Development of a photoionization-detection technique for on-line measurement of biomass tar concentrations

Partners:

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Abstract from the report

Biomass gasification technology is suffering from a troublesome market penetration due to the simultaneous production of undesired contaminants like tar. Tar is recognized as the most problematic constituent of producer gas since most applications of producer gas require gas cooling. Tars will then condense downstream the gasification reactor, causing fouling, corrosion and blockages. There have been several attempts to avoid the production of tars or to remove and/or convert the tars. It is obvious that the measurement of the tar content in crude and cleaned gases is crucial. Conventional sampling methods based on cold trapping, solvent extraction/evaporation and a final determination by weight or gas chromatography are time consuming, cumbersome and always discontinuous. A real online method producing a continuous signal for low tar concentrations (below 500 mg/Nm^3) does not exist yet.

The project resulted in the “Proof of Principle” of an online tar analyzer based on Photo Ionization Detection (PID). The PID utilises ultraviolet light to ionize gas molecules; an electron can be removed from its molecule. The current generated by the lost electron(s) is a measure for the concentration of the organic compound.

Main findings of the project are:

1. the response of each model compound is linear but the slope is different
2. the PID is sensitive to gas flow rate, temperature and gas density
3. the PID signal responds rapidly on changes in concentrations of the model component.
4. the PID-signal and the naphthalene concentration as model compound (measured by SPA) are correlated according to: tar = 1.6 * PID-signal in mV
5. The correlation between the PID-signal and the real tar concentration (measured by SPA) appeared to be: tar = 6.1 * PID-signal in mV

The most important technical problem to be solved is to keep the properties of the flow to the PID constant (rate, density, pressure temperature). Furthermore, the UV-lamp is contaminating. The PID signal decreases linearly by 40% over a period of about 50 hours. A cleaning frequency of two days is acceptable while the cleaning itself is only a matter of few minutes.