

Flow measurements in hydrotransport units using gamma scattering and cross-correlation techniques

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The proposal of this research was to develop a methodology using gamma radiation and cross-correlation techniques to measure the speed of pellets in a hydrotransport pipeline. An experimental unit was designed and built to be used to simulate a two-phase (solid/liquid) flows and it was used to measure the velocity of the solid phase in water. The flowmeter system consists in two independent detection systems, each one composed by a gamma source (²⁴¹Am) and a NaI (1x1") scintillators detector, installed outside the pipeline. Both systems were located in the same vertical plane and separated by 18.0 cm. As pellets it was used a variety of experimental samples with different proprieties (composition, diameter and shape with 1.0-3.0 cm) in order to verify the methodology and test in different conditions.

Using the unit it is possible to measure the transient time between the two detections position and to calculate the critical velocity, the velocity above which the flow is fully suspended.

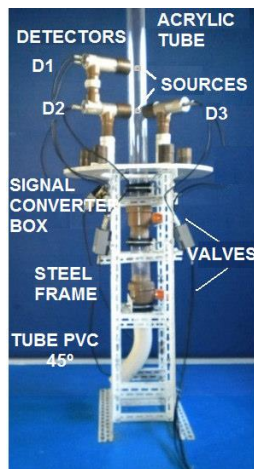


Figure 1. Experimental unit.

During the operation of a pipeline is possible the formation of a “moving bed” when the heavier pellets move towards the bottom of the pipeline and the lighter are carried to the top of the pipe. The results of the signals generated by the detectors are presented in Figure 2.

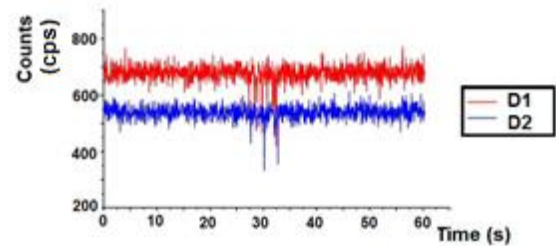


Figure 2. Signals generated by the detectors

The Figure 3 shows the correlation coefficient between D1 and D2 detectors and the curve presents a maximum in $t = 0.963$ s, corresponding to transient time of the pellets. Between $t = 0.94$ s and $t = 4.63$ s, the curve shows a “band structure”, which corresponds to the slow movement of the “moving bed”.

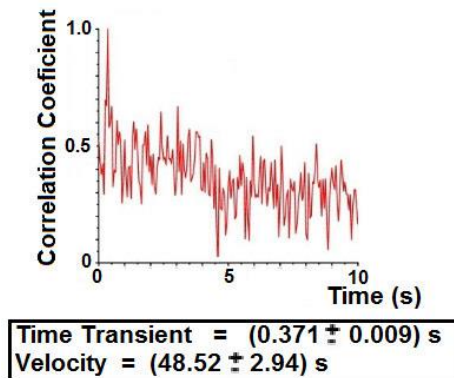


Figure 3. Correlation Coefficient of Moving bed simulation.

References

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