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FT-IR STUDIES OF BULK OIL SOLVENT PROPERTIES AND NATURAL HYDRATE-INHIBITING COMPONENTS (NICS) IN CRUDE OILS

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The thermodynamic conditions required for stable gas hydrate formation are often found in sub-sea and arctic oil pipelines. Hydrate formation is highly undesirable due to the strong tendency of the clathrate crystals to agglomerate and to adhere to the pipe wall and thereby plugging or physically damaging the pipeline, valves and other instrumentation. Hydrate formation can be prevented or slowed down by adding either thermodynamic or kinetic inhibitors or anti-agglomerants. The first shift the hydrate equilibrium conditions towards lower temperatures and higher pressures; the second increase the induction time for hydrate nucleation, while the last prevent the agglomeration of small hydrate crystallites into a plug. At present, the industry makes extensive use of large amounts of thermodynamic inhibitors as a part of their hydrate prevention strategy. On one hand this is very costly; on the other hand the compounds used are of environmental concern. The use of kinetic inhibitors and anti-agglomerants in field operations is a new approach, and requires extensive tests and optimization for each actual system. However, their employment is a very attractive option due to the small concentrations of active component needed, compared to the thermodynamic inhibitors.

Some oils are known to contain naturally inhibiting components (NICs) that seem to act either as kinetic inhibitors or as anti-aglomerants. Extremely little is known about the nature of these components except that they seem to be associated with biodegraded crude oils. Is there a single active component; is it a group of components or is it the interaction between many components? Experiments have shown that if the acidic components in a non-plugging oil are extracted and added to a plugging oil, they will in some cases change the hydrate morphology from solid lumps to fine particles that are easily carried in the bulk oil stream, thus acting as anti-agglomorants (Høiland et al, 2005). However, certain combinations of oil type and concentration of additves seem to be required for the NIC effects to be sufficient to prevent plug formation.

The chemical composition of the acid fractions in biodegraded crude oil is not amenable to conventional molecular analysis (Barth et al, 2004). In this work, we investigate both the bulk composition of the oils and the average composition of the acid extracts for a set of crude oils using FT-IR, trying to find correlations between patterns of functional group

adsorbances and the anti-agglomeration effects. We use curve shape decomposition and multivariate analysis of the spectral data to narrow the range of possible candidates for natural inhibitors, and evaluate whether the solvent properties of the crude oils are contribute to the different effectiveness of the NICs. We also attempt to link these results to fundamental physical properties of the crude oils, like density, viscosity etc.

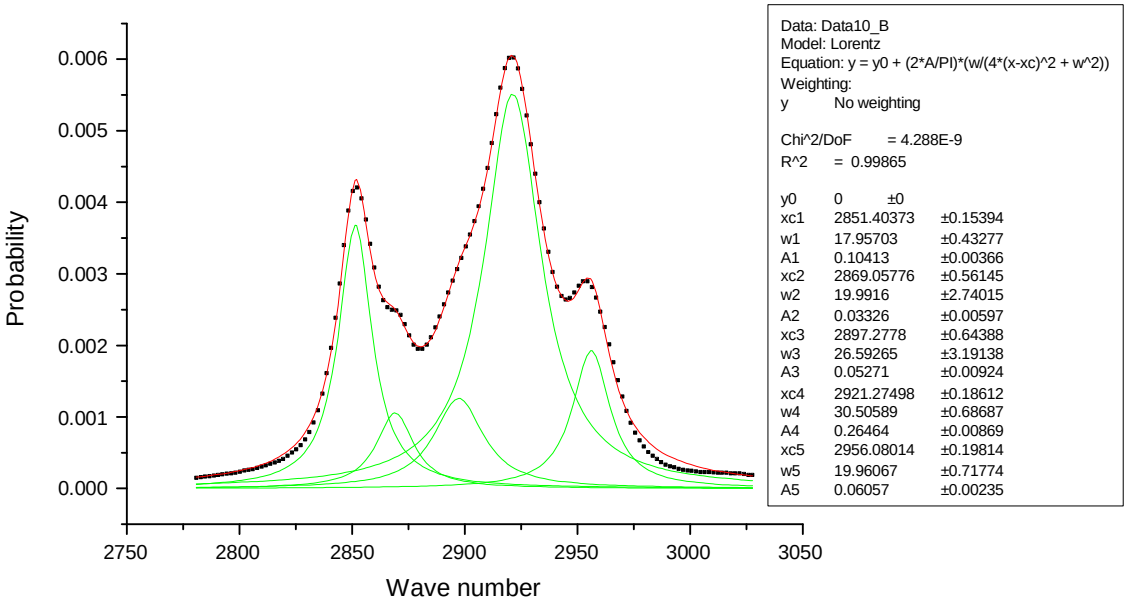

Figure 1. Example of multiple peak treatment of a part of a real oil IR spectrum. The obtained peak parameters are used for assessing physical properties.

REFERENCES

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