8

Poster

GLOBAL FLOW MEASUREMENT WORKSHOP
measuring for the energy transition

New Concept for Improving Measurement of Wet Gas and Liquid Stream with Entrained Gas

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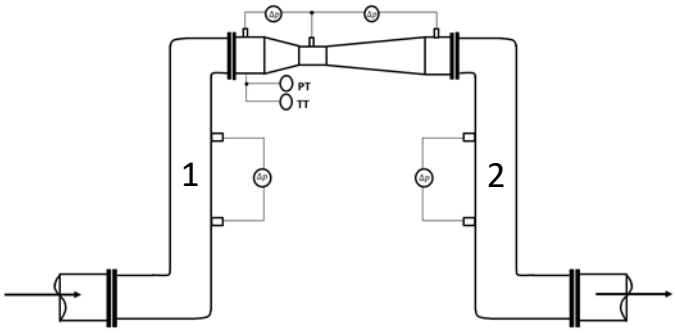
Background:

There are number of challenges in measurement of wet gas over a wide range of liquid loads for fiscal purposes. In addition, conventional single-phase meters may fall short of their calibrated accuracies when applied for flow mixtures containing different liquids or liquid mixture with gas up to 10% vol. To combat the challenges, thus improving accuracies and reliabilities, ABBON AS/ ACCEF AS recently developed a new measurement concept based on the mass conservation principle..

Measurement principle



Total flow: $Q_m = \frac{\pi}{4} D^2 \beta^2 C_d \sqrt{\frac{2\Delta p_t}{\rho_m(1-\beta^4)}}$

Fluid density: $\rho_m = \frac{\Delta p_{eff}}{gh}$

Discharge coefficient: $C_d = f\left(\frac{\Delta p_r}{\Delta p_t}, \frac{L_t}{D}, \frac{L_r}{D}, \alpha\right)$

Gas volume fraction: $GVF = \frac{1}{2}\left(\frac{\rho_m}{\rho_g} + 1\right) - \frac{1}{2}\sqrt{\left(\frac{\rho_m}{\rho_g} + 1\right)^2 - 4(1-\varphi)\frac{\rho_m}{\rho_g}}$

Δp_{eff}, effective pressure drops on the spools 1 & 2. Δp_t and Δp_r, venturi throat and recovered DP's.

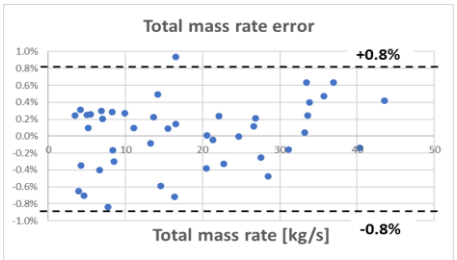
Test setup:

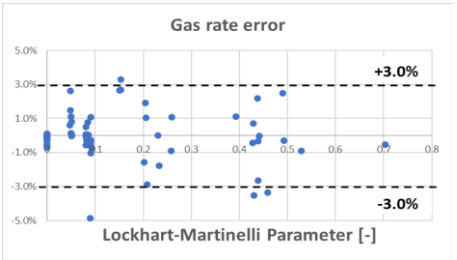
Test peformed at DNV, The Netherlands using a 4-inch, sch. 40 venturi tubes ($\beta = \frac{d}{D} \approx 0.49$). Fluid mixture –gas, Exxsol D120 oil and 4% saline water. Gas: Nitrogen at 10 – 30 bar and Argon at 22 – 30 bar. Fractions include 0 – 100% GVF and 0 – 100% WLR. Gas rate: 0 – 595 m³/h; liquid rate: 0 – 160 m³/h.

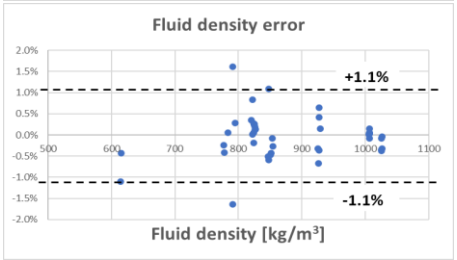
Results

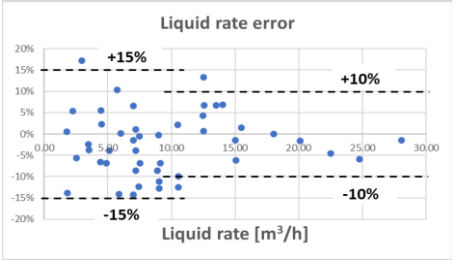
Liquid + entrained gas

0 – 40% GVF
0 – 100% WLR









Wet gas

90 – 100% GVF
0 – 90% WLR

Conclusion:

At 95% confidence level, the mass-based measurement device predicts gas rate within ±3.0% and liquid rate (> 10 m³/h) within ±10%; (<10 m³/h) within ±0.9 m³/h in wet gas stream. For liquid with entrained gas (GVF < 40%), the accuracy of the total mass is ±0.8%, density is ±1.1% and GVF is ±0.8% (abs.). Therefore, the device can also be deployed to overcome CO_2 flow measurement in CCS applications.