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APPLICATION OF CATALYSTS DEVELOPED FROM COMPOST DERIVED FROM MUNICIPAL SOLID WASTE IN THE REMOVAL OF CAFFEINE BY WET PEROXIDE OXIDATION

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Nowadays, waste management through mechanical biological treatment (MBT) consists on the use of the separated organic fraction of municipal solid waste (MSW) to feed anaerobic digestion processes, resulting therein a solid stream, further processed to compost, which can be used as fertilizer. Currently, the production of compost from MBT is higher than the existing demand, and the expected developments on up-coming directives ruling "End-of-waste" criteria are leading to barriers on the use of waste-derived fertilizers (European Commision, 2013). In this context, the current work proposes an alternative strategy to the valorisation of compost, through the production of low-cost materials to be applied in the catalytic wet peroxide oxidation (CWPO) of synthetic wastewater effluents contaminated with caffeine, used as a model pollutant of emerging concern. Caffeine is the most consumed psychoactive drug worldwide. It is one of the components of painkillers, medication against migraine, fatigue, drowsiness and breathing problems. Its consumption is also associated with an overall lower risk of malignant growth like hepatocellular, endometrial or colorectal cancer (Ganzenko *et al.*, 2015). However, the effect of caffeine and its environmental degradation products on aquatic living species is not properly known. Caffeine, is a world wide consumed psychoactive drug, in a way that becomes a persistent compound and cannot be efficiently removed by municipal wastewater treatment facilities (Ganzenko *et al.*, 2015). As a consequence, caffeine and its metabolites are present in the effluents of wastewater treatment plants (Gracia-Lor *et al.*, 2017).

Several materials were prepared from compost obtained from a MBT plant for MSW in order to explore different funcionalization methods, and study the order of application of calcination. For this purpose, the compost was first washed with water and dried overnight at 105 ºC. Then, the resultant solid was treated with H_2SO_4 5 M at 80 ºC during 3 h as previously reported (Gomes *et al.*, 2011), resulting in sample CSA. The original compost and the CSA sample were calcined at 800 ºC for 4 h, resulting in samples C-800 and CSA-800, respectively. In order to explore the funcionalization with thiol and sulfonic acid groups, two additional samples were prepared from C-800 and CSA-800 using the same treatment with H_2SO_4 described above, resulting in C-800-SA and CSA-800-SA, respectively. In addition, the funcionalization with ethylene diamine tetraacetic acid (EDTA) was also explored, since EDTA is known to be a complexing agent able to interact with diferents solutes, increasing the performance of solid materials (Lv *et al.*, 2018). The treatment was carried out in a flask by mixing 0.1 g of EDTA per gramm of CSA-800 suspended (2.8 g/L) in a mixture of ethanol, water and NH_3 25% (150:25:3) at 30 ºC for 4 h, resulting in the sample CSA-800@EDTA. In order to increase the impregnation of EDTA on the surface of CSA-800, one additional sample

was prepared by treatment with tetraethyl orthosilicate (TEOS), adapting the methodology described elsewhere (Lv *et al.*, 2018). Briefly, 5 mL of TEOS per gramm of CSA-800 suspended in the same mixture of ethanol, water and NH_3 25% was added and kept under stirring at 30 ºC during 45 min. Later, 0.1 g of EDTA per gramm of CSA-800 was added and the suspension stirred at 30 ºC for 4 h, resulting in the sample CSA-800@TEOSEDTA.

Prepared catalysts were assessed in the CWPO of caffeine (Figure 1). Batch experiments were performed in a 1 L well-stirred glass reactor (Parr Instruments 5100 reactor) under the following operating conditions: 80 ºC, 500 mg/L of catalyst, 100 mg/L of caffeine and at stoichometric amount of H_2O_2 for mineralization of the caffeine solution. Several samples were withdraw from reactor media and analysed by HPLC to determine the concentration of caffeine. A colorimetric method was used to monitor the concentration of H_2O_2. As observed, all catalysts developed from compost derived from MSW show catalytic activity in the CWPO of caffeine when compared to the non-catalytic run (Figure 1). The calcination at 800 ºC (Figure 1.a) and the funtionalization (Figure 1.b) of the materials lead to an increase of the catalytic activity of the materials in the process. The catalyst prepared by treatment with sulfuric acid, calcination at 800 ºC and functionalization with EDTA (CSA-800@EDTA) was found to present the highest catalytic activity.

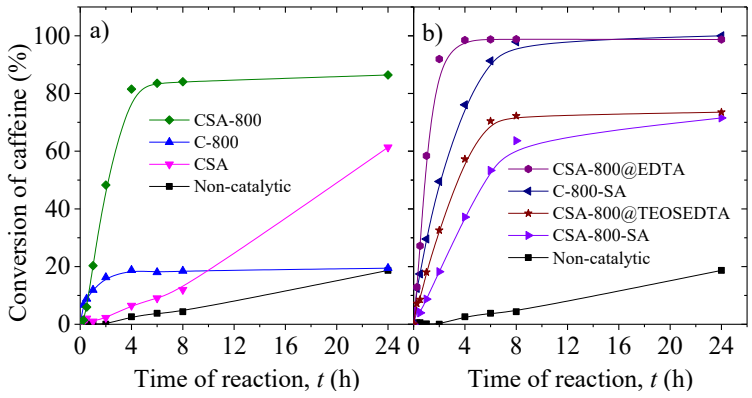

Figure 1. Screening of catalysts developed from compost in the CWPO of caffeine.

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References

European Commission, *End-of-waste criteria for biodegradable waste subjected to biological treatment (compost & digestate): Technical proposals. Final Report* (2013).
Ganzenko O., Oturan N., Huguenot D., van Hullebusch E.D., Esposito G., Oturan M.A., Separation and Purification Technology, 156 (2015) 987.
Gomes H.T., Miranda S.M., Sampaio M.J., Figueiredo J.L., Silva A.M.T., Faria J.L. Applied Catalysis B: Environmental, 106 (2011) 390.
Gracia-Lor E., Rousis N.I., Zuccato E., Bade R., Baz-Lomba J.A., Castrignanò E., Causanilles A., Hernández F., Kasprzyk-Hordern B., Kinyua J., McCall A., van Nuijs A.L.N., Plósz B.G., Raminj P., Ryud Y, Santos M.M., Thomas K., de Voogt P., Yang Z., Castiglioni S., Science of the Total Environment, 609 (2017) 1582.
Lv D., Liu Y., Zhou J., Yang K., Lou Z., Baig S.A., Xu X., Applied Surface Science, 428 (2018) 648.