UHT Direct Steam Injection: Steam and Added Water

Culinary steam to heat a product by direct injection from preheat to UHT temperature (IF97), the water it adds, and the flash in the vacuum cooler that removes it.

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

Input parameters

Unit system: SI

Parameter	Value	Unit
Product flow	10,000	kg/h
Product specific heat	3.9000	kJ/(kg·K)
Preheat temperature	80.000	°C
UHT temperature	145.00	°C
Steam pressure (absolute)	10.000	bar

Calculated results

Parameter	Value	Unit
Steam injected	1,170.1	kg/h
Water added (share of product)	11.701	%
Flash vessel temperature that removes the added water (equals the preheat temperature)	80.000	°C

Notes for this case

- Flashing back to the preheat temperature in the vacuum vessel removes the same water that the steam added.

Formula and method

$$\dot{m}_s = \frac{\dot{M} c_p (T_2 - T_1)}{h_g(p_s) - h_f(T_2)}$$

Variables

$\dot{M}$	Product flow	kg/s
c_p	Product specific heat	J/(kg·K)
T_1	Preheat temperature	K
T_2	UHT temperature	K
p_s	Steam pressure (absolute)	Pa
$\dot{m}_s$	Steam injected	kg/s
Δw	Water added (share of product)	-
T_f	Flash vessel temperature that removes the added water (equals the preheat temperature)	K

Method and standards

Direct-contact heat balance with IF97.

Assumptions and limits

- Complete condensation; no losses.
- With equal specific heat and latent heat in the injection and the flash, the flash vessel must return the product to the preheat temperature to remove exactly the water added; the output repeats the preheat temperature.

References

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

Report details

Report reference	FCC-MPMJ-PAGZ (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/food-dairy/uht-direct-steam-injection

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.