

Measurement of Unsteady Flow Utilizing Orifice Flow Meter

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Abstract Flow meter is very important device for our life and economy. For example, gases that flows in plants have to be measured to control its process. Also, when considering gas and water supply for each house, measuring its flow rate is very important. Now a days, there are so many types of flow meter in the world, but, among them, Orifice flow meter is one of the most popular flow meters because of its simple structure and principle. The flow meter can be used only by inserting punctured disk into pipe and flow rate can be calculated easily from Bernoulli's principle. The flow meter is usually applied to steady flow and has enough accuracy in that situation. However, flow in pipes is not steady completely because motion of pump or propeller are propagated into flow and it makes flow rate unsteady. So in these situation, Orifice flow meter can't measure flow rate accurately and, actually, it is said that measurement result of Orifice flow meter rises when flow vibrates among users. That is why it is needed to investigate unsteady characteristics of Orifice flow meter and reveal the reason that indicated value of Orifice flow meter rises. In this study, we sent unsteady flow to Orifice flow meter while changing parameters of flow (amplitude, frequency and mean flow rate) and tried to observe unsteady characteristics of the flow meter. I reported about its result in this paper.

Keywords: Measurement, Unsteady flow, Orifice flow meter

1 Introduction

Orifice flow meter is very popular. It is very useful because it can measure many types of fluid and its structure is simple. The flow meter is applied to steady usually. But the flow is not steady completely and it is said that vibration of flow makes indicated value rising. Some researchers tried to reveal unsteady characteristics of the flow meter, but they couldn't get effective result [1][2]. There was no flow meter that can measure unsteady flow rate, so comparison between actual flow rate and measured flow rate was difficult. Now, there is flow meter (QFS) that was developed by hunaki [3], the measurable maximum frequency reaches to 50 Hz. In this study, we measured sinusoidal unsteady flow rate with both QFS and Orifice flow meter, and we observed Orifice flow meter's characteristics by comparing measured result gathered by QFS and Orifice flow meter.

2 Experimental apparatus

Fig. 1 shows experimental apparatus. Compressed air in ITC goes through servo valve and servo valve's effective area is changed by function generator, then unsteady air flow passes Orifice flow meter and QFS. At

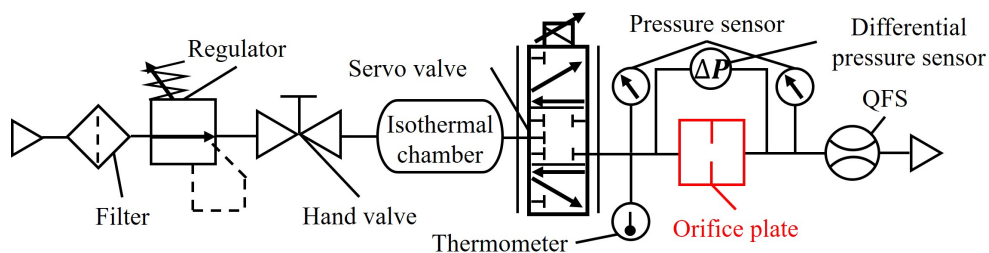


Fig. 1 Experimental apparatus

this time, data is gotten by laptop. In this study, unsteady flow is sinusoidal and flow rate amplitudes are 1, 2, 3 L/min (ANR), mean flow rates are 10, 20, 30, 40, 50 L/min (ANR) and Frequency is 20 Hz.

3 Experimental result

Fig. 2 shows example of measurement. It shows differential pressure of Orifice plate, upstream pressure and

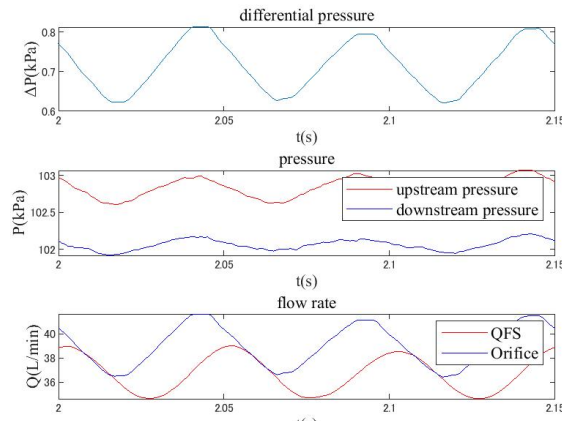


Fig. 2 Measurement example

downstream pressure, flow rate measured by QFS and Orifice flow meter. Flow rate measured by Orifice flow rate is higher than that of QFS. Gathered results are summarized to graph in Fig. 3. In graph, horizontal axis



Fig. 3 Flow rate error

means mean flow rate and vertical axis means flow rate error when QFS is reference. The blue line, red line, grey line and yellow line mean result of steady flow, 1 L/min amplitude, 2 L/min amplitude and 3 L/min amplitude respectively. From these results, flow rate error become bigger compared to measurement of steady flow. Also, it can be said that the bigger flow rate amplitude is, the bigger flow rate error is. When mean flow rate rise, flow rate error becomes smaller and the ratio between flow rate amplitude and mean flow rate can be important parameter.

4 Conclusion

In this study, we got conclusions like below. First, when unsteady flow passes through Orifice flow meter, indicated value by Orifice flow meter rise compared to actual flow rate. Secondly, The bigger ratio between mean flow rate and flow rate amplitude is, the bigger flow rate error is. The number of patterns was few and frequency is constant through experiment. We will conduct experiment with wide frequency, flow rate amplitude in the future.

Reference

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