LMECA2160 – COMBUSTION AND FUELS

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INSTRUCTIONS OF THE LABORATORY

1. Before beginning the laboratory, you have to ask to the technicians for the CO detector and the TESTO gas analyzer.

2. Start the laboratory gas extractor if it is not yet in service. The command button is on the control panel from the blue electric cabinet near the low pressure gas burner setup. Its role is to evacuate flue gases from the experimental setup so if you start the gas burner without it, you could have flue gases in the hall (including CO).

3. Open the yellow gas valve and the two red water valves. Gas pipes are usually yellow in Belgium, it is a convention used very often. For water, you can notice that two colors were used, blue and red, respectively designating cold and on water. You should thus be careful when approaching red pipes or valves. Do not forget how ball valves work, the valve is open when the handle is parallel to the pipe.
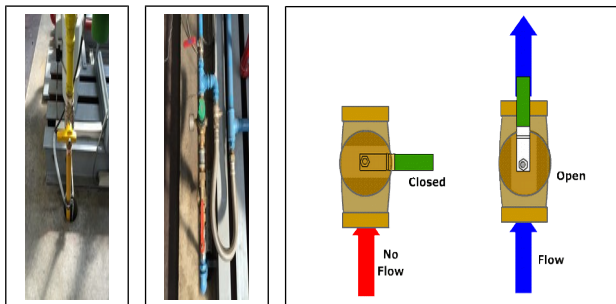

4. Start the computer using the session named « *Labo chaudière* »; the password is: « *dell* » .

5. Before starting the control software, check that the data acquisition case is ON. It is ON when the green light under « Armoire sous tension » is ON. If not, use « *Start* » button to start it.
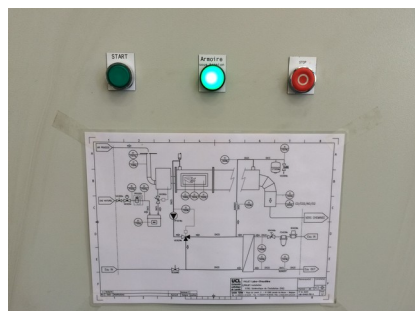
6. To access the software, go to the « *LABO CHAUDIERE* » directory on the desktop. In this folder, double-click on the file « *Labo chaudière.llb* », then double-click on the first file on the list named « *Labo chaudière* ». The software developed using LabVIEW® will then start.

7. The software is a development software and is not compiled. To use it, you have to compile it using the compiling button designated by a white arrow on the top left of the window as shown on the figure below.
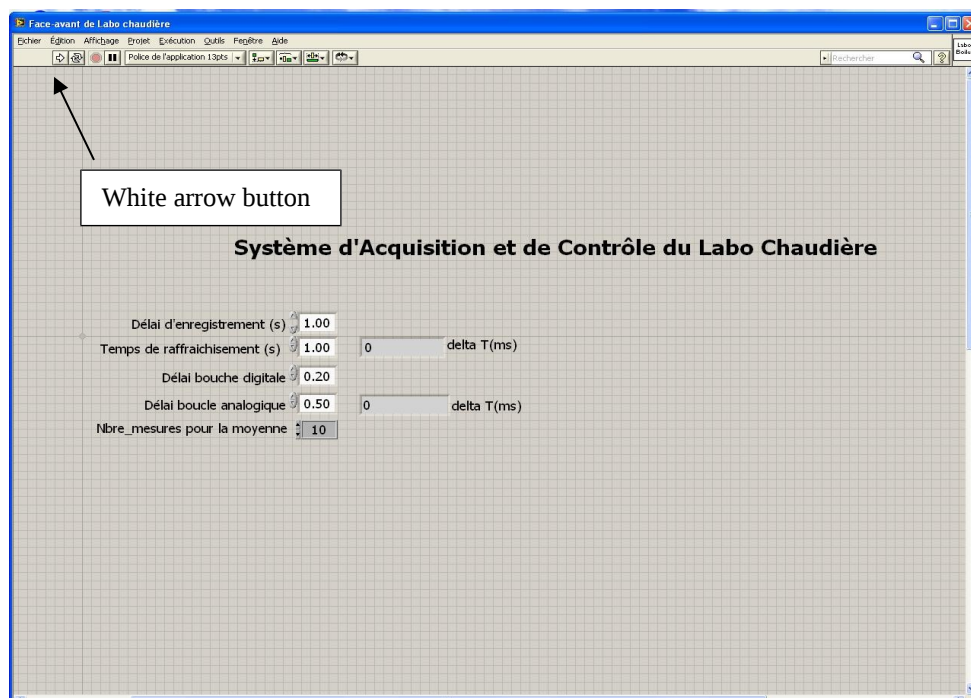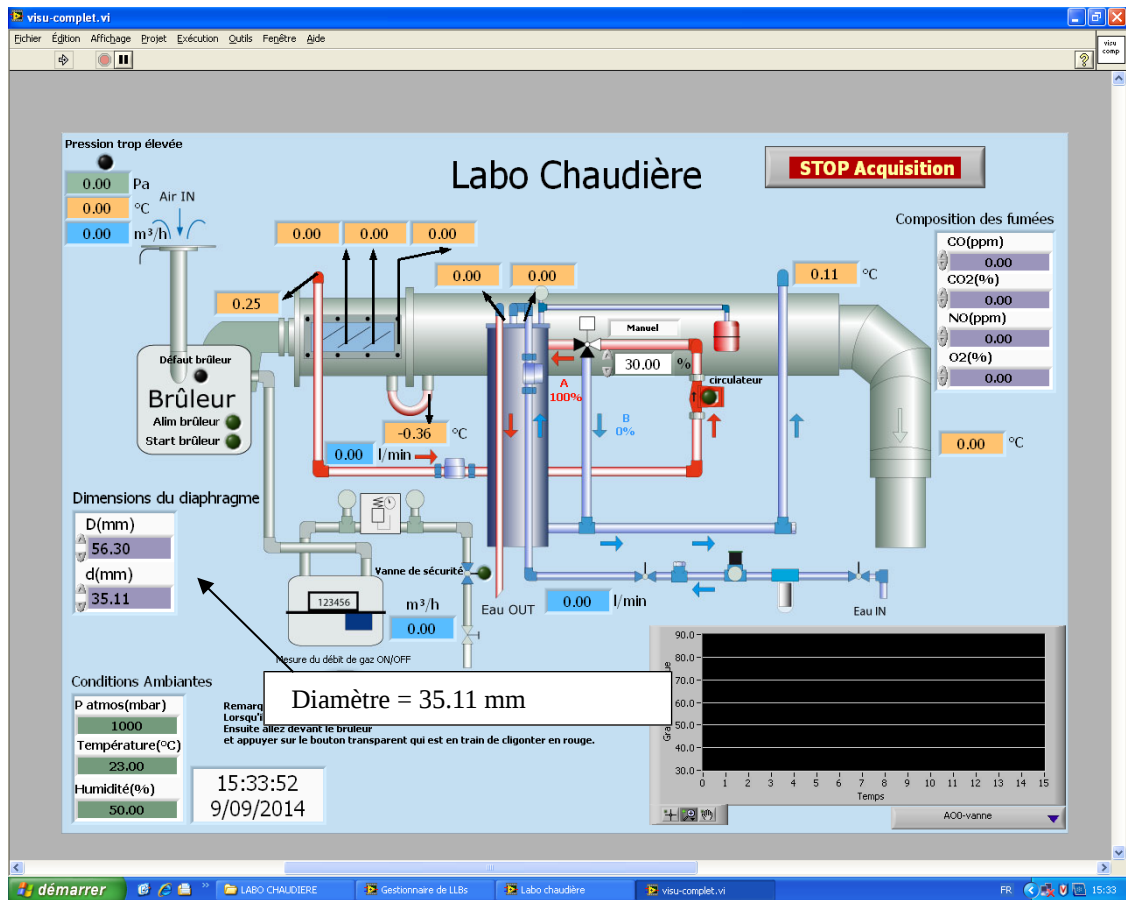

8. The following window pops up.
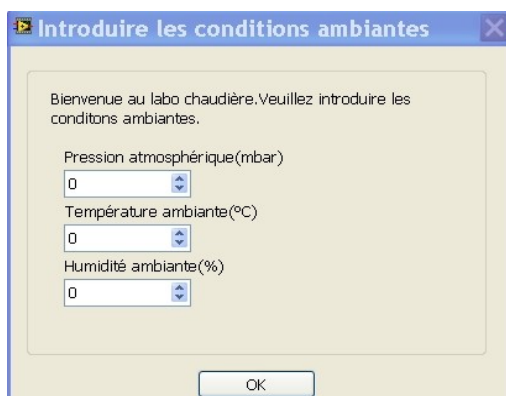
Ambient conditions are used to calculate the airflow rate. The barometer is located in the office of Julien Vervotte. For the ambient air moisture, you can introduce the value 50 %. For the temperature, introduce 23°C.

9. After introducing the ambient parameters, the following window appears:

Check the value introduced for the inner and outer diameter of the diaphragm. They should be set to 35.11mm and 56.30mm to get correct measurements.

To start the gas burner, open the air valve completely by turning it in the anti-clockwise direction. Activate, through the software, the following command buttons in this particular order: « *Circulateur* » « *Vanne de sécurité* », « *Alim brûleur* » and « *Start brûleur* ».

Because you opened the air valve completely, the airflow rate will be too high to start the burner. Decrease it to approximately 32 m³/h by closing the valve. If you do not close the valve fast enough, the burner will put itself in default mode. A red blinking light on the burner shows the default. Before trying to start the burner again, you need to reset it by pushing the blinking button. Continue to start to adjust the airflow rate.

When the combustion is started, you will be able to choose the airflow rate thanks to the valve. Always turn the valve **slowly**; you should **NEVER** let the airflow rate drop below **18 m³/h**.

To start measuring the airflow rate, check that the numbers on the gas flow meter next to the yellow valve are moving. If it's the case, you can activate the measurements by clicking the button « *Mesure du débit de gaz ON/OFF* ». Wait several minutes to get

the first measurement. If the numbers are not moving, the gas burner is not started and you should repeat the previous steps to start it.

Remarks: 1) The differential pressure sensor at the air inlet cannot go over 500 Pa because this value if the end of the scale. Every value over the upper end of the scale cannot be measured.

2) The temperature T304W has to be kept under 80°C.

3) The center of the combustion chamber is reached when the thermocouple measures 16 centimeters on the rules.

4) Check from time to time that the flows shown by the software correspond to the ones displayed directly on the flow meters.

5) Ensure that the pressure in the heat exchanger **NEVER** exceeds 2 bars.

!!!!CAREFULL!!!!
!!Do NOT touch the external face of the combustion chamber!!

10. An operating point is set thanks to the divider valve. If we close it, the temperature in the circuit before it will increase.

    For example:

    - Valve open at 40%, T300Wa=72.5°C, T304Wa=54.3°C

    - Valve open at 35%, T300Wa=77.5°C, T304Wa=60.0°C

    - Valve open at 30%, T300Wa=85.5°C, T304Wa=68.4°C

11. For flue gases composition measurements, use the « Testo 300XL » gas analyzer. Start the device by pressing « *I/O* ». When the "switch" window opens, click on « *OK* ». Wait for the end of initialization and select « Gaz-Naturel » in the fuel list. Place the probe in the exhaust chimney after the heat exchanger. Press "Start" to take a measurement. Wait for stabilization then enter the value in the software window to store it with the rest of the data in a ".txt" file.

12. All the results are stored in a « .txt » file saved in the folder named ″Enregistrement″. Here is the order in which they are saved:

    1   Hour

    2   Minute

    3   Second

4   Atmospheric pressure   mbar

5   Ambient temperature °C

6   Ambient moisture   %

7   T108Ap : Air inlet temperature   °C

8   T200Gb : Temperature of the first thermocouple inside the combustion chamber   °C

9   T201Gb : Temperature of the second thermocouple inside the combustion chamber   °C

10   T202Gb : Temperature of the third thermocouple inside the combustion chamber   °C

11   T203GB : Exhaust gas temperature after the heat exchanger   °C

12   T300Wa : Water temperature after the heat exchanger with flue gases   °C

13   T304Wa : Water temperature before the heat exchanger with flue gases   °C

14   T400Wa : Water temperature after the heat exchanger with water °C

15   T405Wa : Water temperature before the heat exchanger with water   °C

16   T406Wa :   Water temperature before the heat exchanger around the combustion chamber °C

17   Air flow rate   m³/h

18   Gas flow rate m³/h

19   F303Wa : Water flow rate in the water/flue gases heat exchanger l/min

20   F401Wa : External water flow rate in the cooling exchanger   l/min

21   P107Ap : Pressure drop through the diaphragm   Pa

22   CO   ppm   (Added manually through the software)

23   CO2   %   (Added manually through the software)

24   NO   ppm   (Added manually through the software)

25   O2   %   (Added manually through the software)

13. When the tests are done, do not forget to shut the gas burner setup down following this list of actions:

    i) Disable gas flow measurement.

    ii) Stop the gas burner by clicking on « *Start brûleur* » again.

    iii) Shut down its electrical supply by clicking on « *Alim brûleur* ».

    iv) Shut down the security valve by clicking on « *Vanne de sécurité* ».

    v) Wait for the temperature measurement T304Wa (cfr. P&ID) to be under 50°C and shut the circulator by clicking on « Circulateur ».

    vi) Check that the burner is not in service anymore.

14. When the temperature measurement are cooled down a little, click on « *STOP Acquisition* », the software will shut down and you can get the file with your results under the directory « *Enregistrement* » from the directory « *LABO CHAUDIERE* ».

15. Before leaving, shut down the computer and close the three valves (1 gas and 2 water) you opened in the beginning.

16. Do not forget to write your name and sign the list of students on the wall.

17. If you started the gas extractor of the laboratory **AND** if nobody else is using it, shut it down before leaving.

18. Shut down the data acquisition electrical cabinet.

YOUR LABORATORY REPORT HAS TO BE SENT BEFORE THE 14th OF DECEMBER 2016, 9:30 am