

## VACUUM MEMBRANE APPLICATIONS IN DOMESTIC WASTEWATER REUSE

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### ABSTRACT

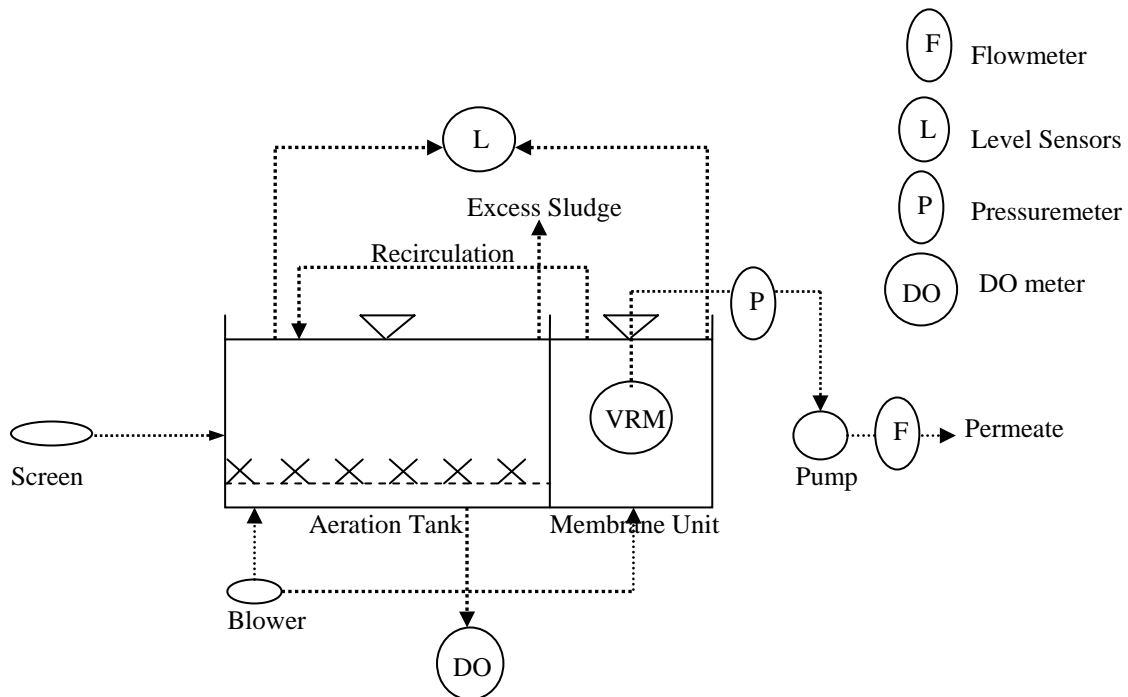
A flat type membrane bioreactor (MBR) with a pore size of 0,038  $\mu\text{m}$  and having a total surface area of 540  $\text{m}^2$  was operated intermittently for over a year in METU campus at Ankara to treat domestic effluents from dormitories and academic village. At the first stage the MBR plant was operated continuously for 140 days with hydraulic retention times ranging between 18 and 22h. During this period, sludge concentration increased from an initial 2.4 g/L to 21. The dissolved oxygen (DO) concentration was adjusted to between 4 and 0.1 mg/l to see the effects of oxygen concentration on the process. The average influent COD and BOD<sub>5</sub> concentrations were 400 and 200 mg/L respectively;  $\text{NH}_4^+\text{-N}$  concentration varied between 32 and 78 mg/L. Over 99.99% BOD<sub>5</sub> removal and 95% COD removals were achieved in the system. When DO concentration was 2 mg/L and MLSS concentration was 16 g/L, simultaneous nitrification and denitrification was observed in the system. The effluent nitrogen concentration was close to zero and COD was less than 10 mg/l then. The effluent NTU was always below one, equal to or below that of tap water. There was always around 6-7 log coliform removal in the system. Effluent fecal coliform counts ran steadily close to zero/100 mL. When DO concentration in the aeration tank was lowered to about 0.1 mg/L, to stop nitrification and to preserve  $\text{NH}_4^+\text{-N}$  as it is, in order to supplement irrigation waters with nitrogen, severe blockage of the membrane has occurred. Blockage of the membrane had to be removed by chemical treatment with chlorine.

The VRM Unit shown in Fig 1 was donated by HUBER A.G. of Germany. The civil construction, piping and electrification were undertaken by METU.



**Figure 1** Vacuum Rotation Membrane Unit.

Unlike most MBR units in the market HUBER VRM has a rotating drum where membrane modules are fixed. Water is filtered through the membranes under vacuum and collected by six pipes running on each corner of the hexagonal drum. Course aeration under the revolving drum provides the cross flow. The membrane holder drum is rotated at 2.5 rpm, driven by an electric motor. A 200 m<sup>3</sup> of wastewater was treated daily in the plant at maximum flow. A schematic diagram of the plant is given in Fig. 1.



**Figure 1** Schematic Diagram of the Full-scale VRM Unit