Calibration of flowmeters in oil and gas industry using radioactive tracers

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Oil and gas production plants are the typical example of industrial facilities where they need accuracy in flow measurement's procedures. In this installation, large quantities of materials are moving daily inside pipes, and one of the major problems of this industry is the safety of operations in transport of these flammable materials. In order to monitor the transference processes many flowmeters are installed in the pipes to constantly measure the condition of the transported fluid.

These flowmeters must be periodically calibrated, and one of the problems in this operation is that they need to be removed from the pipelines where they are operating and transported to the accredited laboratories to be calibrated.

To remove a flowmeter from a pipe is not an easy operation, and it is very expensive. In addition, any changes in the pipeline configuration can provoke leaks and when a leak occurs, it is impossible to operate the whole line.

Using proper radiotracers, for oil or for gas, is possible to measure the flow without any disturbance in the normal operation of the pipeline.

A more attractive alternative is the use of non-invasive methods employing nuclear techniques such as radiotracer methods. Using a proper radiotracer for the specific material moving inside the pipeline is possible accurately to measure the flow without any disturbance in the normal operation of the pipeline.

Our proposal is to develop technical competence in order to have certified laboratories for gas flow measurement using radiotracers and then offer these specialized services to the companies.

The method is to measure the transient time between the signals registered by two independents scintillator detectors, D1 and D2, from a radiotracer pulse injected into the pipeline. The flow rate Q is calculated by dividing the V volume between the two measure points by the transient time T:

$$Q = \frac{V}{T} \Rightarrow Q = \frac{A\,L}{\tau_2 - \tau_1}$$

Q - Flow rate (m3 /minutes)
V - Pipe volume between D1 and D2
T - Transient time between D1 and D2
τi - Mean residence time of tracer in position i
A - Pipe internal cross section
L - Distance between D1 and D2

All the results were measured on the test pipelines for organic flow in the IEN radiotracer laboratory. These pipelines were built in 2" and 3/4 " PCV ducts with 18 meters length and where Lubrax Essential © 20W50 API SJ / SJ ANP lubricant oil is used as oil phase. The radiotracer used was ^{123}I and the result for q= 120 l/h is show is show in table 1.

Table 4 - Oil flow in 2 pipe, labelled with ^{123}I

Q_T= 120 l/h	**Test**	**($\tau_T \pm \delta\tau_T$)**	**($Q \pm \delta Q$) l/h**
L (m) 6.00±0.005 A (m^2) 2.85e-4 ± 0.42e-6	1	51.94 ± 0.675	119.94 ± 1.334
	2	50.45 ± 0.34	120.83 ± 0.94
	3	50.87 ± 0.71	121.02 ± 1.40
		Q_{mean} =	120.60 ± 0.58
		Uncertainty =	(0.48 %)
		Error % =	(0.50)

The results show the Transient Time method is accurate to measure the oil flowrate in pipelines.

References

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