Calculation Homework 1

Home Assignment 1 – Combustion and Emissions

A power plant is fueled on coal with high sulphur content and needs to invest in a SO2-scrubber. Before the managers start searching for equipment suppliers, they need to have a rough estimation of the total flue gas amount that the scrubber should treat and the specific mass flow of SO2 passing the equipment per minute. Also, the power plant is obliged to report to the national authorities how much carbon dioxide (CO2) is emitted per one year of nominal operation.

To be calculated:

1. Real flue gas flow in scrubber [**m^3/s]** - *The volume of a gas is a direct function of the temperature*
2. The fraction of SO_2 in total flue gas [**ppm] -** *Parts per Million (refers to volume ratio =mol ratio)*
3. SO_2 mass flow per minute [**kg/min]**
4. Carbon dioxide CO_2 emission (in thousand tons per year) [**10^3 t/year]**

The following is given:

Flue gas temperature	120 °C - *at the SOx scrubber*
Power plant operation hours per year	8000 h
Air excess for combustion (air factor)	m = 1.25 (a*ssume dry technical air)*
Fuel flow (total mass basis)	5 kg/s
Density of SO_2 at normal conditions	~2.87 kg/m_n^3 *(can also be solved without this value)*
Density of CO_2 at normal conditions	~1.978 kg/m_n^3 *(can also be solved without this value)*

Fuel (coal) composition on dry basis, mass-%:

C	50 %
H_2	3.5 %
O_2	*find it from the other given data!* %
N_2	2.3 %
S	3 %
Ash	20 %

Moisture content of fuel on total basis (mass-%): 10 %

Instructions:

There are two possible ways to handle this assignment (either one or the other):

1) A detailed solution on paper with the input parameters given above, including all equations and all sub-procedures for reaching the final results. Try to fit it into 1 sheet of paper (two sides). The paper solution can be submitted to a teacher during any SPG class event.

2) A web-based solution, where the assignment is accessed and submitted entirely online in CANVAS. The calculation results - a range of partial and final answers - shall be uploaded directly into CANVAS for an automatic check.

In all cases, the solution procedures and any related questions can be discussed with a teacher during the homework help sessions.

For the online submittal in CANVAS - the assignment should ultimately be solved at 100% correct answers. It remains open and can be restarted unlimited number of times, until solved to 100%.

CANVAS does not function well enough yet! The online submittal option will be improved and updated while the course proceeds. Moreover, CANVAS will not grade the answers properly if any of the answer fields remains empty!

Solving all home assignments in the SPG course with 100% correct answers will provide you with 1.5 credits towards completion of the course (appearing as “ÖVN1” or “Exercise1” in the transcript).