Measuring flow direction in compressed air networks: Just a gimmick or a useful feature?

In the industries that use compressed air, the awareness is growing that flow measurements are necessary to cut down on energy usage and costs. Permanent monitoring of compressed air consumption is key to substantial savings. In some cases however, measuring the air demand is not as straightforward as it seems, for example when measuring in ring networks or near buffer vessels.

Ring networks

In some factories, the pipe network of the compressed air system is a closed ring. An example of this is shown in figure 1 where you can see a ring network of a factory in Germany. The production halls A, B and C are interconnected. As a result, the flow direction depends on the actual air consumption of each division and is unpredictable.
For example, when the production in hall B is stopped while hall A and hall C are still using air, hall B can act as a buffer or as a transport pipe. The amount of air that flows from hall B to hall A and/or C is difficult to predict.

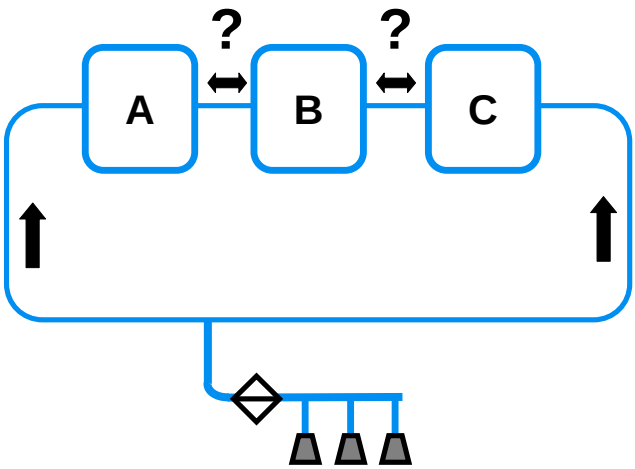

Fig. 1: Ring network of German company

Buffers- demand side

The behaviour of an air buffer is similar to a capacitor. Air is stored in the buffer, so it can deliver peak flows. Buffers are also installed near end users, for instance before a packaging machine that uses compressed air in short bursts. Without a non-return valve, measurement of compressed air consumption can be tricky, as the buffer can also deliver air back to the network.

Flow direction: the classical way

A paddle flow switch (see figure 2) can determine the flow direction. The principle of operation is very straightforward. The air pushes a paddle, and the paddle is connected to an electromechanical switch, which can trigger an alarm signal. This alarm signal is monitored by a PLC, which combines the alarm with the output of a flow sensor. This is all quite complicated: the PLC needs to be programmed and two installation points need to be made in the compressed air line. This also increases the installation costs.

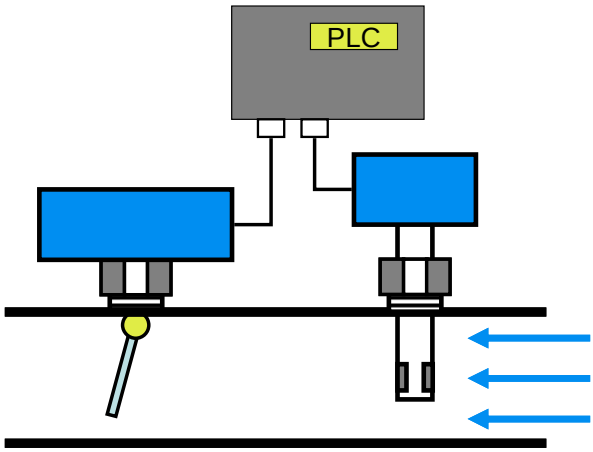

Fig. 2: Measurement of flow direction by using a paddle flow switch and PLC

Editorial

Flow direction: Thermabridge™ technology

The VPFlowScope of VPInstruments can measure the direction of flow without the usage of extra equipment. The unique Thermabridge™ sensor of the VPFlowScope offers you the direction sensitivity.

With Thermabridge™ technology, the VPFlowScope can measure mass flow and the direction of the flow, using a single sensor element. The flow sensor is heated, and the heat distribution over the flow sensor is dependent on the flow direction (see figure 3). If flow comes from right to left, the right part of the sensor is cooled down a little more than the left side, and vice versa.

The measurement signal is analyzed by the VPFlowScope's microcontroller and transformed in a minus or plus signal (see figure 4).

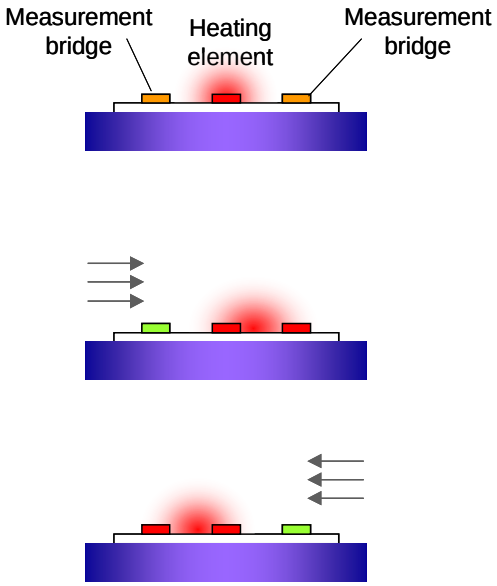

Fig 3: Thermabridge™ sensor

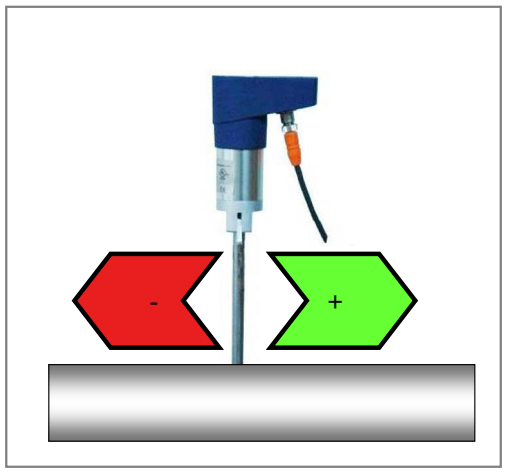

Fig 4: Flow direction

Ring network solution

Now, the compressed air consumption of the ring network of the German company can be easily measured. By installing four VPFlowScopes the flow direction is monitored and the air consumption per division is measured (fig. 5).

The individual demand of each production hall can be measured by placing a VPFlowScope before and after each production hall at locations 1, 2, 3 and 4.

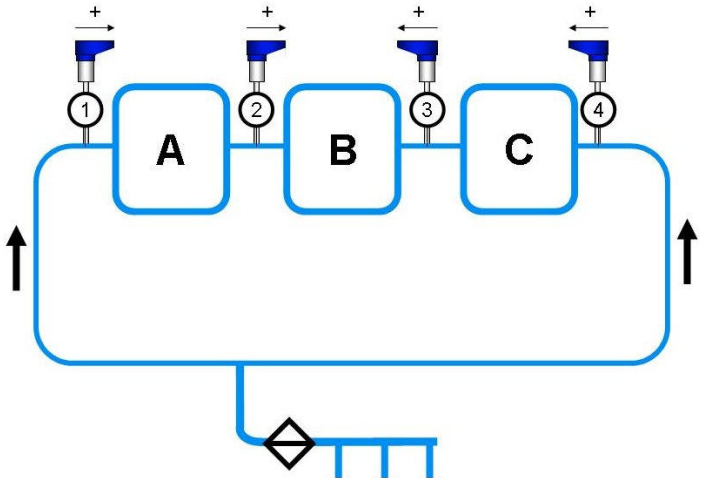

Fig 5: solution for measuring ring network of German company

Taking the direction of the VPFlowScope into account, the air consumption of production hall A can be calculated by: flow at location 1 minus flow at location 2. Thus the air consumption of each hall is now:

Hall A	:	1-2
Hall B	:	2+3
Hall C	:	4-3
Total consumption:		4+1

So the measurement of the consumption is now a matter of adding and subtracting. It is just basic bookkeeping, nothing more, without the usage of additional direction sensors or complicated wiring. You only have to keep track of the installation direction of the VPFlowScope. Note that also the totalizer of the VPFlowScope automatically adds or subtracts, depending on the flow direction.

Buffers- demand side solution

In figure 6 you see an example of an air buffer before an end-user, in this case a packaging machine. The customer wants to measure the average air consumption of the machine. It is not possible to install a non-return valve as the supply line could not be changed. A VPFlowScope upstream the buffer can measure the average air consumption of the machine downstream the buffer and it can also monitor the backflow.

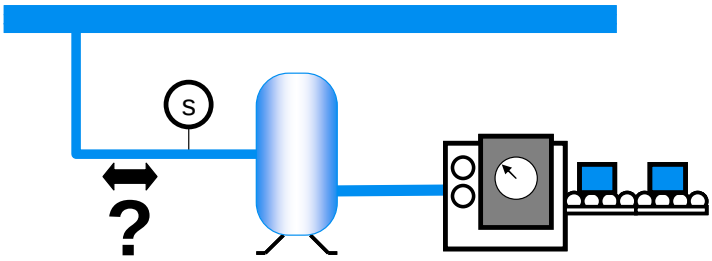

Fig 6: Example of air buffer before end user

Conclusions

- With the VPFlowScope, measuring compressed air demand in ring shaped networks is an easy task.
- The direction sensitivity feature saves on installation costs, because there is no need for additional sensors or wiring.
- Measuring air demand of individual users can be enhanced, as the VPFlowScope can detect backflow into the pipe network.

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