

Combustion of coal

This document shows how **Thermo Utilities, MS Excel Add-ins** can be used for calculation of combustion.

Dry anthracite with the following composition by mass:

C 90%; H 3%; O 2%; N 1%; S 1%; ash 3%

has been burned in a boiler, when 150% excess air is supplied.

Combustion efficiency is 0.75 Calculate:

- 1- the stoichiometric air-to-fuel (A/F) ratio
- 2- the A/F ratio
- 3- analysis of combustion products (dry and wet)
- 4- temperature of exhaust gases

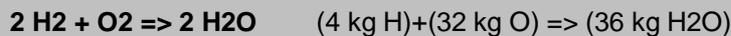
Air is supplied at atmospheric pressure and 18 C with 0.008 specific humidity. The fuel has an average temperature of 35 C when enters the boiler. The net calorific value of the fuel at 15 C is 33 500 kJ/kg
The specific heat capacity of fuel is 3.2 kJ/kg,K.

Combustion Equations

Combustion equation for coal:



Combustion equation for hydrogen:



Combustion equation for sulphur:



Fuel Analysis			
Constituent	Mass fraction	Required oxygen kg/kg fuel	Product mass kg/kg fuel
Carbon	0.900	2.400	3.300
Hydrogen	0.030	0.240	0.270
Oxygen	0.020	-0.020	0.000
Nitrogen	0.010	0.000	0.010
Sulphur	0.010	0.010	0.020
Ash	0.030	0.000	0.030
	1.000	2.630	3.630
Analysis of Supplied Air			
Specific Humidity	0.008		
Composition by mass			
Constituent	Dry Air	Humid Air	
N2	0.76280	0.75670	
O2	0.23290	0.23104	
CO2	0.00300	0.00298	
Ar	0.00130	0.00129	
H2O	0.00000	0.00800	
SO2	0.00000	0.00000	
	1.00000	1.00000	

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Air required per kg of fuel	11.38	Stoichiometric A/F ratio	kg/kg
Excess Air	1.5		
Actual A/F ratio kg/kg	28.45867		
Exhaust Gases		Wet Mass	Dry Mass
Constituent	Mass	Composition	Composition
N2	21.54461	0.73210	0.74469
O2	3.94500	0.13405	0.13636
CO2	3.38469	0.11501	0.11699
Ar	0.03670	0.00125	0.00127
H2O	0.49767	0.01691	0.00000
SO2	0.02000	0.00068	0.00069
	29.42867	1.00000	1.00000
Exhaust Gases			Volume
Constituent	Kg/kmol	Mole Fraction	Composition
N2	28	0.02615	0.77058
O2	32	0.00419	0.12346
CO2	44	0.00261	0.07704
Ar	40	0.00003	0.00092
H2O	18	0.00094	0.02769
SO2	64	0.00001	0.00031
		0.03393	1.00000
Mass balance			
Fuel	1.00000		
Supplied Air	28.45867		
	29.45867		
Exhaust Gases	29.42867		
Ash	0.03000		
	29.45867		
Supplied Air Temp.	18	C	
Fuel Cp	3.2	kJ/(kg.K)	
Net Calorific Value	33500	kJ/kg	
Combustion efficiency	0.75		
	Enthalpy	Mass Flow	m³h
	kJ/kg	kg/s	kJ/s
Supplied Air	38.31	28.46	1090.14
Fuel	64.00	1.00	64.00
Fuel Energy Supplied	33500.00	1.00	25125.00
			26279.14
Exhaust Gases	892.07		
Exhaust Gases Temp	774.	C	
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If you want to know more about "Taftan Data" or other software developed			

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