Biomass Fuel Storage: Mass, Volume and Energy for a Number of Days

Mass, volume and energy density of biomass fuel stored for a number of days, from boiler heat input, moisture, dry calorific value and bulk density.

Method: Moisture correction of calorific value (definitions; latent heat 2.442 MJ/kg at 25 °C from IAPWS-IF97)

Input parameters

Unit system: SI

Parameter	Value	Unit
Boiler fuel heat input (NCV basis, not GCV)	20.000	MW
Operating hours per day	24.000	h
Days of storage	15.000	
Net calorific value, dry basis	18.000	MJ/kg
Moisture, wet basis	35.000	%
Bulk density as stored (wet)	250.00	kg/m³

Calculated results

Parameter	Value	Unit
Net calorific value as received	10.845	MJ/kg
Fuel flow	6.6388	t/h
Fuel to store	2,390.0	t
Storage volume	9,559.8	m³
Energy density of the stored fuel (NCV)	753.15	kWh/m³

Notes for this case

• NCV as received = NCV_dry(1 − w) − 2.442 MJ/kg × w (evaporation of the moisture at 25 °C, IAPWS-IF97). The heat input must be on the NCV basis; a GCV-basis rating understates the fuel flow. Covered storage keeps moisture down; add 10–20 % volume for access and rotation.

Formula and method

$$NCV = NCV_d(1-w) - h_{fg,25}\,w, \quad \dot{m}_f = \frac{Q_{in}}{NCV}$$

$$M = \dot{m}_f h_d\, n, \quad V = \frac{M}{\rho_b}, \quad e_V = \rho_b\, NCV$$

Variables

Q_{in}	Boiler fuel heat input (NCV basis)	W
h_d	Operating hours per day	s
n	Days of storage	-
NCV_d	Net calorific value, dry basis	J/kg
w	Moisture, wet basis	-
ρ_b	Bulk density as stored (wet)	kg/m³
NCV	Net calorific value as received	J/kg
$\dot{m}_f$	Fuel flow	kg/s
M	Fuel to store	kg

V	Storage volume	m³
e_V	Energy density of the stored fuel (NCV basis)	J/m³
$h_{fg,25}$	latent heat of water at 25 °C (IAPWS-IF97), 2.442	MJ/kg

Method and standards

Mass and energy balance.

Assumptions and limits

- Uniform moisture.
- The heat input is on the NCV basis. Boiler ratings are often on GCV; entering a GCV-basis input here understates the fuel flow and the storage.

References

- Moisture correction of calorific value (definitions; latent heat 2.442 MJ/kg at 25 °C from IAPWS-IF97)

Report details

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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/biomass-storage-volume

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.