流体力学 II 試験問題 (2)

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3. A reservoir, surface level 60m above datum, supplies a junction box through a 300 mm pipe, 1500 m long. From the junction box two 300 mm pipes, each 1500 m long, feed respectively into two reservoirs whose surface levels are 30 m and 15 m above datum, f for all pipes being 0.01. What will be the quantity entering each reservoir?

（解）

1.

$$H_A = H_B + \frac{4fL_1}{d_1}\frac{v_1^2}{2g} + \frac{4fL_2}{d_2}\frac{v_2^2}{2g}$$

$$60 = 30 + \frac{4\times 0.01\times 1500}{0.3}\frac{v_1^2}{2g} + \frac{4\times 0.01\times 1500}{0.3}\frac{v_2^2}{2g}$$

$$10.2v_1^2 + 10.2v_2^2 = 30$$

$$H_A = H_C + \frac{4fL_1}{d_1}\frac{v_1^2}{2g} + \frac{4fL_2}{d_2}\frac{v_3^2}{2g}$$

$$60 = 15 + \frac{4\times 0.01\times 1500}{0.3}\frac{v_1^2}{2g} + \frac{4\times 0.01\times 1500}{0.3}\frac{v_3^2}{2g}$$

$$10.2v_1^2 + 10.2v_3^2 = 45$$

$$\frac{1}{4}\pi d_1^2 v_1^2 = \frac{1}{4}\pi d_2^2 v_2^2 + \frac{1}{4}\pi d_3^2 v_3^2$$

$$d_1 = d_2 = d_3, \quad v_1 = v_2 + v_3$$

$$v_2 = \sqrt{(2.94 - v_1^2)}, \quad v_3 = \sqrt{(4.42 - v_1^2)}$$

$$v_1 - \sqrt{(2.94 - v_1^2)} - \sqrt{(4.42 - v_1^2)} = 0$$

This equation is solved by successive approximation, or graphically.

$$v_1 = 1.663\ m/s$$

$$v_2 = 0.4\ m/s, \quad v_3 = 1.28\ m/s$$

$$Q_B = \frac{1}{4}\pi d_2^2 v_2^2 = \frac{1}{4}\pi \times (0.3)^2 \times 0.4 = 0.028\ m^3 = 28.3 dm^3/s$$

$$Q_C = \frac{1}{4}\pi d_3^2 v_3^2 = \frac{1}{4}\pi \times (0.3)^2 \times 1.28 = 0.0907\ m^3 = 90.7 dm^3/s$$