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Going from a critical flux concept to a threshold flux concept on membrane processes treating olive mill wastewater streams

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In a recent paper, Field and al. introduces the concept of threshold flux for a wide range of membrane applications, in particular wastewater treatment processes, as an addition to the concept of critical flux [1]. The latter concept applies strictly to membrane systems where no fouling at all is observed below critical flux values. This is mostly not true for membrane processes treating wastewater streams, where at best conditions a very slow, long term fouling is still observed and absolutely not avoidable. Therefore a critical flux value cannot be strictly found on these processes, and it is possible to perform only a distinction between short term and long term fouling conditions. These two conditions are separated by the new threshold flux value.

The main author of this work, in particular M. Stoller, have published recently many papers about critical flux value determination on olive mill wastewater exiting the 3 phase oil production process ("OMW3") [2-4]. This type of production is very common in Italy. Moreover, laboratory experiments were started by using the wastewater stream exiting a 2 phase oil production process, common in Spain ("OMW2"). Although similarities of the two wastewater streams may be found, the behavior on membranes appears to be completely different.

The results obtained in laboratory will be presented separately from this work. The aim of this one is to review, on the basis of the data collected on the wastewater treatment membrane processes throughout the years, the concept of critical flux applied on batch membrane processes treating olive mill wastewater, and to introduce for these systems the new concept of threshold flux.

The transition from critical flux to threshold flux is not immediate, and needs some adjustments. The main problem relies that the critical flux is a unique data point which may be precisely identified. This is not true for the threshold flux value since the transition from long term to short term fouling exists within a small, but existing operating conditions interval. Therefore the transition from one fouling condition to the more severe one is gradual.

This aspect needs to be incorporated into the developed batch membrane optimization methods based on critical flux discussed in the past years to permit a proper update of the model to batch membrane optimization methods based on threshold flux [5-7]. The novelty (and the difficulty) relies to introduce in the past relationships of the model based on critical flux an additional parameter, called fouling factor ζ, which ranges from 0 to 1 to connect low fouling conditions as a quota to the high fouling conditions. The solutions of the model are therefore not unique, and criteria for an optimized choice of the operating conditions will be introduced, discussed and validated on the basis of the experience made on laboratory (10 l/day), near to pilot (100 l/day) and pilot (1 m^3/day) plants.

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