

Fluid Mechanics- compression problem solution

A non-deformable pressure vessel of $V_1 = 0,10\text{m}^3$ volume filled completely with methyl alcohol was heated from temperature $T_1 = 273\text{K}$ to temperature $T_2 = 323\text{K}$. Calculate the pressure increase in the vessel. For the calculation assume $\beta = 0,122 \cdot 10^{-3} \frac{\text{m}^2}{\text{N}}$, $\alpha = 1,19 \cdot 10^{-3} \frac{1}{\text{K}}$.

Two formulas to use:

Compression by pressure

$$\beta = \frac{-\Delta v/v}{\Delta p}$$

Expansion by temp.

$$\alpha = \frac{-\Delta v/v}{\Delta T}$$



Contraction
by pressure



Expansion by
Temp.

$$= 0 \quad [\text{Non-Deformable}]$$

$$\Rightarrow \Delta V_p + \Delta V_T = 0$$

$$\Delta V_{\text{Temp}} + \Delta V_p = 0 \quad [\text{Non deformable}]$$

$$\alpha \Delta T + (-\beta \Delta p) = 0$$

$$\Rightarrow \alpha \Delta T = \beta \Delta p$$

$$\Rightarrow \Delta p = \frac{\alpha \Delta T}{\beta} = 4,88 \times 10^7 \text{ Pa}$$

Ans.

$$[\Delta T = 323\text{K} - 273\text{K} = 50\text{K}]$$

$$\left[\frac{1,19 \times 10^{-3} \times 50}{0,122 \times 10^{-3}} \right]$$

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