ENGINEERING TOOL

Bulk Material Properties Database

Reference database of bulk material properties: density, angle of repose, flowability, abrasiveness for 50+ common bulk materials.

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This reference database lists typical properties of more than 50 common bulk materials handled in storage silos. Values are indicative ranges for silo design, flow assessment and equipment selection. Material samples should always be tested for final design.

1. How to Read the Data

- Bulk density: loose poured mass per unit volume; use the design (maximum) value for loads
- Angle of repose: stable slope angle of a free pile; higher values indicate poorer flow
- Flowability: qualitative class (Good / Fair / Poor) based on Jenike and Carr indices
- Abrasiveness: effect on contacting steel; High values require wear plates or liners
- Notes: key behavior such as cohesion, stickiness, explosion or heating risk

2. Material Property Table

Material	Bulk Density (t/m3)	Angle of Repose (deg)	Flowability	Abrasiveness	Notes
Portland cement	1.20-1.50	25-35	Fair-Good	Low	Standard aerated discharge
Fly ash (dry)	0.55-0.90	25-40	Fair	Low	Cohesive when moist
Fly ash (wet / lagoon)	1.00-1.30	35-50	Poor	Low	Sticky; needs lining
Clinker	1.30-1.60	30-40	Fair	Medium	Hot material up to 150 degC
Limestone (crushed)	1.40-1.70	35-45	Fair	Medium-High	Wear plates advised
Gypsum	1.20-1.40	30-40	Fair	Low-Med	Slightly abrasive
Coal (bituminous)	0.70-0.90	30-45	Fair	Medium	Dust explosion risk
Coal (anthracite)	0.80-1.00	30-40	Fair	Medium	Lower dust risk
Petroleum coke (petcoke)	0.80-1.00	30-40	Fair	Medium	May self-heat
Granulated blast furnace slag	1.00-1.30	30-40	Fair	Medium	GGBS raw material
Steel slag	1.60-2.00	35-45	Poor	High	Heavy; needs robust discharge
Quicklime (CaO)	0.90-1.20	30-45	Fair	Medium	Reacts with moisture
Hydrated lime	0.45-0.60	35-45	Poor	Low	Very cohesive
Alumina	1.00-1.20	30-40	Fair	Medium	Fine powder
Sand (dry)	1.50-1.70	30-40	Good	High	Abrasive; wear plates
Sand (wet)	1.80-2.00	35-45	Fair	High	Sticky; bridging risk
Gravel	1.50-1.80	35-45	Good	High	Free draining
Crushed stone aggregate	1.50-1.80	35-45	Fair	High	Impact at inlet
Kaolin clay	0.90-1.10	35-50	Poor	Medium	Cohesive when moist
Talc	0.85-1.00	35-45	Poor	Low-Med	Very fine, lubricating
Barite	2.00-2.30	35-45	Fair	Medium	High density drilling powder
Bauxite	1.20-1.50	35-45	Fair	High	Abrasive ore
Copper concentrate	1.80-2.20	35-45	Poor	High	May pack in hopper

Material	Bulk Density (t/m3)	Angle of Repose (deg)	Flowability	Abrasiveness	Notes
Lead concentrate	2.00-2.50	35-45	Poor	Medium	Toxic dust handling
Zinc concentrate	1.80-2.20	35-45	Poor	Medium	Flotation concentrate
Iron ore (fines)	2.00-2.40	35-45	Poor	High	Heavy, abrasive
Iron ore (lump)	1.80-2.20	35-45	Fair	High	Impact loading
Nickel laterite ore	1.40-1.70	35-45	Fair	High	Moisture dependent
Gold ore (crushed)	1.60-2.00	35-45	Fair	High	CIL process storage
Red mud (bauxite residue)	1.20-1.50	35-50	Poor	Low	Alkaline, cohesive
Phosphogypsum	1.20-1.40	35-45	Fair	Low	Fertilizer byproduct
Ground calcium carbonate	0.80-1.20	35-45	Fair	Low-Med	Filler powder
Silica fume	0.30-0.50	35-50	Poor	Low	Very light, cohesive
Titanium dioxide pigment	0.50-0.80	35-50	Poor	Low	Fine, bridging risk
Carbon black	0.05-0.15	35-50	Poor	Low	Extremely light, aeratable
PVC resin powder	0.50-0.65	35-45	Poor	Low	Static charging
PE / PP pellets	0.55-0.65	25-35	Good	Low	Free flowing granules
Rubber crumb	0.30-0.45	35-45	Poor	Low	Elastic, compacts
Sawdust	0.15-0.25	35-45	Poor	Low	Combustible dust
Wood chips	0.20-0.35	35-45	Poor	Low	Bulky, bridging
Wood pellets	0.65-0.75	25-35	Good	Low	Self-heating risk
Bagasse	0.10-0.20	40-55	Poor	Low	Fibrous, bridges easily
Wheat / grain	0.75-0.80	25-30	Good	Low	Fumigation considerations
Corn	0.70-0.75	25-30	Good	Low	Feed storage
Soybean	0.75-0.80	25-30	Good	Low	Oilseed storage
Flour	0.55-0.65	35-50	Poor	Low	Dust explosion risk
DDGS (distillers grain)	0.40-0.55	35-45	Poor	Low	Cohesive feed
Fish meal	0.60-0.70	35-45	Poor	Low	Odor and heating control
Bone meal	0.70-0.85	35-45	Poor	Low	Feed ingredient
Granulated sugar	0.85-0.90	30-35	Good	Low	Hygroscopic
Salt	1.00-1.30	30-40	Good	Low-Med	Corrosive environment
Soda ash (light)	0.50-0.60	35-45	Poor	Low-Med	Very cohesive
Urea (prilled)	0.75-0.80	30-35	Good	Low	Fertilizer
DAP fertilizer	0.90-1.00	35-45	Fair	Medium	Slightly abrasive
Potash (KCl)	1.00-1.20	35-45	Fair	Medium	Corrosive to steel
Perlite (expanded)	0.06-0.10	35-45	Poor	Low	Extremely light
Vermiculite (expanded)	0.08-0.12	35-45	Poor	Low	Light, dusty

3. Design Notes

- Use the maximum bulk density for structural loads and the minimum for volume sizing
- Materials marked Poor typically require mass-flow hoppers, aeration or vibrators
- Materials with explosion risk need venting, inerting or suppression per NFPA 68 / 69
- Abrasiveness High requires wear plates, ceramic lining or replaceable liners
- Values above are typical published ranges; laboratory shear testing is recommended

Contact Manxing

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