Sugar Factory Steam Balance (Hugot's Method)

Steam from bagasse, live steam to turbines and turbo-generator, exhaust, process make-up and surplus bagasse per tonne cane by Hugot's method.

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

Input parameters

Unit system: SI

Parameter	Value	Unit
Crushing rate	100.00	t/h
Bagasse per tonne cane	285.00	kg/t
Bagasse moisture	48.000	%
Sugar in bagasse	2.0000	%
Air factor	1.4000	
Flue gas temperature	200.00	°C
Boiler factors	91.270	%
Live steam pressure (absolute)	28.439	bar
Live steam temperature	380.00	°C
Feed water temperature	90.000	°C
Electric load per t cane/h	18.600	kWh/t
Motors and lines, to alternator terminals Hugot: 0.85 × 0.97.	82.450	%
Turbo-generator steam rate	11.000	kg/kWh
Turbine-driven load (mills, shredder) per t cane/h	13.300	kWh/t
Drive turbine steam rate	13.500	kg/kWh
Exhaust recovered from the turbines	95.000	%
Process steam incl. losses per tonne cane	450.00	kg/t

Calculated results

Parameter	Value	Unit
Steam per kg bagasse	2.1866	
Steam available from bagasse per tonne cane	623.18	kg/t
Steam to the turbo-generator per tonne cane	248.15	kg/t
Steam to drive turbines per tonne cane	179.55	kg/t
Exhaust available per tonne cane	406.32	kg/t
Live steam make-up to process per tonne cane	43.685	kg/t
Exhaust surplus per tonne cane	0	kg/t
Live steam needed per tonne cane	471.39	kg/t
Bagasse surplus	24.358	%
Live steam	47.139	t/h

Notes for this case

- Live steam make-up to process is counted kilogram for kilogram, without desuperheating water or boiler blowdown.
- Hugot's example (100 t/h, 285 kg bagasse/t, 28 kg/cm² g 380 °C): 624 kg steam/t available, 427 to the prime movers, 406 exhaust, 450 needed, 44 make-up, 471 live and about 24.5 % bagasse surplus.

Formula and method

$$\frac{S}{B} = \frac{M_v}{h_s - h_f}, \quad S_g = \frac{P_e}{\eta_g} SR_g, \quad S_t = P_t SR_t, \quad E = x_e(S_g + S_t)$$

$$M = \max(0, S_p - E), \quad S_l = S_g + S_t + M, \quad \sigma = \frac{BS/B - S_l}{BS/B}$$

Variables

A	Crushing rate	kg/s
B	Bagasse per tonne cane	kg/kg
w	Bagasse moisture	-
s	Sugar in bagasse	-
m	Air factor	-
t	Flue gas temperature	K
$\alpha\beta\eta$	Boiler factors	-
p_s	Live steam pressure (absolute)	Pa
T_s	Live steam temperature	K
t_f	Feed water temperature	K
P_e	Electric load per t cane/h	J/kg
η_g	Motors and lines, to alternator terminals	-
SR_g	Turbo-generator steam rate	kg/J
P_t	Turbine-driven load (mills, shredder) per t cane/h	J/kg
SR_t	Drive turbine steam rate	kg/J
x_e	Exhaust recovered from the turbines	-
S_p	Process steam incl. losses per tonne cane	kg/kg
S/B	Steam per kg bagasse	-
S_a	Steam available from bagasse per tonne cane	kg/kg
S_g	Steam to the turbo-generator per tonne cane	kg/kg
S_t	Steam to drive turbines per tonne cane	kg/kg
E	Exhaust available per tonne cane	kg/kg
M	Live steam make-up to process per tonne cane	kg/kg
X	Exhaust surplus per tonne cane	kg/kg
S_l	Live steam needed per tonne cane	kg/kg
σ	Bagasse surplus	-
$\dot{m}_s$	Live steam	kg/s

Method and standards

Hugot's steam balance structure.

Assumptions and limits

- Steady crush; all exhaust used in process.
- Live steam must be superheated. Make-up to process is counted 1:1 (no desuperheating water, no blowdown). A negative bagasse surplus is a deficit and is flagged.

References

- Hugot
- Handbook of Cane Sugar Engineering
- 3rd ed. (Elsevier, 1986)
- ch. 41
- steam balance example
- pp. 1012–1016

- with eqns 41.25
- 41.48 and 41.50
- Steam and feed enthalpies from IAPWS-IF97

Report details

Report reference	FCC-HSA3-4EFD (the same inputs always give the same reference)
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Calculator	Sugar Factory Steam Balance (Hugot's Method)
Method last reviewed	13 November 2026
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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/sugar-factory-steam-balance-hugot

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.