

Experiment n°9

Experimental determination of the power of the pump

Objective

The goal of this experiment is to create a formula in order to predict the power delivered by the pump

Theories

These are the basic theories on head losses:

-linear head losses (major losses):

Darcy-Weisbach formula: $\Delta P_t = \xi * \frac{L}{D} * \frac{1}{2} * \rho * U m^2$ ξ regular head loss coefficient

-Laminar flow: $\xi = \frac{64}{Re}$

-Turbulent flow in a smooth pipe: $\xi = \frac{0.316}{\sqrt[4]{Re}}$ (Blasius formula)

-Turbulent flow in a rough pipe: $\frac{1}{\sqrt{\xi}} = -2 \log_{10} \left[\frac{\epsilon}{3.71D} + \frac{2.51}{Re\sqrt{\xi}} \right]$ (Colebrook formula)

- Singular head losses (minor losses): $\Delta P_s = K * \frac{1}{2} \rho U m^2$ K singular head loss coefficient

The Bernoulli formula will be used here:

$$P_a + \frac{1}{2} \rho U a^2 + \rho g z_a + \Delta P_{pump} = P_b + \frac{1}{2} \rho U b^2 + \rho g z_b + \Delta P_s + \Delta P_l$$

With ΔP_{pump} , pressure given by the pump, here, $P_{pump \text{ used}} = \Delta P_{pump} * Q_v$

Q_v flow rate in m³/s, $P_{pump \text{ used}}$ in W

Description

The HD98B Hydraulic Bench will be used with all of its pipes

Two U-shaped manometers will be used one filled with water, the other one filled with oil

Central manometers will be used (they are graduated in water column 1McE=9800Pa)

Experiment

- Check the opening of the exit valve
- Open one of the pipes;
- Connect the manometers to the bench
- Measure the head losses
- Determine the power of the pump
- Repeat this protocol for different pipes
- Conclude on the power of the pump and its characteristic