



Modelling Trace Elements Mercury

Background

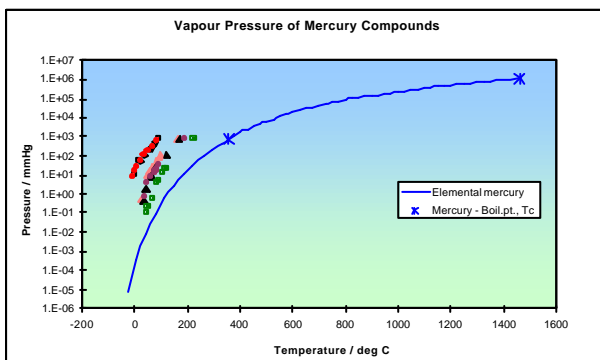
Mercury, both elemental and in compound form, has been detected and reported in petroleum fluids from a number of locations, particularly the Netherlands and Germany, but also in Canada, USA, Malaysia, Brunei, and latterly in the North Sea. This can give rise to both toxicological and equipment corrosion problems. Mercury and its compounds react with aluminium process equipment, forming an amalgam, which can lead to failure. The reported corrosion of an upstream heat exchanger at an LNG plant in Algeria was probably due to this effect. Corrosion of steel, chromium, brass and other copper and/or zinc alloys is also possible

Mercury in petroleum fluids

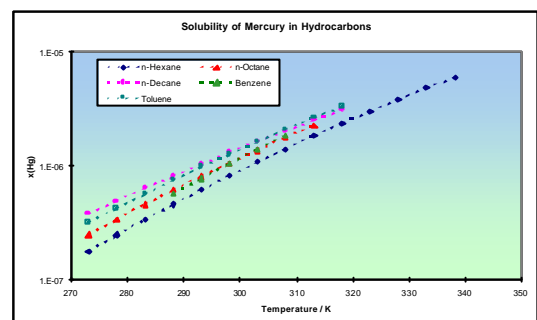
There is some information in the literature regarding the proportion and nature of mercury and organomercury compounds in petroleum fluids. It is generally agreed that mercury in natural gas is almost all in elemental form, but in condensates and petroleum liquids organomercury compounds are significant and may be the predominant form of mercury. Mercury analysis techniques used for gas and condensate samples usually determine either total mercury, or elemental mercury, dimethyl and diethyl mercury only. At present organomercury compounds are not generally explicitly detected.

Modelling of mercury partitioning

Infochem have implemented a model in order to predict the phase distribution of mercury and mercury compounds. An advanced Redlich-Kwong-Soave equation of state (RKSA) with an excess Gibbs energy mixing rule was chosen as the basis. As a result of literature searches pure component properties were correlated or estimated for elemental mercury and some organomercury compounds.

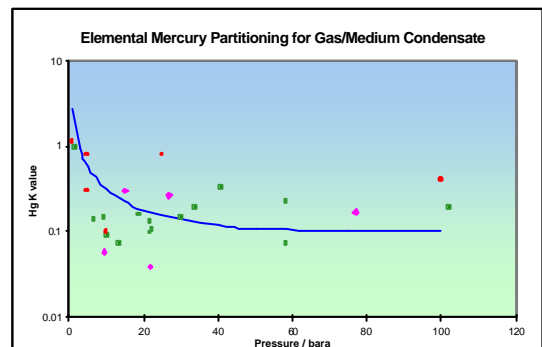


A further literature search was conducted for experimental data for the solubility of mercury and mercury compounds in hydrocarbons and water. Such data provide the framework for fitting binary interaction parameters BIPs for the mercury model. Generally solubility data for hydrocarbon systems were sparse and covered only a limited temperature range. Data for solubility in water were more plentiful.



Field data

Mercury partitioning data were collected from both literature and proprietary sources to validate the model. Comparisons were made for mercury partitioning between gas and condensate, gas and aqueous phase and condensate and aqueous phase. Various cases were tested; the hydrocarbon fluid was treated as a light, medium and heavy condensate; the mercury was presumed to be all elemental or a mix of elemental and organomercury. Diphenyl and dimethyl mercury were chosen to represent non-volatile and volatile components respectively.



An important application of the model is the prediction of mercury dropout in pipelines and equipment.

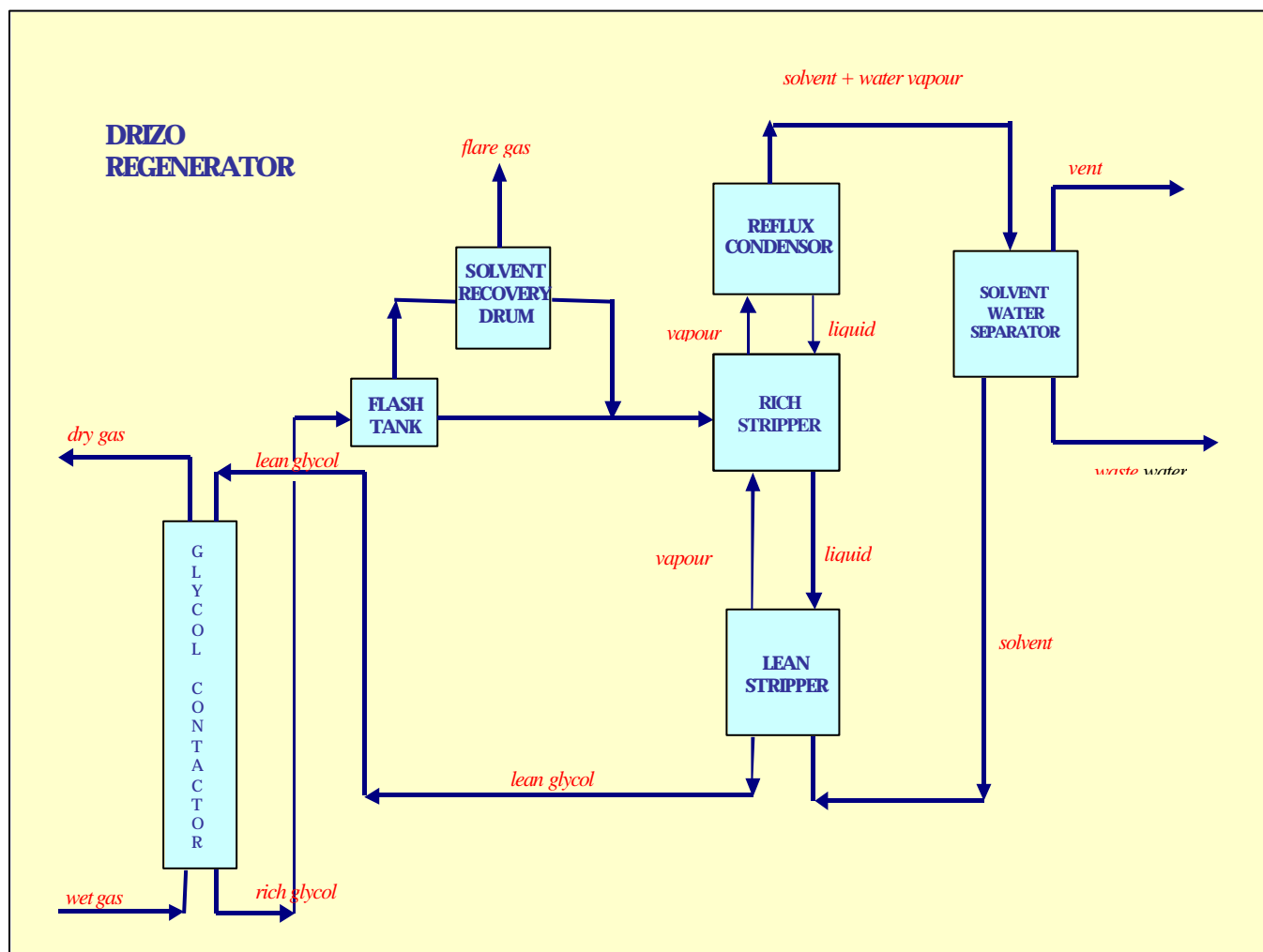
In applying the model to mercury distribution and dropout in a real gas processing plant one of the major difficulties was a lack of data for the solubility of mercury in light gases and glycols. The latter meant we had to ignore the effect of the dehydrator. However, work on several further projects related to mercury modelling, gave us the opportunity to have experimental measurements made for the solubility of mercury in triethylene glycol (TEG) and aqueous TEG.

As a result of these measurements we were able to model a TEG glycol dehydrator, in the first case with a simple reboiler regeneration and in the second case with a more complex Drizo regeneration process.

We were interested to see the amount, depending on the conditions for the dehydrator, of mercury removed from the gas. Frequently this was around 50% of the mercury entering with the inlet gas, with 98% of this mercury in the recycled TEG being lost to the atmosphere on regeneration.

The Drizo process is somewhat more complex in that a stripper is used to help remove the water from the glycol on regeneration. This process causes less mercury to leave the glycol than the simple regeneration scheme and we calculate that Drizo is around 13% less efficient at removing the mercury from the recycled TEG, even when starting with clean solvent. If recycled liquids from later in the process are used in place of the solvent, these will already contain mercury and so more mercury will be retained in the Drizo unit

This loss of mercury in dehydrators is supported in the literature, for example Dr. Benayoun the Industrial Director, of IFP (Institut Français du Pétrole) is quoted as saying that “a significant amount, if not most, of the mercury will be absorbed in the dehydrator towers and will be subsequently desorbed into the regeneration off gas”. This may have important implications for health and safety and commercial implications in the location of mercury removal beds.



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