

Turbine flowmeters as “perpetuum mobile”?

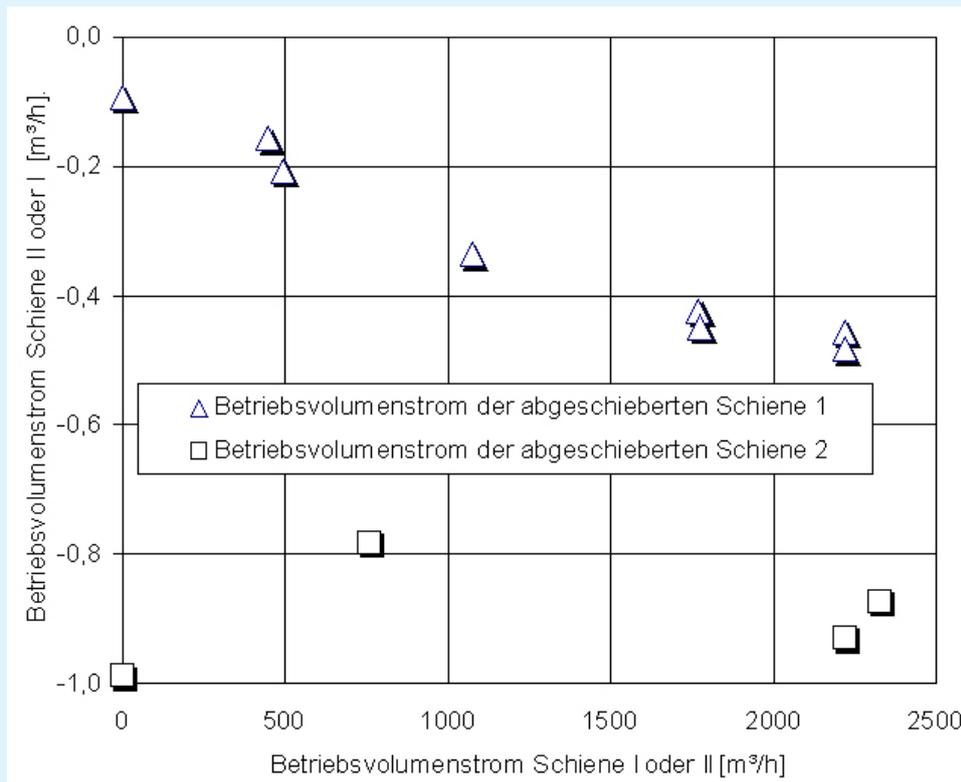
Rotating of turbine flowmeters are not rare, even in sections of measurement with closed valves. Generally, the turbine flowmeter shows a positive flow, which is registered by the mechanic counter mechanism – but not by the volume conversion ($< Q_{min}$). The rotating of the flowmeters is often caused by weak pulsations of the gas column. They are excited by a broadband noise within the pipeline system. By enclosing the turbine flowmeter (closing the input and output side of the valves), the cause - and therefore the rotating of the fan wheels – can be eliminated usually.

At a metering and regulating station for natural gas with two parallel pipelines the situation was different. Operating pipeline I and closing the valve at the output side of pipeline II, the turbine flowmeter of pipeline II showed a negative flow (backflow) at the mechanic counter mechanism. Even by closing additionally the valve at the input side, the turning of the fan wheels could not be avoided. Furthermore, the fan wheel continued turning even after shut down of the whole station. In this situation, the flowmeters of both pipelines at the mechanical counter mechanism showed a negative flow.

After a short amusing discussion about the possibility of a “perpetuum mobile” as well as about the use of turbine wheels as electric generator the decisive issue came up: Both heat exchangers of both pipelines were still active. So, the physical explanation of the phenomenon was quite clear: The gas heated by the heat exchangers flows into the upper pipe cross section in negative direction through the turbine flowmeter. So, it cools down and flows into the lower pipe cross section back to the heat exchanger. Within the lying pipes a convective circulating flow occurs, whereas the flow velocity of the warm gas - due to the lower density (conservation of mass) predominates and the turbine turns in negative direction. This theory could be confirmed immediately by information about individual paths of the ultrasonic flowmeters connected in series. While the upper path showed a negative flow velocity of $-0,08$ m/s (sound velocity around 403 m/s), the lower path showed a positive velocity of $+0,04$ m/s (sound velocity around 392 m/s).

A possible solution of the problem is to shut down the heat exchangers of the non-flown through pipeline. Due to the low shortfall, the operator decided not to disturb the supposed “perpetuum mobile”.

FLUID MECHANICS



Course of the operating volume flow of both pipelines with closed valves.



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