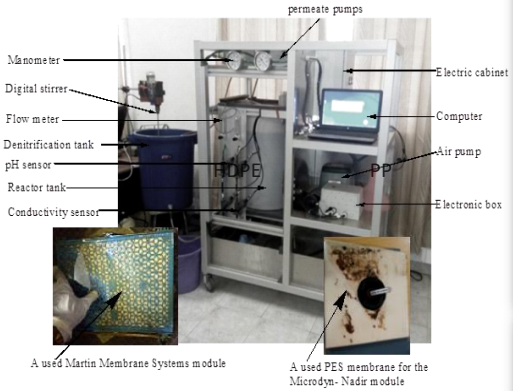


Fig. 1 Lab-scale membrane bioreactor unit

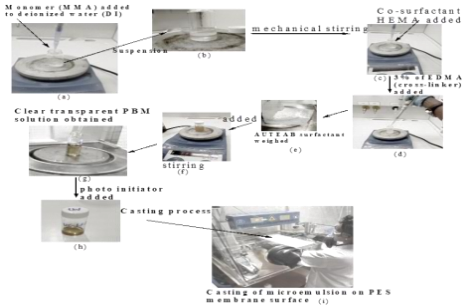


Fig. 2 Development of low fouling membranes

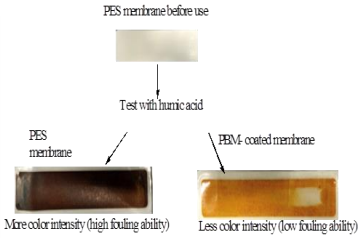


Fig. 3 Low Color intensity deposited on PBM-coated membrane

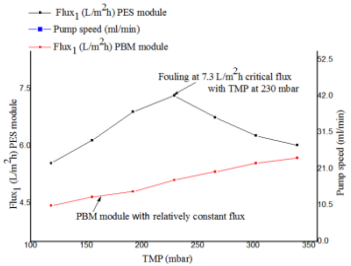


Fig. 4 Critical flux measurement for PES and PBM module

Treatment procedure:

- Fish processing wastewater multiple sample units were collected from the processing drainage system in Makindi fish farm
- Pre-filtered fish processing wastewater, screened through a mesh of 0.8 mm was feed in the anoxic tank. It was mixed with liquor returning from the aerobic tank, and was recycled between anoxic and aerobic tank to achieve the desired denitrification levels.
- Low fouling membranes were developed by modifying the surface characteristics of PES membranes through a coating process via the polymerizable bicontinuous microemulsion (PBM) technique. The performance of the modified PBM-coated membranes was tested for the very 1° time using fish processing wastewater and its performance compared to commercial PES membrane in terms of fouling propensity and effluent quality.

Discussion

- A novel low fouling PBM-coated module with improved ability for foulant rejection attributed to improved surface hydrophilicity was developed
- The findings of this study showed no fouling for the modified membrane a key point towards the implementation of the MBR technology for use by fish industries in Kenya

Conclusion

The MBR technology is effective for treatment and resue of fish processing wastewater for irrigation