

Answer on Question #80497, Chemistry/ General Chemistry

The pickling of steel is a process to remove rust from the metal before subsequent processing into rolls, extrusions, or galvanizing. Hydrochloric acid (muriatic acid) is typically used for this process. The typical concentration for the hydrochloric acid is 18.0% by mass of the solution in water. The density of this solution is 1.154 grams per milliliter (at 20°C) and 6.0×10^5 liters of the solution is used per year. How many kilograms of pure hydrochloric acid (not the solution) is used per year? Show your work.

Solution

$$w(\text{HCl}) = 18.0\% \text{ or } 0.18$$

$$d(\text{solution}) = 1.154 \text{ g/mL}$$

$$V(\text{solution per year}) = 6.0 \times 10^5 \text{ L}$$

$$m(\text{HCl per year}) - ?$$

$$V(\text{solution per year}) = 6.0 \times 10^5 \text{ L} \times \frac{1000 \text{ mL}}{1 \text{ L}} = 6.0 \times 10^8 \text{ mL}$$

$$m = d \times V$$

$$m(\text{solution per year}) = 1.154 \frac{\text{g}}{\text{mL}} \times 6.0 \times 10^8 \text{ mL} = 6.924 \times 10^8 \text{ g}$$

$$\text{mass \%} = \frac{\text{mass of solute}}{\text{mass of solution}} \times 100 \Rightarrow \text{mass of solute} = \frac{\text{mass \%} \times \text{mass of solution}}{100}$$

$$m(\text{HCl per year}) = \frac{18 \times 6.924 \times 10^8 \text{ g}}{100} \times \frac{1 \text{ kg}}{1000 \text{ g}} = 1.246 \times 10^5 \text{ kg}$$

$$\text{Answer: } 1.246 \times 10^5 \text{ kg}$$