Sulphur Burner: Air, SO_2 Strength and Tray Area

Sulphur burnt for a dose, the air for an SO_2 strength in the gas, excess air, burner tray area and heat released (Hugot ch. 25, from stoichiometry).

Method: Hugot; Handbook of Cane Sugar Engineering; ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Crushing rate	100.00	t/h
Sulphur per tonne cane Hugot: 0.3–0.45 kg/t cane for juice; about 0.9 for juice and syrup.	0.40000	kg/t
SO_2 in the gas (by volume) Hugot: 12–16 %, about 14 %; 21 % is the theoretical maximum.	14.000	%
Tray loading Hugot: 20–25 kg/(m²·h), up to 35.	22.500	kg/(m²·h)

Calculated results

Parameter	Value	Unit
Sulphur burnt	40.000	kg/h
Air	199.75	Nm³/h
Air	258.14	kg/h
Excess air	49.643	%
Burner tray area	1.7778	m²
Heat released (2217 kcal/kg S)	103.13	kW

Notes for this case

- Burning sulphur replaces each O_2 molecule by one SO_2, so the gas volume stays that of the air; dry the air to limit SO_3.

Formula and method

$$\dot{m}_S = d_S A, \quad \dot{n}_{air} = \frac{\dot{m}_S / M_S}{y_{SO_2}}, \quad \lambda - 1 = \frac{0.2095}{y_{SO_2}} - 1, \quad A_t = \frac{\dot{m}_S}{g}$$

Variables

A	Crushing rate	kg/s
d_S	Sulphur per tonne cane	kg/kg
y_{SO_2}	SO_2 in the gas (by volume)	-
g	Tray loading	kg/(m²·s)
$\dot{m}_S$	Sulphur burnt	kg/s
$\dot{V}_a$	Air	Nm³/s
$\dot{m}_a$	Air	kg/s
$\lambda - 1$	Excess air	-
A_t	Burner tray area	m²
$\dot{Q}$	Heat released (2217 kcal/kg S)	W

Method and standards

Stoichiometry of sulphur combustion.

Assumptions and limits

- Complete combustion to SO_2; sublimed sulphur and burner efficiency are not included.
- Air is dry, in normal m^3 at 0 °C and 1 atm, not air at the compressor conditions.
- The heat of combustion 2 217 kcal/kg S is used as a fixed figure on this page.

References

• Hugot
• Handbook of Cane Sugar Engineering
• 3rd ed. (Elsevier, 1986)
• ch. 25
• sulphur furnaces
• pp. 407–410
• Stoichiometry $S + O_2 \rightarrow SO_2$; air O_2 20.95 % by volume; molar volume at 0 °C
• 1 atm

Report details

Report reference	FCC-E3AY-C9YX (the same inputs always give the same reference)
Generated	17 November 2026, 19:36 UTC
Calculator	Sulphur Burner: Air, SO_2 Strength and Tray Area
Method last reviewed	13 November 2026
Software release	FireCAD Calc, release of 17 November 2026
Release checks	2 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/sugar-ethanol/clarification/sulphur-burner-air

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Reopens the calculator with the inputs of this report.