Liquid Hydrogen Tank Boil-Off

Boil-off rate of a liquid hydrogen tank from its heat leak, as kg per day and per cent of the full tank per day, with the hold time to empty.

Method: Boil-off energy balance of a cryogenic tank

Input parameters

Unit system: SI

Parameter	Value	Unit
Heat leak into the tank	0.25000	kW
Tank liquid volume	50.000	m³
Latent heat of vaporisation (446 kJ/kg at 1 atm)	446.00	kJ/kg
Liquid density (70.8 kg/m³ at 1 atm)	70.800	kg/m³
Fill fraction	90.000	%

Calculated results

Parameter	Value	Unit
Boil-off rate	2.0179	kg/h
Boil-off per day	48.430	kg
Boil-off per day (fraction of contents)	1.5201	%
Hydrogen in the tank	3,186.0	kg
Time to boil off the contents	65.785	d

Notes for this case

• ṁ = Q/h_fg with all leaked heat evaporating liquid at constant pressure (vented tank). Small tanks lose 1–3 % a day, large spheres about 0.1 % a day because heat leak grows with surface and contents with volume. Ortho-para conversion adds heat in freshly liquefied hydrogen.

Formula and method

$$\dot{m}_b = \frac{\dot{Q}}{h_{fg}}, \quad \frac{\dot{m}_b \cdot 1\,d}{\rho_l V f}$$

Variables

$\dot{Q}$	Heat leak into the tank	W
V	Tank liquid volume	m³
h_{fg}	Latent heat of vaporisation (446 kJ/kg at 1 atm)	J/kg
ρ_l	Liquid density (70.8 kg/m³ at 1 atm)	kg/m³
f	Fill fraction	-
$\dot{m}_b$	Boil-off rate	kg/s
$\dot{m}_{day}$	Boil-off per day	kg
$\dot{m}/m$	Boil-off per day (fraction of contents)	-
m	Hydrogen in the tank	kg
t_{empty}	Time to boil off the contents	s

Method and standards

Cryogenic boil-off.

Assumptions and limits

- Vented tank at constant pressure.

References

Boil-off energy balance of a cryogenic tank

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/environmental/hydrogen-fuel-cells/liquid-hydrogen-boil-off

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.