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Fluid Mechanics: Fundamentals and Applications (4th Edition)

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Problem

Water at 15°C from a garden hose fills a 1.5 L container in 2.85 s. Using unity conversion ratios and showing all your work, calculate the volume flow rate in liters per minute (Lpm) and the mass flow rate in kg/s.

Step-by-step solution

Step 1 of 4

Calculate volume flow rate in Lps.

$$Q = \frac{V}{t}$$

Here, the volume flowing is V and time taken for flow is t .

Substitute 1.5 L for V and 2.85 s for t .

$$\begin{aligned} Q &= \frac{1.5\text{L}}{2.85\text{ s}} \\ &= 0.52\text{ Lps} \end{aligned}$$

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Step 2 of 4

Calculate the volume flow rate in Lpm.

$$\begin{aligned} Q &= 0.52 \frac{\text{L}}{\text{s}} \times \frac{60\text{ s}}{\text{min}} \\ &= 31.2 \frac{\text{L}}{\text{min}} \\ &= 31.2\text{ Lpm} \end{aligned}$$

Therefore, the volume flow rate in Lpm is **31.2 Lpm**.

[Comment](#)

Step 3 of 4

Obtain the relation for the mass flow rate in kg/s.

$$\dot{m} = \rho \times Q \dots\dots (1)$$

Here, density of water is ρ and the volume flow rate is Q .

Convert the volume in m^3 .

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$$= 1.5 \times 10^{-3} \text{ m}^3$$

Calculate the volume flow rate

$$Q = \frac{V}{t}$$

Substitute $1.5 \times 10^{-3} \text{ m}^3$ for V and 2.85 s for t .

$$Q = \frac{1.5 \times 10^{-3} \text{ m}^3}{2.85 \text{ s}}$$

$$= 0.5263 \times 10^{-3} \text{ m}^3 / \text{s}$$

Obtain the density of water from table A-3, "Properties of saturated water" at 15°C as follows:

$$\rho = 999.1 \text{ kg/m}^3$$

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Step 4 of 4

Calculate the mass flow rate in kg/s.

Substitute $0.5263 \times 10^{-3} \text{ m}^3 / \text{s}$ for Q and 999.1 kg/m^3 for ρ in equation (1).

$$\dot{m} = \rho \times Q$$

$$= 999.1 \frac{\text{kg}}{\text{m}^3} \times 0.5263 \times 10^{-3} \frac{\text{m}^3}{\text{s}}$$

$$= 0.5258 \text{ kg/s}$$

Therefore, the mass flow rate in kg/s is .

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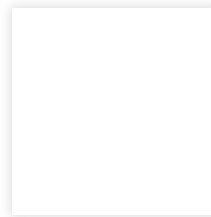
On average, an adult person breathes in about 7.0 liters of air per minute. Assuming atmospheric pressure and 20°C air...

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Chapter 1, Problem 41P

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