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Spectroscopic diagnostic methods for combustion and gasification

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Combustion research involves the study of the chemical reaction between a fuel and an oxidizer in a reactor. Traditionally shielded thermocouples are used for temperature monitoring and extractive gas sampling probes measuregas concentrations. Unlike such intrusive probes optical spectroscopic sensing methods allow combustion monitoring without disturbing the system. Miniature fibre coupled spectrometers are capable of givingdetailed information about the flames over a wide spectral range. They are robust, suitable for hostile environmentsand available at affordable cost. This technology referred to as flame emission spectroscopy (FES) was applied to evaluate the performance of natural gas, coal and oil flames in the pilot scale research tunnel furnace at CanmetENERGY. Spectra from collected flame radiation were analyzed to study the correlation between firing rates, air/fuel ratios, temperatures and stack gas emissions at ambient pressure.In recent years the mandate for reductions in greenhouse gas emissions has enhanced the interest in high pressure oxygen fired gasification which is recognized as a fuel conversion technology that enables CO2 capture. We have extended the applicationof FES to monitor the interiorchamber of the CanmetENERGYgasifier which is an oxy-fired gasification reactor designed to operateat 15 atmospheres.

Laser induced breakdown spectroscopy (LIBS) andtunable diode laser absorption spectroscopy (TDLAS) are laser based optical technologies which are also being applied at CanmetENERGY for the performance evaluation of pilot scale flames. This presentation briefly describes some of these investigations and their relevance to the monitoring and control of large scale combustion and high pressure gasification.

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