

# The Suitability of Horse Manure and Bedding Materials for Combustion

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## 1 Introduction

The number of horses has increased in Finland since 1994 approximately by 2000 horse/year and 2008 there was almost 70000 registered horses and ponies in Finland. This has derived to a considerable number of new stables at city area where the waste management, particularly of the mixture of manure and bedding material, is a challenge (Kauppinen, 2005). These stables have disposed their residues often by land filling. The present legislation prohibits the dispose of organic material by land filling since the anaerobic decomposition emits for example methane that is a greenhouse gas (Maa- ja metsätalousministeriö, 2007). The legislation also regulates using of manure as fertilizer in fields (Valtioneuvosto, 2000). This leads to the situation where stable owners have urge for new ways to dispose of residues.

## 2 Objectives of the research

In Finland peat, sawdust, and straw are commonly used as a bedding material for horses in stable boxes. (Airaksinen, 2006) The more important function of the bedding material is to keep the boxes dry and clean by absorbing urine. The selection of bedding material depends on the properties of the materials such as availability, price, absorption capacity, and hygiene properties.

Composting of sawdust is slower than peat, therefore mixture of manure and sawdust is not preferred for utilization as fertilizer. (Airaksinen, 2001) Additionally use of the manure residues as fertilizers is limited by impurities such as plant seeds in manure. Combustion would be attractive way to solve disposal problems of the mixture of manure and bedding materials. At the moment legislation in Finland defines manure residues as a waste (Ympäristöministeriö 2003). Therefore the combustion is only allowed in waste combustion units (Valtioneuvosto, 2003). If the combustion of the manure residues would be allowed at farms or at small local boilers, it enables farms to have better degree of self-sufficiency of energy.

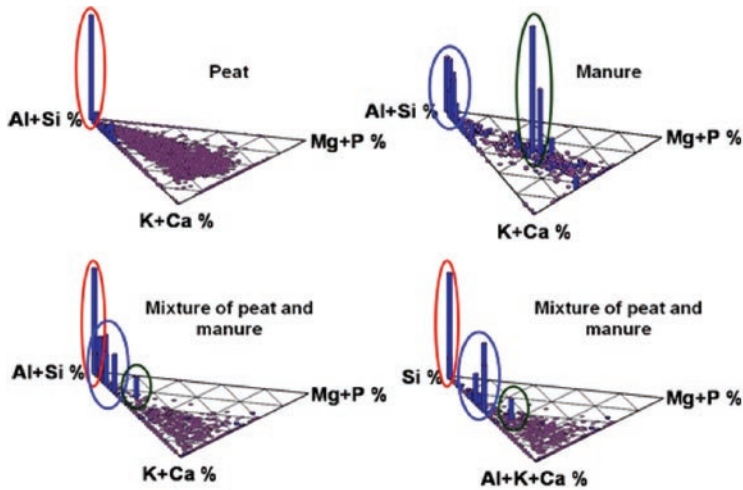
The utilization of these new materials as a fuel demands study of combustion properties of these biomasses. It is also essential to have knowledge of chemical composition and behaviour of ashes, when the final disposing is considered e.g. as fertilizers or soil enrichment substances. Our research consisted several analyses for peat, sawdust, manure samples and residue mixtures.

## 3 Results

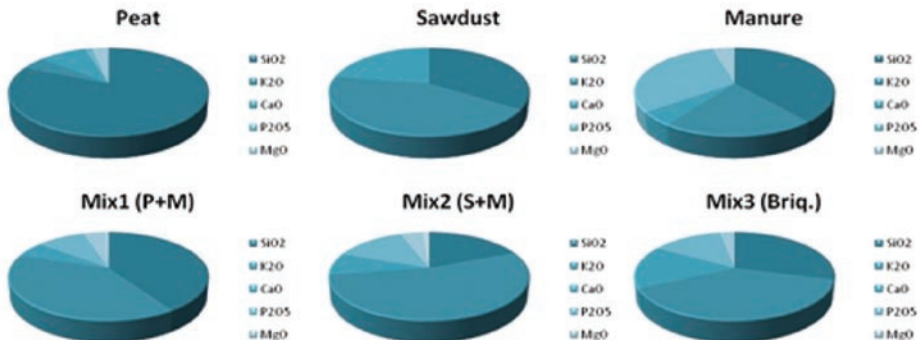
Moisture and ash contents for all the samples were determined (ISO-589, 2003, SS 18 71 71, 1984) and results were comparable with results from previous studies of peat and sawdust (Zevenhoven, 2001). The C, H, N, S determinations suggested that NO<sub>x</sub> and SO<sub>x</sub> emissions would be unsubstantial. Chemical compositions of the samples were characterized

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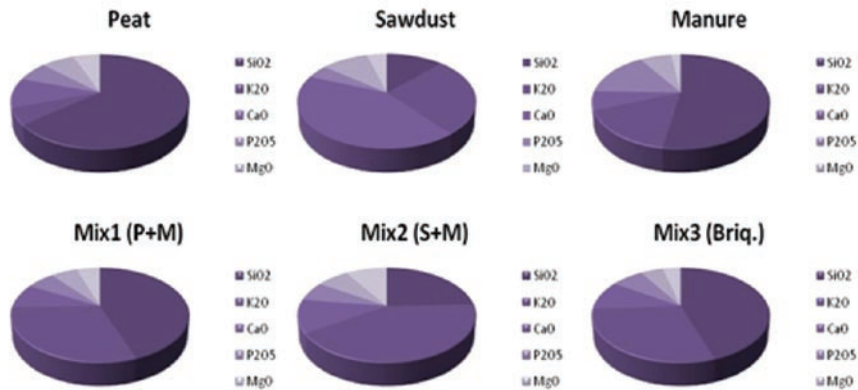
by SEM-EDS (Scanning Electron Microscope-Energy Dispersive X-Ray Spectrometry) and ICP-OES (Inductively Coupled Plasma-Optical Emission Spectroscopy). Solid fuel and ash samples were characterised by SEM-EDS and results were visualized by a quasiternary diagrams (Figure 1). The chemical compositions for the main ash-forming elements of the liquid fuel and ash samples are shown in Figure 2 and in Figure 3.



**Figure 1** Chemical compositions of the peat, manure and mixture samples presented as a quasiternary diagram.



**Figure 2** Liquid fuel samples analysed by ICP-OES.



**Figure 3** Liquid ash samples analysed by ICP-OES.

#### 4 Relevance of the research

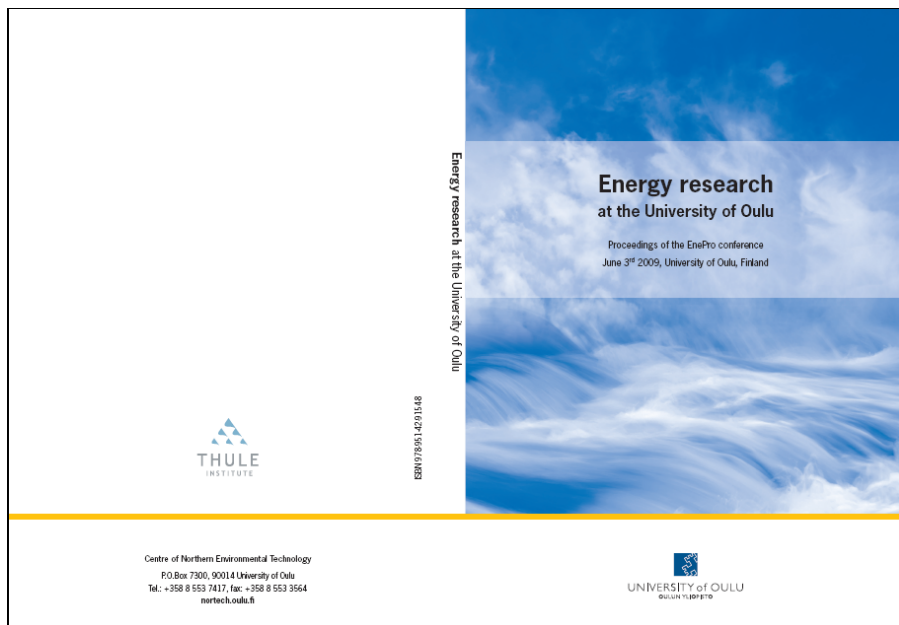
Extensional studies are required especially to predict released emissions and ash related problems before manure residues are allowed to combust in small scale boilers. According to our study it can be concluded that horse stable residues could be suitable combustion material and combustion would be suitable way to dissolve stable residue disposal problem. More details will be presented in our poster.

#### References

- Airaksinen S (2006) Bedding and Manure Management in Horse Stables. Kuopio Univ. Publ. C. Nat. and Environ. Sci-Kuopio, 20–21.
- Airaksinen S, Heinonen-Tanski H, Heiskanen M-L (2001) Quality of Different Bedding Materials and Their Influence on the Compostability of Horse Manure *Journal of Equine Veterinary Science* Vol.(21), 125–130.
- ISO-589 (2003) Hard Coal-Determination of Total Moisture, International Organization for Standardization.
- Kauppinen P (2005) Hevosen lannan hyötykäytön mahdollisuudet, Bioenergiakeskuksen julkaisusarja, Jyväskylän ammattikorkeakoulu, (12), 6–9.
- Maa- ja metsätalousministeriö (2007) Maa- ja metsätalousministeriön asetus lannoitevalmisteista, (12/2007).
- SS 18 71 71(1984), Biobränslen – Bestämning av askhalt, Sveriges Mekanstandardisering.
- Valtioneuvosto (2003) Valtioneuvoston asetus jätteen polttamisesta 362.
- Valtioneuvosto (2000) Valtioneuvoston asetus maataloudesta peräisin olevien nitraattien vesiin pääsyn rajoittamisesta 931.
- Ympäristöministeriö (2003) Hevostallien ympäristönsuojeluohje 4.11.2003 Ympäristöministeriön moniste, Vol.(121): 23.
- Zevenhoven M, Skrifvars B J, Yrjas P, Hupa M, Nuutinen L, Laitinen R (2001) Searching for improved characterization of ash forming matter in biomass, 16th International Conference on Fluidized Bed Combustion, Reno, USA.

Reference to this article:

Tyni, S.K.; Tiainen, M.S. and Laitinen, R.S. (2009) The Suitability of Horse Manure and Bedding Materials for Combustion. In: Paukkeri, A.; Ylä-Mella, J. and Pongrácz, E. (eds.) Energy research at the University of Oulu. Proceedings of the EnePro conference, June 3<sup>rd</sup>, 2009, University of Oulu, Finland. Kalevaprint, Oulu, ISBN 978-951-42-9154-8. pp. 41-43.



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