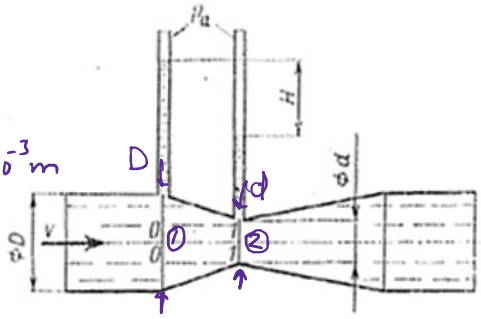
Hydrodynamics, Bernoulli and continuity Equation more practice

Determine the flow rate Q_V of water using a Venturi nozzle with dimensions $D = 100mm$, $d = 50mm$ inserted into a horizontal pipe through which water flows, if the pressure difference between the inlet to the nozzle and the throat is $H = 50mm$.

$50 \times 10^{-3} m$

$\frac{\Delta P}{\rho g} = \frac{P_1 - P_2}{\rho g} = 50 \times 10^{-3} m$



$Q = AV$ ← m^3/s

$\frac{P_1}{\rho g} + \frac{V_1^2}{2g} + z_1 = \frac{P_2}{\rho g} + \frac{V_2^2}{2g} + z_2$

$\frac{P_1}{\rho g} - \frac{P_2}{\rho g} = \frac{V_2^2}{2g} - \frac{V_1^2}{2g}$

$\frac{\Delta P}{\rho g} = \frac{V_2^2}{2g} - \frac{V_1^2}{2g}$

$\frac{V_2^2}{2g} - \frac{V_1^2}{2g} = 50 \times 10^{-3} m$ (Given) — ①

$\dot{m}_1 = \dot{m}_2$ — continuity equation

$\rho A_1 V_1 = \rho A_2 V_2$

$A_1 V_1 = A_2 V_2$

$V_1 = \frac{A_2}{A_1} V_2$ → put in ①

$\frac{A_2}{A_1} = \frac{\frac{\pi}{4} d_2^2}{\frac{\pi}{4} d_1^2} = \frac{d_2^2}{d_1^2} = 0.25$

① becomes:

$\frac{V_2^2}{2g} - \frac{\left(\frac{A_2}{A_1} V_2\right)^2}{2g} = 50 \times 10^{-3} m$

$D = 100mm$, $d = 50mm$ i

d_1 d_2

$\frac{V_2^2 - (0.25 V_2)^2}{2g} = 50 \times 10^{-3}$

$V_2 = 1.023 m/s$

$Q = A_2 V_2 = A_1 V_1$

$Q = \frac{\pi}{4} (50 \times 10^{-3})^2 \times 1.023$

$= 2 \times 10^{-3} m^3/s$

ANS.

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