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ON THE ESSUE OF THE CALCULATION CO_2 EMISSIONS INTO THE ATMOSPHERE OF WHEAT STRAW

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Calculation of combustion parameters of lignocellulosic raw materials in a heating boiler of low power.

The theoretical value of the air required for the complete combustion of the fuel (at t = 1) and the heat content of the combustion products.

The volumes and heat content of air and combustion products are determined based on 1 kg of fuel under normal conditions (0°C and 101.3 kPa) of the boiler operation [1].

Theoretical value of the volume of air required for complete combustion of fuel in the boiler, m3\kg

$$V^o = 0,0889 \cdot \left(C^p + 0,375 \cdot S^p \right) + 0,265 \cdot H^p - 0,033 \cdot O^p =$$
$$= 0,0889 \left(59,3 + 0,375 \cdot 0,8 \right) + 0,265 \cdot 3,6 - 0,033 \cdot 4,6 = 6,25 \; м^3 / кг$$

Calculation of the theoretical min volumes of combustion products obtained with complete burnout of the fuel with the theoretically required amount of air. Theoretical value of the minimum volume of diatomic nitrogen N_2

$$V^0_{N_2} = 0,79 \cdot V^0 + 0,8 \cdot \frac{N^p}{100} = м^3 / кг$$

V^0_{N2}=0.79*6.25+0.8*0.33/100=4.94м^3/кг

Theoretical value of the minimum volume of triatomic gases:

$$V_{RO_2} = 1,866 \cdot \frac{C^p + 0,375 \cdot S^p}{100} = м^3 / кг$$

V_{RO2}=1.866* 48.58+0.375*0/100=0.9м^3/к

Theoretical value of the minimum volume of water vapor:

$$V^0_{H_2O} = 0,111 \cdot H^p + 0,0124 \cdot W^p + 0,0161 \cdot V^0 = м^3 / кг$$

V^0_{H20}= 0,111*5,07+0,0124*0+0,0161*6,25=0,66м^3/кг

Theoretical value of the total minimum volume of flue gases:

$$V_Г = V^0_{R_2O} + V^0_{N_2} + V_{H_2O} = м^3 / кг$$

$V_г$=0,9+4,94+0,66=6,5 м^3/кг

Calculation of enthalpies (heat content) of air and gases.

The enthalpy of the theoretically required amount of air at n. y. (temperature in the boiler room 300C (normalized)) [4].

The theoretical value of the enthalpy of gases at the corresponding temperatures in the range

from t = 400C to 600C. (calculated fuel combustion temperatures in a heating boiler, power up to 100 kW)

The value is taken according to [1]

Enthalpy (heat content) of gases att = 400^{0}C

$$H^o_{г\,400} = V_{RO_2}(C\vartheta)_{RO_2} + V^0_{N_2}(C\vartheta)_{N_2} + V^0_{H_2O}(C\vartheta)_{H_2O} = кДж \setminus кг$$

$H_г{}^0_{400}$=0.9*184.4+4.94*125.8+0.66*149.6=886.148kJ/kg

Enthalpy (heat content) of gases att = 500^{0}C

$$H^o_{г\,500} = V_{RO_2}(C\vartheta)_{RO_2} + V^0_{N_2}(C\vartheta)_{N_2} + V^0_{H_2O}(C\vartheta)_{H_2O} = кДж \setminus кг$$

$H_г{}^0_{500}$=0,9*238+4,94*1586+0,66*189,8=1122,952kJ/kg

Enthalpy (heat content) of gases at t = 600^{0}C

$$H^o_{г\,600} = V_{RO_2}(C\vartheta)_{RO_2} + V^0_{N_2}(C\vartheta)_{N_2} + V^0_{H_2O}(C\vartheta)_{H_2O} = кДж \setminus кг$$

$H_г{}^0_{600}$=0,9*292+4,94*192+0,66*231=1363,74kJ/kg

According to the heat release in the volume of the furnace space, we determine:

1. Adiabatic fuel combustion temperature (at maximum heat release):
2. Average temperature of the furnace space:
3. Average temperature at the outlet of the furnace (assumed to be 50C lower than the average due to cooling by the walls of the furnace).

Calculation of the main characteristics of the boiler according to CTPK IEC 60335-2-102-2012 IEC 60335-2-102:2009 Household and similar electrical appliances - Safety - Part 2-102: Particular requirements for gas, oil and solid-fuel burning appliances having electrical connections (IDT) [2].

$Q_н{}^р$ - calorific value of fuel, kJ/kg

Q - boiler heat output, MWt

B=22,5322*360000/15420=526 kg/h

Nominal thermal power of the boiler. Nz, kW.

$$N_{p} = \frac{B \cdot Q_{н}^{p} \cdot \eta}{100 \cdot 3600} = MBm$$

N_p=526*15420*0,85/100*3600=19,15 MWt

Calculation of CO2 emissions depending on the carbon content in the fuel.

Calculate CO2 emissions for: wheat straw CO2 emissions according to the Order of the Minister of Ecology [3], Geology and Natural Resources of the Republic of Kazakhstan dated September 13, 2021 No. 371, registered with the Ministry of Justice of the Republic of Kazakhstan on September 16, 2021 No. 24383 are calculated:

$$B_{CO_2} = KB_{mб}^{y} \cdot Q_{н}^{p} \cdot 44/12$$

where:B - CO2 emissions, t

$KB_{mб}^{y}$ - carbon emission factor for solid biomass 29.48 t/TJ

B_{CO2}=29,48*15420*44/12*526=3168,8

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