Three phase envelopes of asphaltene reservoir fluid: Difficulties in their tracing and

Phase equilibria is of great interest in the oil and gas industry, at either the upstream and downstream processes. The usual approach in phase equilibria prediction is based on the utilization of flash calculations, which are computationally intensive.

A better way of determining phase equilibria regions is by calculating the whole phase envelope with efficient mathematical methods like the continuation method proposed by Michelsen [cita\_MM] for biphasic systems.

In the case of reservoir fluids, the compositional complexity can give complex behaviors, due to the high asymmetry in the system which is originated as a cause of the presence of simple hydrocarbon mixtures, polar compounds and heavy compounds like asphaltenes. This complexity can cause the origination of a third incipient phase. Cismondi proposed a method to trace phase envelopes for system with three phase boundaries on asphaltenic systems, where an incipient phase could be either a vapor or a liquid [cita\_E&F2018]. This approach has two important considerations that must be taken into account:

* Provide a good initialization to start tracing the boundary line.
* Effectively detect critical points and intelligently readapt the algorithm to take this into account.

Developing effective ways to satisfy this two considerations is crucial to avoid potential incomplete diagrams that could lead to incorrect interpretations.

Starting from already known cases where some of this conditions aren’t fully satisfied, which results in incomplete phase diagrams that won’t fully represent the studied system and could lead to false assumptions. We explore in this work possible solutions to this two problems, begining from an analysis on why these cases diverge and later on how these problems can be battled. We tackle this two scenarios separatedly, but that doesn’t mean that both can’t happen at the same time in the same system.

All the implementations in this work have been structured into a Modern Fortran Library, available for public use.