

Investigating performance of Integrated Permeate Channel membranes for sewage treatment and establishing chemical cleaning protocols

Aditya Sharma^{a*}, Purnendu Bose^a, Sofie Van Ermen^b

^a Indian Institute of Technology Kanpur, Uttar Pradesh, India

^b Flemish Institute for Technological Research (VITO), Belgium

*Corresponding author: shaditya@iitk.ac.in, +91-7754016622

Abstract:

This work discusses the application of Integrated Permeate Channel (IPC) based ultrafiltration membranes (pore size 80 nm) in sewage treatment. IPC technology employs direct and simultaneous coating of polymer solution on 3D spacer-fabric, allowing high-pressure backwash (~2 bar) of relatively rigid flat-sheet modules.

IPC-MBR was tested in several operational modes to mitigate fouling by optimizing filtration flux and airflow rate. Operating the MBR at an optimal flux of 15 L/h-m², without sludge wasting, reduced COD from 250 mg/L in feed to 20 mg/L in permeate. Critical transmembrane pressure of 0.5 bar was reached in 15 days. To assess the removal efficiency by membrane filtration alone, HRT was reduced by intermittent extraction of activated sludge to inhibit biodegradation, which resulted in a two-fold decrease in the total duration of a membrane cycle without any increase in permeate COD. This firmly indicates that biodegradation in an IPC-MBR helps in the longer operational cycle of membranes but does not affect the permeate quality in its absence. We also investigated the effect of different concentrations of sodium hypochlorite on reduction in membrane resistance and establishing membrane longevity. Low-dose NaOCl (50 and 100 ppm) caused accelerated fouling, while a higher dose (300-900 ppm) promoted efficient membrane cleaning. For weekly cleaning, 300 ppm NaOCl was found sufficient for restoring the membrane to its original condition, whereas biweekly cleaning required 600 ppm NaOCl. Several consecutive clean water rinsing cycles decreased the membrane life due to increased irreversible fouling resistance; however, recovery cleaning with 900 ppm NaOCl transformed the surface to a near-original state. Halogenated organics, measured as dissolved organic carbon and nitrogen, increased proportionately with the strength of NaOCl solution and contact time. Nevertheless, the maximum concentration was less than ten ppm which can be easily dechlorinated subsequently.

Keywords: Ultrafiltration, IPC membrane, sewage treatment, chemical cleaning