liquid streams such as non-aqueous liquid hydrocarbonaceous streams upon contact with a Hg-complexing agent for mercury to form insoluble complexes for subsequent removal.

[006] There is still a need for improved methods to extract trace amounts of heavy metals such as mercury and arsenic, wherein the heavy metals form water-soluble metal complexes for subsequent removal from the crude by water-oil phase separation. .

SUMMARY OF THE DISCLOSURE~~INVENTION~~

[007] In one aspect, the disclosure~~invention~~ relates to an improved method to treat a crude oil to reduce its heavy metal concentration. In the method, a water stream consisting essentially of an oxidizing agent is added to the crude oil to extract at least a portion of the heavy metals into the water stream forming a waste stream. The improvement comprises adding a complexing agent, facilitating the formation of soluble compounds in the water stream, prior to separating the wastewater from the crude oil, leaving a treated crude oil having a reduced heavy metal level.

[007a] In one aspect, there is provided a method for treating a crude oil to reduce its mercury level, comprising adding to the crude oil a water stream consisting essentially of an oxidizing agent selected from the group of elemental halogens, halogen containing compounds, ozone, oxyhalites, hydroperoxides, and organic peroxides, inorganic peracids and salts thereof, organic peracids and salts thereof, to convert at least a portion of the mercury to mercury cations, and extracting at least a portion of the mercury cations into the water stream forming a mercury-rich wastewater, and separating the wastewater from the crude oil, leaving a treated crude oil having a reduced concentration of mercury, the improvement comprising: adding a complexing agent to convert at least a portion of the mercury cations to soluble mercury compounds in a water phase prior to separating the water phase containing soluble mercury compounds from the crude oil, leaving a treated crude oil having a reduced mercury level.

[008] In another aspect, the disclosure~~invention~~ relates to a method for reducing a trace amount of heavy metals, e.g., mercury, arsenic, etc., in a crude oil. The method comprises mixing into the crude oil an amount of an oxygen-containing compound selected from the group of oxyhalites, hydroperoxides, and organic peroxides, inorganic peracids, organic peracids, molecular halogens such as iodine (I_2), bromine (Br_2), and ozone to extract the heavy metals into a water-oil emulsion; adding an amount of a complexing agent to the water-oil emulsion to facilitate the formation of soluble heavy metal complexes in the water phase; and separating the water containing the soluble heavy metal complexes from the crude oil, leaving a treated crude oil having a reduced concentration of heavy metals such as arsenic and or mercury.

[008a] In another aspect, there is provided a method for reducing a trace amount of heavy metals in a crude oil, comprising: mixing into the crude oil an effective amount of at least an oxidizing agent selected from the group of hydroperoxides, organic peroxides, inorganic peracids and salts thereof, organic peracids and salts thereof, molecular halogens, ozone and combinations thereof to extract at least a portion of the heavy metals in a water oil emulsion; adding an effective amount of a complexing agent to convert at least a portion of the extracted heavy metals in the water oil emulsion to soluble heavy metal compounds in a water phase; separating the water phase containing the soluble heavy metal compounds from the crude oil to obtain a treated crude oil having a reduced concentration of heavy metals; wherein the heavy metals comprise any of mercury, arsenic and combinations thereof.

[008b] In another aspect, there is provided a method for reducing a trace amount of mercury in a crude oil, comprising: mixing into the crude oil an amount of at least an oxidizing agent selected from the group of oxyhalites, hydroperoxides, organic peroxides, inorganic peracids and salts thereof, organic peracids and salts thereof, ozone and combinations thereof to extract at least a portion of the mercury into a water-oil emulsion; adding an amount of a complexing agent to convert the extracted mercury to soluble mercury compounds in a water phase; and separating the water phase containing the soluble mercury compounds from the crude oil, leaving a treated crude oil having a reduced concentration of mercury.

[009] In yet another aspect, the disclosure~~invention~~ relates to a method for reducing a trace amount of arsenic in a crude oil. The method comprises: mixing into the crude oil an effective amount of at least an oxidizing agent selected from the group of oxyhalites, hydroperoxides, organic peroxides, inorganic peracids and salts thereof, organic peracids and salts thereof, molecular halogens, ozone and combinations thereof to extract at least a portion of arsenic into a water-oil emulsion as arsenic cations, forming a mixture; adding an effective amount of a complexing agent to the water-oil emulsion mixture to convert the extracted arsenic cations to water-soluble arsenic compounds in a water phase; and