

Task:

a flat piece mild steel was coated with 445 micrometers thick layer of zinc. the surface area of the plate is 85.47cm². the density is 7.13. how much zinc atoms are used in the coating?

Solution:

The volume of the layer = thickness x surface area

Let's convert micrometers to cm:

$$1 \text{ micrometers} = 1 \cdot 10^{-6} \text{ m}$$

$$1 \text{ cm} = 1 \cdot 10^{-2} \text{ m}$$

$$1 \text{ micrometers} = 1 \cdot 10^{-4} \text{ cm}$$

that's why

$$445 \text{ micrometers} = 445 \cdot 10^{-4} \text{ cm} = 0.0445 \text{ cm}$$

Now we can find the volume of the layer:

$$V = 0.0445 \text{ cm} \cdot 85.47 \text{ cm}^2 = 3.80 \text{ cm}^3$$

The mass of the layer is

$$m(\text{g}) = d(\text{g/cm}^3) \cdot V(\text{cm}^3)$$

d- density of the layer

$$m(\text{g}) = 7.13 \text{ g/cm}^3 \cdot 3.80 \text{ cm}^3 = 27.1 \text{ g}$$

The number of moles of Zn in this layer:

$$n(\text{mol}) = m(\text{g}) / \text{MW}(\text{g/mol})$$

$$n(\text{Zn}) = 27.1 \text{ g} / 65.4 \text{ g/mol} = 0.414 \text{ mol}$$

According to Avogadro Law:

$$n(\text{mol}) = N / N_A$$

n – number of moles

N – number of atoms

N_A – Avogadro constant

The number of atoms is

$$N = n(\text{mol}) \cdot N_A$$

$$N = 0.414 \cdot 6.02 \cdot 10^{23} = 2.49 \cdot 10^{23}$$

Answer: N = 2.49 · 10²³ atoms