

## Influence of DLC coatings on the formation of paraffin surface deposits from crude oils

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**Abstract** - In the present work the formation of paraffin deposits from crude oils onto uncoated and DLC coated surfaces of stainless steel substrates with and without the use of inhibitors was studied. Results show that the use of DLC coatings can lead to a further reduction of the total deposited mass even when a commercial inhibitor is used (fig. 1 - obtained from [1]). Chromatography spectra show that deposits obtained on the DLC coated substrates present a very low condensation of high molecular weight paraffins, reducing the viscosity of the deposits (fig. 2).

High molecular weight paraffins (waxes) deposits can be formed during transportation and processing of petroleum as the oil leaves the reservoir at high temperature and flows through the pipelines in a cooler environment. The crystallization of paraffin leads to the formation of gels with a complex morphology well adhered to the pipelines walls, restricting the oil flow, thus decreasing the production and eventually causing the total blockage of the pipelines.

In this work the influence of diamond-like amorphous carbon (DLC) coatings on the formation of paraffin deposits onto the surface of stainless steel (SS) substrates was investigated both with and without the addition of a commercial inhibitor. The inhibitor is one of the most used methods by the oil industry to reduce the formation of paraffin deposits.

Substrates were coated with DLC films by radio frequency plasma enhanced chemical vapor deposition (rf-PECVD) from pure methane. Paraffin deposition experiments were performed onto DLC/SS and SS substrates using a cold-finger apparatus under continuous magnetic stirring. After deposition, the obtained deposits were weighted and characterized by gas chromatography measurements. The employed crude oils were obtained from two different Brazilian fields and supplied by Petrobras.

When DLC coatings were employed a reduction of the total deposited mass was observed. The use of inhibitor also resulted in a decrease of the deposited mass, as expected. However, the combination of both methods (inhibitor + DLC coating) resulted in the smaller quantities of deposits in all cases. A detailed analysis of the chromatography spectra of the obtained deposits is presented and reveals that the use of DLC coatings results in a very low condensation of high molecular weight paraffin molecules, reducing viscosity of the deposits. This effect can facilitate the removal of paraffin deposits in oil pipelines.

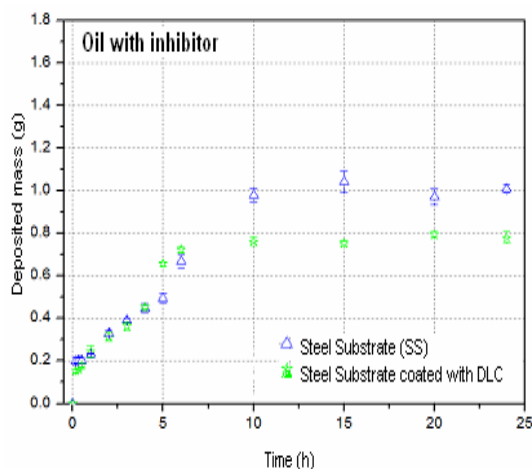


Figure 1: Deposited mass vs time for steel substrates (SS) polished and coated with diamond-like amorphous carbon films (DLC) using oil with inhibitor.

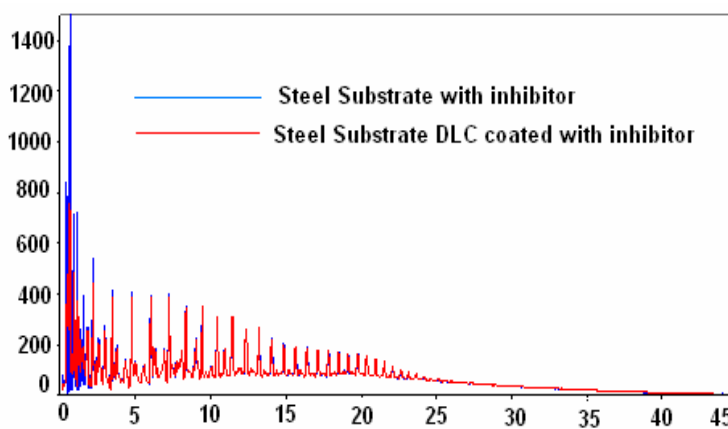


Figure 2: Chromatographic spectrum of 1 hour deposition.