Calibration factor for the total count technique

L. E. B., Brandão[1],E. R., Gonçalves[3]; A. W., Nobrega[2], H. O., Kenup[1]
e-mail: brandao@ien.gov.br, eduardogoncalves@iff.edu.br, atomum@atomum.com.br, hkenup@ien.gov.br

[1]*SETMQ/ IEN*
[2] *ATOMUM Serviços Tecnológicos Ltda.*
[3]*Instituto Federal Fluminense - Macaé*

Keywords: radiotracer, flow measurement, oil.

The unique properties of nuclear technologies provide to get information on real time with the plant on-stream, by the way, without disrupting the processes, and this hand, lead to economic benefits.
The total count technique avoids numerous restrictions on the use of mechanical flow meters in pipelines closed. It can be employed in large-scale flow and in all types of flow, even in partially filled ducts. Hull [1]. This measurement got an uncertainty of 1-3% [2].
At total count technique, a small amount of radiotracer with known activity, ***A***, is detected by a detection system with well-defined geometry, which, positioned after homogenization distance, provides a total count, ***N***. The flow rate, ***Q***, can be obtained by Equation 1.

(01) $$Q = \frac{A \cdot F}{N}$$

Where ***F*** is the calibration factor obtained at laboratory, and it has constant value, specific to each measurement system.
As the detection is done after homogenization of the radiotracer in the medium, the calibration factor F, can be determined in a static model [1] [2]. In order to obtain the calibration factor F, an apparatus was constructed, in this case, a pipe closed at one end. It's consisting by a pipe of 2" PVC, which simulates a transmission line, where they were deposited 900 ml oil, coupled to a detection system composed by three detectors accommodated in different positions in relation to pipe, where Aliquots with (50.00 ± 0.01) µl of radiotracer(I^{123}) [3], with (242 ± 2) kBq activity were deposited successively.
The collected signals by detector 2 from ten injected aliquots are represented in figure 1. The count levels were discriminated using a linear adjustment as shown in figure [4].
Factor F is numerically the angular coefficient of the set line, as represented in figure 2.

The use of the experimental apparatus proved to be effective to obtain the Factor F, in which the following values were obtained F_1 = (0.433 ± 0.019), F_2 = (3.307 ± 0.074) and F_3 = (0.933 ± 0.005) respectively for the detection systems 1,2 and 3.

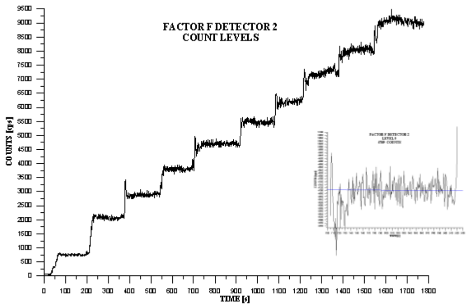

Figure 1. Signals from aliquots.

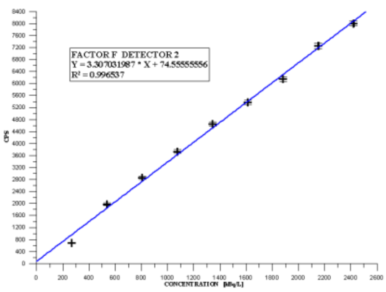

Figure 2. Linear adjustment

References

[1] HULL, D. E. The total-count technique: a new principle in flow measurement, **International Journal of Applied Radiations and Isotopes**, Amsterdam, v. 4, n. 1/2, p. 1-15, 1958.
[2] GASPAR, E.; ONCESCU, M. **Developments in hydrology**: radioactive tracers in hydrology. Amsterdam: Elsevier Publishing Company, 1972. Não paginado.
[3] KENUP, H. O. **Produção de traçador radioativo por eletromarcação de derivado de petróleo com ^{123}I**. 2016. 77 f. Dissertação (Mestrado em Engenharia Nuclear)- COPPE/UFRJ, Rio de Janeiro, 2016.
[4] GONÇALVES, E. R. **Desenvolvimento de Metodologia para Medidas de Atividade Total de Amostras de Óleo Marcado com ^{198}Au**. 2013. 62 f. Dissertação (Mestrado em Engenharia Nuclear)- UFRJ/COPPE, Rio de Janeiro, 2013.