Membrane bioreactors for municipal wastewater treatment
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MBR (Membrane Biological Reactor) technology derives from coupling of conventional suspended growth processes and microfiltration or ultrafiltration processes. It certainly represents one of the most promising approaches to the municipal wastewater treatment due to the several advantages offered; among these, high compactness, very good quality of the effluent and low sludge production. However, many aspects have still to be evaluated from both biological and hydraulic point of view, especially in terms of biomass behaviour under stressed conditions and fouling control.
This research was developed through two experimental phases. During the first phase (lab scale experimentation) the cell activity in MBR systems was investigated and a particular care was addressed to the modelisation of sludge production. The respirometric technique allowed to estimate a relevant reduction in nitrifiers activity respect in comparison with traditional activated sludge processes. The second phase was performed on a large pilot scale plant within two different membranes were submerged; the used modules (a plate and frame Kubota E50 and an hollow fibre Zenon ZW 500c) are typically applied on full scale plant and the whole pilot plant was fed with real sewage. Due to the size of modules a deep analysis of fouling dynamics wasp performed, especially aimed to the evaluation of chemical cleaning requirements, to air supplying for the turbulent conditions preservation (on the membrane surface) and to the optimal concentration of total suspended solids (TSS). A special phase of the experimentation was dedicated to the critical flux assessment. The critical flux concept was introduced in 1995 and it defines the flux value above which membrane fouling is observed. Until today, most of critical flux assessments have been carried out on lab scale modules fed with ideal suspensions or synthetic feed; such conditions are really very far from the typical working conditions of full scale plants. The non applicability of critical flux (in its strictest sense) was verified for the heterogeneous matrix filtered in this experimental work. However, a limiting flux (as maximum sustainable flux for sustained periods) was evaluated for both modules under different conditions of TSS and specific air flow rate.