SYNCHROTRON RADIATION TOTAL REFLECTION X-RAY FLUORESCENCE ANALYSIS OF SOIL SOLUTION IN CONTACT WITH METALLIC MATERIALS

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Different types of soils show a characteristic corrosivity when they are in contact with metallic materials. In order to avoid or minimizing corrosion attack, some alternatives have been developed to protect the metallic structures without take into account the nature and the mechanism of corrosion process due to metal-soil interaction. The soil solution from three types of soil – Arenic Hapludalf, Typic Quartzipsamment and Typic Haplaquox – obtained by centrifugation method were tested in metallic material to improve the understanding of how and in what intensity the corrosion attack occurs. Therefore, were tested samples of steel API 5L X70 whose main application are in pipelines with requirements under or over the surface. Multielemental analyses of soil solution were done by total reflection X-ray fluorescence. Investigations of this nature presume correlation between chemical and physical properties of several chemicals elements in soil solution and the corrosivity imposed by the soil that originates the solution. Among other analytical techniques, TXRF is adequate since it permits the analysis of trace elements content in small amount of sample material sampling. This technique is a variant of energy dispersive X-ray fluorescence (EDXRF) which is based on the measuring of the x-ray fluorescence intensity emitted from the chemical elements contained in the sample when they are properly excited with a x-ray beam. In order to prepare the test specimen for TXRF analysis a single drop (10 µl) of each soil solution was dried in a quartz support and after that irradiated with synchrotron radiation during 200 sec of measuring time. A typical variation of the electron beam current between 178 to 227 mA was observed during the measurements procedure. The results from Figure 1 show that the most representative elements are Fe, Ca, K, Cl, S and P. Table 1 shows loss weight in all test specimens. Considering the pH sequence shown in Table 2 for Typic Quartzipsamment (TQ) > Typic Haplaquox (TH) > Arenic Hapludalf (AH), it is expected that a high degree of corrosion could happen in this sequence, although, the results suggest that another variables can be considered so the sequence in this case would be TQ > AH > TH for the corrosion process in API steel samples. SR-TXRF showed to be suitable to carry out qualitative as well as quantitative analysis of soil solution as an electrolyte, showing adequate analytical results and simple sample preparation. Due to the low detection limit reached by the SR-TXRF technique, sample preparation must be done under careful condition and in clean places.

Acknowledgements

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References:

NASCIMENTO FILHO, V. F.; POBLETE, V. H.; PARREIRA, P. S.; ESPINOZA, V. E. NAVARRO, A. A. – Analytical sensibility of a X-ray fluorescence by total reflection system (in Portuguese). Anais VII CGEN, Belo Horizonte, MG, 1998.

Figure 1 – Graphic of concentration of chemicals elements in soil solution

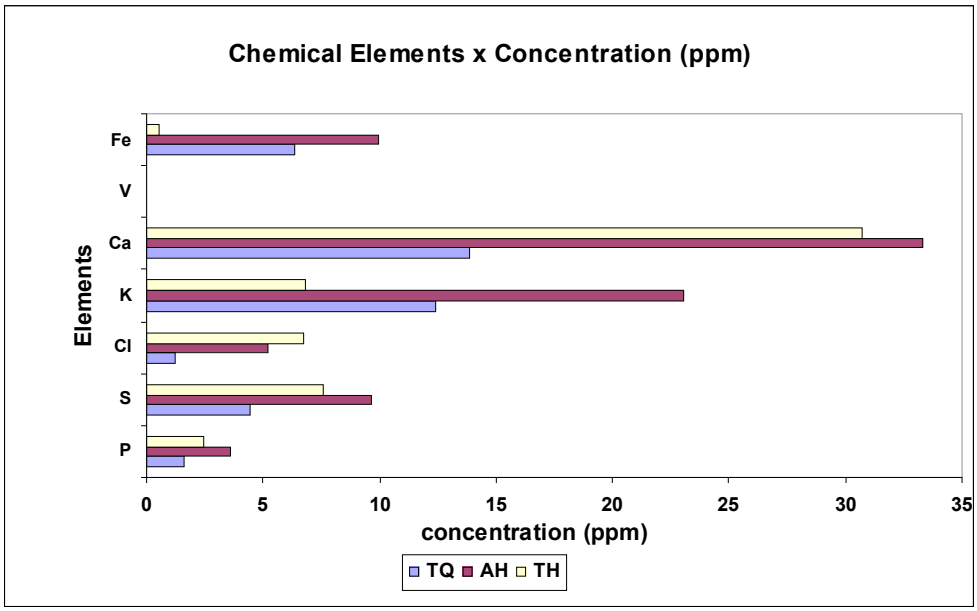

Table 1 – Test specimen mass before and after tests.

Test Specimen	Initial weight (g)	Relative Standard deviation (RSD)	Final weight (g)	Relative Standard deviation (RSD)	Loss weight $W_i - W_f$ (g)	Mean Value (g)	Soil Type
1	28.1261	0.1814	28.1054	0.0117	0.0207	0.0241	**AH**
2	27.9601	0.0049	27.9329	0.0040	0.0271		
3	28.0539	0.0098	28.0295	0.0080	0.0245		
4	27.8949	0.0080	27.8695	0.0049	0.0255	0.0273	**TQ**
5	27.9832	0.0110	27.9561	0.0040	0.0271		
6	27.8484	0.0150	27.8192	0.0063	0.0292		
7	28.0802	0.0102	28.0558	0.0080	0.0244	0.0229	**TH**
8	28.1904	0.0248	28.1682	0.0075	0.0222		
9	28.1258	0.0049	28.1036	0.0049	0.0221		

Table 2 - Results of analyses of soils and soil solutions.

Characteristics/soil •	**Arenic Hapludalf (AH) •**	**Typic Quartzipsamment (TQ) •**	**Typic Haplaquox (TH) •**
conductivity**	254 µS.cm^{-1}	174,4 µS.cm^{-1}	366 µS.cm^{-1}
pH**	7.84	7.26	7.68

• Soil Taxonomy, 1996.