Experiment n°7

Head losses for laminar and turbulent flow

Objective

The aim of this experiment is to highlight the differences between singular head losses in a laminar and in turbulent flow. The evolution of the K coefficient will be studied here.

Theories

A singularity in a hydraulic circuit create a singular head losses, singular head losses are ruled by the following formula:

For singular head losses (minor losses): $\Delta Ps = K * \frac{1}{2}\rho Um^2$ K singular head losses coefficient.

The venturi tube can be seen as a convergent pipe followed by a divergent pipe.

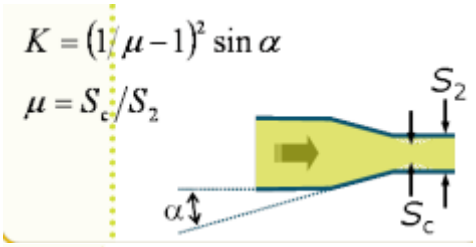

Figure 1: Convergent pipe

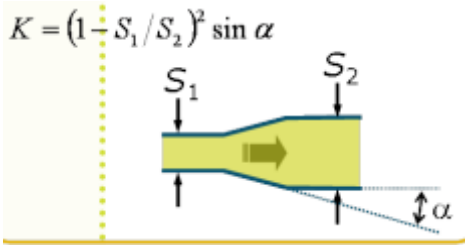

Figure 2 : Divergent pipe

For the orifice plate, pressures losses follow this law:

$$\frac{\Delta\bar{\omega}}{\Delta p} = \frac{\sqrt{1-\beta^4(1-C^2)} - C\beta^2}{\sqrt{1-\beta^4(1-C^2)} + C\beta^2}$$

This formula can be approximate by

$$\frac{\Delta\bar{\omega}}{\Delta p} = 1 - \beta^{1.9}$$

Description of the installation

The HD98B Hydraulic Bench is used here. Pipe n°5 is mounted with a globe valve (blue) and a globe valve (yellow lever)

Pipe n°6 is mounted with a T like structure and a gate valve (yellow).

Pipe n°2 is equipped with a venturi tube, pipe n°3 is also equipped with a flow meter, it is an orifice plate flowmeter.

A rotameter is equipped on the circuit.

Experiment

a) Check the opening of the exit valve;
b) Open the desired pipe;
c) Connect the manometers to the used pipes
d) Activate the pump;
e) Pick up values of the manometers in the following table
f) Establish a law for the singularity in the circuit.

Qv m^3/s	U m/s	K	K theoretical	Measure differences (%)

Sources

Figure 1 and 2: http://res-nlp.univ-lemans.fr/NLP_C_M02_G02/co/Contenu_32.html