A preliminary study of salts content in aqueous solutions by MCNP-X

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This report presents a preliminary study about a possibility to measure concentration and types of salts presents in water, indicating the type of water was used in oil wells. The constant measure it is very important because the composition of water injected in oil well may be interfere in others measures, like volume fractions measurement, among others [1]. The formation of salts, because big concentrations of chlorides, may be create incrustations, that which can interfere with the measurements that are constantly made to maintain the pattern of what is produced [1].
To initiate the research, was choose to develop a model using the MCNP-X code, because it is a very useful tool to simulate radiation transport, and it is validated [2]. The model was developed with 3 types of salts, varying the concentration between 2%, 4% and 6% to each type of salt. To modeling the radiation source, was used values of an X- ray spectrum previously obtained with another program [1].
Figure 1 shows the model developed in the MCNP-X, with the source positioned at the origin, the sample with radius of 1.98 cm and NaI(Tl) detector of 3x3 ".

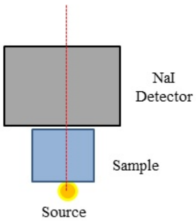

Figure 1. Model developed in MCNP-X.

Simulations were performed by altering the sample type (material and concentration), for aqueous solution containing NaCl, $MgCl_2$ and KCl, with concentrations of 2%, 4% and 6%. The sample volume was 50 ml. The number of generated events was 10E8 and for the definition of the source, the distribution command was used, where photopeak data generated in other software was inserted.
With the MCNP-X value, it was possible to calculate the mass attenuation coefficient of each solution, and thus to identify the types and concentrations of salts. To calculate the mass attenuation coefficient, the Beer-Lambert equation described as in equation 1, where I and I_0 are the beams emitted and transmitted, x the thickness of the material, and μ the density of the material.

$$I = I_0 e^{-\mu x} \qquad \text{Eq. 1}$$

To use it, it is important to know the parameters of the path traveled by the radiation until arriving at the detector, the type of material and its density. The best region is the low energy, where it is possible to differentiate the concentrations of each type of solution. The region where it is possible to notice these differences more clearly is from 20 keV to 30 keV. With this, you can focus on working with low energies, which is important for radiation protection. Figure 2 shows the graph with the results of the mass attenuation coefficient calculation.

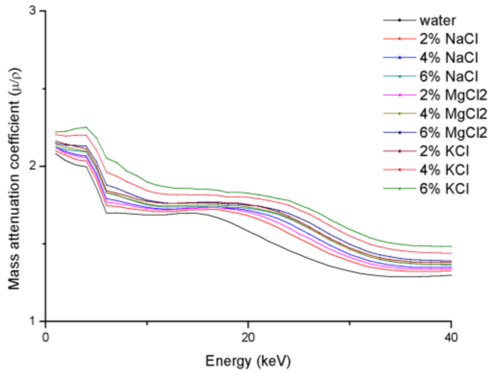

Figure 2. Results of mass attenuation coefficient.

The results obtained were satisfactory and serve as the basis for the development of a more elaborate model and also for the elaboration of experimental measures.

References

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