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Challenges in Managing Mercury in Field Development and Production

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A New Approach in Managing Mercury Risk through Mercury Partitioning Chemicals in High Mercury Condensate Production System

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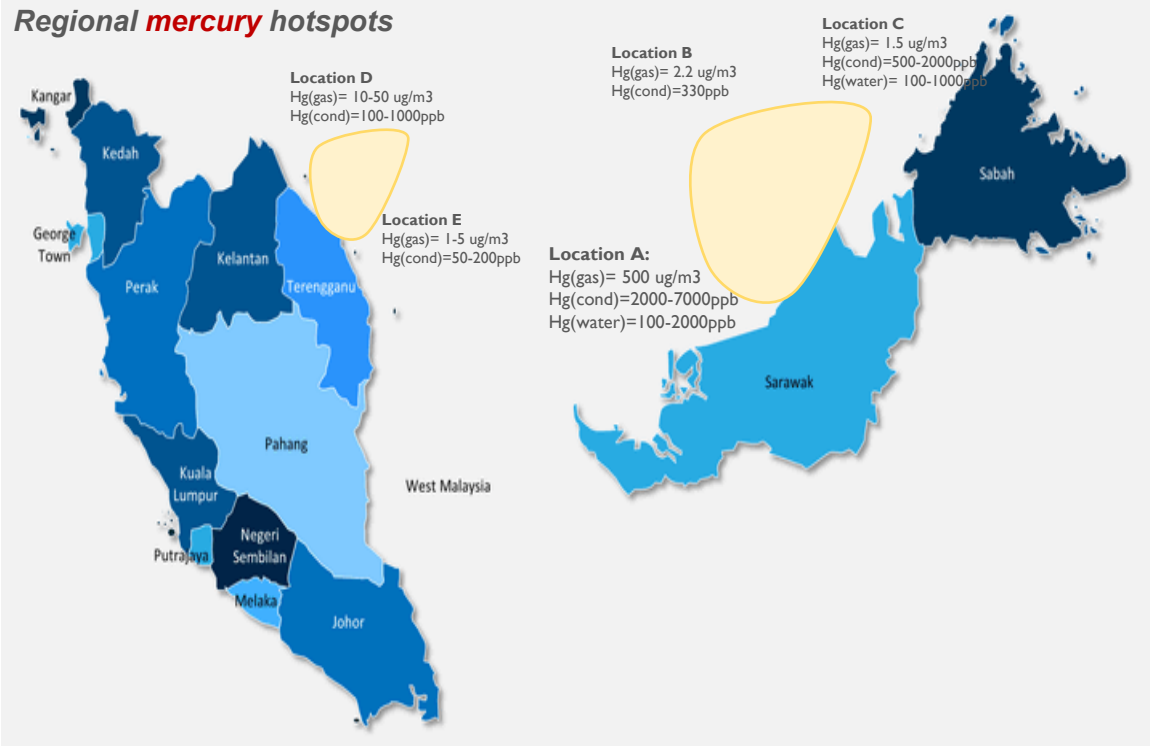
Background

- Mercury concentrations in Southeast Asia, especially in Malaysia, are rising in produced fluids, reaching 2000-7000 ppb in condensate and up to 2000 ppb in the water phase.
- Elemental mercury (Hg^0) is the dominant species.
- Key Impacts on HSE controls, engineering modifications like Mercury Removal Units (MRUs), preventive measures for asset integrity, and addressing potential threats to sales quality and environmental discharge impacts.
- Emerging levels necessitate “Tailor Made” solutions to manage Hg holistically and efficiently.



Facts & Challenges

- Mercury exists in a variety of speciation states
  - Not stable and undergo changes in their physical states and chemical compositions at dynamic process conditions.

Solubility of mercury compounds @ 20C

Solvent	Hg^0 solubility(ppb)	HgCl2 solubility	(Ch3)2 Hg Solubility
water	50	6.6 g/100ml	<1.0ppm
Methanol	549	51.5 g/100ml	Soluble
1-propanaol	527	23.2 g/100ml	
Acetone	520	140 g/100ml	
Mono-ethylene glycol(MEG)	182		
Hexane	1200	11500ppb	Miscible

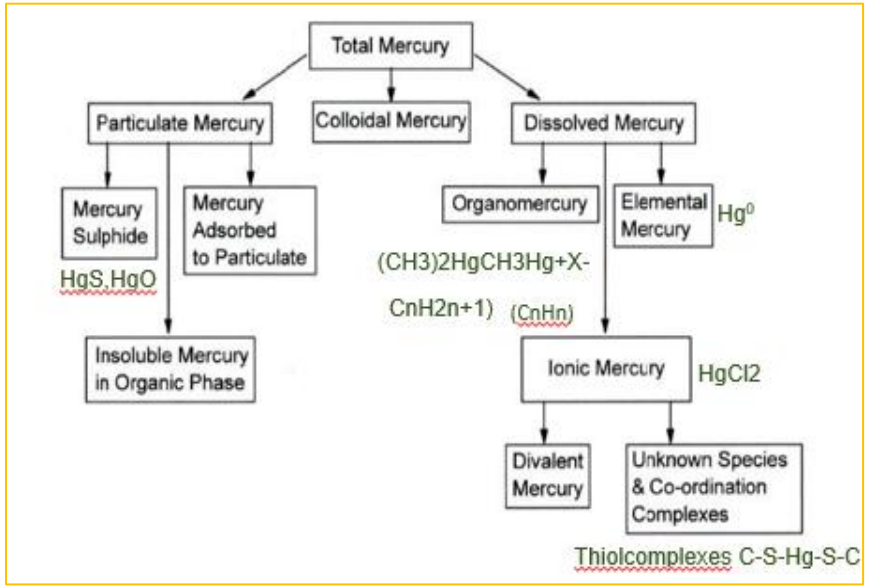


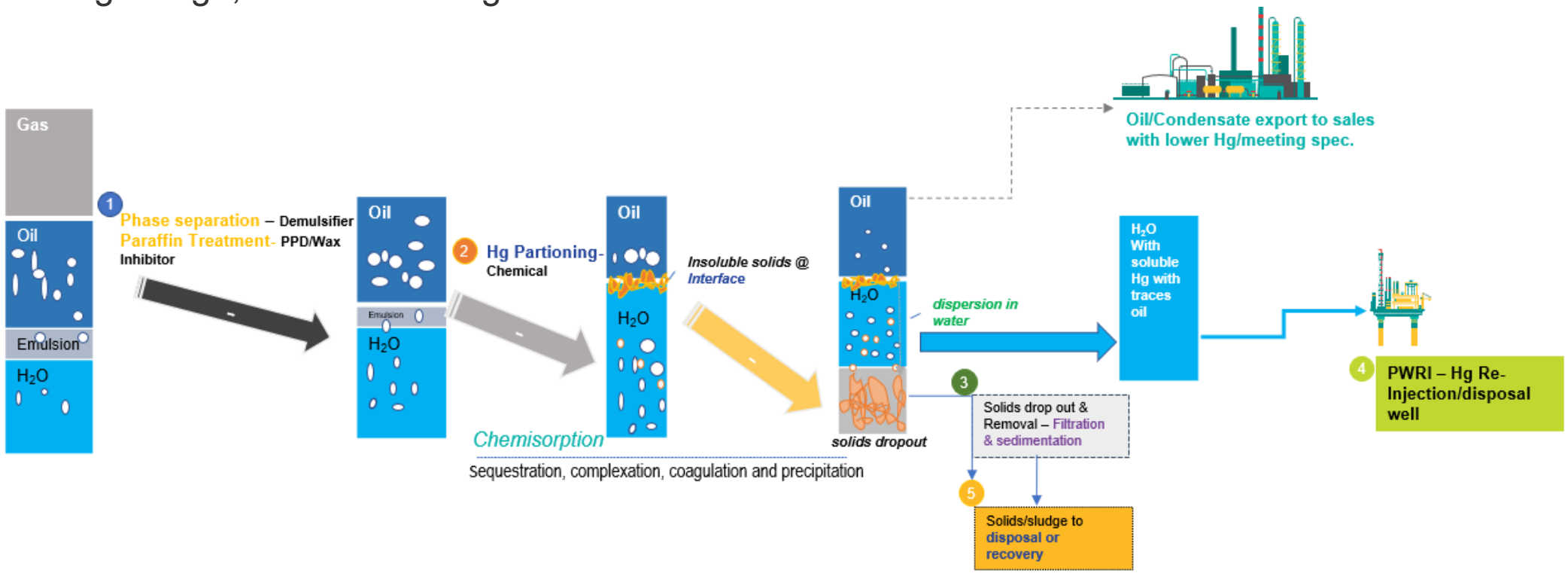
Fig 2: The mercury species/groups

- Mercury will partition to different phases and components (arrays) based on:
  - solubilities of the species in each matrix.
  - oxidation states (Hg^o, Hg+1, Hg+2).
  - composition of the matrix.

- Challenges often arise with sampling and analysis when establishing reliable data trends.

Experimental Concept

- The concept of Hg Chemisorption methods was assessed.
- A 5-stage process was designed to enable the adoption of a future state modus operandi, optimize engineering design, and maximizing HC value.



Mercury- Chemisorption methods concept with 5 process stages to manage mercury in condensate liquid streams

“Tailor- Made” Chemistries

- Chemisorption methods using novel chemistries have been studied in this case; the aim is to chemically react with the Hg metal or its compounds to result in salts that are insoluble in crude oil and soluble in water; thus, allowing phase partioning to the aqueous, or forming insoluble compounds that will form sludge, separating from both phases.

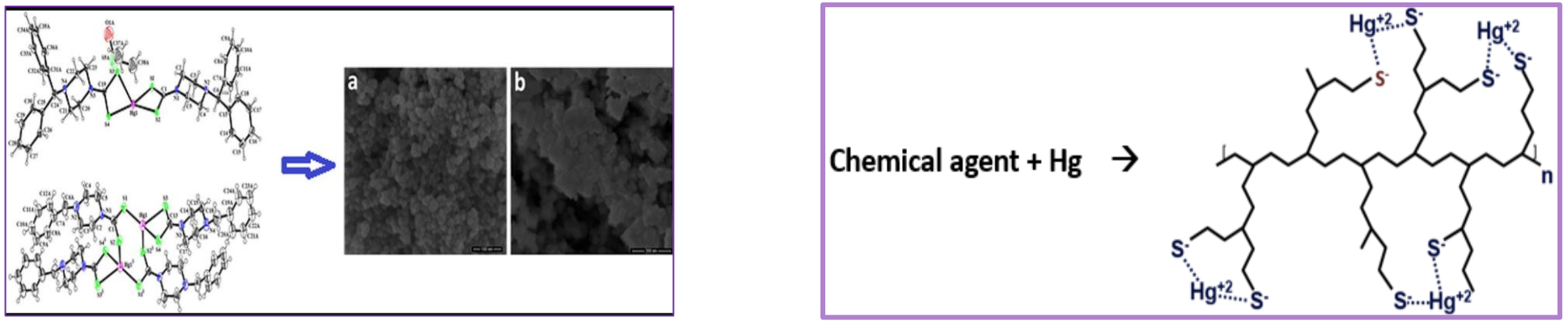


Fig 4: Mercury- Chemisorption methods concept with 5 process stages to manage mercury in condensate liquid streams

“Tailor- Made” Chemistries

- All chemicals significantly reduced condensate mercury from 1100-1438 ppb to 70-95 ppb, achieving **80-93%** reductions in the LAB scale.
- Positive Improvement of Hg incremental in water phase up to 139ppb and further high to **521ppb** at 5000ppm (120-700 % from baseline Hg in water 13-60ppb)

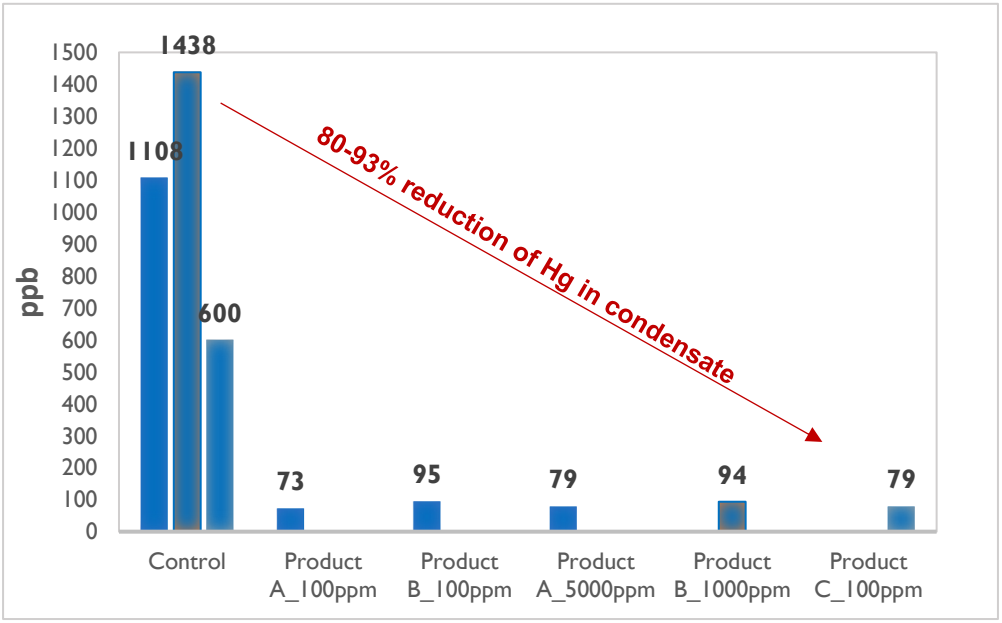


Fig 5: 80-93% reduction of Hg in condensate fluids

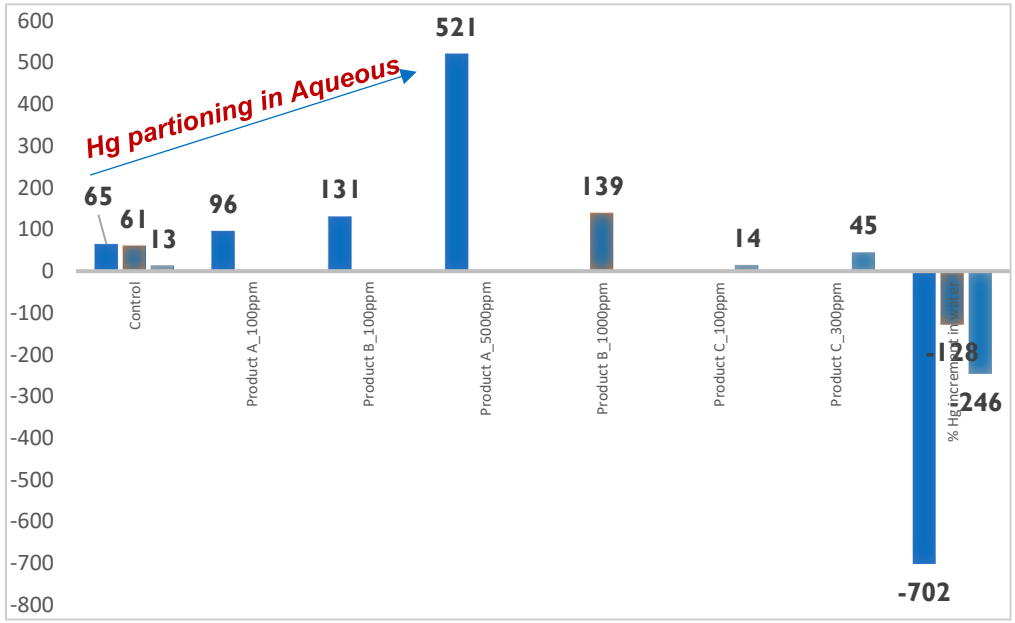
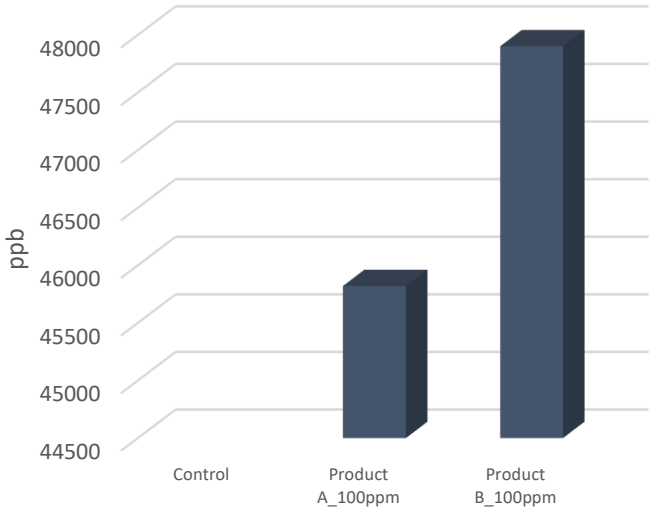
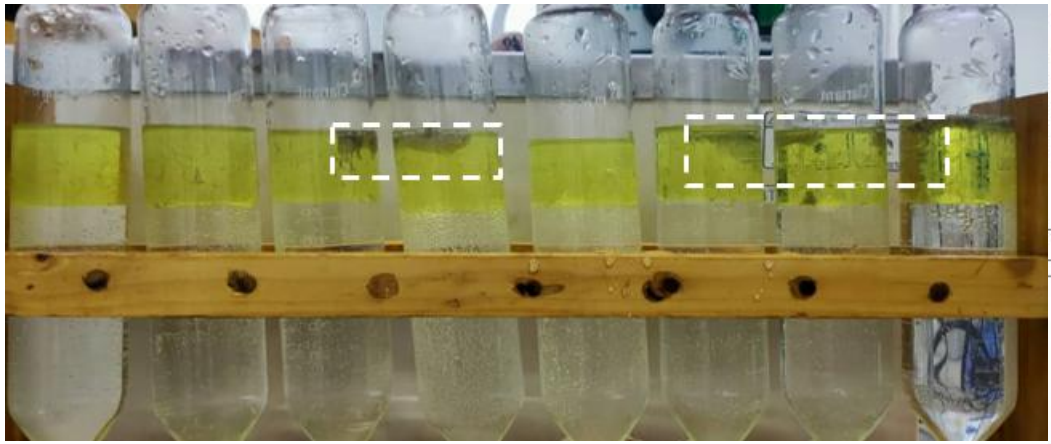


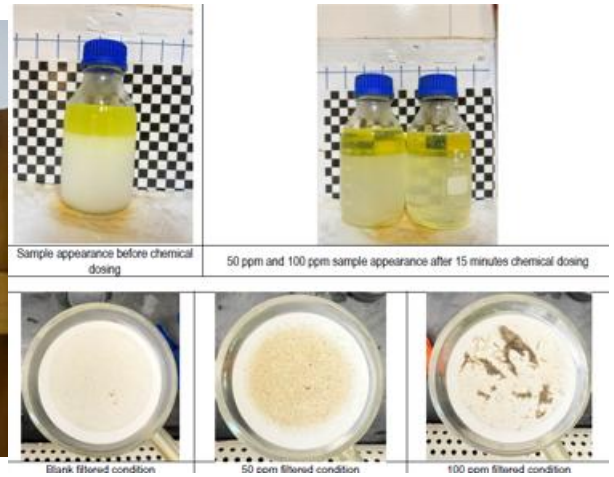
Fig 6: Significant Improvement of Hg partioning in Aqueous Phase

“Tailor- Made” Chemistries

- Products has shown insoluble salts/solid up to 47000ppb of Hg







The Hg is being transformed into insoluble salt/solid particulates through chemical addition in the total fluid

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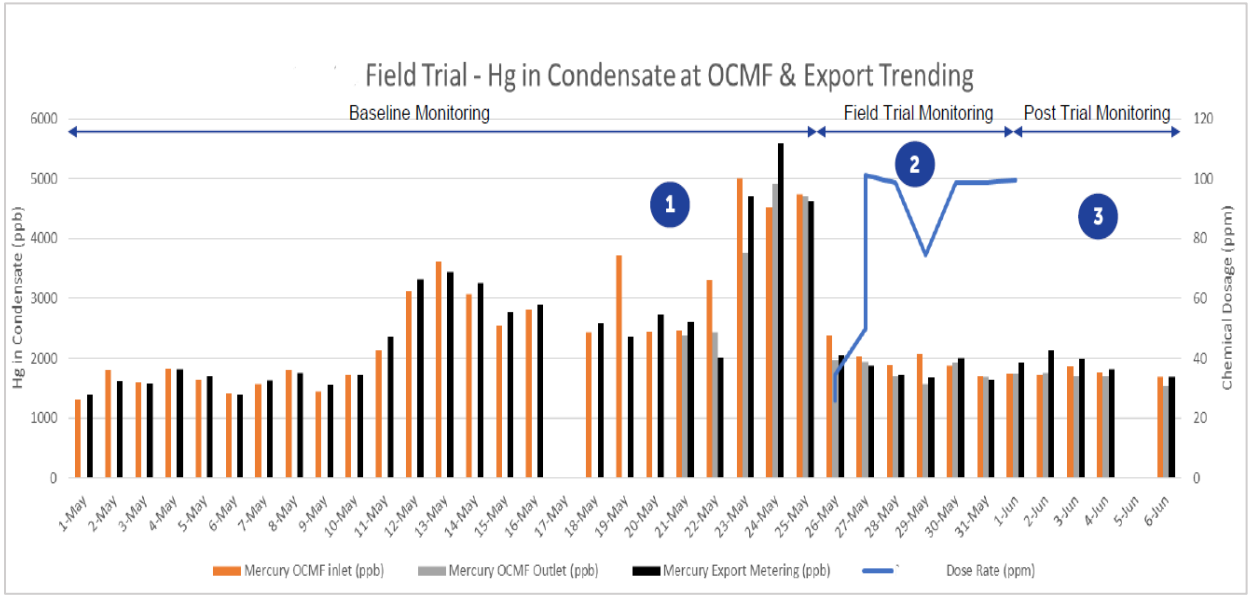
“Field Results”

- ~67% total Hg reduction in condensate with the chemical treatment

Average V 2010 **Inlet,** ppb	**With Hg Agglo** V 2010 Outlet,ppb	Overall Hg Reduction %
5630	1836	**67**

- Observed fluctuation of Hg in condensate that challenges to establish a good trend



~67% of Mercury reduction observed during the pilot period in total condensate liquid stream

“Conclusions”

- Hg chemisorption methods have shown positive reduction of Hg in condensate, with partitioning into solid and aqueous phases from both experimental proof of concept trials in the lab for field applications.
- The biggest challenge lie around sampling and analysis which are particularly tricky.

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Thank You for Your Attention!