Bakery Oven Heat Load

Heat to bake bread or biscuits: heating the dough to the crumb temperature, evaporating the bake loss, heating the tins or band, plus losses, and the fuel per tonne.

Method: Mass and energy balances (definitions); latent heat 2 257 kJ/kg

Input parameters

Unit system: SI

Parameter	Value	Unit
Dough throughput	2,000.0	kg/h
Dough specific heat	2.8000	kJ/(kg·K)
Dough in	30.000	°C
Crumb out	98.000	°C
Bake loss (water evaporated)	10.000	%
Tins or band heated	1,500.0	kg/h
Tin specific heat	0.48000	kJ/(kg·K)
Tin temperature rise	150.00	K
Oven efficiency	45.000	%
Fuel heating value	46.000	MJ/kg

Calculated results

Parameter	Value	Unit
Heat to the dough	105.78	kW
Heat to evaporate the bake loss	125.85	kW
Heat to the tins	30.000	kW
Fuel heat input	581.40	kW
Fuel	45.501	kg/h
Fuel per tonne of dough	22.751	kg/t

Formula and method

$$Q = \frac{\dot{M} c_p (T_2 - T_1) + \dot{M} b (\lambda + c_w (100 - T_2)) + \dot{M}_t c_t \Delta T_t}{\eta}$$

Variables

$\dot{M}$	Dough throughput	kg/s
c_p	Dough specific heat	J/(kg·K)
T_1	Dough in	K
T_2	Crumb out	K
b	Bake loss (water evaporated)	-
$\dot{M}_t$	Tins or band heated	kg/s
c_t	Tin specific heat	J/(kg·K)
T_t	Tin temperature rise	K
η	Oven efficiency	-
λ	latent heat of water at 100 °C, 2 257 kJ/kg	J/kg
c_w	specific heat of water, 4.1868 kJ/(kg·K)	J/(kg·K)

LHV	Fuel heating value	J/kg
Q_d	Heat to the dough	W
Q_e	Heat to evaporate the bake loss	W
Q_t	Heat to the tins	W
Q	Fuel heat input	W
$\dot{m}_f$	Fuel	kg/s
$\dot{m}_f/\dot{M}$	Fuel per tonne of dough	kg/kg

Method and standards

Useful heat over oven efficiency.

Assumptions and limits

- The dough term heats the whole dough, water included, to the crumb temperature; the bake loss then adds the heat from the crumb temperature to 100 °C and the latent heat, so nothing is counted twice.

References

- Mass and energy balances (definitions); latent heat 2 257 kJ/kg

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/bakery-oven-heat

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Reopens the calculator with the inputs of this report.