Digester Blow Heat: Flash Steam Recovered

Flash steam released when a batch digester is blown from cooking temperature to the blow tank pressure, from liquor and pulp mass, by an IF97 heat balance.

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

Input parameters

Unit system: SI

Parameter	Value	Unit
Liquor and water blown	200,000	kg
Pulp blown (OD)	25,000	kg
Fibre specific heat	1.3400	kJ/(kg·K)
Cooking temperature	170.00	°C
Blow tank pressure (absolute)	101.33	kPa

Calculated results

Parameter	Value	Unit
Temperature after the blow	99.974	°C
Flash steam	27.648	t
Enthalpy of the flash steam (above water at 0.01 °C)	73.973	GJ
Flash share of the liquor	13.824	%

Notes for this case

- Blow steam is condensed in an accumulator to make hot water; recovering it saves a large part of the digester steam.
- The steam enthalpy is on the IAPWS datum (water at 0.01 °C); the heat recoverable into an accumulator at T_w is m_f (h_g − h_f(T_w)), some 15 % less with hot water at 70–80 °C.

Formula and method

$$m_f = \frac{M\left[h_f(T_1) - h_f(p_2)\right] + M_f c_f (T_1 - T_2)}{h_{fg}(p_2)}$$

Variables

M	Liquor and water blown	kg
M_f	Pulp blown (OD)	kg
c_f	Fibre specific heat	J/(kg·K)
T_1	Cooking temperature	K
p_2	Blow tank pressure (absolute)	Pa
T_2	Temperature after the blow	K
m_f	Flash steam	kg
Q	Enthalpy of the flash steam (above water at 0.01 °C)	J
m_f/M	Flash share of the liquor	-

Method and standards

Adiabatic flash heat balance.

Assumptions and limits

- Liquor as water (no boiling-point rise), so the real flash is somewhat lower; no heat loss.
- Q is the steam enthalpy on the IAPWS datum (liquid water at 0.01 °C). The heat an accumulator can recover to hot water at T_w is m_f [h_g − h_f(T_w)], about 15 % less for water at 70–80 °C.

References

- Smook
- Handbook for Pulp & Paper Technologists
- 3rd ed. (Angus Wilde, 2002)
- ch. 8.5 (blow heat recovery)
- Steam and water enthalpies from IAPWS-IF97 (liquor treated as water)

Report details

Report reference	FCC-M8AC-S05R (the same inputs always give the same reference)
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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/chemical/pulp-paper/blow-heat-recovery

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.