

Mercury and Contaminates in Oil & Gas Exploration and Production

Mercury, arsenic and naturally-occurring radionuclides (NOR) are present as various chemical and elemental forms throughout hydrocarbon exploration and production systems. While mercury and technology enhanced NORM (TENORM) are well recognized contaminants other toxic metals (i.e., arsenic) are emerging as contaminants of concern (COCs) for the operation and subsequent decommissioning of contaminated hydrocarbon production assets.

Similar to other toxic metals such as mercury, the solubility and vapor pressures of arsenic (alkyl arsines: predominate species in oil and gas – trimethylarsine – TMA) are a critical aspect of distribution and partitioning in a hydrocarbon process system. The concentration and accumulation of these contaminants in natural gas and associated fluids varies with geology and reservoir conditions.

Mercury and other COCs adsorb and chemisorb to carbon and stainless steel process equipment so understanding the mass, distribution and species along with corrosion profiles in process equipment are critical to successful chemical decontamination and spent chemistry processing plans and objectives.

However, mercury and arsenic complexed and incorporated into metal surfaces is not easily removed by typical hydrocarbon chemical decontamination chemistries and methods. ISCT has formulated a series of chemistries that have been tested in numerous research and development projects in Thailand and the U.S., as well as deployed our chemistries full scale from the Americas to Australasia.

Innovative Toxic Metals and Hydrocarbon Removal Chemical Technologies

ISCT 400 series chemical formulations provide ~95 – 100% mercury contaminate mass removal from a variety of metal alloys and depth profiles without damaging process equipment (effective from 10 - 65°C) and are used for 1) process risk reduction, 2) minimising occupational exposure risks to personnel during maintenance events, 3) near total and total mass removal from high value equipment for reuse and 4) total mass removal from assets scheduled for decommissioning (subsea pipelines, topside processing equipment, FPSO cargo holds, and shore based hydrocarbon processing plants). The 400 series formulations are designed for a range of hydrocarbon removal/degassing and mercury removal options simultaneously so only a neutralization step is required for sequential use or post chemical decontamination.

400 Series Formula

- 400-66
- 400-71
- 400-73

Manufactured Alkaline Based Formulas and Options:

Powerful alkaline surface cleaners and scale removers with various proprietary blends of surfactants, chelants, corrosion inhibitors, pH adjustment agents, sequestering agents and hydrogen sulfide scavengers that allow rapid penetration and reduction of heavy metals in hydrocarbon processing systems. Each formula has an A/B version and can be modified based on mass removal criteria, hydrocarbon loading, depositional environment, scale composition, metallurgy and depth profile. ISCT provides each formula in concentrated form (stable for 36 months).

400 Series Formula

- 400-69
- 400-70
- 400-74

Manufactured Acid Based Formulas and Options:

Strong to extremely powerful mineral acid blends/scale removal formulas with controlled foaming, various corrosion inhibitors, wetting agents, oxidants, hydrogen sulfide scavengers and hydrogen embrittlement inhibitors that allow controlled penetration and scale removal to metal substrates. Additional oxidizers can be added in the field based on mercury mass, distribution, species and depth profile. Each formula has an A/B version and can be modified based on mass removal criteria, hydrocarbon loading, depositional environment, scale composition, metallurgy and depth profile. Both 400-69 and 74 can be modified to solubilize BaSO₄. TENORM is commonly entrained in barium sulfate (BaSO₄) and calcium carbonate (CaCO₃) scales. ISCT provides each formula in concentrated form (stable for 36 months) or in its activated optimal use dilution (stable for ~ 3 months). Based on the 400 series formula selected and metallurgy certain oxidants are unstable in solution so require addition to the formulation in the field.

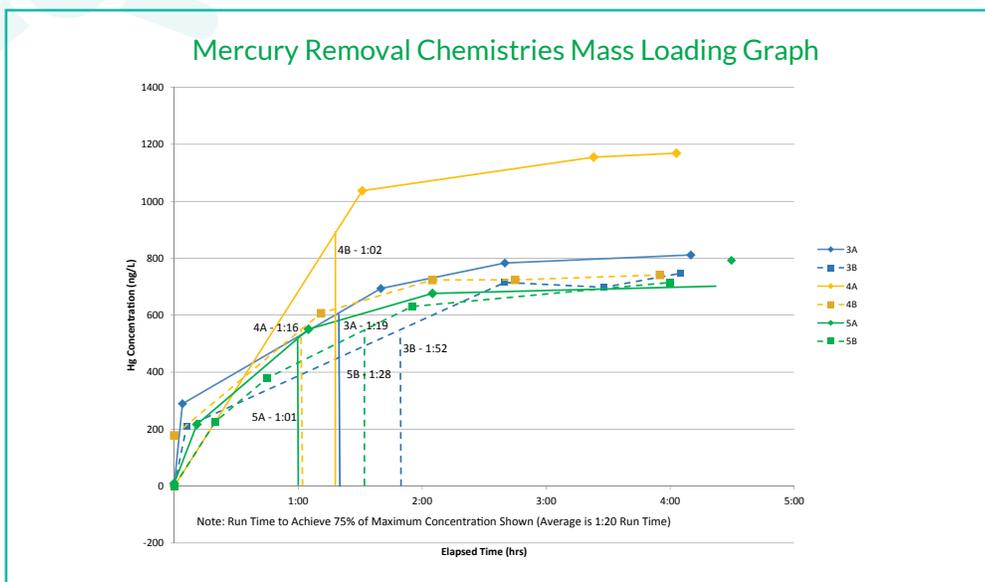


Fig 1: ISCT chemical formulations mercury uptake over time

Technical Support

ISCT provides technical support for toxic metals (Hg and As) and TENORM chemical decontamination including onsite/offsite chemical performance and verification chemical analysis along with mass loading graphs, non-destructive and destructive testing methods for verification of chemical decontamination objectives. In certain cases formulas may be applied based on performance criteria if mass, corrosion profile and objectives are clearly defined. ISCT also provides chemistry and technical options for processing (waste minimisation) of spent chemistries to achieve a range of treatment objectives and discharge criteria. Consideration of spent chemistry processing should be incorporated at the start of chemical decontamination planning optimizing treatment (alkaline and acidic 400 series are preferentially processed using different technologies). It makes sense to perform chemical decontamination of tubing and topside processing equipment offshore then rock the spent chemistries down-well into the formation. Other spent chemistry may require processing (minimisation) and can be performed onshore or offshore based on many factors such as costs, schedule, operations footprint, discharge criteria and final options available for final disposition of fluids, sediments, and concentrated solids.



Application Methods

For use in phased chemical cleaning programs for mercury decontamination of hydrocarbon processing systems. Most of the 400 series formulas can be applied via vapor phase, cascade phase, full circulation, RHD, robotic crawler applications for pipelines, sequential chemical pig trains, foaming and various viscosity gel applications (slug catchers, desalters and FPSO cargo holds) using ISCT gel and gel breaker formulas. ISCT provides guidance for select application methods based on a range of criteria and objectives with an emphasis on reducing spent fluids and solid streams. A critical element is selecting an application technology with the most effective contact time and highest production rate.

ISCT and U.S. Chemical Cleaning Partner SIR

- Bench scale testing of metallic test coupons to develop and support cost effective toxic metals decontamination chemical development and chemical cleaning programs
- Design/implement research and development programs to support asset COCs management
- Chemistries and chemical application method selection for: Marine assets – FSOs, FPSOs, Riser Platforms, Production Platforms, Gathering Platforms
- Chemical decontamination guidance: Onshore processing assets – Dehydration Plants, Gas Plants, NGL and LNG plants
- Design and implementation of COCs chemical decontamination of offshore and onshore process systems for continued use and decommissioning



For more information

ISCT and our U.S. chemical cleaning partner SIR have over 50 years experience in product formulation, specialised chemical manufacturing, advanced product application. Our specialty chemicals enhance many aspects of the hydrocarbon processing industry ranging from upstream exploration and production, processing, NGL and LNG processing and petrochemical plants to downstream processing. Within the upstream, midstream and downstream energy markets, ISCT offers a growing portfolio of products, capabilities and innovations to solve complex processing and environmental issues.

For more information including technical services and research contact us at rradford@isctgroup.com or asiapactech@isctgroup.com or visit us online at www.isctgroup.com



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