

## Technical–economic evaluation of chromium recovery from tannery wastewater streams by means of membrane processes

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### ABSTRACT

Leather tanning processing and manufacturing industry uses high large amounts of water in the range of 40–45 L kg<sup>-1</sup> during processing. As a result, tannery wastewater rises by the same amount, is characterized by a large inorganic load (chlorides, with concentration ranging from several hundred to over 10,000 mg L<sup>-1</sup> Cl<sup>-</sup>; sulphate (VI), ammonium ions and sulphide ions, exhibiting concentration that ranges from tens to several hundred mg L<sup>-1</sup>) and together with organic pollution (the chemical oxygen demand value is usually several thousand mg L<sup>-1</sup> O<sub>2</sub>). The use of conventional treatment processes to treat wastewater streams from the tannery industry resulted to bear not satisfactory. In the case of biological treatment methods, the treatment results are incomplete and complicated by an excessive sludge production at the end. On contrary, physical and chemical methods are too expensive in terms of energy and chemicals. Therefore, the only partially treated tannery wastewater is given passed to the industrial sewer system or, in the worst case, directly to the environment, representing therefore a threat to the environment. In this work, a nanofiltration membrane operation was used, developed to treat tannery wastewater after an initial sedimentation process. To avoid severe membrane fouling operating conditions, the determination of the boundary flux was determined. In the second step, experimental work was carried out to permit the validation of the adopted approach. The purification target of the here proposed process for tannery wastewaters was reached, that is the legal discharge to municipal sewer system according to Italian law of 90% of the initial volume. Since discharge costs to municipal sewer system are approx. 1/3 compared with the industrial one, the practice allows immediate cost saving of 26%. Moreover, an additional benefit is achieved by the by-production of chromium rich concentrate streams in amount equal to 5% of the initial volume, suitable to tannery process recycle and reuse. In total, cost saving rates may exceed 30%. At the end, scale-up of the proposed process will be discussed from technical and economic point of view.

**Keywords:** Chromium; Tannery wastewater; Reuse; Recovery

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