Bagasse Boiler Surface, Furnace and Grate (Hugot)

Heating surface from the standard evaporation rate (Hugot 41.55–41.60), furnace volume (41.53) and grate area (41.54) of a bagasse boiler.

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

Input parameters

Unit system: SI

Parameter	Value	Unit
Steam	50.000	t/h
Steam pressure (absolute)	28.439	bar
Steam temperature	380.00	°C
Feed water temperature	90.000	°C
Standard (French) evaporation rate Hugot Table 41.24: 2-circuit step grate 22; 3-circuit horseshoe or Ward 32; bent-tube spreader 36; up to 40 kg/(m²·h).	32.000	kg/(m²·h)
Steam per kg bagasse	2.2000	
Net calorific value of the bagasse	1,900.0	kcal/kg
Furnace heat release per m³ On the NCV basis, as the volume uses the NCV above. Hugot: 200 000 kcal/(m³·h) on NCV; his spreader figures up to about 260 000 are on GCV and must be converted to NCV first.	232.60	kW/m³
Grate loading Hugot: step grates 500–1000; horseshoe 1300–1800; spreaders designed near 800 kg/(m²·h).	800.00	kg/(m²·h)

Calculated results

Parameter	Value	Unit
Heat per kg of steam	2,809.6	kJ/kg
Actual evaporation rate	30.471	kg/(m²·h)
Heating surface	1,640.9	m²
Bagasse fired	22.727	t/h
Furnace volume	215.91	m³
Grate area	28.409	m²
Heating surface per grate area	57.760	

Notes for this case

- Hugot's French standard evaporation is referred to 639 kcal per kg of steam. He reports 30–75 m² of surface per m² of grate (about 50 for spreaders).

Formula and method

$$\tau = \tau_0 \frac{639}{h}, \quad S = \frac{Q}{\tau}, \quad B = \frac{Q}{r}, \quad V = \frac{BN}{q_v}, \quad s_g = \frac{B}{\beta}$$

Variables

Q	Steam	kg/s
p_s	Steam pressure (absolute)	Pa
T_s	Steam temperature	K
t_f	Feed water temperature	K

τ_0	Standard (French) evaporation rate	kg/(m²·s)
r	Steam per kg bagasse	-
N	Net calorific value of the bagasse	J/kg
q_v	Furnace heat release per m³	W/m³
β	Grate loading	kg/(m²·s)
h	Heat per kg of steam	J/kg
τ	Actual evaporation rate	kg/(m²·s)
S	Heating surface	m²
B	Bagasse fired	kg/s
V	Furnace volume	m³
s_g	Grate area	m²
S/s_g	Heating surface per grate area	-

Method and standards

Hugot's sizing rules.

Assumptions and limits

- Hugot's practice figures.
- The furnace heat release must be on the NCV basis, like the NCV entered; convert GCV-based figures first.
- Steam superheated (or dry) and feed water liquid and colder; otherwise the page stops.

References

• Hugot
• Handbook of Cane Sugar Engineering
• 3rd ed. (Elsevier, 1986)
• ch. 41
• eqns 41.53–41.60 and Tables 41.23–41.24
• pp. 944–958
• Steam and feed enthalpies from IAPWS-IF97

Report details

Report reference	FCC-RVZA-6TKW (the same inputs always give the same reference)
Generated	17 November 2026, 19:36 UTC
Calculator	Bagasse Boiler Surface, Furnace and Grate (Hugot)
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/steam-power/bagasse-boiler-sizing-hugot

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.