Optical Moisture Measurements from Municipal and Industrial Press Sludges

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1 Introduction

To increase the utilization of sludge, more information is needed on its quality. Moisture is one of the key parameters of sludge quality. Information about moisture would help in optimizing the pressing process of sludge, and in the thermal drying of fuel making process. In this project, sludge moisture was measured using infrared spectroscopy (Dias et al. 2008) and microwave technique (Yamaguchi 1996).

2 Objectives of the research

The research material consisted of one sludge sample from Helsinki Water, twelve samples from UPM-Kymmene Kajaani paper mill and one sample from UPM-Kymmene Jämsänkoski paper mill. At the start of the measurements, moisture of the samples was 54–75%.

Microwave measurements were made with Slim Form Probe (Agilent Technologies) at 200 MHz–40 MHz frequency band. NIR-reflection spectra were measured at 714 nm–2631 nm with a spectrophotometer (ABB FTPA2000-263) based on Fourier transformation. The probe was Axiom FDR-780 diffuse measuring head. Microwave and NIR-reflection spectra were measured at four points in every sample, 2–4 times per working day, during four days. Samples were weighed at the start of every measuring time. Afterwards, the samples were dried in an oven and residual moisture was measured.

3 Results

With microwave measurements, the correlation between dielectricity and moisture was 0,87 in the Helsinki Water sludge sample, as shown in Fig. 1 and 0,80–0,84 in the UPM-Kymmene sludge samples. Measured with infrared spectroscopy, the correlation was 0,94 in the UPM-Kymmene sludge samples. A partial least squares regression model was developed to estimate moisture from NIR-reflection spectra measurements, is presented in Fig. 2. The model was based on the samples from Kajaani, and its reliability was tested on the sample from Jämsänkoski. As a whole, the modelling results were very good. The best model estimated moisture in the Jämsänkoski sample with an average error less than 2 moisture percentage units. The accuracy of the moisture model can be regarded sufficient for practical applications

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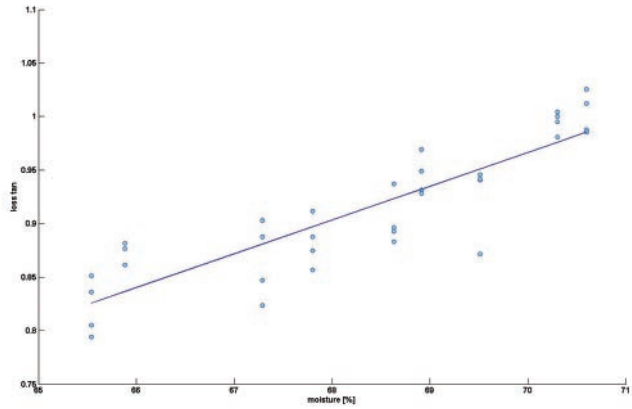

Figure 1 The loss tan as function of the moisture concentration

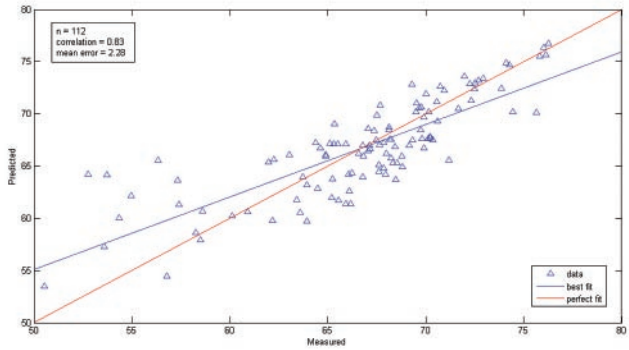

Figure 2. PLS calibration model of the moisture concentration by using the infrared spectroscopy

References

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Yamaguchi, S. (1996) New type of sludge density meter using microwaves for application in sewage treatment plants. Water Science and Technology. 33: 53–60.

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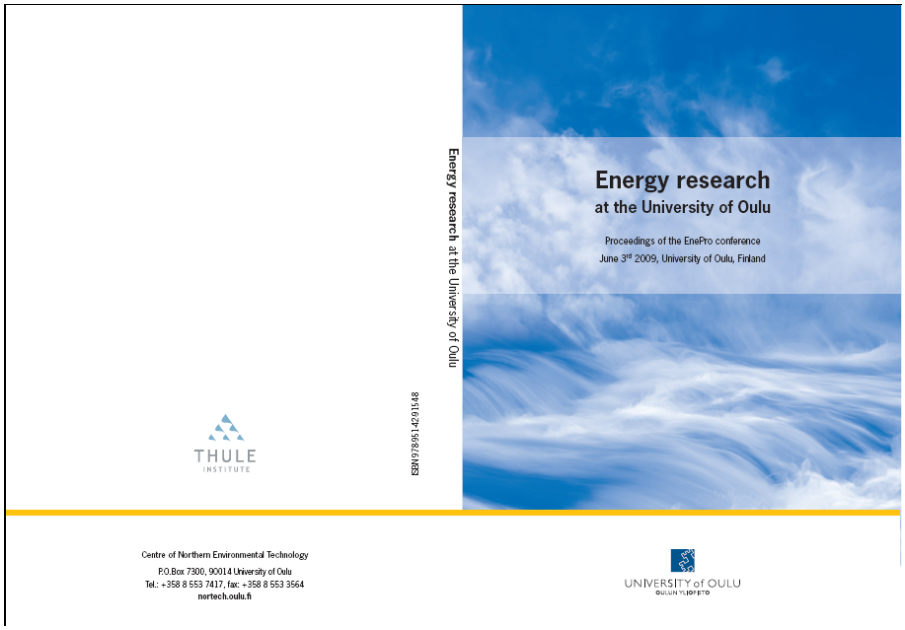

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