Recovery Boiler: Black Liquor Solids, Heat Input and Steam

Black liquor dry solids per day, heat input and steam generation of a kraft recovery boiler from liquor flow, solids content, heating value and boiler efficiency.

Method: Smook; Handbook for Pulp & Paper Technologists; ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Heavy black liquor flow	2,400.0	t/d
Dry solids content	72.000	%
Heating value of the dry solids	14.000	MJ/kg
Boiler efficiency (on HHV of solids)	65.000	%
Enthalpy rise feedwater to steam	2,900.0	kJ/kg
Pulp production (oven-dry)	500.00	t/d

Calculated results

Parameter	Value	Unit
Dry solids fired	1,728.0	t/d
Heat input	280.00	MW
Steam generated	225.93	t/h
Dry solids per OD tonne of pulp	3.4560	kg/kg
Steam per OD tonne of pulp	10.845	kg/kg

Notes for this case

• Recovery boilers are rated in tonnes of dry solids per day; 1.5–1.8 t of solids per air-dry tonne (ADt) of pulp is typical for kraft. Here 3.11 t per ADt (the output is per oven-dry tonne; 1 ADt = 0.9 OD t).

Formula and method

$$\dot{m}_{DS} = \dot{m}_{BL} x, \quad Q = \dot{m}_{DS} HHV, \quad \dot{m}_s = \frac{\eta Q}{\Delta h}, \quad DS/\text{pulp} = \frac{\dot{m}_{DS}}{\dot{m}_{OD}}, \quad \text{steam/pulp} = \frac{\dot{m}_s}{\dot{m}_{OD}}$$

Variables

$\dot{m}_{BL}$	Heavy black liquor flow	kg/s
x	Dry solids content	-
HHV	Heating value of the dry solids	J/kg
η	Boiler efficiency (on HHV of solids)	-
Δh	Enthalpy rise feedwater to steam	J/kg
$\dot{m}_{OD}$	Pulp production (oven-dry)	kg/s
$\dot{m}_{DS}$	Dry solids fired	kg/s
Q	Heat input	W
$\dot{m}_s$	Steam generated	kg/s
DS/pulp	Dry solids per OD tonne of pulp	kg/kg
steam/pulp	Steam per OD tonne of pulp	kg/kg

Method and standards

Heat input and simple efficiency.

Assumptions and limits

- Efficiency on dry-solids HHV.
- The per-pulp figures are per oven-dry tonne; multiply by 0.9 for per air-dry tonne (ADt), the basis of the usual 1.5–1.8 t solids per ADt.

References

- Smook
- Handbook for Pulp & Paper Technologists
- 3rd ed. (Angus Wilde, 2002)
- ch. 10 (chemical recovery: heavy black liquor at 70–75 % solids burnt in the recovery furnace)

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/chemical/pulp-paper/recovery-boiler-black-liquor

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Reopens the calculator with the inputs of this report.