PhD in Civil and Environmental Engineering

Research Title:

Fluid dynamics in membrane-based separation systems

Funded by	Politecnico di Torino (through the Clean Water Center)

Thematic area referent	Prof. Costantino Manes (costantino.manes@polito.it)

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Context of the research activity	The research will focus on the fluid dynamics mechanisms that govern mass transport and fouling phenomena in membrane-based water treatment systems. Concentration polarization and fouling at the surface of the membrane are interrelated phenomena that amplify each other and that impair the performance of the purification process. The occurrence and magnitude of these detrimental phenomena are inherently related to tangential flow properties and to the mass transport characteristics of the system. Inducing high shear stress at the fluid-membrane interface has long been recognized as one of the most efficient way of inhibiting fouling. Increasing shear stress, however, comes to a cost as it is associated with increased energy consumption and ultimately increased costs.

Objectives	Objective of this research is the systematic investigation and optimization of pulsating flows as hydrodynamic means of enhancing instantaneous shear stress while maintaining low energetic costs. The research plan will involve: numerical simulations to identify a range of promising pulsating flow configurations; validation of the numerical results by experiments where fouling rates and flow properties will be monitored in a channel-flow rig constructed ad hoc, by means of state of the art laser-diagnostic techniques; application of the most promising methodologies and configurations in a laboratory scale cross-flow filtration system, to simulate the behavior of the membrane module in real application. The investigation will also encompass the analysis and optimization of the best spacer geometry.

Skills and competences for the development of the activity	The ideal candidate has a strong background in fluid dynamics and thorough understanding of hydrodynamic processes; speaks and writes in correct English; has good written and oral communication skills; is motivated, independent, and shows the potential to develop an original research activity leading to exceptional scientific accomplishments.