Stack Opacity, Optical Density and Path-Length Correction

Optical density from measured opacity, opacity corrected to the stack exit path length, the extinction coefficient and an estimated dust concentration.

Method: Bouguer attenuation for transmissometers

Input parameters

Unit system: SI

Parameter	Value	Unit
Measured opacity	15.000	%
Measurement path length	3.2000	m
Stack exit path length	2.5000	m
Specific extinction coefficient	2.5000	m²/g

Calculated results

Parameter	Value	Unit
Optical density at measurement	0.070581	
Opacity at stack exit	11.924	%
Extinction coefficient	0.050787	1/m
Estimated dust concentration	20.315	mg/m³

Notes for this case

• Bouguer: D = −log₁₀(1 − Op) is proportional to path length, so $D_2 = D_1 L_2/L_1$ converts opacity to the stack exit, where regulations usually define it. Dust concentration c = b/K_e needs K_e from gravimetric tests at the same plant: it depends strongly on particle size and colour.

Formula and method

$$D = -\log_{10}(1 - Op), \quad D_2 = D_1 \frac{L_2}{L_1}, \quad b = \frac{2.303 D_1}{L_1}, \quad c = \frac{b}{K_e}$$

Variables

Op_1	Measured opacity	-
L_1	Measurement path length	m
L_2	Stack exit path length	m
K_e	Specific extinction coefficient	m²/kg
D_1	Optical density at measurement	-
Op_2	Opacity at stack exit	-
b	Extinction coefficient	1/m
c	Estimated dust concentration	kg/m³

Method and standards

Opacity.

Assumptions and limits

- Uniform particle cloud across the path; single scattering.

References

Bouguer attenuation for transmissometers

Report details

Report reference	FCC-D4CG-4D2S (the same inputs always give the same reference)
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Calculator	Stack Opacity, Optical Density and Path-Length Correction
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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/instrumentation/analysers/opacity-optical-density

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.