

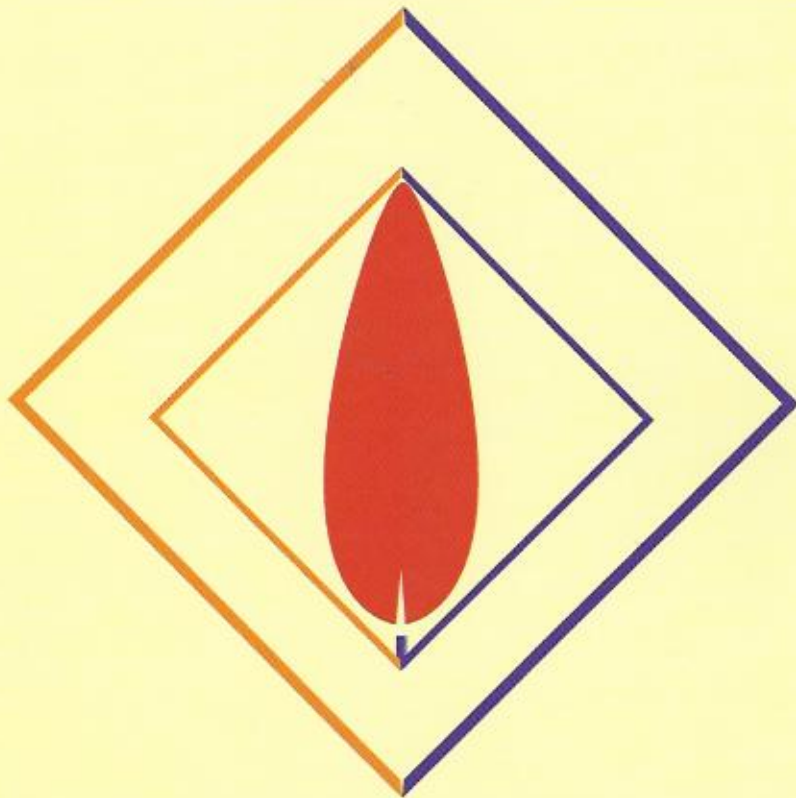
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# BOOK OF ABSTRACTS

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## PHYTOREMEDIATION DRIVEN ENERGY CROPS PRODUCTION ON HEAVY METAL DEGRADED AREAS AS LOCAL ENERGY CARRIER - LAB TESTS RESULTS OF THE 1<sup>ST</sup> YEAR BIOMASS FEEDSTOCK AND SOLID GASIFICATION RESIDUES PROPERTIES

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### ABSTRACT

The scope of the lab tests is to determine the characteristics of the physical and chemical characteristics of the year 1 biomass, ash and tar samples from the control year samples of *Miscanthus x giganteus*, *Sida hermaphrodita*, *Panicum virgatum*, *Spartina pectinata*.

The lab tests carried out and the methods used for determinations were as it follows:

- Elemental Analysis – using PO-ATI-16 Method / PERKIN-ELMER 2400
- Total Organic Carbon and Nitrogen determination - MULTI N/C 2100
- FTIR analysis with spectrum GX PERKIN-ELMER Spectrometer

### BIOMASS ELEMENTAL ANALYSIS

Determinations were made using PO-ATI-16 Method. The value obtained during the biomass experimental tests and presented below represents the average of two determinations.

The largest share of chemical components in all the biomass samples is for oxygen and carbon, while nitrogen has the smallest share.

Content of heavy metals, chlorine, volatile matter (VOC and TOC) and moisture in the biomass samples supplied for gasification test by were analysed.

The highest concentration of lead was found for *Panicum virgatum* (86.96 mg/kg) and *Spartina pectinata* (92.66 mg/kg), while for cadmium in the tissues of *Sida hermaphrodia* (5.20 mg/kg). For zinc the lowest concentration was found for *Miscanthus x giganteus* (83.28 mg/kg), while for other tested plants were slightly higher in the range 120-150 mg/kg.

The highest concentration of chlorine (Cl-) level was found for *Miscanthus x giganteus* (417.4 mg/kg), followed by *Panicum virgatum* (343.4 mg/kg), *Spartina pectinata* (174.4 mg/kg) and *Sida*



*hermaphrodita* (98.3 mg/kg).

## END-PRODUCTS ANALYSIS

### Ash

Analysing the content of metals in the ashes after gasification, resulted that the maximum content of lead was for *Miscanthus x giganteus* (240 mg/kg d.w.) and *Sida hermaphrodita* (227 mg/kg d.w.) while for *Spartina pectinata* and *Panicum virgatum* the lead content is of 120.1 mg/kg d.w. In case of cadmium, the lowest concentrations were registered for *Miscanthus x giganteus* and *Panicum virgatum* (<0.6 mg/kg d.w.) while the highest value is for *Spartina pectinata* (9.8 mg/kg d.w.). For zinc, the maximum content was found for *Sida hermaphrodita* 794.2 mg/kg d.w. and the minimum content was found for *Miscanthus x giganteus* 219.0 mg/kg d.w.

The level of chlorine is the lowest for *Panicum virgatum* (639.9 mg/kg d.w.) and the highest for *Spartina pectinata* (1305.0 mg/kg d.w.).

Electrical conductivity (EC) has the highest value for *Sida hermaphrodita* (3610  $\mu\text{S/cm}$ ), followed by *Miscanthus x giganteus* (1681  $\mu\text{S/cm}$ ), *Panicum virgatum* (1045  $\mu\text{S/cm}$ ) and *Spartina pectinata* (789  $\mu\text{S/cm}$ ).

The levels of nutrients ( $\text{P}_2\text{O}_5$ ,  $\text{K}_2\text{O}$ ) in ashes of tested plant species are the range of 0.19 to 0.33 %w/w for  $\text{P}_2\text{O}_5$ , respectively 0.22 to 1.33% w/w for  $\text{K}_2\text{O}$ .

Ash fusion temperatures and particle size distribution couldn't be determined by the laboratory because of the small quantity of the ash samples.

### Tar

In case of tar analysis, the content of metals in the ashes after gasification, we can see that the maximum content of lead is for *Miscanthus x giganteus* (67.60 mg/kg d.w.) and *Sida hermaphrodita* (30.51 mg/kg d.w.) while for *Spartina pectinata* and *Panicum virgatum* the lead content is the lowest (23.29 mg/kg d.w., respectively 23.32 mg/kg d.w.). For zinc, the maximum content was found for *Miscanthus x giganteus* (30.67 mg/kg d.w.) and the minimum content was found for *Panicum virgatum* (11.63 mg/kg d.w.).

The level of chlorine is the lowest for *Sida hermaphrodita* and *Panicum virgatum* (392.6 mg/kg, respectively 400.0 mg/kg d.w.) and the highest for *Spartina pectinata* (632.9 mg/kg d.w.).

Electrical conductivity (EC) has the highest value for *Sida hermaphrodita* (1883  $\mu\text{S/cm}$ ), followed by *Miscanthus x giganteus* (1806  $\mu\text{S/cm}$ ), *Spartina pectinata* (1566  $\mu\text{S/cm}$ ) and *Panicum virgatum* (1012  $\mu\text{S/cm}$ ).

The levels of nutrients ( $\text{P}_2\text{O}_5$ ,  $\text{K}_2\text{O}$ ) in tar of tested plant species are very different that in case of the ashes. For  $\text{P}_2\text{O}_5$  were registered values of 50 mg/kg d.w. for *Miscanthus x giganteus*, 90 mg/kg d.w. for *Sida hermaphrodita* and 30 mg/kg d.w. for *Spartina pectinata*, while for *Panicum virgatum* was registered a value below 10 mg/kg d.w. For  $\text{K}_2\text{O}$ , the smallest value was registered for *Spartina pectinata* (84.05 mg/kg d.w.) and the largest for *Miscanthus x giganteus* (250.00 mg/kg d.w.).

## FTIR ANALYSIS

After elemental analysis of biomass samples, FTIR analysis for each biomass, tar and ash sample were carried out, resulting different FTIR spectrum for the all four biomass samples.

The *Miscanthus x giganteus*, *Sida Hermaphrodita*, *Panicum virgatum*, *Spartina pectinata* biomass, and tar and ash samples were analysed by FTIR spectrometry, ATR technique, with a Spectrum GX Perkin Elmer spectrometer.

For each analysed sample were illustrated FTIR spectrum for biomass, tar and ash.

## CONCLUSIONS

### • Biomass

- ✓ *Spartina pectinata* has the highest absorbance for lead (Pb) and zinc (Zn) from soil, while for cadmium (Cd) the highest absorbance is for *Sida hermaphrodita*;
- ✓ The highest concentration of chlorine (Cl<sup>-</sup>) level was found for *Miscanthus x giganteus* (417.4 mg/kg), followed by *Panicum virgatum* (343.4 mg/kg), *Spartina pectinata* (174.4 mg/kg) and *Sida hermaphrodita* (98.3 mg/kg);
- ✓ In case of volatile matter, the largest quantity is for *Panicum virgatum* (13336.6 mg/kg), meaning a value about 2 times larger than in case of *Miscanthus x giganteus* and *Spartina pectinata* and about 3 times larger than in case of *Sida hermaphrodita*.

### • Ash

- ✓ the ashes from *Miscanthus x giganteus* gasification contained the largest quantity of lead

(Pb);

- ✓ the largest quantity of cadmium (Cd) was found in the ashes from *Spartina pectinata*;
  - ✓ the largest quantity of zinc (Zn) was found in the ashes from *Sida hermaphrodita*;
  - ✓ the levels of nutrients (P<sub>2</sub>O<sub>5</sub>, K<sub>2</sub>O) in ashes of tested plant species are the range of 0.19 to 0.33 %w/w for P<sub>2</sub>O<sub>5</sub>, respectively 0.22 to 1.33% w/w for K<sub>2</sub>O, with the highest values for *Sida hermaphrodita*.
- **Tar**
- ✓ The lead (Pb) and zinc (Zn) content have the highest values for *Miscanthus x giganteus* and the smallest values for *Panicum virgatum*, while the cadmium (Cd) content was below determination limit (<DL) for all the tar samples.
  - ✓ The levels of nutrients (P<sub>2</sub>O<sub>5</sub>, K<sub>2</sub>O) are very different that in case of the ashes. For P<sub>2</sub>O<sub>5</sub> were registered values of 50 mg/kg d.w. for *Miscanthus x giganteus*, 90 mg/kg d.w. for *Sida hermaphrodita* and 30 mg/kg d.w. for *Spartina pectinata*, while for *Panicum virgatum* was registered a value below 10 mg/kg d.w. For K<sub>2</sub>O, the smallest value was registered for *Spartina pectinata* (84.05 mg/kg d.w) and the largest for *Miscanthus x giganteus* (250.00 mg/kg d.w.)

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