

The characterization of heavy metals in waste-based fuel by SEM-EDS and LA-ICP-MS

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1 Introduction

Waste materials are a potential source of fuel, since they contain biomass, paper, cardboard, plastics, rubber, and fabrics. Inorganic compounds that constitute ash may cause problems in the boilers and have environmental consequences. The knowledge of the chemical composition of fuel and ash will provide better understanding of the factors behind these problems.

SEM-EDS provides information about the spatial distribution of the chemical composition instead of average bulk concentrations. SEM-EDS results can be visualized by use of the quasiternary diagrams providing detailed information of the compositional distribution. LA-ICP-MS is suitable for the determination of trace contents of, for instance heavy metals. By combining the information obtained from fuel samples by different analytical methods, it may be possible to predict and prevent the fuel- and ash-related problems in boilers.

2 Objectives of the research

In this study, three waste-based fuels (I-III) have been analyzed. Samples I-II are household waste-based fuels, and sample III was wood-based fuel sample. SEM-EDS was used for quantitative determinations and LA-ICP-MS for qualitative examination.

3 Results

The results of the samples III have been visualized by quasiternary diagrams shown in Fig. 1. Sample I is a mixture of silicates. The content of phosphorus is substantially higher in sample II than in sample I. The calcium content is also higher in sample II than in sample I. Samples II and III contain heavy metals such as zinc, lead and titanium. Zinc and titanium are used as pigments in paints and lead may originate from building materials, especially in sample III (Fig. 1).

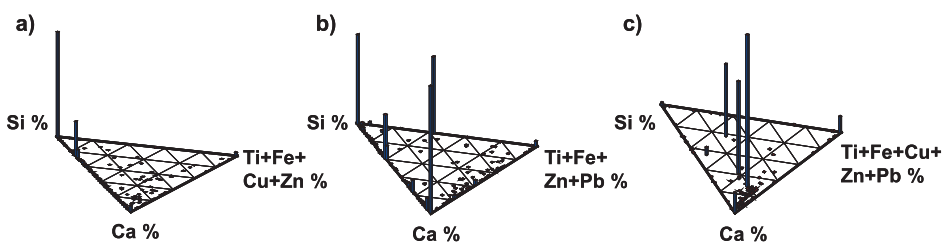


Figure 1 The quasiternary diagrams of the samples I, II, and III

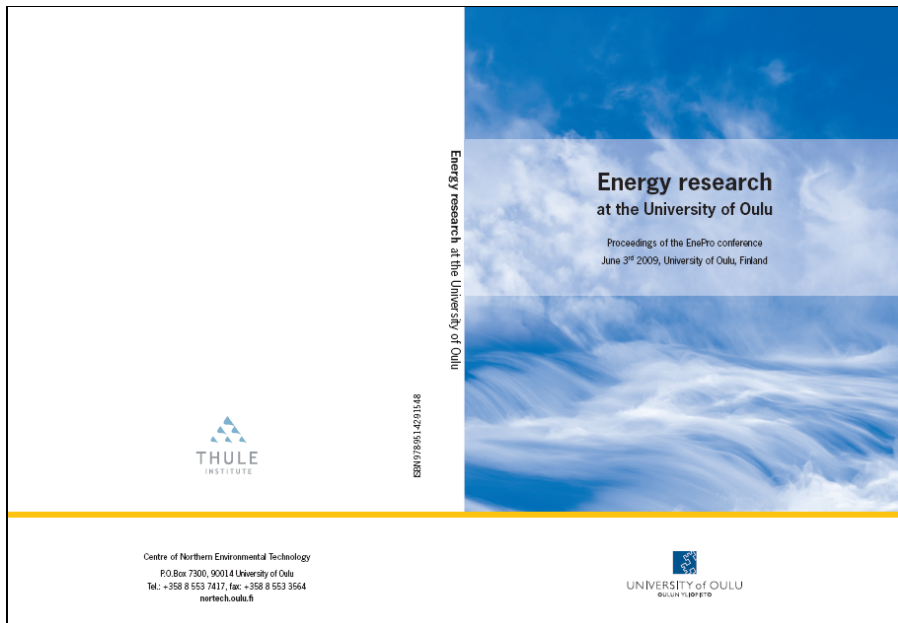
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References

- Manninen H, Peltola K and Ruuskanen J (1997) Co-combustion of refuse-derived and packaging-derived fuels (RDF and PDF) with conventional fuels *Waste Management & Research* 15:137–147
- Spears DA (2004) The use of laser ablation inductively coupled plasma-mass spectrometry (LA- ICP-MS) for the analysis of fly ash *Fuel* 83(13) 1765–1770.
- Spears DA and Martinez-Tarrazona MR (2004) Trace elements in combustion residues from a UK power station *Fuel* 83(17–18) 2265–2270.
- Sørum L, Øyvind S, Glarborg P, Jensen A and Dam-Johansen K (2001) Formation of NO From Combustion of Volatiles From Municipal Solid Wastes *Combustion and flame* 123:195–212.
- Virtanen ME, Heikkinen REA, Patrikainen HT, Laitinen RS, Skrifvars B-J and Hupa M (1999) A Novel Application of CCSEM for Studying Agglomeration in Fluidised Bed Combustion In: Gupta RP, Wall TF and Baxter LL (eds.) *Impact of Mineral Impurities in Solid Fuel Combustion*, Kluwer Academic Plenum Publishers, New York, 147–154.
- Virtanen ME, Tiainen MS and Laitinen RS (2000) SEM-EDS and Image Analysis in the Characterisation of Coatings and Adhesive Material in the Quartz-bed Proc. 11.–14.4., Porto, Portugal, 117–126.
- Virtanen ME, Tiainen MS, Pudas M and Laitinen RS (2001) A Tool for Visualization and Statistical Analysis of SEM-EDS Data In: Bridgewater AV (ed.) *Progress in Thermochemical Biomass Conversion*, Blackwell Science, Cornwall, 671–677.

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