



Floating Production Facility Improves Mercury Management Accuracy

Advanced modeling delivers reliable predictions and guides safer, compliant designs

Benefits

- Clear visibility into mercury risks
- Trusted model to support design and operations
- Improved accuracy over traditional tools
- Operational insights for better safety and compliance

Background

- International energy company with FPSO needed to understand the behavior of mercury in multi-phase systems
- Original model failed to detect mercury in gas and condensate phases

KBC Solution and Results

- Petro-SIM with Multiflash, selecting the CPA-Infochem EoS with mercury model
- 12 base cases simulated various streams and conditions
- Identified opportunities to remove liquid and solid mercury using LTS.
- Four sensitivity cases tested temperature, pressure, adding stripping gas, and mercury variation in the feed

Challenge

An international energy company was developing a complex floating production facility. As part of the design process, they needed to understand how trace amounts of mercury would behave in gas and condensate streams throughout the topside production process.

Their existing model, based on a conventional simulator using the Peng-Robinson equation of state (EoS), misrepresented mercury as an aqueous-only component. This led to incorrect predictions, overestimating mercury content in the water phase and missing mercury presence in hydrocarbon streams entirely. These inaccuracies created risk and uncertainty in design decisions, particularly corrosion control, safety, and meeting export specifications.

To address these challenges, the client turned to KBC for a more robust, thermodynamically sound and comprehensive approach.

Solution

KBC applied its industry-leading Petro-SIM® simulation software integrated with Multiflash® to allow for the prediction of simultaneous phases. Using CPA-Infochem EoS and a dedicated mercury model, a process simulation model for the entire gas processing system on the FPSO was created to handle mercury in complex fluid systems.

This robust solution enabled a multi-phase, multi-stream compositional model capable of predicting mercury partitioning across vapor, liquid hydrocarbon, water, and methanol streams. The study covered normal operation, cool-down, blowdown, and sensitivity scenarios.

Twelve base cases were developed to cover variations in arrival pressure, arrival temperature, and fluid composition. Additional sensitivity studies examined the impact of increasing stabilizer reboiler temperature by around 3°C, lowering the operating pressure by around 0.55 bar and adding stripping gas at around 14 MMSCFD, and the effects of varying mercury concentrations in the feed. The simulations also identified the locations in the process where both liquid and solid mercury phases could form and be effectively removed.

This allowed KBC to predict and localize where mercury would appear and how it could be safely and cost-effectively managed.

Results

The enhanced modeling approach provided an accurate and realistic picture of mercury behavior throughout the floating production facility's processing system. The analysis confirmed that mercury was present in hydrocarbon streams - contradicting the earlier model's assumptions - and revealed the true distribution of mercury between phases. Export gas mercury levels were predicted to remain well below the project specification across all cases, with the worst case reaching only around 1.5 µg/Nm³.

In contrast, condensate mercury concentrations were found to exceed the specification in several cases, with the highest predicted at approximately 71 ppb(wt). This early warning allowed the client to plan mitigation measures and avoid non-compliance.

The modeling also pinpointed specific opportunities for mercury removal. In the first low-temperature separator (LTS 1), a liquid mercury phase was predicted to form and be decanted at a rate of about 500 g/h. Following Joule-Thomson expansion in the second low-temperature separator (LTS 2), a mixture of solid and liquid mercury was expected to form, with up to 10 g/h removable through decanting.

In addition, hydrate formation temperatures were compared with operating temperatures to assess methanol injection requirements. In many cases, the hydrate margin exceeded 10°C, indicating potential to optimize and reduce methanol usage, though this was outside the scope of the present study.

Overall, the findings enabled the client to make safe, cost-effective, and specification-compliant design decisions with a far greater degree of confidence.

