Université catholique de Louvain
Louvain School of Engineering

LMECA2160: Combustion and fuels

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Laboratory

Deadline of submission of the lab report, **Wednesday 2/12/2020 10:30 am**

The objective of this laboratory is to study the combustion inside a domestic gas burner supplied with natural gas. The power of the gas burner studied here is 17.5 kW. The measured composition of UCL natural is the following: CH_4=0.827, C_2H_6=0.039, C_3H_8=0.012, CO_2=0.014, N_2 = 0.108. The investigations will focus on three air flowrates: $\dot{m}_{\text{air}}$ = 20 , 24 , 28 m^3/h. The calculations should be made on the basis of the conditions on the lab. For this reason, you should measure the temperature and ambient pressure.

1) Calculate: `i)` the lower heating value (LHV) in kJ/m^3 and the volumetric flowrate of the gas and the air in m^3/h for a complete and stoechiometric combustion, `ii`) the stoichiometric air-to-fuel ratio AF_{st} and the stoichiometric products-to-fuel ratio PF_{st} . Draw the Ostwald triangle for natural gas combustion for the given composition. (30 %)

2) For each air flowrate and with the hypothesis of a complete combustion, calculate: `i`) the excess-air coefficient λ, `ii)` the flue gas composition on dry basis (for dry exhaust gases), and `iii`) the adiabatic combustion temperature. For each airflow, identify the combustion conditions on the Ostwald diagram. (30 %)

3) For each air flowrate, measure the flue gas composition and temperature (maximum temperature measured in the combustion chamber). Compare your measurement with the theoretical calculations from question 2 and explain the differences. (20 %)

4) For each air flowrate, measure the axial temperature profile using the three thermocouples placed in the combustion chamber. Use these thermocouples to measure the radial temperature profile by modifying their radial position. You can consider 3-4 different radial positions. Is it possible to estimate the advancement of the combustion process (concentration of reactant) in the gas burner based on these temperature measurements ? (20 %)