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832

Copper and Zinc Alloys

Discussion Responses



Acknowledgement

Mr John Gibson is a highly regarded educator and engineer. John taught Industrial Arts at a number of high schools before taking a position at Sydney Teachers' College, then University of Sydney. He had an engineering education consultancy and has extensive experience working with NESA on Engineering Studies syllabus development and the HSC examination committee. The STEM Industry School Partnerships (SISP) Program asked John for his responses to the iTeachSTEM topic discussion questions. SISP is grateful to John for submitting these example discussion responses.

1. **Explain why copper plays a significant role in many electrical appliances and electrical systems.**

   Copper's chemical, electrical, mechanical and physical properties indicate desirable properties for applications in electrical systems

2. **Name instances where copper is used in electrical applications.**

   - overhead and underground power supply systems (wires and posts)
   - generators (power stations)
   - alternators (vehicles)
   - electric motors (household appliances)

3. **Name and describe the properties and applications of the following alloys:**

   Using a predominant property of each alloy and a modern application ~

Cu – Zn	Brass (5 – 30%)	high ductility	auto radiator core
Cu – Sn	Bronze (5 – 15%)	strength	monuments
Cu – Al	Aluminium Bronze (4 – 11%)	heat treatable, corrosion-resistant	vessels
Cu – Be	Beryllium Bronze (1 – 2%)	age-hardens, high strength	tools
Cu – Cd	Electrical (0 – 5%)	conductivity	overhead train wires (catenary system)

4. **How is copper wire manufactured?**

   The pure copper is heated to its hot working temperature and drawn through a die. Several passes are made, with the wire becoming thinner and consequentially, longer.

5. **What is electrolytic tough pitch copper?**

   Refined pure copper with a residual amount (0.02 - 0.05%) of copper oxide in its structure. The copper oxide is an insoluble impurity.

6. **What insulation is often added on the wire used in electrical motor windings?**

   Early electrical motors were coated with an insulating lacquer. High performance systems use insulating polymers such as epoxy resin.

7. **Compare the use of aluminium alloy wire to copper alloy wire when used as an electrical transmission medium.**

   The historical reasoning was that copper wire has very low internal resistance, it is readily reduced from copper ore, and does not corrode. However, its specific gravity is high at 8.9, making it less desirable for transmission wires.

   On the other hand, aluminium also has good corrosion resistance, coupled with a low SG at 2.7. However, aluminium was very expensive before the 1930s due to its complex chemical extraction process, and before the invention of the Hall-Heroult process, which significantly reduced the price, increasing demand.

