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NANOREMEDIATION THE TANNERY WASTEWATER: A CASE STUDY FROM THE UPPER BASIN OF THE BOGOTÁ RIVER (COLOMBIAN)

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Leather tanning industry have left a trail of environmental problems, including the generation of the tannery wastewater from tanning stage (TTW) with high concentrations of Cr (III and VI) and organic matter represented by chemical oxygen demand (COD). The TTW is responsible for physical, chemical, and biological degradation of aquatic habitats. In the Colombia, this has been a significant problem especially in the upper basin of the Bogotá River. To avoid detrimental impacts, the TTW must be collected and treated before being discharged into the environment. Heterogeneous Fenton oxidation treatment (HFO) is one possibility of the treatment.

In this study, we determined of the performance of HFO using commercial zerovalent iron nanoparticles (nZVI) as catalyst and compare it with the conventional Fenton, involving $FeSO_4 \bullet 7H_2O$ as control. Laboratory tests were carried out with real TTW with high concentration of Cr VI (49.6 ± 9.2 mg L^{-1}), Cr III (886.5 ± 43.5 mg L^{-1}) and COD (8400 ± 105.5 mg L^{-1}). The main operating parameters, such as pH, temperature and reagents amount, contact time, and sedimentation time were optimized using Plackett–Burman, central composite design and response surface methodological approaches. Finally, to confirm the reliability of the model, an additional laboratory experiment was conducted applying the oxidant (H_2O_2) in a on single-step or two-step dosing.

The optimal conditions found for HFO were H_2O_2/COD (w/w) = 0.5, nZVI/H_2O_2 (w/w) = 1.25, and pH=3, when the oxidizer is applied in two-step dosing with 24 h of difference. The two-step dosing was found to be a crucial influencing factor to improve the overall HFO performance by effectively utilizing the hydroxyl radicals (•OH) and avoiding the scavenging reactions. The two-step dosing resulted in more efficient removal of Cr VI, Cr III, and COD (> 98%, > 70% and > 60%, respectively) with respect to the control process (> 90%, > 62% and > 49%, respectively).

These results clearly showed that the proposed HFO processes lead to higher treatment efficiency in removal of hazardous pollutants, giving an option to leather businessmen to deal with TTW.