Bagasse Furnace Temperature (Hugot)

Theoretical furnace temperature for bagasse from moisture, sugar, excess air and air temperature with Hugot's mean gas specific heats (41.44–41.46).

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

Input parameters

Unit system: SI

Parameter	Value	Unit
Bagasse moisture	48.000	%
Sugar in bagasse	2.0000	%
Air factor	1.5000	
Ambient temperature (bagasse and air before any heater)	30.000	°C
Heated combustion air temperature (0 = air not heated) Air leaving the air heater. Leave at 0 when the air enters at ambient temperature.	-273.15	°C
Combustion efficiency (unburnt) Hugot: 0.98–0.99 for step grates, horseshoe and spreader furnaces; 0.94–0.95 Ward.	98.000	%
Furnace radiation factor	99.000	%

Calculated results

Parameter	Value	Unit
Net calorific value 4250 − 4850w − 1200s	7,946.5	kJ/kg
Heat brought by the air above 0 °C (for information; not added to the balance)	135.44	kJ/kg
Furnace temperature with air at ambient	1,075.0	°C
Rise in furnace temperature per degree of air heating (Hugot 41.79)	0.59489	
Furnace temperature	1,075.0	°C

Notes for this case

- Hugot's table ($\alpha\beta_0$ = 0.96, air at 30 °C): about 1 100 °C at 45 % moisture and m = 1.5, 1 040 °C at 50 %.

Formula and method

$$(T_0 - t_0)\sum_i P_i(a_i + b_i T_0) = \alpha\beta_0 N, \quad N = 4250 - 4850w - 1200s \ \ [\text{kcal/kg}]$$

$$\theta = \frac{T - T_0}{t - t_0} = \frac{1}{1.375 + \frac{1}{4.19(1-w)m}}, \quad T = T_0 + \theta\,(t - t_0)$$

Variables

w	Bagasse moisture	-
s	Sugar in bagasse	-
m	Air factor	-
t_0	Ambient temperature of the bagasse and air before any heater	K
t	Heated combustion air temperature (0: air not heated, T = T_0)	K
T_0	Furnace temperature with air at ambient	K
θ	Rise in furnace temperature per degree of air heating	-

P_i	Mass of product gas i per kg bagasse (Hugot's average composition)	kg/kg
$a_i\$, \$b_i$	Mean specific heat coefficients of gas i, c = a + bT	kcal/(kg·°C), kcal/(kg·°C²)
α	Combustion efficiency (unburnt)	-
β_0	Furnace radiation factor	-
N	Net calorific value 4250 − 4850w − 1200s	J/kg
q_a	Heat brought by the air above 0 °C (for information; not added to the balance)	J/kg
T	Furnace temperature	K

Method and standards

Hugot's heat balance of the furnace gases (Handbook of Cane Sugar Engineering, 3rd ed., eqns 41.44–41.46) gives the temperature T_o with air at ambient. For heated air, Hugot eqn 41.79 (p. 978) adds $\theta(t - t_o)$: only the air is heated, while the bagasse and its moisture enter cold, so the furnace gains less than the air heating, θ being about 0.6 for 46–48 % moisture and an air factor of 1.4–1.5 (Hugot p. 979).

Assumptions and limits

- Hugot's average composition and mean specific heats (0.24 for air, 0.33 for the gases in eqn 41.79).
- t_o is the ambient temperature; enter heated air separately, not as t_o.

References

- Hugot
- Handbook of Cane Sugar Engineering
- 3rd ed. (Elsevier, 1986)
- ch. 41
- furnace temperature
- eqns 41.44–41.46 and Tables 41.14–41.17
- pp. 924–931

Report details

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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-furnace-temperature

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Reopens the calculator with the inputs of this report.