Development of a test section for the study of scales in Petroleum pipelines

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Oil extraction is accompanied by water, gas and sediment that due to changes in pressure, temperature, and fluid flow can cause these elements to precipitate, forming scale deposits on pipe walls [1]. The main reason of the formation of barium sulfate scale is the use of sea water (rich in sulfate, about 2800 ppm SO_4^{2}) to maintain the reservoir pressure during oil production [2]. This report presents a study for the development of a test section for prediction of scales formed by a tube-scale-fluid system through the interpretation of gamma-rays spectra recorded by scintillating NaI(TI) detectors. A container was also developed to accommodate the ^{137}Cs (662 keV) source at the top together with the collimator to obtain the attenuation coefficient of barium sulfate. The container was printed in polylactic acid on a 3D printer, represented by Figure 1.

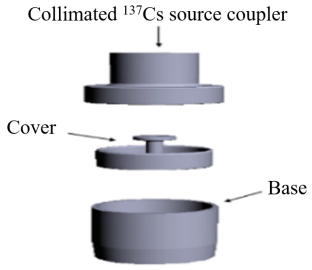

Figure 1. Container in 3D view

The study of the measurement geometry was performed by means of simulations using the MCNPX code Five different pipe heights are used (20, 30, 40, 50 and 60 cm) and three diameters (35, 45, and 55 mm), simulations are performed for each diameter in the five pipe heights, diameter for simulation in eccentric and concentric scale, as shown in Figure 2. The test section is represented in a 3D model. The prototype consists of an acrylic tube 200 mm outside diameter, an acrylic rod divided into three diameters, three 2×2″ NaI(TI) detectors and a collimated source of ^{137}Cs, all fixed on a wooden base, as shown in the Figure 3.

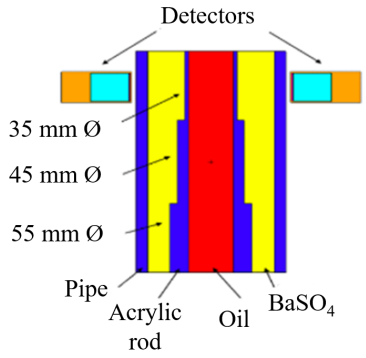

Figure 2. Detection system proposed

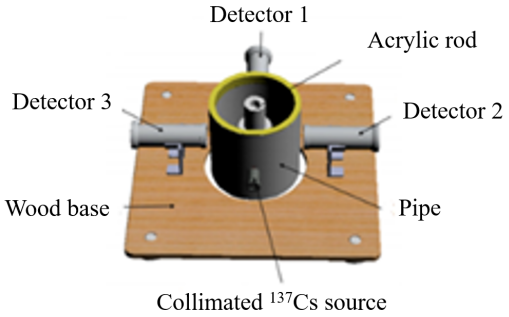

Figure 3. 3D model of the test section prototype

This system was developed aiming at a better positioning of the three detectors in relation to the collimated source of ^{137}Cs. The wooden base support the components and in positioning them at different heights, to measure transmission and scattering in the different diameters that the acrylic rod will form in the scale used. The test section containing the acrylic rod allows to create different diameters for any position it is placed inside the tube, providing the analysis of eccentric inlays. In the next steps, through the results obtained from the simulation, it will be possible to establish the parameters for experimental validation [1].

References

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