Microwave Drying Power and Energy per kg of Water

Microwave power absorbed and electrical power needed to heat and dry a product stream, from feed rate, moisture contents, specific heat and magnetron efficiency.

Method: Energy balance of microwave drying

Input parameters

Unit system: SI

Parameter	Value	Unit
Wet feed rate	100.00	kg/h
Feed moisture (wet basis)	40.000	%
Product moisture (wet basis)	10.000	%
Specific heat of the wet feed	2.8000	kJ/(kg·K)
Heating of the feed to evaporation temperature	75.000	K
Latent heat	2,260.0	kJ/kg
Overall electrical-to-absorbed efficiency	60.000	%

Calculated results

Parameter	Value	Unit
Water evaporated	33.333	kg/h
Microwave power absorbed	26.759	kW
Electrical power	44.599	kW
Electricity per kg of water (kWh/kg)	1.3380	

Notes for this case

• Microwaves heat the water inside the product directly, so the absorbed power must warm the feed to evaporation temperature and supply the latent heat of the water removed. Magnetrons convert 60–80 % of the mains power to microwaves and not all of it is absorbed, so the electrical demand is the absorbed power over the overall efficiency. Microwave drying is fast and uniform but uses expensive electricity: it is usually used to finish products dried mostly by hot air.

Formula and method

$$\dot{m}_w = \dot{m}_f \frac{w_0 - w_1}{1 - w_1}, \quad P_a = \dot{m}_f c_p \Delta T + \dot{m}_w \lambda, \quad P_e = \frac{P_a}{\eta}$$

Variables

$\dot{m}_f$	Wet feed rate	kg/s
w_0	Feed moisture (wet basis)	-
w_1	Product moisture (wet basis)	-
c_p	Specific heat of the wet feed	J/(kg·K)
ΔT	Heating of the feed to evaporation temperature	K
λ	Latent heat	J/kg
η	Overall electrical-to-absorbed efficiency	-
$\dot{m}_w$	Water evaporated	kg/s
P_a	Microwave power absorbed	W
P_e	Electrical power	W
SEC	Electricity per kg of water (kWh/kg)	-

Method and standards

Microwave drying.

Assumptions and limits

- Steady continuous drying; constant properties.

References

Energy balance of microwave drying

Report details

Report reference	FCC-5SEX-ZNYN (the same inputs always give the same reference)
Generated	23 November 2026, 17:34 UTC
Calculator	Microwave Drying Power and Energy per kg of Water
Method last reviewed	17 November 2026
Software release	FireCAD Calc, release of 22 November 2026
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/chemical/drying/microwave-drying-power

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.