Retort or Blancher Steam: Product Heating Load

Steam to heat a batch of product and containers (or a blancher feed) from initial to process temperature, with the vessel's own heat and losses, by IF97 latent heat.

Method: Mass and energy balances (definitions); Steam and water properties from IAPWS-IF97

Input parameters

Unit system: SI

Parameter	Value	Unit
Product	2,000.0	kg
Product specific heat	3.7000	kJ/(kg·K)
Containers, crates and vessel steel	1,500.0	kg
Their specific heat	0.48000	kJ/(kg·K)
Initial temperature	20.000	°C
Process temperature	121.00	°C
Steam pressure (absolute)	4.0000	bar
Losses and venting share	15.000	%
Come-up time	15.000	min

Calculated results

Parameter	Value	Unit
Heat required	964.85	MJ
Steam	452.27	kg
Average steam rate during come-up	1,809.1	kg/h

Notes for this case

- Venting air at the start of a steam retort uses a lot of extra steam; it is part of the loss share here.
- Latent heat only: with steam injected into retort water the condensate's sensible heat is also used (the steam here is conservative), and the retort water must be added to the heated masses.

Formula and method

$$Q = \frac{(M_p c_p + M_c c_c)(T_2 - T_1)}{1 - \varepsilon}, \quad m_s = \frac{Q}{h_{fg}(p_s)}$$

Variables

M_p	Product	kg
c_p	Product specific heat	J/(kg·K)
M_c	Containers, crates and vessel steel	kg
c_c	Their specific heat	J/(kg·K)
T_1	Initial temperature	K
T_2	Process temperature	K
p_s	Steam pressure (absolute)	Pa
ε	Losses and venting share	-
t_u	Come-up time	s
Q	Heat required	J
m_s	Steam	kg
$\dot{m}_s$	Average steam rate during come-up	kg/s

Method and standards

Sensible heat balance with IF97 latent heat.

Assumptions and limits

- Uniform final temperature.
- Only the latent heat of the steam is counted. In water-immersion or water-spray retorts and blanchers with steam injection, the condensate mixes with the water and also gives up sensible heat, so the steam here is on the safe side. The retort water itself and its heating are not included: add it to the containers term.

References

- Mass and energy balances (definitions)
- Steam and water properties from IAPWS-IF97

Report details

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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/food-dairy/retort-steam-load

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.