Dust Emission from Fuel Ash (mg/Nm³)

Dust concentration before and after the dust collector, in mg/Nm³ dry and at reference O_2, from the fuel ash, fly-ash share, excess air and collector efficiency.

Method: Exact-ratio combustion balance with ASME PTC 4-2013 air; EU IED 2010/75/EU Annex VI (O_2 correction, also used in Indian practice)

Input parameters

Unit system: SI

Parameter	Value	Unit
Carbon	45.000	%
Hydrogen	3.5000	%
Oxygen	5.0000	%
Nitrogen	1.0000	%
Sulphur	0.50000	%
Ash	35.000	%
Moisture	10.000	%
Fuel firing rate	12,000	kg/h
Excess air	20.000	%
Air humidity (kg water per kg dry air)	0.013000	kg/kg
Share of the residue leaving as fly ash	80.000	%
Carbon in the residue	2.0000	%
Dust collector efficiency	99.800	%
Reference O_2 of the limit	6.0000	%
O_2 in air used by the rule 21 % in EU IED and India CPCB practice; 20.9 % in US EPA Method 19.	21.000	%

Calculated results

Parameter	Value	Unit
Dust at the stack, dry, at reference O_2	88.017	mg/Nm³
Dust at the stack, dry, at actual O_2	102.18	mg/Nm³
Dust at the collector inlet, dry	51,090	mg/Nm³
Dust emitted	6.8571	kg/h
Dry flue gas, normal volume	67,108	Nm³/h
O_2 in dry flue gas	3.5863	%
Correction factor to reference O_2	0.86139	

Formula and method

$$c_{in} = \frac{A\,x_f/(1-c_r)}{v_{dry}} \qquad c_{out} = c_{in}(1-\eta_c) \qquad k = \frac{O_{2,air}-O_{2,ref}}{O_{2,air}-O_{2,d}} \qquad c_{ref} = k\,c_{out}$$

$$\dot{V}_{dry,N} = \dot{m}_f v_{dry} \qquad \dot{m}_d = \dot{m}_f \frac{A\,x_f}{1-c_r}(1-\eta_c)$$

Variables

$C\$, \$H\$, \$O\$, \$N\$, \$S$	carbon, hydrogen, oxygen, nitrogen, sulphur in the fuel as fired	–
A	ash	–
M	moisture	–
$\dot{m}_f$	fuel firing rate	kg/s
EA	excess air	–
ω	air humidity	kg/kg
x_f	share of the residue leaving as fly ash	–
c_r	carbon in the residue	–
η_c	dust collector efficiency	–
$O_{2,ref}$	reference O_2 of the limit	–
$O_{2,air}$	O_2 in air used by the rule	–
c_{ref}	dust at the stack, dry, at reference O_2	kg/m³
c_{out}	dust at the stack, dry, at actual O_2	kg/m³
c_{in}	dust at the collector inlet, dry	kg/m³
$\dot{m}_d$	dust emitted	kg/s
$\dot{V}_{dry,N}$	dry flue gas, normal volume	Nm³/s
$O_{2,d}$	O_2 in dry flue gas	–
k	correction factor to reference O_2	–
v_{dry}	dry flue gas per kg of fuel, normal	m³/kg

Method and standards

Dry flue gas volume from the exact-ratio combustion balance with ASME PTC 4-2013 air; fly ash from the ash balance; the O_2 correction of EU IED 2010/75/EU Annex VI, the same form Indian limits use.

Assumptions and limits

- All fly ash reaches the collector; deposits in the boiler and economiser hoppers are counted as bottom ash.
- Sulphate, unburned carbon in fly ash beyond the residue carbon, and sorbent are not added.
- Normal conditions 0 °C and 101.325 kPa, dry basis.
- The residue carbon raises the fly-ash mass, but the combustion balance burns all fuel carbon; the small inconsistency (about 1–2 % of the carbon at usual values) slightly overstates the gas volume.

References

• Exact-ratio combustion balance with ASME PTC 4-2013 air; EU IED 2010/75/EU Annex VI (O_2 correction, also used in Indian practice)

Report details

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Release checks	3 reference cases of this calculator, computed independently, are checked on every release

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/boilers-power-plant/emissions-stacks/dust-emission-from-ash

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.