Heat Pump Dryer: SMER and Energy Saving

Specific moisture extraction rate and specific energy of a heat pump dryer from water removed and electrical input, compared with a conventional hot-air dryer.

Method: Specific moisture extraction rate of heat pump dryers

Input parameters

Unit system: SI

Parameter	Value	Unit
Water removed	40.000	kg/h
Compressor power	10.000	kW
Fan power	3.0000	kW
Auxiliary heater power	0	kW
Latent heat of evaporation	2,400.0	kJ/kg
Thermal efficiency of the conventional dryer	50.000	%

Calculated results

Parameter	Value	Unit
Specific moisture extraction rate (kg per kWh)	3.0769	
Specific energy (kWh per kg)	0.32500	
Conventional dryer, heat per kg (kWh per kg)	1.3333	
Ratio of conventional heat to heat pump electricity	4.1026	
Dryer COP (latent heat removed per electrical energy)	2.0513	

Notes for this case

• A heat pump dryer condenses the water out of recirculated air on its evaporator and returns the latent heat through the condenser, so its specific moisture extraction rate (kg of water per kWh of electricity) is typically 1–4, against 0.5–1 kg per kWh of heat for a hot-air dryer. Compare costs with the price of electricity against the price of fuel heat; the energy ratio alone favours the heat pump, the price ratio may not. Low drying temperatures (below about 60 °C) suit heat-sensitive products and heat pumps alike.

Formula and method

$$SMER = \frac{\dot{m}_w}{P_c + P_f + P_h}, \quad SEC_c = \frac{\lambda}{\eta_c}$$

Variables

$\dot{m}_w$	Water removed	kg/s
P_c	Compressor power	W
P_f	Fan power	W
P_h	Auxiliary heater power	W
λ	Latent heat of evaporation	J/kg
η_c	Thermal efficiency of the conventional dryer	-
$SMER$	Specific moisture extraction rate (kg per kWh)	-
SEC	Specific energy (kWh per kg)	-
SEC_c	Conventional dryer, heat per kg (kWh per kg)	-
SEC_c/SEC	Ratio of conventional heat to heat pump electricity	-
COP_{dryer}	Dryer COP (latent heat removed per electrical energy)	-

Method and standards

SMER.

Assumptions and limits

- Steady operation; latent heat constant.

References

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Report details

Report reference	FCC-5R64-A09S (the same inputs always give the same reference)
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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/chemical/drying/heat-pump-dryer-smer

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.