Grate Ash Quench Water

Heat to remove from hot grate or bottom ash and the quench water flow for a water temperature rise, with ash specific heat 0.2 Btu/lb·°F by default.

Method: Energy balance; residue specific heat 0.2 Btu/lb·°F (837 J/kg·K, owner-confirmed default)

Input parameters

Unit system: SI

Parameter	Value	Unit
Ash discharged	1.2000	t/h
Ash temperature	500.00	°C
Ash temperature after quench	60.000	°C
Ash specific heat	0.83736	kJ/(kg·K)
Quench water temperature rise	20.000	K
Share of the heat taken by evaporating water Red-hot ash boils off part of the water. Leave 0 for a quench where all the heat warms the water; 0.3–0.6 is plausible for ash above 500 °C.	0	%

Calculated results

Parameter	Value	Unit
Heat removed	122.81	kW
Quench water	5.2800	t/h
Water evaporated (lost as vapour, to make up)	0	t/h

Notes for this case

• Above 100 °C some water flashes off on the ash; enter the evaporated share to see the vapour and make-up. Each kg evaporated removes about 27 times the heat of a kg warmed by 20 K.

Formula and method

$$\dot{Q} = \dot{m}_a c_a (T_a - T_o)$$

$$\dot{m}_{ev} = \frac{f_{ev}\,\dot{Q}}{h_{fg}}, \quad \dot{m}_w = \frac{(1 - f_{ev})\,\dot{Q}}{c_w \Delta T_w} + \dot{m}_{ev}$$

Variables

$\dot{m}_a$	Ash discharged	kg/s
T_a	Ash temperature	K
T_o	Ash temperature after quench	K
c_a	Ash specific heat	J/(kg·K)
ΔT_w	Quench water temperature rise	K
$\dot{Q}$	Heat removed	W
$\dot{m}_w$	Quench water	kg/s
f_{ev}	share of the heat taken by evaporating water	-
$\dot{m}_{ev}$	water evaporated, lost as vapour	kg/s
h_{fg}	latent heat of water at 101.325 kPa (IF97), about 2.257	MJ/kg
c_w	specific heat of water, 4186.8	J/(kg·K)

Method and standards

Energy balance. Latent heat from FireCAD's IAPWS-IF97 at atmospheric pressure.

Assumptions and limits

- With $f_{ev} = 0$ (the default) all the heat warms the water and none evaporates. Ash above 100 °C flashes some water; the evaporated share is your estimate, and the heat to bring that water to 100 °C is neglected.
- Ash specific heat is a constant 0.2 Btu/lb·°F; ASME PTC 4 gives a curve rising with temperature, so for bed ash at 800 °C and above the heat may be understated by some per cent.

References

- Energy balance; residue specific heat 0.2 Btu/lb·°F (837 J/kg·K, owner-confirmed default)

Report details

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Release checks	3 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/boilers-power-plant/fuel-ash-handling/ash-quench-water

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.