

Apparatus for stabilize oil flow profile for accurate fluid flow measurements

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The oil and natural gas oil industries produce, transport and distribute thousands of cubic meters of oil/gas per year. Because of the economic importance of these commodities, the correct measurement of transported volume in these operations is essential and the flow measurement must be not only accurate but also reliable for a variety of conditions.

For example, in Brazil for oil and gas industries, the ANP (Agencia Nacional do Petróleo), the Federal agency witch regulate and supervise activities of members of the oil and gas industry, in Portaria Conjunta Nº 1[1] establishes the values as the minimum requirements for errors and uncertainties in oil and gas flow measuring, according ANP these values are:

- Oil: 0.3% for tax collection and 1.0% for sale transactions;
- Gas: 1.5% for tax collection and 2.0% for sale transactions.

Flowmeters are subject to the effects of flow velocity profile and existence of turbulence inside the fluid being measured. Because this situation, the equipment calibration factor is valid only if geometric and dynamic similarity exists between the metering and calibration conditions.

Straight and uniform pipe lengths with more than 100 diameters is required to ensure that the uniformity in the flow profile can reach a satisfactory value at the flow measurement point, but experimental data suggesting that such length is not always sufficient.

Non-uniformity of flow due to the presence of curves, valves, and narrowing inside the pipeline affect the fluid flow measurement and make it extremely difficult to guarantee the quality necessary for the flow measurement. [3]

This condition becomes more evident for pumping viscous fluids in large diameter pipes.

The purpose of this project was to develop a special device that can be installed in the experimental oil

pipelines and that allows to homogenize the oleo flow profile and inside the pipe. [4]

The device is used in the calibration plant of flowmeters, and it ensures that, over a defined distance equal to 2.5m, the oil flow profile moving inside the pipe is stable. The flow stabilizer isolates flow meters from piping-induced turbulences and thereby allows more accurate flow measurements.

The flow conditioner device was built in PVC and is composed of two independent parts: a connection chamber (in the entrance and in the exit) that allows the quickly connection of the device with the experimental pipeline and an uniformization chamber which is used to uniform the flow profile.

The chamber acts as a perfect mixer, and it is composed of a cylindrical cavity of 5.1 cm height and 5.1 cm diameter containing 0.7 cm diameter glass balls confined by two stainless steel webs with 0.2 cm of weft.

The device has a simple design and when in operation, it did not cause any pressure loss in the pumping oil. This allow us to measure oil flows between 10 l/h and 1000 l/h. [2]

Experimental data show that the stratification effect of the velocity profile for the oil flow is eliminated in a distance of up to 2,5 m, allowing the installation of the scintillator detectors and the measurement of the movement of the radiotracer inside the pipeline.

References

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