Bismuth, commercial purity

General information

Designation

Bismuth Metal (as sold on world commodity markets)

Typical uses

Alloying element; Pharmaceuticals; Electronics; Catalysts; Cosmetics; Pigments; Medicines; Thermocouples; Carrier for Uranium fuel in nuclear reactors; Fire sensing equipment;

Composition overview

Compositional summary

Bi100

Material family	Metal (other)
Base material	Bi (Bismuth)

Composition detail (metals, ceramics and glasses)

Bi (bismuth)	100			%

Price

Price	*	24.1	-	29.5	USD/kg

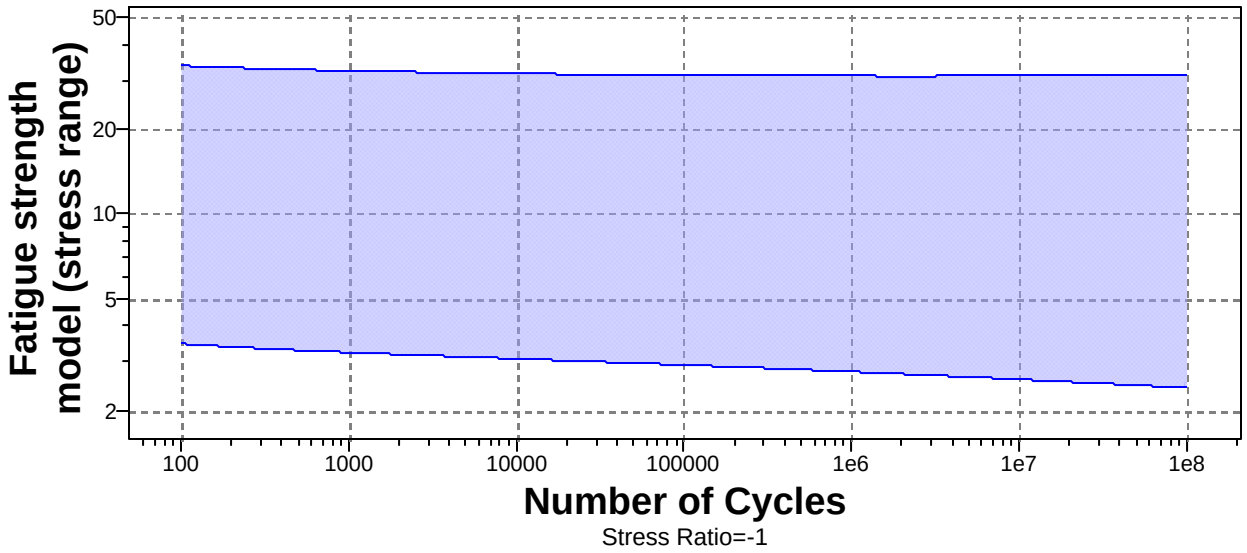
Physical properties

Density		9.74e3	-	9.8e3	kg/m^3

Mechanical properties

Young's modulus		33	-	35	GPa
Yield strength (elastic limit)	*	2	-	14	MPa
Tensile strength		4	-	20	MPa
Elongation	*	20	-	30	% strain
Compressive strength	*	2	-	14	MPa
Flexural modulus	*	33	-	35	GPa
Flexural strength (modulus of rupture)	*	2	-	14	MPa
Shear modulus		12	-	13.5	GPa
Bulk modulus		31	-	36	GPa
Poisson's ratio		0.325	-	0.335	
Shape factor		30			
Hardness - Vickers	*	5	-	10	HV
Fatigue strength at 10^7 cycles	*	8	-	10	MPa
Fatigue strength model (stress range)	*	2.57	-	31.1	MPa

Parameters: Stress Ratio = -1, Number of Cycles = 1e7cycles



Mechanical loss coefficient (tan delta)	* 0.02	-	0.2	

Impact & fracture properties

Fracture toughness	* 5	-	20	MPa.m^0.5

Thermal properties

Melting point	267	-	272	°C
Maximum service temperature	240	-	250	°C
Minimum service temperature	-273			°C
Thermal conductivity	8.1	-	8.7	W/m.°C
Specific heat capacity	115	-	130	J/kg.°C
Thermal expansion coefficient	13	-	13.6	µstrain/°C
Latent heat of fusion	48	-	56	kJ/kg

Electrical properties

Electrical resistivity	105	-	109	µohm.cm
Galvanic potential	* -0.25	-	-0.17	V

Magnetic properties

Magnetic type	Non-magnetic

Optical properties

Transparency	Opaque

Durability

Water (fresh)	Excellent
Water (salt)	Excellent

Weak acids	Acceptable
Strong acids	Unacceptable
Weak alkalis	Acceptable
Strong alkalis	Limited use
Organic solvents	Excellent
Oxidation at 500C	Unacceptable
UV radiation (sunlight)	Excellent
Galling resistance (adhesive wear)	Limited use
Flammability	Non-flammable

Primary production energy, CO2 and water

Embodied energy, primary production	* 138	-	152	MJ/kg
CO2 footprint, primary production	* 8.63	-	9.51	kg/kg
Water usage	* 2.8e3	-	3.09e3	l/kg

Processing energy, CO2 footprint & water

Casting energy	* 5.27	-	5.83	MJ/kg
Casting CO2	* 0.395	-	0.437	kg/kg
Casting water	* 9.98	-	15	l/kg
Rough rolling, forging energy	* 0.319	-	0.353	MJ/kg
Rough rolling, forging CO2	* 0.0239	-	0.0265	kg/kg
Rough rolling, forging water	* 1.69	-	2.53	l/kg
Extrusion, foil rolling energy	* 0.354	-	0.391	MJ/kg
Extrusion, foil rolling CO2	* 0.0265	-	0.0293	kg/kg
Extrusion, foil rolling water	* 1.7	-	2.55	l/kg
Wire drawing energy	* 0.542	-	0.599	MJ/kg
Wire drawing CO2	* 0.0407	-	0.045	kg/kg
Wire drawing water	* 0.2	-	0.31	l/kg
Metal powder forming energy	* 4.17	-	4.62	MJ/kg
Metal powder forming CO2	* 0.334	-	0.37	kg/kg
Metal powder forming water	* 4.55	-	6.83	l/kg
Vaporization energy	* 2.07e3	-	2.29e3	MJ/kg
Vaporization CO2	* 155	-	171	kg/kg
Vaporization water	* 862	-	1.29e3	l/kg
Coarse machining energy (per unit wt removed)	* 0.48	-	0.531	MJ/kg
Coarse machining CO2 (per unit wt removed)	* 0.036	-	0.0398	kg/kg
Fine machining energy (per unit wt removed)	* 0.526	-	0.582	MJ/kg
Fine machining CO2 (per unit wt removed)	* 0.0395	-	0.0436	kg/kg
Grinding energy (per unit wt removed)	* 0.578	-	0.639	MJ/kg
Grinding CO2 (per unit wt removed)	* 0.0433	-	0.0479	kg/kg

Non-conventional machining energy (per unit wt removed)	* 20.7	-	22.9	MJ/kg
Non-conventional machining CO2 (per unit wt removed)	* 1.55	-	1.71	kg/kg

Recycling and end of life

Recycle	✓			
Embodied energy, recycling	* 25.3	-	28	MJ/kg
CO2 footprint, recycling	* 1.99	-	2.2	kg/kg
Recycle fraction in current supply	9.59	-	10.6	%
Downcycle	✓			
Combust for energy recovery	✗			
Landfill	✗			
Biodegrade	✗			

Notes

Warning

Excess bismuth can cause mild kidney damage to humans;

Other notes

Bismuth is one of the less toxic heavy metals. It has a silver luster with a pink tinge.

Links

ProcessUniverse

Producers

Reference

Shape