

Thesis topic M.Sc./B.Sc. (m/w/d)

Integration of portable NIR sensors into biomass boilers for online prediction of fuel quality

Background

Optimized boiler control contributes to low levels of harmful emissions, e.g. CO, particulate matter and NO_x during biomass combustion. Selected fuel characteristics, e.g. moisture, nitrogen content and content of aerosol forming elements are important parameters influencing emission levels. It has been shown that these parameters can be estimated using sophisticated near infrared spectroscopy (NIR) [1,2]. In the current market, low-cost miniaturized spectrometers with limited NIR ranges have become available enabling integration of these devices in small-scale biomass combustion appliances.

Task

To enable the integration of portable NIR devices into the fuel feeding and boiler control of small-scale biomass combustion units <500 kW_{th}, standard signals from portable NIR sensors have to be studied and adapted to enable continuous on-line monitoring of the fuel quality (e.g. moisture, nitrogen content) during fuel feeding.

Specifically, the following tasks need to be addressed:

- Literature research on portable NIR sensors and its communication interface (UART, HID, BLE).
- Signal conversion and conditioning of portable NIR sensors to a standard boiler controller protocol (Modbus) and programmable controller interface with UART (RS232C or RS48-2 lines).
- Design of a customised user interface for portable NIR sensor control.

We offer you:

- A good technical introduction to the subject matter as well as competent and motivated scientific support in dealing with the task,
- A modern, well-equipped workplace and an advanced laboratory and technical centre
- An introduction into the topic of analysis and energetic use of solid biofuels.

Expected prerequisites:

- Knowledge in the field information technology, automation and control engineering are mandatory. Skills in the field of programming and control are desirable.
- Beside a motivation to learn about instrumental analytic systems, we expect goal-oriented work, the ability to apply the knowledge, open-mindedness and the ability to work in a team.
- The candidate should be interested in renewable energies, energy technologies and innovative methods.

Possible starting date: 1.10.2020

Time limit for processing: 6 months

References

[1] Chadwick DT et al.: Evaluation of infrared techniques for the assessment of biomass and biofuel quality parameters and conversion technology processes: A review. Renewable and Sustainable Energy Reviews 2014;30:672–81.

[2] Xu F et al.: Qualitative and quantitative analysis of lignocellulosic biomass using infrared techniques: A mini-review. Applied Energy 2013;104:801–9.

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