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COMPARISON OF CADMIUM BINDING BY HUMIC AND FULVIC ACIDS EXTRACTED FROM TWO COMPOSTS OF DIFFERENT ORIGIN

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ABSTRACT
Composting has been proven to be an environmentally friendly process for urban organic waste, that can represent an opportunity for new uses under the circular economy framework. The binding of cadmium to fulvic-like and humic-like acids extracted from compost of algae and urban residues were evaluated, and the results show significant differences. The fulvic and humic acids from algae compost bind cadmium more efficiently than those from urban residues compost. Furthermore, data from humic acids from both composts display significantly higher ability to bind to cadmium than both their corresponding fulvic acids and the generic soil extracted humic matter.

Keywords: Humic matter; Composting; Metal binding

INTRODUCTION
Compost is a material produced by controlled decomposition of the organic matter. Composting can be regarded as an environmentally friendly process that can be employed for the treatment of urban organic waste in alternative to incineration or landfill disposal [1].
The properties of compost are closely related to the presence of humic-like substances (HS), formed during the natural decomposition of organic matter, and that are operationally divided into fulvic acids (FA), which are soluble in all the pH range, humic acids (HA), that are insoluble in acidic media and humin, which is insoluble.
These substances contain a significant amount of carboxylic acids and phenolic groups that are responsible for some of their properties like their solubility and ability to complex metal ions [2].
In the scope of the project Res2ValHum [3] two different composts were selected, one from composting of algae waste (CWA) and another from the domestic composting of selective organic urban residues (COUR), and compared the fulvic acid (FA) and the humic acid (HA) extracts regarding their ability to bind Cd^{2+}. The free cadmium ion was measured using an electroanalytical technique, absence of gradients and nernstian equilibrium stripping, AGNES [4]. The purpose of this study is to provide insight on the effect of the nature of the biomass on the properties of the HS.

RESULTS AND DISCUSSION
Table 1 show the amount of fulvic-like and humic-like acids obtained from the extractions performed to these composts following the procedure recommended by the IHSS [5]. These

results show that similar amounts of humic substances are formed by composting despite of the different nature of the two samples of biomass.

Table 1 – Amount of humic-like and fulvic-like acids obtained from the extractions performed to the algae and to the urban residues compost.

	Humic acid [% compost]	Fulvic acid [% compost]
waste algae compost	1.99	0.27
organic urban residues compost	1.90	0.42

Figure 1 resumes the experimental data, obtained by AGNES, for cadmium binding by fulvic-like and humic-like acids from composts produced from waste algae and from organic urban residues.

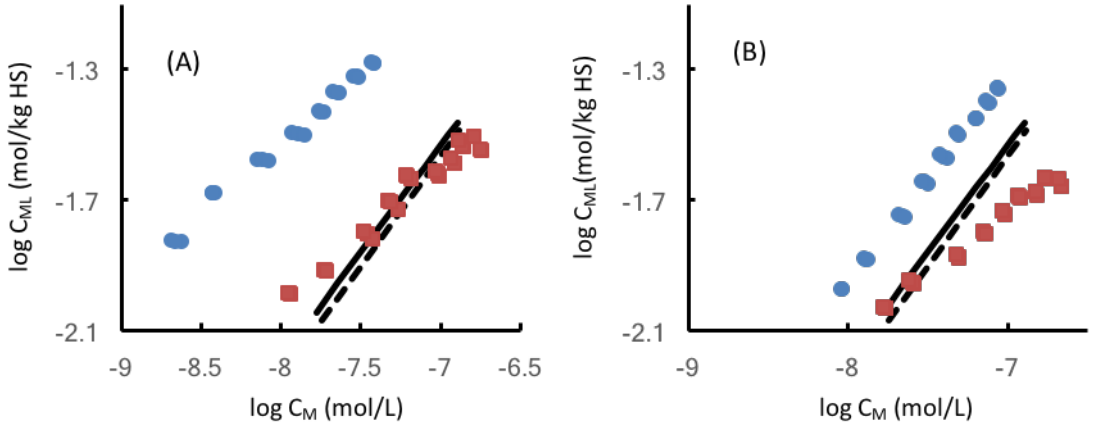

Fig. 1 Plots showing experimental data, obtained by AGNES, for the cadmium binding by fulvic (■) and humic (●) acids of algae compost (A) and urban residues compost (B), compared with the NICA-Donnan model description [6] using the generic parameters for humic acids (solid line) and fulvic acids (dashed line) from soil.

Experimental results for FA and HA are compared with the predicted ones for cadmium complexation obtained using Visual MINTEQ [7] with the generic parameters for protons [8] and cadmium [6]. Results show significant differences regarding the binding of cadmium to fulvic-like and humic-like acids extracted from CWA and COUR. The humic-like substances from CWA bind cadmium more efficiently than those from COUR. Data from humic-like acids from both composts display significantly higher ability to bind to cadmium than both their corresponding fulvic acids and the generic soil extracted humic matter.
The observed differences between experimental results and the predicted using the generic parameters for humic substances of soil show that the humic-like substances formed by composting have a higher capacity to bind cadmium and a larger degree of heterogeneity than the natural occurring humic substances.

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