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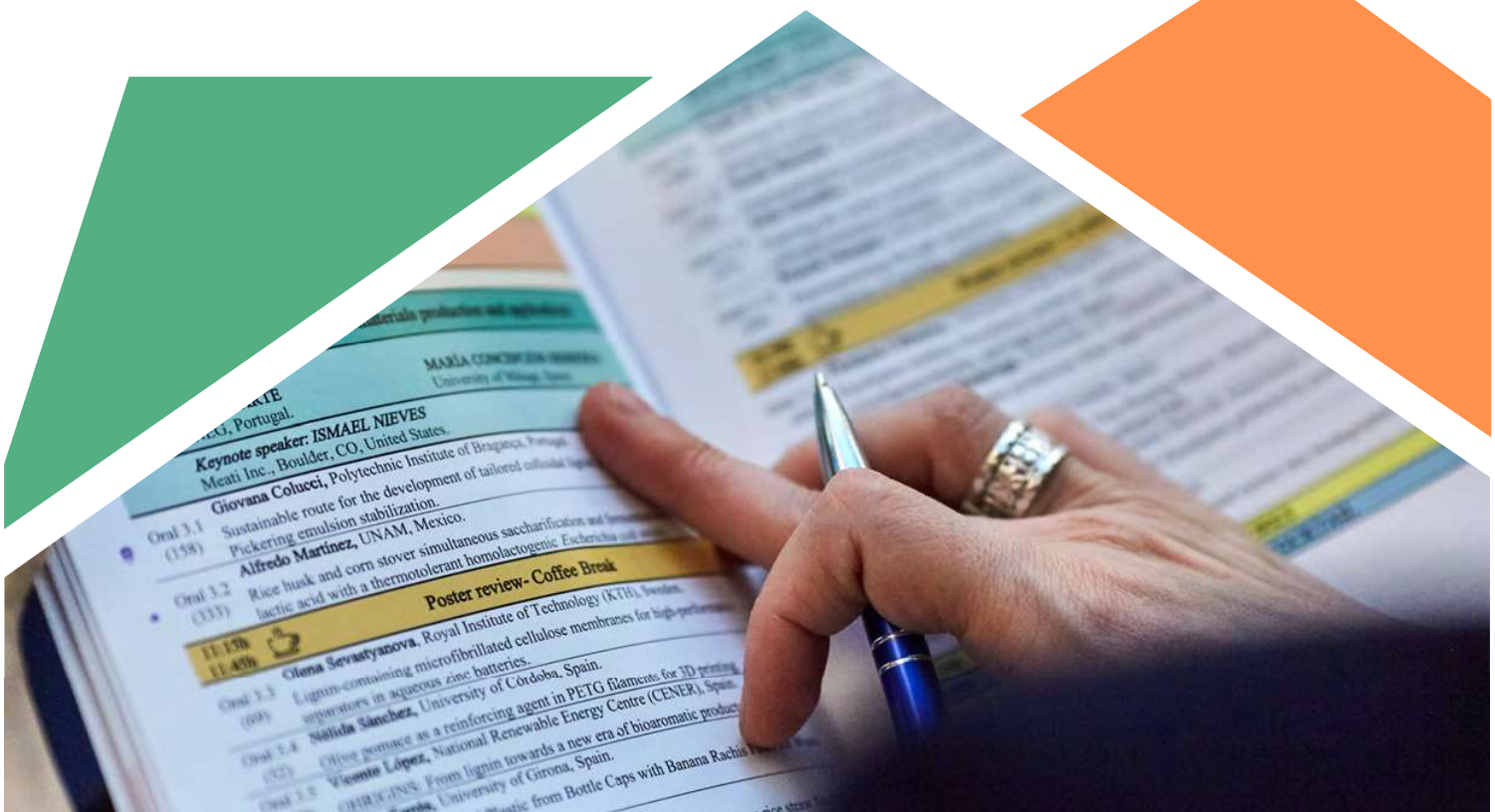
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ADVANCEMENTS IN BIOREFINERY TECHNOLOGIES AND FRACTIONATION OF BIOMASS (Index)

An expedite methodology for identification of inorganic contaminants in biomass origin feedstock: wavelength dispersive x-ray fluorescence (WD-XRF) spectrometry

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Keywords: Biomass feedstocks; WD-XRF; inorganic contaminants; characterization

Abstract

The use of biomass feedstock for bioenergy production has increased in recent years. In the context of a circular economy, wastes such as municipal solid wastes and industrial wastes (namely by-products from agro-food wastes, agro-livestock wastes and sewage sludge) have been tested as new feedstocks of biomass origin. However, the presence of some inorganic contaminants in these new feedstocks might be problematic for thermochemical and biochemical conversion processes.

Wavelength Dispersive X-Ray Fluorescence (WD-XRF) spectrometry is an easy and fast technique that uses only a small amount of sample, presenting a low contamination risk and is a non-destructive methodology. Thus, if potential contaminants are identified, then samples remain available for subsequent analysis.

In the aim of the Horizon 2020 project "BRISK2 - Biomass Research Infrastructure" (https://brisk2.eu/) an expedite methodology was developed in order to better evaluate the use of endogenous biomasses for energy production by biochemical or thermochemical processes. In this study five samples received from project partners were used: beech wood chips, *Ulva Lactuca*, palm kernel, brewers grains and *Miscanthus* pellets.

In a first step, qualitative analysis, *i.e.* examination to identify the presence of elements in each sample, was performed following a procedure based on the ISO/TS 16996:2015 but using directly the milled biomass dried at (105 ± 2) ºC. All measurements were carried out by WD-XRF spectrometry using an AXIOS sequential wavelength dispersive spectrometer, fitted with a 4 kW generator and a rhodium anode X-ray super sharp tube and using five crystals (LiF220, LiF200, Ge, PE and PX1) and controlled by PANalytical SuperQ through the IQ+ analytical software, by referring to a database for elemental identification.

Afterwards, the values given by the equipament software, were normalized taking into account each ash mass fraction at (550 ± 10) ºC. This step was the basis of the semiquantative analysis. The mass fraction level of each element were then classified on the in-house classification ranges: major elements [$\omega > 4$ %(m/m)], minor elements [1 %(m/m) < ω < 4 %(m/m)] and trace elements [$\omega < 1$ %(m/m)], where ω represents the mass fraction (m/m) in dry basis at 105 °C.

The validation of this procedure was performed by comparison among certified values of biomass materials and the results obtained by both the expedite methodology and the classification ranges proposed. Five biomass certified reference materials from the National Institute of Standards and Technology and the Community Bureau of Reference and seven solid biofuels from DCC and BIMEP Proficiency Testing were considered in order to enlarge the elemental mass fraction ranges.

In conclusion, WD-XRF spectrometry proved to be an expedite methodology for mass fraction range prediction of inorganic contaminants in biomass origin feedstock and could be used as an approach to new feedstock, that are few or still to be explored. Furthermore, in the cases of inorganic contaminant identification, the same sample may go to subsequent analysis.

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