

CIVIL AND ENVIRONMENTAL ENGINEERING

DM 630/SMAT - Hydrodynamic methods to minimize clogging in membrane systems working in cross-flow

Funded By	MINISTERO DELL'UNIVERSITA' E DELLA RICERCA [Piva/CF:97429780584] SOCIETA' METROPOLITANA ACQUE TORINO S.P.A. [Piva/CF:07937540016]
Supervisor	MANES COSTANTINO - costantino.manes@polito.it
Contact	TIRAFERRI ALBERTO - alberto.tirafferri@polito.it
Context of the research activity	This project aims at developing a method to minimise clogging in membrane systems working in cross flow conditions. The idea is to employ flow pulsation to generate flow conditions preventing the settling of particles on the membrane surface and hence avoiding loss of permeability and increase in energy costs associated with pumping. the project is mainly experimental and will be developed in two phases. the first in the lab and the second in an existing plant. Progetto finanziato dal PNRR a valere sul DM 630/2024 - CUP E14D24002410004
Objectives	Membrane systems often involve flows bounded by porous walls made of thin fibrous or flat-sheet filters (i.e. the membranes) that retain particles and hence separate the feed stream (the fluid to be purified) from the permeate stream (the purified fluid). In most cases membrane systems work in so-called cross-flow conditions where the permeate represents the wall normal flow (as in suction boundary layers) and the feed the overlying flow. The feed is often kept turbulent to maximise mixing, thus minimizing membrane clogging (referred to as fouling, namely, the deposition of particles and molecules onto the membrane surface and within membrane pores) and concentration polarization, which represent a major problem for this filtering technique as it leads to increased energy consumption associated with feed pumping and hence increased coperalational costs. In this project we propose that clogging can be minimised if pulsations are imposed to the cross flow. This hydrodynamic technique is not new and has been proposed in the past with however poor success partly because of the difficulties of identifying the right frequency, amplitudine and shape of the pulsation waves to be imposed. Such difficulties are associated with a poor understanding of the physics controlling mass transfer process occurring at the membrane-fluid interface

in turbulent, pulsating flow conditions. In the past years the Hydraulics group at Politecnico di Torino investigated and clarified such processes and is now ready to build upon this work to develop pulsating flow systems for engineering applications. Towards this end, the proposed project intends to carry out detailed laboratory experiments to quantify the benefits of flow pulsations in membrane systems working at different hydrodynamic and water conditions. After this initial laboratory phase, the tuned pulsating system will be implemented in an existing membrane-plant nearby Turin to test its effectiveness in a realistic scenario.

Skills and competencies for the development of the activity

The position is open to candidates with a degree in Civil, Mechanical and Environmental Engineering or related fields. We are looking for a candidate with (i) a good background in hydraulics and fluid dynamics (ii) good proficiency in English; and most importantly (iii) with a great passion for innovation and laboratory work.