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1-5 Steel is often coated with a thin layer of zinc if it is to be used outside. What characteristics do you think the zinc provides to this coated, or galvanized, steel? What precautions should be considered in producing this product? How will the recyclability of the product be affected?

Solution: The zinc provides corrosion resistance to the iron in two ways. If the iron is completely coated with zinc, the zinc provides a barrier between the iron and the surrounding environment, therefore protecting the underlying iron. If the zinc coating is scratched to expose the iron, the zinc continues to protect the iron because the zinc corrodes preferentially to the iron (see Chapter 22). To be effective, the zinc should bond well to the iron so that it does not permit reactions to occur at the interface with the iron and so that the zinc remains intact during any forming of the galvanized material. When the material is recycled, the zinc will be lost by oxidation and vaporization, often producing a "zinc dust" that may pose an environmental hazard. Special equipment may be required to collect and either recycle or dispose of the zinc dust.

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1-14 Aluminum has a density of 2.7 g/cm^3 . Suppose you would like to produce a composite material based on aluminum having a density of 1.5 g/cm^3 . Design a material that would have this density. Would introducing beads of polyethylene, with a density of 0.95 g/cm^3 , into the aluminum be a likely possibility? Explain.

Solution: In order to produce an aluminum-matrix composite material with a density of 1.5 g/cm^3 , we would need to select a material having a density considerably less than 1.5 g/cm^3 . While polyethylene's density would make it a possibility, the polyethylene has a very low melting point compared to aluminum; this would make it very difficult to introduce the polyethylene into a solid aluminum matrix - processes such as casting or powder metallurgy would destroy the polyethylene. Therefore polyethylene would NOT be a likely possibility.

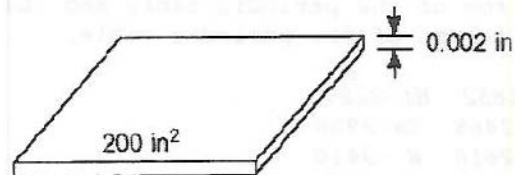
One approach, however, might be to introduce hollow glass beads. Although ceramic glasses have densities comparable to that of aluminum, a hollow bead will have a very low density. The glass also has a high melting temperature and could be introduced into liquid aluminum for processing as a casting.

2-8 In order to plate a steel part having a surface area of 200 in.^2 with a 0.002 in. thick layer of nickel, (a) how many atoms of nickel are required and (b) how many moles of nickel are required?

Solution: $\text{Volume} = (200 \text{ in.}^2)(0.002 \text{ in.})(2.54 \text{ cm/in.})^3 = 6.555 \text{ cm}^3$

$$(a) \frac{(6.555 \text{ cm}^3)(8.902 \text{ g/cm}^3)(6.02 \times 10^{23} \text{ atoms/mol})}{58.71 \text{ g/mol}} = 5.98 \times 10^{23} \text{ atoms}$$

$$(b) \frac{(6.555 \text{ cm}^3)(8.902 \text{ g/cm}^3)}{58.71 \text{ g/mol}} = 0.994 \text{ mol Ni required}$$



2.18

The bonds between carbon and carbon in diamond are covalent bonds. Covalent bond is strong bond which provides the diamond with a high strength, high melting point and high toughness of a material. The carbon-carbon bonds in diamond are completely covalently bonded together as opposed to graphite which has a weaker strength property due to the weak bonding between the planes even though they are both carbon based.