Exercise 1.94

In 2009, a team from Northwestern University and Western Washington University reported the preparation of a new "spongy" material composed of nickel, molybdenum, and sulfur that excels at removing mercury from water. The density of this new material is 0.20 g/cm^3, and its surface area is 1242 m^2 per gram of material. (**a**) Calculate the volume of a 10.0-mg sample of this material. (**b**) Calculate the surface area for a 10.0-mg sample of this material. (**c**) A 10.0-mL sample of contaminated water had 7.748 mg of mercury in it. After treatment with 10.0 mg of the new spongy material, 0.001 mg of mercury remained in the contaminated water. What percentage of the mercury was removed from the water? (**d**) What is the final mass of the spongy material after the exposure to mercury?

Solution

Part (a)

Use the density to determine the volume of this given mass.

$$10.0 \cancel{\text{mg}} \times \frac{1 \cancel{\text{g}}}{1000 \cancel{\text{mg}}} \times \frac{1 \text{ cm}^3}{0.20 \cancel{\text{g}}} = 5.0 \times 10^{-2} \text{ cm}^3$$

Part (b)

Use the surface density to determine the surface area of this given mass.

$$10.0 \cancel{\text{mg}} \times \frac{1 \cancel{\text{g}}}{1000 \cancel{\text{mg}}} \times \frac{1242 \text{ m}^2}{1 \cancel{\text{g}}} \approx 12.4 \text{ m}^2$$

Part (c)

The percentage of mercury removed is the ratio of the mass of mercury removed to the mass of mercury present initially.

$$\begin{aligned} \text{Percentage of Mercury Removed} &= \frac{\text{Mass of Mercury Removed}}{\text{Initial Mass of Mercury}} \times 100\% \\ &= \frac{7.748 - 0.001}{7.748} \times 100\% \\ &\approx 99.99\% \end{aligned}$$

Part (d)

Add the mass of spongy material to the mass of mercury it picked up in order to get the final mass.

$$\text{Final Mass} = 10.0 \text{ mg} + (7.748 - 0.001) \text{ mg} \approx 17.7 \text{ mg}$$