Scanner device to monitor deposits inside pipelines using gamma scattering methodology

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When a flow meter is used to measure flow rate, two parameters are essential: the accuracy of a measurement and the repeatability of the measuring device [1,2,3]. Using a proper radiotracer for the specific material moving inside the pipeline is accurately possible to measure the flow rate without any disturbance in the regular operation of the pipeline. This procedure is the Transient Time Method (TTM).[4] . The method consists of measuring the transient time T between two measure sections (P1 and P2), separated by a distance equal to L. The mass flow rate Q in an oil pipeline (internal diameter D) is calculated by:

$$Q \quad \frac{Volume\ \overline{P_1P_2}}{Transient\ Time\ \overline{P_1P_2}} = \frac{\pi D^2}{4} \cdot \frac{L}{(\tau_2 - \tau_1)} \quad (1)$$

The transient time T is calculated using the residence time curves (RTD) for P2 and P1, τ is the first moment around the mean of the E (t) curve. [5] and the variance S^2 associated with τ is the second statistical moment of E(t), around the τ. The uncertainty u (Q) associated with Qis:

$$\frac{u\,(Q)}{Q} = \sqrt{\left(\frac{2u\,(D)}{D}\right)^2 + \left(\frac{u\,(L)}{L}\right)^2 + \left(\frac{u\,(T)}{T}\right)^2} \quad (4)$$

The measurement system must be adequately designed for the specific measurement task and estimate the measurements' desired uncertainty.
It is essential to check the pipeline condition because the volume V between the two measure positions must be full of the fluid. Any material deposited on the pipeline wall creates a stagnancy zone and produces a slightly negative pressure region downstream; portions of fluid flow can move from the part with a higher velocity into this dead zone and create vortices modifying the RTD curves.
To correctly measure the flow rate, previously scanned each measure position to certify there is no solid material or air bubble. As shown in Figure 1, a scattering device was used to evaluate the pipe wall using a 241Am source and a 1"x1" NaI scintillator detector.

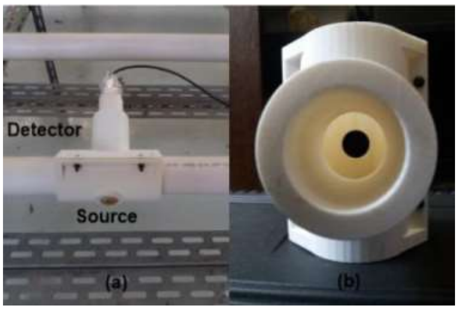

Figure 1- The scattering device in it is used to analyze the internal pipe wall and identify solid deposits or air bubble.

The device is positioned, then measured the transmitted gamma radiation in two directions to prove there is no deposit inside the duct in the perpendicular and the parallel flow direction.
Table 1 shows the scanning for two sets, A and B, in the pipeline, and the data demonstrates there is no material or air bubble in the measure positions.

Table 1: Pipeline scan in the measurement positions using a 241Am gamma source.

	Measure A		Measure B	
	D1	D2	D1	D2
Vertical	4204	4181	4176	4182
Horizontal	4172	4189	4193	4177

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