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OPTIMIZED METHOD FOR THE DETERMINATION OF ARSENIC, CADMIUM AND LEAD FROM THE BIOMASS WASTES

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Introduction

The recycling and reuse of the biomass wastes as added-value materials, for different productive sectors is essential from an economic and environmental perspective. The advantage of this process consists in reducing costs for biomass power producers and favoring the development of a circular and sustainable economy. The biomass wastes transformed in pellets and briquettes are used as secondary biofuels in combustion plant. The characteristics of biofuels, which will influence the combustion plant, are the moisture, ash content, net calorific value, the proportion of volatile matter, combustible carbon content and also the toxic metals content. The excessive accumulation of toxic metals such as As, Cd, Pb in some biomass waste presents a risk for human health.

The purpose of the study was to establish an optimal method of determination for toxic elements (As, Cd and Pb) from the biomass wastes, in order to indicate additional data for the valorisation process.

Materials and methods

To accomplish the study were selected some types of biomass ashes coming from: agriculture (P1), forestry (P2) and food industry (P3). The moisture content was approx. 3%– 3.7% for all the analysed samples. The biomass samples were thermal treated with two different methods, such as: calcination at 550ºC (method I), respectively at 820ºC (method II) for 1h in a calcination oven.

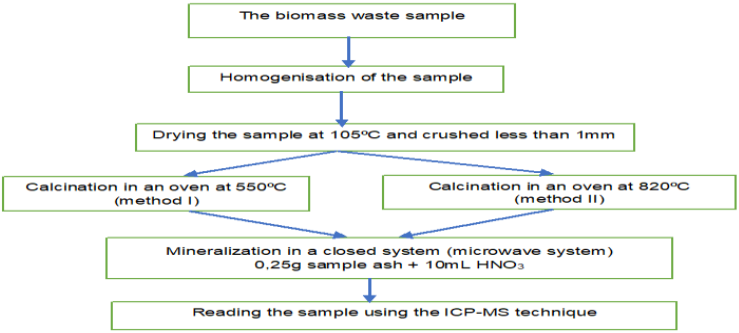

Figure 1. The sample of the preparation scheme

Results and conclusions

Determination of the As, Cd, Pb in the biomass ash

In table 1 are presented the values of performance parameters obtained in the in-house validation experiments using applied analytical method (ICP-MS technique).

Table 1. Performance parameters of As, Cd and Pb using ICP-MS technique

Metals	LOD (mg/Kg)	LOQ (mg/Kg)	Acuracy (mg/Kg)	RSD_r* (%)	RSD_{Ri}** (%)	U_{ex}*** (%)	Recovery (%)
As	0.04	0.15	0.05	0.64	2.14	17.67	84
Cd	0.06	0.19	0.13	0.61	1.92	18.33	90
Pb	0.08	0.27	0.06	0.81	1.95	16.52	92

*Repeatability; **Intermediate precision; ***Measurement uncertainty

The differences between three biomass wastes include the moisture content and chemical composition of the biomass ash wastes, which will have a potential effect on the plant combustion efficiency.

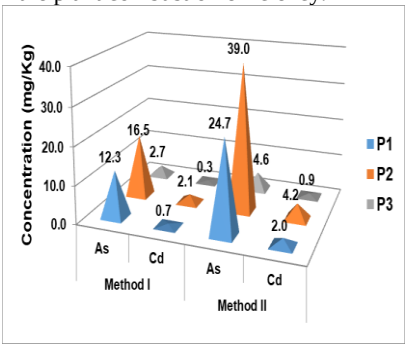

Figure 2. Graphic representantion of As and Cd concentrations

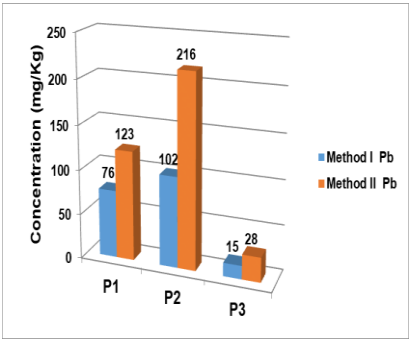

Figure 3. Graphic representantion of Pb concentrations

In the P2 sample ash it was obtained a higher metal concentrations compared to the other two samples as shown in Figure 2 and 3. The lead highlighted a higher concentration for the P2 sample coming from the wood waste (Figure 3).

Biomass sample calcination at 550°C can give inaccurate results from ICP-MS analysis as result of significant unburned carbon content, retained in the ash mass. Processing the sample at a temperature of 820°C produces an ash composition more suitable for ICP-MS analysis. The recovery percentage were higher that 84%, the highest recovery yields (>90%) was obtained for cadmium and lead. As a conclusion, method calcination at 820°C is suitable for the characterization of the toxic elements As, Cd and Pb from the biomass wastes. The amount of the ash and the metals content gives us valuable information for the reusable biomass wastes, these being potential materials for valorisation as pellets or briquettes.

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