2678
doi:10.1017/S1431927620022400
Microsc. Microanal. 26 (Suppl 2), 2020

SEM Study of Oxidative Stage of the Electro-Fenton Process in the Treatment of Effluents from Pulp and Paper Plants

Carlos Moura Junior[1], Naiara dos Santos[1], Julio Spadotto[1], Guillermo Solórzano[1] and Luiz Alberto Teixeira[1,2]

[1]PUC-Rio, Rio de Janeiro, Rio de Janeiro, Brazil, [2]Peróxidos do Brasil Ltda (Solvay Group), Curitiba, Parana, Brazil

*Corresponding author: naia.osantos@gmail.com

Most effluents from the pulp and paper industry have color, even after conventional biological treatment processes. This characteristic arises mainly from the presence of lignin compounds (LC), which are recalcitrant (non-biodegradable). As it is required by environmental legislation when discarding effluent in water bodies, effluents do not change the color of water in the receiving body. In this context, it is important to investigate treatments that enable the efficient removal of these compounds.

Electro-Fenton process (EF) has been shown to be efficient in removing several recalcitrant compounds, especially for the removal of the effluent color [1][2]. The present study has investigated the removal efficiency of lignin compounds from a pulp and paper industry effluent containing 118 mg. L^{-1} dissolved organic carbon (DOC), turbidity 2.3 NTU and true color 1099 uC. The Electro-Fenton experiments were conducted in a 1L reactor, using two electrodes (anode and cathode) of rectangular shape, made of SAE 1010 steel (total surface area of 58cm²), hydrogen peroxide (H_2O_2) dose = 670 mg/L, initial pH 4 and current density 4 mA/cm². The experiments were performed by adding dosages of H_2O_2 in the reactor containing the effluent and the two electrodes. As a result of anode oxidation, a free radical with high oxidative potential (‘OH) capable of reacting with the complex structure of the target pollutant is formed. Removal of LC was evaluated in relation to the removal of DOC (TOC-L Shimadzu), color, and absorbance in UV_{280nm} (spectrophotometer Shimadzu UV 1800). The oxidation and the microstructure of the electrode (anode) were evaluated using a scanning electron microscope (SEM JEOL JSM-7100FT) coupled with X-ray energy dispersive spectroscopy (XEDS) detector operating at 15 kV.

SEM-BSE (backscattered electron) images in Figures 1a and 1c show the electrode surface before and after EF reaction, respectively. The predominance of regions with a brighter contrast on the electrode surface before the EF reaction refers to the presence of elements with greater atomic weight (Fe) [3]. The higher presence of O on the material surface (Fig. 1d) evidences the oxidation step to which the electrode surface was exposed, forming different oxides species. Such oxidation step resulted from the current density, H_2O_2 dosage, and pH imposed on the system. SEM secondary electron–SE images of Figures 2b, 2c, and 2d show heterogeneous oxides morphologies produced on the electrode surface during the EF reaction. It is pertinent to observe here that some similar oxide morphologies formed on the steel surface after an oxidative system using H_2O_2 but without applied current have been reposted [4]. From this oxidative stage confirmed in the present work, in which the electrode surface was entirely oxidized, satisfactory rates of removal of the target pollutant were obtained: 82% DOC, 99% LC measured as Abs_{280}, and 99% color removal [5].

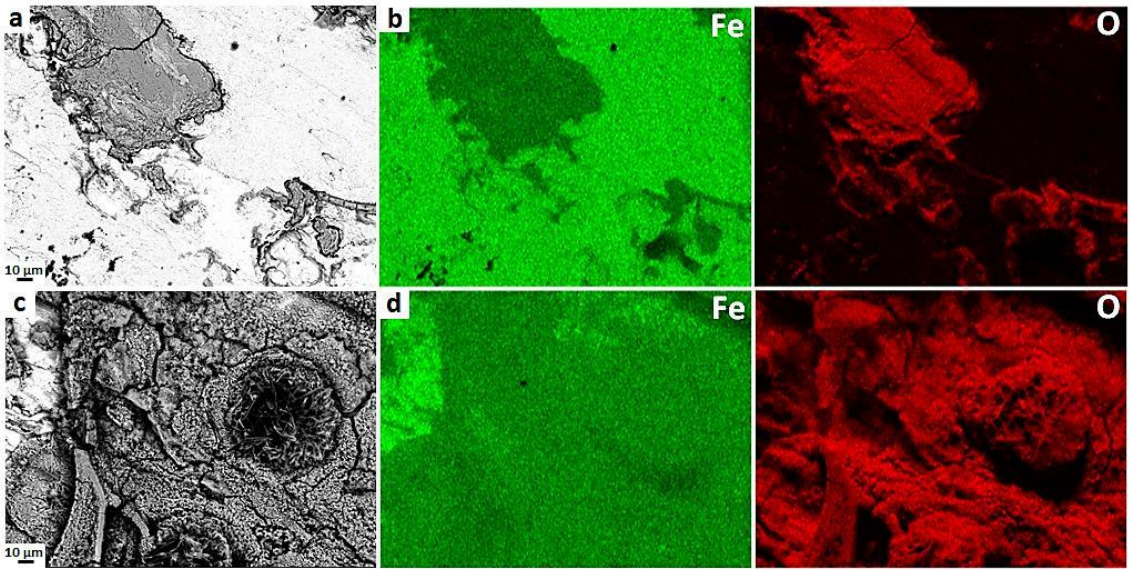
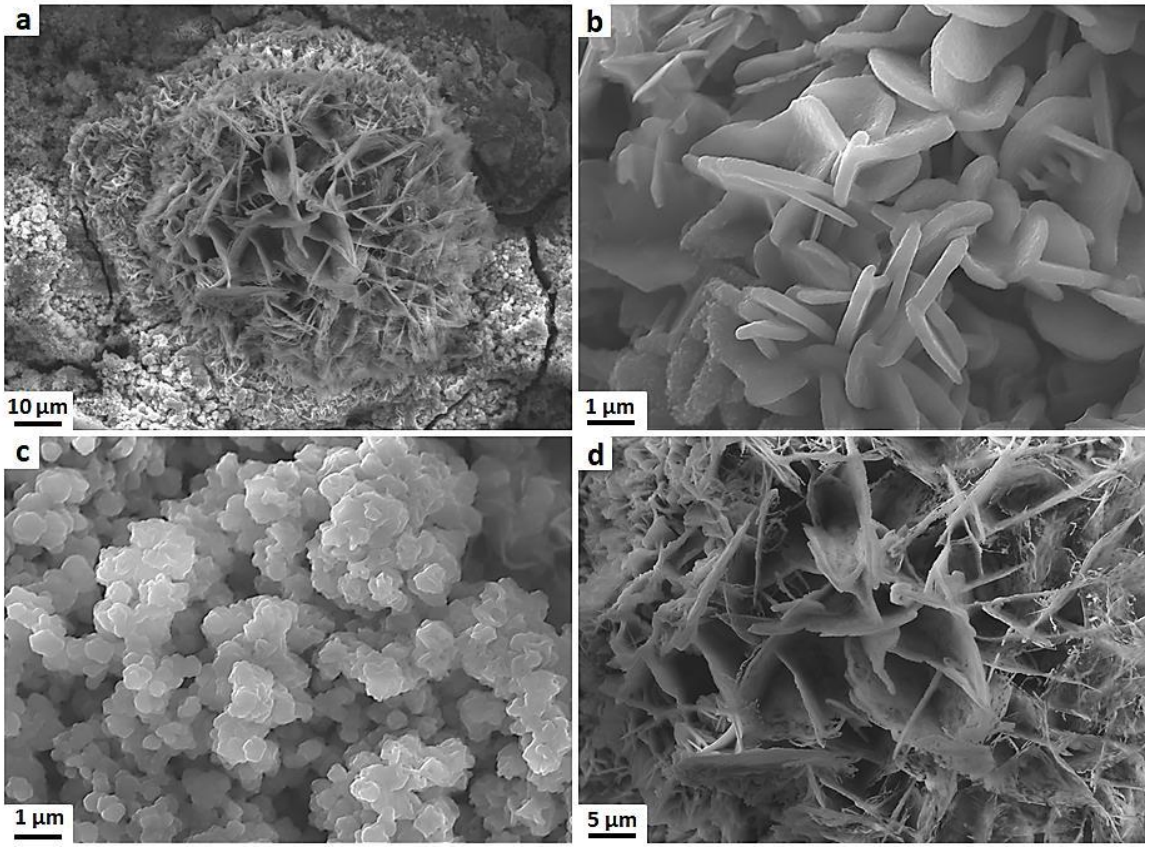


Figure 1. BSE-SEM images (a) and (c) of the electrode surface before and after the EF reaction, respectively. XEDS maps of Fe and O in images (b) and (d) acquired from the electrode surface before and after EF reaction, respectively. These results confirm the oxidative step of the anode electrode during the EF process.



References

[1] Gandhimathi and Nidheesh. **Desalination, 299**, pp. 1-15, 2012.

https://doi.org/10.1017/S1431927620022400 Published online by Cambridge University Press

[2] Brillas *et al.* **Chemical Reviews, 109**, pp. 6570-6631, 2009.
[3] Goldstein *et al*. **Scanning Electron Microscopy and X-Ray Microanalysis**, **3thEd**, 2003
[4] Santos *et al*. **Proceedings of Microscopy and Microanalysis, 25**, pp. 798-799, 2019.
[5] The authors are grateful to Peróxidos do Brasil Ltda (Solvay Group), to LABNANO/CBPF-Brazil and the Brazilian Research Funding Agencies- CNPq and Capes.

https://doi.org/10.1017/S1431927620022400 Published online by Cambridge University Press