



EAAOP-6

**6TH EUROPEAN CONFERENCE ON
ENVIRONMENTAL APPLICATIONS
OF ADVANCED OXIDATION
PROCESSES**

**BOOK OF
ABSTRACTS**

**26-30 June 2019
Portorož-Portorose, Slovenia**

SLOVENIAN CHEMICAL SOCIETY
 Hajdrihova 19, P.O. Box 660
 SI-1001 Ljubljana, Slovenia



Book of Abstracts

**6th European Conference on Environmental Applications of
 Advanced Oxidation Processes, Portorož – Portorose, Slovenia, 26-30 June 2019**

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Technical editor: **Taja Žgajnar, Infokart, d.o.o.**

Issued and published by:
 Slovenian Chemical Society; Ljubljana, Slovenia, June 2019.

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CIP - Kataložni zapis o publikaciji
 Narodna in univerzitetna knjižnica, Ljubljana

66:628.3(082)(0.034.2)

EUROPEAN Conference on Environmental Applications of Advanced Oxidation Processes
 (6 ; 2019 ; Portorož)

Book of abstracts [Elektronski vir] / 6th European Conference on Environmental
 Applications of Advanced Oxidation Processes - EAAOP-6, 26-30 June 2019, Portorož,
 Portorose, Slovenia ; [editors Albin Pintar ... [et al.] ; ilustrator Polona Kolar]. - Ljubljana :
 Slovenian Chemical Society, 2019

ISBN 978-961-93849-5-4
 1. Pintar, Albin
 COBISS.SI-ID 300546304

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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 Commission, 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 functionalization methods, and study the order of application of calcination. For this purpose, the compost was first washed with water and dried overnight at 105 °C. Then, the resultant solid was treated with H₂SO₄ 5 M at 80 °C 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 °C for 4 h, resulting in samples C-800 and CSA-800, respectively. In order to explore the functionalization with thiol and sulfonic acid groups, two additional samples were prepared from C-800 and CSA-800 using the same treatment with H₂SO₄ described above, resulting in C-800-SA and CSA-800-SA, respectively. In addition, the functionalization with ethylene diamine tetraacetic acid (EDTA) was also explored, since EDTA is known to be a complexing agent able to interact with different 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 gram of CSA-800 suspended (2.8 g/L) in a mixture of ethanol, water and NH₃ 25% (150:25:3) at 30 °C 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 °C during 45 min. Later, 0.1 g of EDTA per gramm of CSA-800 was added and the suspension stirred at 30 °C 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 °C, 500 mg/L of catalyst, 100 mg/L of caffeine and at stoichiometric 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 °C (Figure 1.a) and the functionalization (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 °C and functionalization with EDTA (CSA-800@EDTA) was found to present the highest catalytic activity.

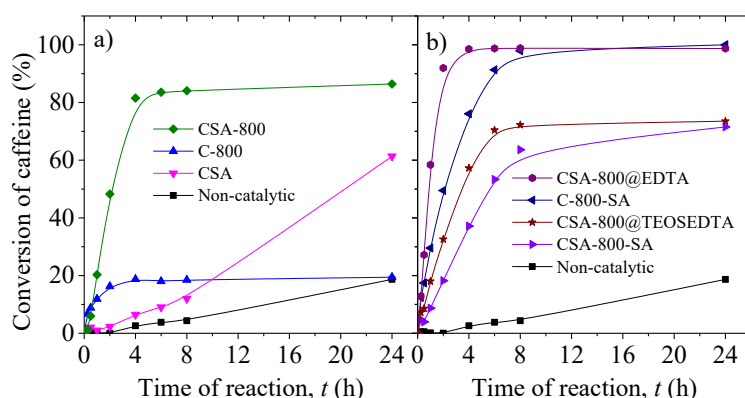


Figure 1. Screening of catalysts developed from compost in the CWPO of caffeine.

Acknowledgments. This work was financially supported by project “VALORCOMP - Valorización de compost y otros desechos procedentes de la fracción orgánica de los residuos municipales”, 0119_VALORCOMP_2_P, and project “AIProcMat@N2020 - Advanced Industrial Processes and Materials for a Sustainable Northern Region of Portugal 2020”, reference NORTE-01-0145-FEDER-000006, supported by NORTE 2020, under the Portugal 2020 Partnership Agreement, through FEDER, and Project Associate Laboratory LSRE-LCM - UID/EQU/50020/2019 - funded by national funds through FCT/MCTES (PIDDAC).

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