Data analysis of the experiment performed on the bench

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Two set of experiment were made on the hydraulic bench, one with the already equipped U manometers and the other one with the PASCO PS-2164 unit. This two set were made in order to prove that the experiment were achievable on the bench. It also served as a test for the every devices used for the bench.

1. flow meter comparison

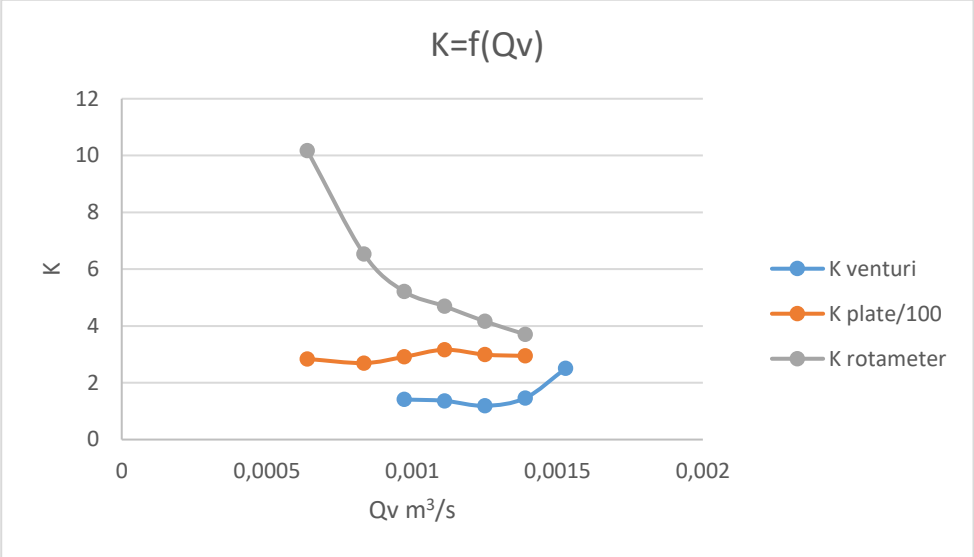

Figure 1 flow meter comparison with the quad pressure sensor

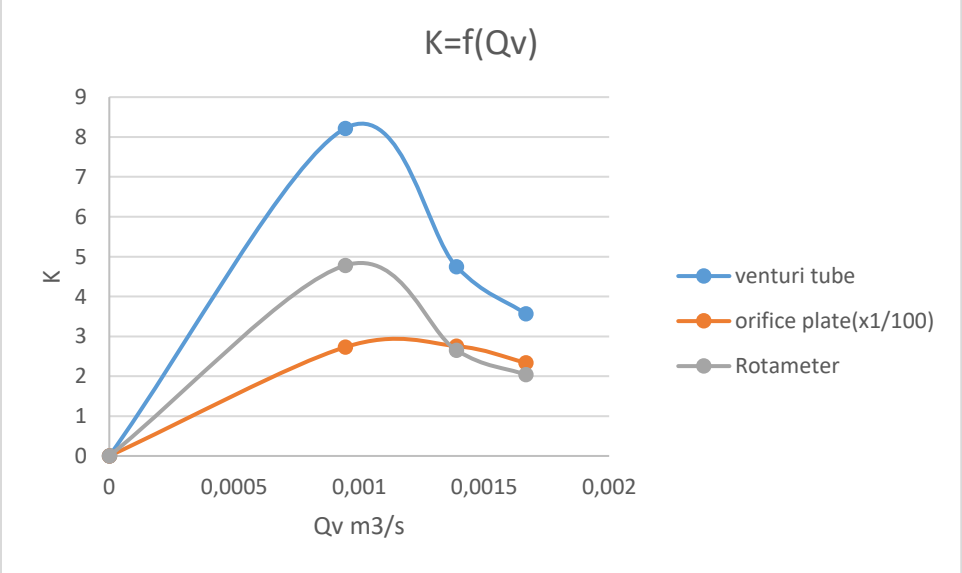

Figure 2 flow meter comparison with the embedded instrumentation

The comparison between the flow meter prove that the venturi tube have a smaller impact on the circuit, the rotameter is in second place, the third place for the orifice plate could

have been predicted due to the shape of the flowmeter itself: the plate reduce considerably and abruptly the flow of water. For the experience realized with the U manometers, the head losses of the flow meter is reduced when the flow rate increase, despite multiple attempt of the experiment, the same result happen. In the other and, the quad pressure sensor show are more logical result (except for the rotameter) the head losses of the flow meters seems to be constant.

2. Head losses

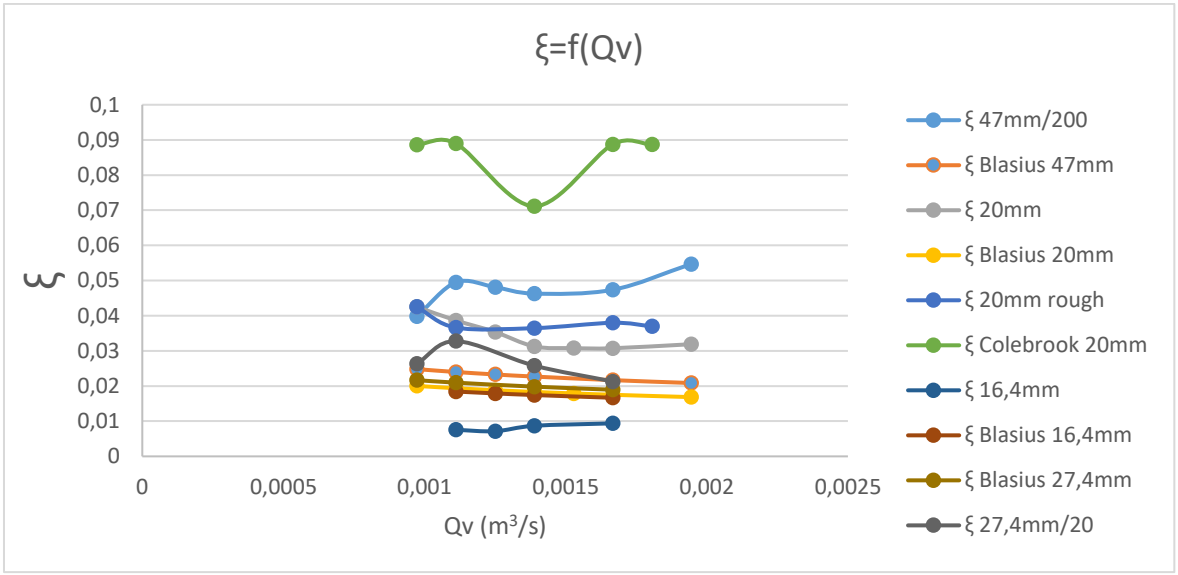

Figure 3 linear hed losses coefficient measured with embeded devices

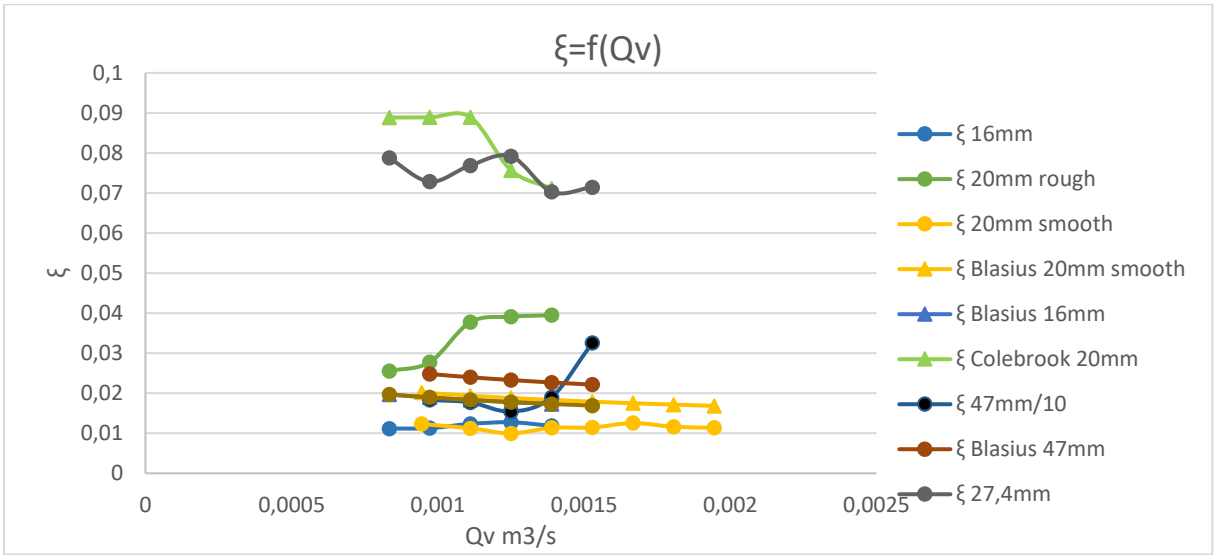

Figure 4 linear head losses comparison with quad pressure sensor

Whit this result, we can see that the 47mm pipe is in violation of the Blasius formula with each device, the 27.4mm pipe is also in the same condition. This can be a result of the placement of the pressure connector, the proximity with a singularity (the entry valve for the

27.4mm pressure connector and the pipe enlargement for the 40mm pressure sensor) can be altering the flow in this way. This theory can be supported by the fact that the 27.4mm pipe and the 40mm pipe are the only pipes with this pressure captor placement.

The second conclusion on the comparison of the two measuring systems is that the U manometers seem the overestimate the pressure losses due to the fact that every experimental ξ coefficient is above the one given by the Blasius formula related.

3. Hydraulic resistance

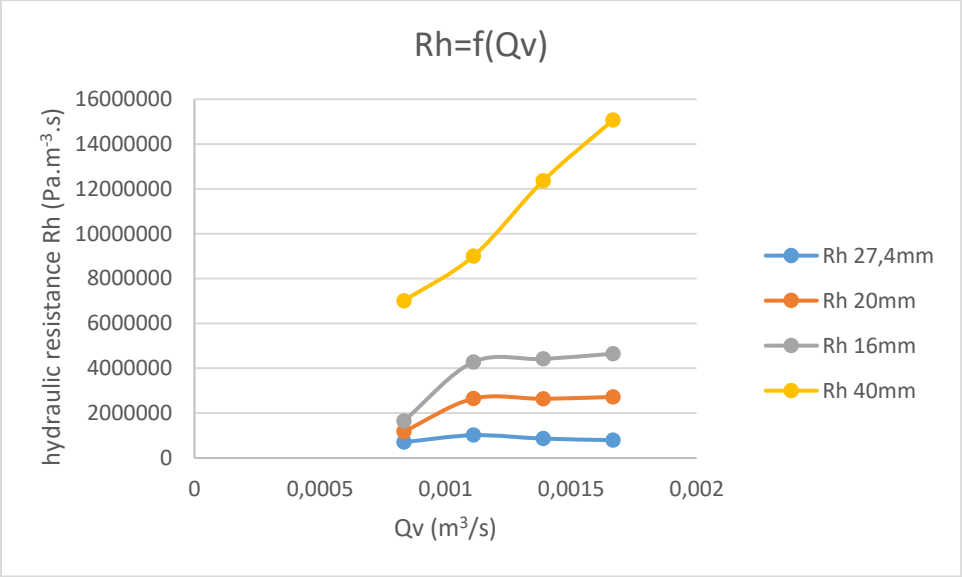

Figure 5 hydraulic resistance comparison of different pipes

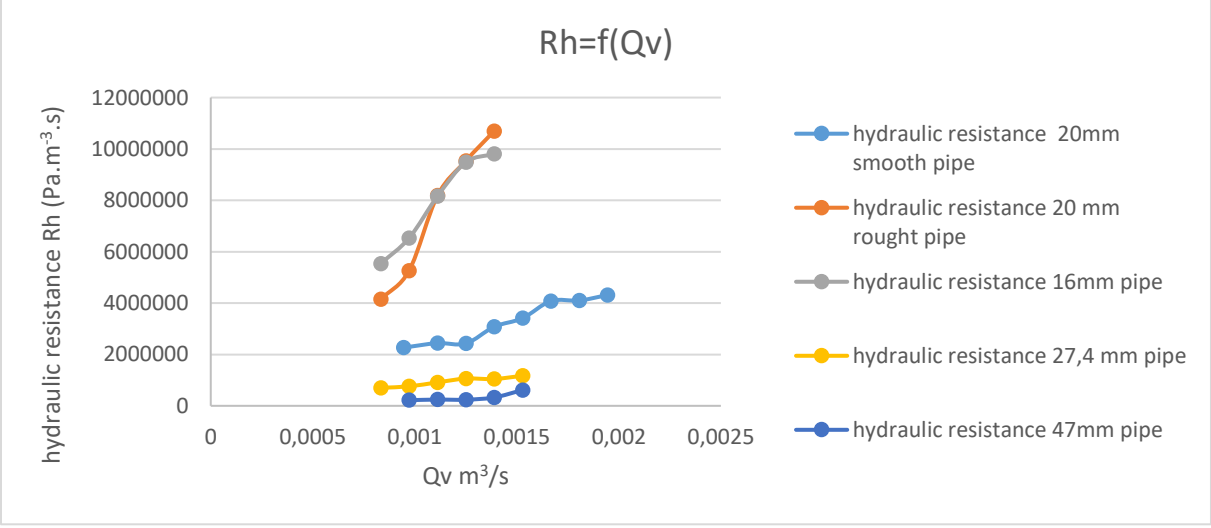

Figure 6 hydraulic resistance comparison with the quad pressure sensor

The measure realised with the quad pressure sensor are close to the expected result: we can see that the more important is the diameter, the lesser is the hydraulic resistance. The measure realised with the embedded equipment does not show this expectation for the 40mm pipe. More the values of the experiment made with the U manometer seem a bit

overestimated. Thereby, the quad pressure sensor is more appropriate in regard to the conclusion: the expected result are present within the experiment.

4. Comparison of experimental head losses

With the result displayed in the 3rd experiment, we can see that the Blasius formula is followed however, in laminar flow, the Poiseuille's formula is not respected. That mean the either the pressure measure is false or the laminar flow is not reached.

5. Technical solution comparison

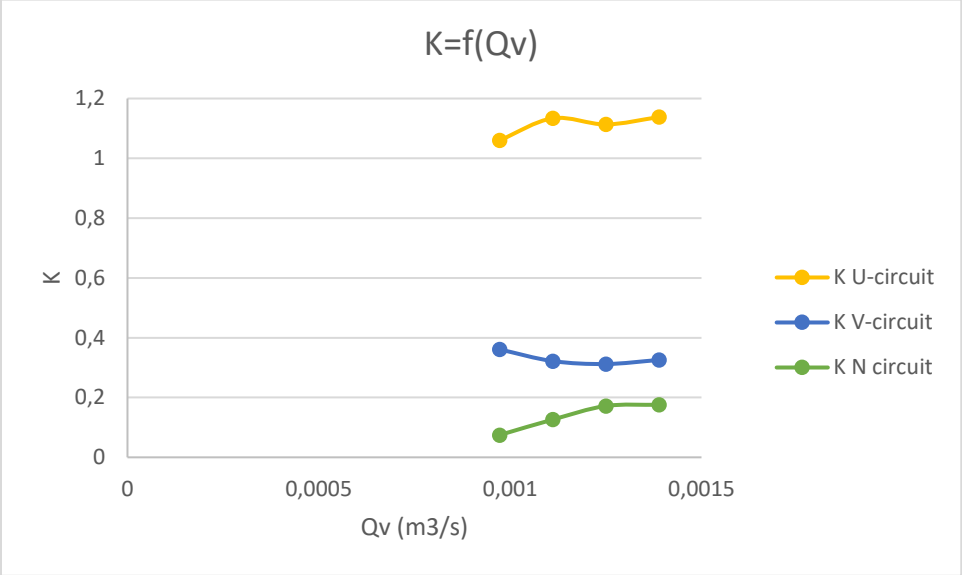

Figure 7 cicuit comparison with the quad pressure sensor

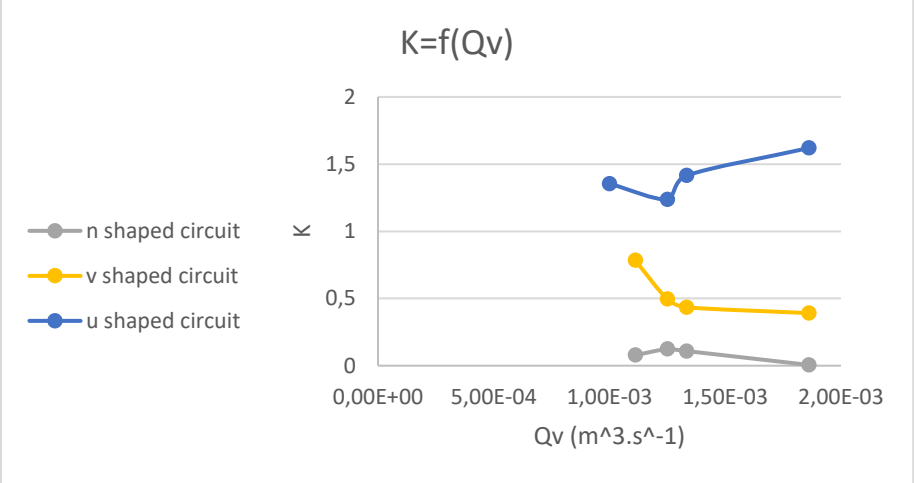

Figure 8 solution comparison with the U manometers

The result indicate that the U shaped circuit generate more head losses in the circuit than the two other circuit.

6. Valves authority

Following the realisation of the experiment, the average authority measured for the blue valve was 0.5185 which is quite close to the 0.50 of an efficient valve. For the yellow valve,

the average authority is 0.162, not enough for the 20mm pipe where the valve is plugged. The comparison with other pipes showed that this valve is best suited on a 16.4mm pipe (the average authority is 0.443).