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Treatment of phenol effluents coupling Fenton's oxidation and nanofiltration

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Polluted waters are nowadays a major concern due to the necessity for preserving water as an essential factor for human development. Biological wastewater treatment plants (BWWTP's) are frequently used for treating polluted waters. Nevertheless, industrial effluents usually contain biorefractory substances that cannot be directly treated in BWWTP's. Thus, a pre-treatment has to be implemented to amend the polluted water so it can be subsequently sent to the BWWTP without causing operational problems. The Fenton process has shown to be an efficient way for partially oxidising phenol, a biorefractory compound usually found in industrial wastewaters. The Fenton process is based on the formation of hydroxyl radicals using both hydrogen peroxide (oxidant) and ferrous ions (homogeneous catalyst). However, as iron ions continuously leave the reactor with the treated effluent, they enter the BWWTP and finally appear in the excess sludge. Thus, continuous addition of iron ions causes an extra cost. Moreover, according to the legislation, it is mandatory to decrease the level of iron dissolved in the effluent from the reactor to avoid problems in the biological treatment. In addition to these two drawbacks, as the goal of Fenton process is not the total mineralisation of the organic matter present in the initial wastewater, partial oxidation products are produced during the Fenton treatment. Some of the phenol oxidation by-products, such as quinone-like compounds, have been found to be even more refractory than the phenol itself. Due to the above operating, environmental and economical problems, technical solutions must be designed to improve the overall treatment. The use of nanofiltration after the Fenton's reaction is investigated for oxidising 2500 mg/L phenol solutions. Both Fenton's oxidation and membrane separation performance are presented. On one hand, the effect of the Fenton's oxidation variables (oxidant and catalyst concentration) on the phenol oxidation efficiency, Total Organic Carbon (TOC) conversion and concentration of oxidation by-products is examined. On the other hand, three commercial nanofiltration membranes (NF, NF90 and NF270, manufactured by Dow Filmtec) have been tested to filter the Fenton's effluents in crossflow continuous operating mode at 6 bar of transmembrane pressure. The most efficient membrane was found to be NF90, which was then selected for performing the studies concerning the effect of the Fenton's operating variables on the membrane efficiency. Membrane efficiency was evaluated in terms of phenol, iron, by-products and color retention as well as of permeate flux decrease and fouling. To test the membrane re-usability, four successive nanofiltration runs were performed by using the same membrane and conditions, with a cleaning step using EDTA between filtration runs. The results demonstrate that membrane separation efficiency was not affected with use and permeate flux was restored after the cleaning steps or, which is the same, fouling was eliminated.

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Old reverse osmosis modules in the future: solutions of reuse

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Water desalination processes have contributed to a better standard of living in a number of countries during the second half of the 20th century, following an increase in water demand for drinking purposes as well as industrial and agricultural uses. Membrane fouling is a frequent problem in most seawater reverse osmosis units, particularly when raw water is drawn from an open sea intake. Membranes tend to foul slowly, which makes it necessary to perform periodic cleanings with physical and chemical products, which in turn produce a decrease in the useful lifetime of the membranes.
Actually the behaviour of old reverses osmosis (RO) membranes from desalination seawater units are burned at the end of their life. Tomorrow the main following way should be to reuse those RO membranes as nanofiltration (NF) or ultrafiltration (UF) membranes, depending on the level of their degradation. To evaluate the level of degradation autopsy analysis were conducted,