**Yıldız Tecjnical University**

**Dept. of Environmental Engineering**

**AIR POLLUTION COURSE**

**TERM PROJECT**

**Estimation of Stack Emissions of**

**a Thermal Power Plant**

**Ali Veli KIRKDOKUZELLİ**

**04175757**

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**AIR POLLUTION** **- TERM PROJECT**

A thermal power plant burns a blend medium fuel oil (MFO) at the rate of 150 tons/hr. Properties of MFO are listed in Table 1. Thermal efficiency of the plant is 65% and the combustion system operates with 15% excess air. Assume relative humidity of the atmospheric air corresponding to 2% absolute humidity. Combustion gases exit the stack at 150⁰C and 1 atm. Combustion process generates noncombustible residue at the rate of 75 kg per ton of fuel.

1. Calculate the rated power of the plant in MegaWatts (MW).
2. Calculate the total volumetric flowrate of stack gases in Nm3/h and in m3/h both on wet and dry basis. Use related combustion reactions.
3. Calculate the followings using related combustion reactions:  
   **(i)** mass emission flowrate of SO2 in kg/h. and   
   **(ii)** stack gas concentration both in mg/Nm3.and ppm based on complete stack gas composition..
4. Calculate the mass emission flowrates and stack gas concentrations of all pollutants using data given in Tabe 2. Complete Table 3 for this question. Judge whether any/some of the parameter(s) need to be controlled.
5. Calculate the minimum stack height of this power plant using the procedure given in the Legislation. Stack exit diameter is 1,5m. The required legislation is “Sanayi Kaynaklı Hava Kirliliğinin Kontrolü Yönetmeliği” which you may get from internet.

**Table 1. Fuel properties**

|  |  |  |
| --- | --- | --- |
| **Property** | **Units** | **Medium Fuel Oil (MFO)** |
| Carbon | %C | 85,3 |
| Hydrogen | %H | 11,2 |
| Sulphur | %S | 3,5 |
| Density @ 15C | kg/l | 0.98 |
| Gross Calorific Value | MJ/kg | 42,26 |

**Table 2. Emission factors for combustion processes**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Fuel Type / Combusiton Type** | **PM** | **SOx** | **CO** | **HC** | **NOx** |
| **COAL**  ***Lignite***  Pulverized  Cyclone  Spreader Stoker  ***Bitumnius*** *coal*  Pulverized  General  Wet  Dry base  Cyclone  Spreader Stoker  Manuel Feed | **kg/ton**  3,2 **A**  2,7 **A**  3,2 **A**  8 **A**  6,5 **A**  8,5 **A**  1,0 **A**  6,5 **A**  10 | **kg/ton**  13,6 **S**  13,6 **S**  13,6 **S**  19 **S**  19 **S**  19 **S**  19 **S**  19 **S**  19 **S** | **kg/ton**  0,5  0,5  0,5  0,5  0,5  0,5  0,5  1  45 | **kg/ton**  <0,45  <0,45  <0,45  0,15  0,15  0,15  0,15  0,5  10 | **kg/ton**  6,4  7,7  2,7  9  15  9  27,5  7,5  1.5 |
| **FUEL OIL**  Thermal Power Plant  Industry,  Heavy fuel-oil  Medium-light fuel-oil  Residential and Commercial use | **kg/ton**  1,26  2,9  1,9  0,1 | **kg/ton**  20,5 **S**  20,1 **S**  20,1 **S**  20,1 **S** | **kg/ton**  0,005  0,25  0,25  0,25 | **kg/ton**  0,50  0,50  0,50  0,63 | **kg/ton**  13,02  8,96  8,96  1,46 |
| **NATURAL GAS**  Thermal Power Plant  Industry  Residential and Commercial use | **g/m3**  0,24  0,24  0,24 | **g/m3**  0,01  0,01  0,01 | **g/m3**  0,272  0,272  0,272 | **g/m3**  0,016  0,048  0,128 | **g/m3**  11,1  3,6  1,9 |
| **OIL**  Gasoline (k**g/m3**)  Diesel (k**g/m3)** | 1,4  13,2 | 1,1  4,8 | 275  7,2 | 24  16,3 | 14  26,6 |
| **S**: Sulfur content (%) of fuel **A:** Ash content (%) of fuel | | | | | |

**Table 3. Pollutant emissions**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Parameter** | **Unit** | **Pollutant** | | | | |
| **PM** | **SOx** | **CO** | **HC** | **NOx** |
| Mass emission flowrate | **kg/hr** |  |  |  |  |  |
| Stack gas real\* concentration | **mg/Nm3** |  |  |  |  |  |
| Stack gas real\* concentration | **mg/m3** |  |  |  |  |  |
| Stack gas real\* concentration | **ppm** |  |  |  |  |  |
| Stack gas standard\*\* concentration | **mg/Nm3** |  |  |  |  |  |
| Legislative limit value of mass emission flowrate |  |  |  |  |  |  |
| Legislative limit value of stack gas concentration |  |  |  |  |  |  |
| Name of the Legislation: |  | | | | | |
| Position of the plant in the legislation: |  | | | | | |
| \*: concentration of pollutant based on stack conditions  \*\*: concentration based on legislative requirements (Dry, Standard conditions and Ref Oxygen correctes) | | | | | | |

**GENERAL REQUIREMENTS FOR THE PROJECT REPORT:**

* + - 1. A Cover Page is required including Project Title and your Identification
      2. Completed Project will be sumitted in a plastic folder.
      3. The Project report will be prepared in neat legible hand writing with book letters not with personal letters.
      4. Order and appearance of the report will get point. Order of solutions should appear in regular appearance. Any disorder or untidy appearance will violate this point.
      5. Results of calcultions should stand in a separate line to be seen easly..
      6. Table 3 will appear in your Project as it appear in this document

**GRADING OF THE PROJECT:**

Question 1: 10 points

Question 2: 30 points:

Question 3: 10 points

Question 4: 20 points

Question 5: 10 points

Overall Appearance and Presentation: 20 points. You will get this point if your solutions are correct with a sound presentation.

**DUE DATE: DEC 20, 2019**

**DUE HOUR: 16.00**

**\*\*\*\*SUBMISSIONS LATER THAN THİS DATE AND HOUR WILL NOT BE ACCEPTED\*\*\*\***

**CORRESPONDING STUFF FOR SUBMISSION: Res. Assisstant Elif YAVUZ**

**Office: Z-013**