"*Organic Petrology Research and Applications for the 21st Century*"
Oviedo, Spain, September 22 - 29, 2024

CHARACTERIZATION OF THE ASH SAMPLES USED FOR THERMAL RECOVERY OF PHOSPHORUS

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Objective

The present paper presents a prospect of poultry manure ash samples used to recover phosphorus (P) for biofertilizer application.

Experiments & Results

•The P-rich ash samples produced at different temperatures (750 °C and 950 °C) were collected from some Fluidized Bed Combustion Power Plants from Türkiye, respectively Güres and Beypi burning laying hens' manure, and INEVA and MIMSAN burning sewage sludge.

•The ashes were analysed using a multi-technique combination including proximate analysis, total sulphur by Escka and LECO method, and XRF for P_2O_5 determination, respectively, incident light microscopy for morphotypes identification, and SEM-EDS for detailed imaging.

•Proximate and elemental results reveal moisture variation between 0.08 wt.% and 0.48 wt.%, while the ash content (on a dry basis; db) ranged from 71.68 wt.% to 99.71 wt.%. The volatile matter (db) ranged between 0.29% and 4.40%, and the fixed carbon (db) reached up to 25.96%. Additionally, total sulfur content (db) spanned from 0.65 % to 8.72%. XRF investigations show that the concentration of P_2O_5 in the P-rich ashes ranged from 6.3 wt.% to 19.37 wt.%. The highest P content (8.52%) was found in Güres cyclone ash.

•The morphological aspect of the ash particles resulting from the combustion of sewage sludge (SS) from the INEVA and MIMSAN samples are shown in Figure 1A-1C. These particles' morphology is spherical, and many have very high reflectance, evidencing the presence of metal oxides.

•Examples of Güres bottom ash (BA) and fly ash (FA) are shown in Figure 1D-1L. Both ash types contain residual isotropic and slightly porous biomass carbon Figures 1D-1F. The BA essentially consists of calcium carbonate sand (Fig. 1G and 1H), and this sand partially decomposed and surrounded by Ca-K-S-P-rich rims (Fig. 1G). Other materials in these BA include silicate sand bed led to Si-K-Ca-S-P-rich rims and bone fragments (Fig. 1I and1J).

•Güres cyclone fly ash (CY) is composed of particles with sizes ranging between 25 µm and 200 µm, primarily consisting of fragments of calcium carbonate sand, rims, and bone, and discrete particles of manure that in part or totally underwent thermal transformation forming phosphospheres without reacting with the fluidized bed sand. This FA also contains fragments of cereal husk silica relics and small-sized silica sand (Fig. 1K-L).

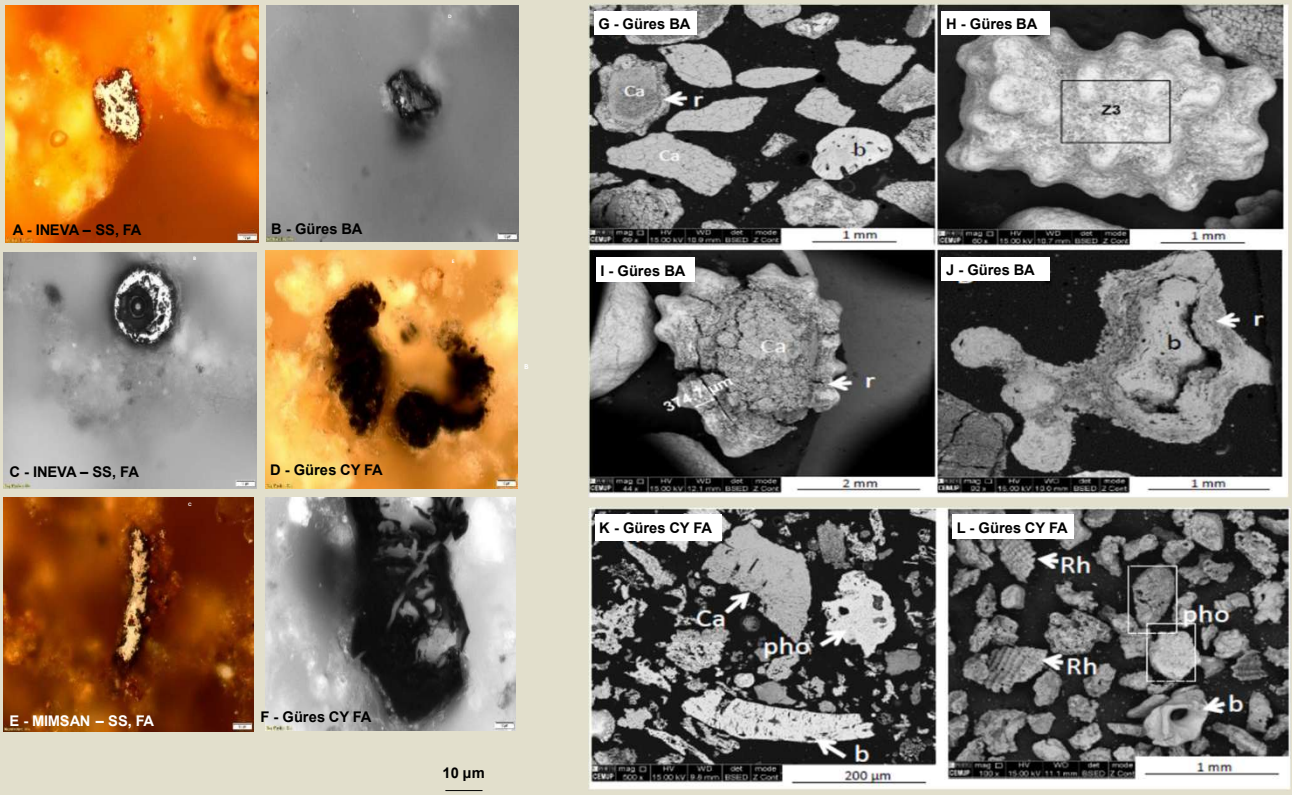

Figure 1: A-F, (Incident light microscopy) bright morphotypes (A-C; INEVA and MIMSAN ash); residual char (D-F; Güres ash; G-L, (SEM BSE mode) Güres ashes (G, I and K polished block; b –bone, Pho – phosphospheres, r – rim, Rh – rish husk silica).

Conclusions

Compared with sewage sludge ash and laying hens' manure BA, the concentration of P_2O_5 is the highest in the laying hens' manure FA.

The type of fluidizing sand bed used has a major influence on the composition of the BA and FA in the laying hens' manure ashes.

Compared with the BA, the FA is thinner, and the morphotype composition is more heterogeneous and mainly composed of fragments.

Acknowledgements
The authors acknowledge the ERA-MIN3 Joint Call (2021) for funding the PHIGO project through Vinnova -Sweden (ref. 2022-00072), TUBITAK-Türkiye (ref. 122N038), UEFISCDI-Romania (ref. 310/01.03.2022). B.V. thanks FCT-Portugal (UIDB/04683/2020; UIDP/04683/2020).