Description

Image

Caption

1. Organ pipes are made of tin or of a tin - lead alloy. 2. Close-up of the material. © Håkan Svensson (Xauxa) at en.wikipedia - (CC BY-SA 3.0)

The material

Tin (symbol Sn) has been know to man since at least 3500 BC. The discovery that copper alloyed with tin to give bronze, greatly improving the mechanical properties, launched the Bronze age. In 1800 Napoleon offered prize of 12,000 francs for a method for preserving food for his armies. The tin can (steel coated with tin), which revolutionise the storage and preservation of foodstuffs and liquids, was invented in 1810, ironically by an Englishman; the first commercial canning factory opened just 3 years later.

Compositional summary

Tin,

General properties

Density		453	-	454	lb/ft^3
Price	*	9.57	-	10.6	USD/lb
Date first used		-3500			

Mechanical properties

Young's modulus		5.95	-	6.53	10^6 psi
Shear modulus		2.03	-	2.61	10^6 psi
Bulk modulus		5.51	-	6.67	10^6 psi
Poisson's ratio		0.325	-	0.335	
Yield strength (elastic limit)		1.02	-	2.18	ksi
Tensile strength		1.6	-	2.61	ksi
Compressive strength		1.02	-	2.18	ksi
Elongation		55	-	75	% strain
Hardness - Vickers		3	-	5	HV
Fatigue strength at 10^7 cycles	*	0.58	-	1.31	ksi

Fracture toughness	* 13.7	-	27.3	ksi.in^0.5
Mechanical loss coefficient (tan delta)	* 0.015	-	0.045	

Thermal properties

Melting point	446	-	450	°F
Maximum service temperature	* 194	-	212	°F
Minimum service temperature	32	-	55.8	°F
Thermal conductor or insulator?	Good conductor			
Thermal conductivity	34.7	-	35.5	BTU.ft/h.ft^2.F
Specific heat capacity	0.0516	-	0.0545	BTU/lb.°F
Thermal expansion coefficient	12.5	-	13.1	µstrain/°F

Electrical properties

Electrical conductor or insulator?	Good conductor			
Electrical resistivity	10	-	12	µohm.cm

Optical properties

Transparency	Opaque			

Processability

Castability	5			
Formability	4	-	5	
Machinability	5			
Weldability	5			
Solder/brazability	5			

Eco properties

Embodied energy, primary production	* 2.34e4	-	2.58e4	kcal/lb
CO2 footprint, primary production	* 12.5	-	13.8	lb/lb
Recycle	✓			

Supporting information

Technical notes

Tin is extracted by the reduction of cassiterite, SnO2, with carbon. At normal temperatures tin is metallic ("white" tin), but below 13.2 C it transforms (slowly) to non-metallic gray tin -- a problem known as "tin pest" when tin is used at low temperatures.

Typical uses

Tin is used in pure form in storage tanks for pharmaceutical chemical solutions, as electrodes of capacitors, and fuse wire and as organ pipes (though usually alloyed with some lead). Its most important applications, however, are as a coating on steel sheet ("tin plate") and as an alloying element in bronze, pewter and solder. Its salts are used as polymer additives, for antifouling paints, and to produce a transparent, conducting coating on glass.

Further reading

Eco data from Hammond, G. and Jones, C. (2006) "Inventory of carbon and energy (ICE), Dept. of Mechanical Engineering, University of Bath, UK

Links

Reference

ProcessUniverse

Producers