

Learning about the effect of naphthenic acids in steel corrosion using Infrared and Raman spectroscopies

Project offered to UIT Le Creusot students

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Supervisors:



Prof Alda Simões (corrosion science), Prof. Luís Santos (FTIR and Raman spectroscopy)

Host institution: CQE-Centro de Quimica Estrutural, Instituto Superior Técnico, Avenida Rovisco Pais, Lisboa, Portugal.

“Naphthenic acids” (NAs) is a collective term that describes a group of carboxylic acids, which are naturally present in many crude oils, in contents that can go up to 3 wt. %. NAs possess surface-active properties that play an important role in the extraction of bitumen droplets, easing the extraction of oil from oil sands. Despite this advantage, NAs are responsible for two kinds of problems. They can contaminate natural waters, presenting a health risk to aquatic and mammalian species to which they are toxic. Further, they constitute one of the primary causes of corrosion toward process equipment in crude extraction unit operations. For these reasons, it is important to quantify the effect and solubility of NAs in water and to understand the mechanism by which they cause steel corrosion.

The purpose of the project is to analyse the naphthenic acids present on the surface of steel, in an oil/water biphasic system. The analytical techniques will be mainly FTIR (Fourier Transform Infrared Spectroscopy) and Raman spectroscopy. These, together with general purpose techniques, will help understand:

- How much NAs pass from the oil to the water phase.
- Any changes in the structure of the acid (namely due to the conversion into a corrosion product).
- The distribution of corrosion and the composition of corrosion products on the steel surface.

Although some knowledge of Chemistry is desirable, the work will be planned to follow a simple systematic approach, in which increasing amounts of NAs shall be added to the oil and the variation in band intensity in the spectra shall be analysed and quantified. Full scientific support will be provided by the scientific supervisors.

The student will have the chance to work with advanced techniques and to operate the equipment.

General Bibliography:

Patrick James Quinlan, Kam Chiu Tam, Water treatment technologies for the remediation of naphthenic acids in oil sands process-affected water, Chemical Engineering Journal, 279 (2015) 696-714.

Emerson C. Rios, Aloadir L. Oliveira, Alexandro M. Zimer, Renato G. Freitas, Roberto Matos, Ernesto C. Pereira, Lucia H. Mascaro, In situ characterization of naphthenic corrosion of API 5L X70 steel at room temperature, Fuel, Volume 184, (2016) 648-655