HYDROGEN SULFIDE SCAVENGERS AND METHODS FOR REMOVING HYDROGEN SULFIDE FROM ASPHALT

Abstract: A method for reducing hydrogen sulfide in asphalt includes adding a hydrogen scavenger composition to the asphalt. The hydrogen sulfide scavenger includes a polyaliphatic amine having the formula \( \text{H}_n\text{NRNH}-(\text{RNH})_m \) \( \text{H} \) \( (i) \). R is an aliphatic radical and n is from about 0 to about 15. A method for treating asphalt and a hydrogen sulfide scavenger are also provided.

Figure 1

[Graph showing the reduction of hydrogen sulfide (H2S) ppm over time for two samples.]

Legend: Sample 1, Sample 2

Time/min.
HYDROGEN SULFIDE SCAVENGERS AND METHODS FOR REMOVING HYDROGEN SULFIDE FROM ASPHALT

FIELD OF THE INVENTION

[0001] This invention relates generally to hydrogen sulfide scavengers and more particularly, to hydrogen sulfide scavengers for asphalt.

BACKGROUND OF THE INVENTION

[0002] During the refining of crude oil, asphalt products or heavy oil are produced as the residue from crude oil distillation. Asphalt products are black, viscous materials, which can be upgraded to higher-valued gasoline or diesel by further refining. However, asphalt products often contain hydrogen sulfide and upgrading the asphalt products increases the risk of hydrogen sulfide exposure. Since hydrogen sulfide is corrosive in the presence of water and poisonous in very small concentrations, it must be removed before the asphalt products can be upgraded.

[0003] Asphalt has a high temperature range and current commercial technology employs the use of water-based triazines as hydrogen sulfide scavengers. However, these water-based triazine materials can cause foaming, spitting and possible spillovers. Commercially available organic based scavengers are expensive and can contain metal ions. The introduction of additional metal ions can create incompatibility with up-grader catalyst beds.

[0004] What is needed is an improved organic based scavenger for removing hydrogen sulfide from asphalt.

BRIEF DESCRIPTION OF THE INVENTION

[0005] In one embodiment, a method for reducing hydrogen sulfide in asphalt, comprises adding a hydrogen sulfide scavenger composition to the asphalt, wherein
the hydrogen sulfide scavenger composition comprises a polyaliphatic amine having
the formula I:

\[ \text{H}_2\text{NRNH-(RNH)}_n\text{-H} \]

wherein R is an aliphatic radical and n is from about 0 to about 15.

[0006] In another embodiment, a method for treating asphalt comprises adding
a hydrogen sulfide scavenger composition to the asphalt products, wherein the
hydrogen sulfide scavenger composition comprises a polyaliphatic amine having the
formula I:

\[ \text{H}_2\text{NRNH-(RNH)}_n\text{-H} \]

wherein R is an aliphatic radical and n is from about 0 to about 15.

[0007] In another embodiment, a hydrogen sulfide scavenger composition
comprises a polyaliphatic amine and a catalyst, said polyaliphatic amine having the
formula I:

\[ \text{H}_2\text{NRNH-(RNH)}_n\text{-H} \]

wherein R is an aliphatic radical and n is from about 0 to about 15.

[0008] The various embodiments provide an organic-based hydrogen sulfide
scavenger for asphalt and for an improved method of removing hydrogen sulfide from
asphalt products.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] Figure 1 is a bar graph showing the amount of hydrogen sulfide in ppm
in asphalt samples versus time in minutes.
Figure 2 is a bar graph showing the amount of hydrogen sulfide in ppm in asphalt samples versus time in minutes.

DETAILED DESCRIPTION OF THE INVENTION

The singular forms "a," "an" and "the" include plural referents unless the context clearly dictates otherwise. The endpoints of all ranges reciting the same characteristic are independently combinable and inclusive of the recited endpoint. All references are incorporated herein by reference.

The modifier "about" used in connection with a quantity is inclusive of the stated value and has the meaning dictated by the context (e.g., includes the tolerance ranges associated with measurement of the particular quantity).

"Optional" or "optionally" means that the subsequently described event or circumstance may or may not occur, or that the subsequently identified material may or may not be present, and that the description includes instances where the event or circumstance occurs or where the material is present, and instances where the event or circumstance does not occur or the material is not present.

In one embodiment, a method for reducing hydrogen sulfide in asphalt, comprises adding a hydrogen sulfide scavenger composition to the asphalt, wherein the hydrogen sulfide scavenger composition comprises a polyaliphatic amine having formula I:

\[
H_2N\text{R}_nN\text{R}_\text{H} - \text{H} \quad \text{I}
\]

wherein R is an aliphatic radical and n is from about 0 to about 15.

Asphalt products often contain hydrogen sulfide, which is corrosive and poisonous and must be removed before the asphalt products can be upgraded to higher value products, such as gasoline and diesel. Asphalt is any type of crude oil
residuum or heavy oil that is produced from the distillation of crude oil. It is a heavy intermediate or finished product having a boiling point in a temperature range from about 500°F to about 1100°F. The asphalt can have a range of hydrogen sulfide content and any level of hydrogen sulfide can be treated.

[00016] The hydrogen sulfide scavenger controls and removes hydrogen sulfide from asphalt. It is an organic-based composition comprising a polyaliphatic amine. The polyaliphatic amine has the formula I:

\[ \text{H}_2\text{NRNH}-(\text{RNH})_n\text{H} \]

wherein R is an aliphatic radical and n is from about 0 to about 15.

[00017] In one embodiment, n is from about 0 to about 10. In another embodiment, n is from about 1 to about 5.

[00018] In one embodiment, the aliphatic radical may be alkyl, alkenyl or alkoxy. The aliphatic radical may be a straight or branched chain and may be substituted or unsubstituted. In one embodiment, the aliphatic group is substituted with one or more organic or inorganic radicals, such as halogen, alkyloxy, alkoxy, amino, hydroxyl, cyano and mercapto groups. In one embodiment, the halogen group may be chloro, bromo or iodo.

[00019] In another embodiment, the aliphatic group is a C1-C30 alkyl group, a C2-C30 alkenyl group or a C1-C30 alkoxy group. In one embodiment, the alkyl group may be methyl, ethyl, n-butyl, t-butyl, isopropyl, pentyl or hexyl. In another embodiment, the alkoxy group is methoxy, ethoxy or isopropoxy. In another embodiment, the alkenyl group may be ethylene, methylethylene, trimethylene, phenylethylene or propylene.

[00020] In one embodiment, the polyaliphatic amine is a polyalkyleneamine. In another embodiment, the polyalkyleneamine may be ethylenediamine,
diethylenetriamine, triethylenetetraamine, tetraethylenepentamine,
propylethylenediamine, tetrabutylenepentamine, hexaethylenoctamine,
hexapentyleneheptamine, heptaethyleneoctamine, octaethylenenonamine,
nonaethylendecamine, decaethyleneundecamine, decahexyleneundecamine,
undecaethylenododecamine, dodecaethylenetridecamine, tridecaethylenedodecamine,
dodecaethylenetriamine, tridecaethylenetetradecamine or N-tallow propylenediamine.

[00021] The scavenger composition is added to the asphalt in any conventional manner. In one embodiment, the scavenger composition is injected into the asphalt, such as via a metering pump system. The scavenger composition can be added to the asphalt in a continuous manner or can be added in one or more batch modes and repeated additions may be made.

[00022] The scavenger composition is added to the asphalt in any amount sufficient to reduce the levels of hydrogen sulfide in the asphalt. In one embodiment, the scavenger composition is added in an amount of from about 50 ppm to about 3000 ppm by weight, based on the weight of the asphalt. In another embodiment, the scavenger composition is added in an amount of from about 50 ppm by weight to about 1000 ppm by weight, based on the weight of the asphalt.

[00023] The scavenger composition significantly reduces the hydrogen sulfide levels contained in the asphalt. The actual amount of residual hydrogen sulfide will vary depending on the starting amount. In one embodiment, the hydrogen sulfide levels are reduced to 10 ppm by weight or less, based on the weight of the asphalt. In another embodiment, the hydrogen sulfide levels are reduced to 2 ppm by weight or less, based on the weight of the asphalt. In another embodiment, the hydrogen sulfide levels are reduced to less than 1 ppm by weight, based on the weight of the asphalt.
[00024] The hydrogen sulfide scavenger composition may optionally include a solvent. The solvent aids the scavenger composition in dispersing with the asphalt products. The solvent may be any solvent that is miscible with polyaliphatic amines and that has a high flashpoint. In one embodiment, the solvent has a flashpoint of at least 200°F. In one embodiment, the solvent includes, but is not limited to, propylene glycol, 1,4-butanediol, ethylene carbonate or propylene carbonate.

[00025] In one embodiment, the solvent may be added in an amount of from about 0 to about 300 percent by weight based on the weight of the polyaliphatic amine. In another embodiment, the solvent is added in an amount of from about 0 to about 150 percent by weight based on the weight of the polyaliphatic amine. In another embodiment, the solvent is added in an amount of from about 0 to about 80 percent by weight, based on the weight of the polyaliphatic amine.

[00026] In another embodiment, the hydrogen sulfide scavenger is a composition comprising a polyaliphatic amine and a catalyst. The catalyst improves the efficacy of the scavenger composition and enhances removal of hydrogen sulfide. The catalyst may be any suitable quaternary ammonium salt. In one embodiment, the catalyst has formula II:

\[ R_1R_2R_3R_4N^+X^- \quad \text{II} \]

wherein \( R_1, R_2, R_3 \) and \( R_4 \) are each independently alkyl groups having from 1 to 30 carbon atoms, hydroxyalkyl groups having from 1 to 30 carbon atoms or an aryl group having from 6 to 30 carbon atoms; and \( X \) is a halide or methyl sulfate. In one embodiment, the halide may be chloride, bromide or iodide. In another embodiment, the catalyst is alkyl benzyl ammonium chloride or benzyl cocoalkyl dimethyl quaternary ammonium chloride. In another embodiment, the catalyst includes, but is not limited to dicocodimethylammonium chloride, ditallowdimethylammonium
chloride, di(hydrogenated tallow alkyl) dimethyl quaternary ammonium methyl chloride, methyl bis (2-hydroxyethyl cocoalkyl quaternary ammonium chlorde, dimethyl(2-ethyl) tallow ammonium methyl sulfate or hydrogenated tallow alkyl (2-ethylhyexyl) dimethyl quaternary ammonium methylsulfate.

[00027] In one embodiment, a scavenger composition comprises from about 20 to about 98 percent by weight polyaliphatic amine, from about 2 to about 20 percent by weight catalyst and from 0 to about 78 percent by weight of a solvent, based on the weight of the composition. In another embodiment, the scavenger composition comprises from about 50 to about 97 percent by weight polyaliphatic amine, from about 3 to about 10 percent by weight catalyst and from 0 to about 47 percent by weight of a solvent, based on the weight of the composition.

[00028] The scavenger composition may optionally contain other compounds, such as amine dispersants, corrosion inhibitors, surfactants and the like. In one embodiment, the surfactants include anionic surfactants, nonionic surfactants or combinations thereof.

[00029] The scavenger composition may be added to the asphalt as one formulation or the polyaliphatic amine and other components may be added separately to the asphalt. Optional components, such as the catalyst, solvent or other additives may be added separately, may be combined into one formulation with the polyaliphatic amine or may be preblended with other components before adding to the asphalt. In one embodiment, the components in the scavenger composition are blended together before adding to the asphalt.

[00030] In another embodiment, a method for treating asphalt comprises adding a hydrogen sulfide scavenger composition to the asphalt products, wherein the
The document describes a hydrogen sulfide scavenger composition comprising a polyaliphatic amine having the formula:

\[ H_2NRNH-(RNH)_n \cdot H \]

wherein \( R \) is an aliphatic radical and \( n \) is from about 0 to about 15.

In one embodiment, \( n \) is from about 0 to about 10. In another embodiment, \( n \) is from about 1 to about 5.

In one embodiment, the aliphatic radical may be alkyl, alkenyl, or alkoxy. The aliphatic radical may be a straight or branched chain and may be substituted or unsubstituted. In one embodiment, the aliphatic group is substituted with one or more organic or inorganic radicals, such as halogen, alkyloxy, alkoxy, amino, hydroxyl, cyano and mercapto groups. In one embodiment, the halogen group may be chloro, bromo, or iodo.

In another embodiment, the aliphatic group is an \( \text{C}_1-\text{C}_{30} \) alkyl group, a \( \text{C}_{2}-\text{C}_{30} \) alkenyl group or a \( \text{C}_1-\text{C}_{30} \) alkoxy group. In one embodiment, the alkyl group may be methyl, ethyl, n-butyl, t-butyl, isopropyl, pentyl, or hexyl. In another embodiment, the alkoxy group is methoxy, ethoxy, or isopropoxy. In another embodiment, the alkenyl group may be ethylene, methylethylene, trimethylene, phenylethylene, or propylene.

In one embodiment, the polyaliphatic amine is a polyalkyleneamine. In another embodiment, the polyalkyleneamine may be ethylenediamine, diethylenetriamine, triethylenetetraamine, tetraethylenepentamine, propylethylenediamine, tetrabutylpentamine, hexaethyleneheptamine, hexapentyleheptamine, heptaethyleneoctamine, octaethylenonamine, nonaethylenedecamine, decaethyleneundecamine, decahexyleneundecamine.
undecaethylenedodecamine, dodecaethylenetridecamine, tridecaethylenedodecamine, dodecaethylenetriamine, tridecaethylenetetradecamine or N-tallow propylenediamine.

[00035] The hydrogen sulfide scavenger composition may optionally include a catalyst, solvent or other additive as explained above.

[00036] In another embodiment, a hydrogen sulfide scavenger composition comprises a polyaliphatic amine and a catalyst, said polyaliphatic amine having the formula I:

\[ H_2NRNH-(RNH)_n-H \]

wherein \( R \) is an aliphatic radical and \( n \) is from about 0 to about 15.

[00037] In one embodiment, \( n \) is from about 0 to about 10. In another embodiment, \( n \) is from about 1 to about 5.

[00038] In one embodiment, the aliphatic radical may be alkyl, alkenyl or alkoxy. The aliphatic radical may be a straight or branched chain and may be substituted or unsubstituted. In one embodiment, the aliphatic group is substituted with one or more organic or inorganic radicals, such as halogen, alkyloxy, alkoxy, amino, hydroxyl, cyano and mercapto groups. In one embodiment, the halogen group may be chloro, bromo or iodo.

[00039] In another embodiment, the aliphatic group is a \( \text{C}_1-\text{C}_{30} \) alkyl group, a \( \text{C}_2-\text{C}_{30} \) alkenyl group or a \( \text{C}_1-\text{C}_{30} \) alkoxy group. In one embodiment, the alkyl group may be methyl, ethyl, n-butyl, t-butyl, isopropyl, pentyl or hexyl. In another embodiment, the alkoxy group is methoxy, ethoxy or isopropoxy. In another embodiment, the alkenyl group may be ethylen, methylethylene, trimethylene, phenylethylene or propylene.
In one embodiment, the polyaliphatic amine is a polyalkyleneamine. In another embodiment, the polyalkyleneamine may be ethylenediamine, diethylenetriamine, triethylenetetraamine, tetraethylenepentamine, propylethlenediamine, tetrabutylenepentamine, hexaethylenheptamine, hexapentylenheptamine, heptaethylenoctamine, octaethylenenonamine, nonaethylenedecamine, decaethyleneundecamine, decahexylenundecamine, undecaethylenedodecamine, dodecaethylenetridecamine, tridecaethylenedodecamine, dodecaethylenetriamine, tridecaethylenetetradecamine or N-tallow propylenediamine.

In order that those skilled in the art will be better able to practice the present disclosure, the following examples are given by way of illustration and not by way of limitation.

EXAMPLES

EXAMPLE 1

Sample 1 was prepared by dispersing 51 mg of diethylenetriamine in 34 mg propylene glycol. Sample 2 was prepared by dispersing 51 mg of diethylenetriamine and 3 mg of alkyl benzyl ammonium chloride (ARQUAD DMCB-80 from Akzo-Nobel) in 34 mg propylene glycol. Sample 1 was added to 578 g of an asphalt (from Conoco Phillips, West Lake, LA refinery) containing over 350 ppm hydrogen sulfide. Sample 2 was added to 821 g of the asphalt. The concentration of the hydrogen sulfide in the vapor phase was determined at frequent intervals as shown in Figure 1. The data scatter can be attributed to a +/- 15% error in determining $H_2S$ vapor concentrations.
Figure 1 shows that samples 1 and 2 reduce and control the hydrogen sulfide content in the asphalt. The addition of the catalyst (alkyl benzyl ammonium chloride) significantly increases the efficacy of the scavenger composition. Sample 2 effectively controls the hydrogen sulfide level in 42% more asphalt.

EXAMPLE 2

A control sample A was prepared by dispersing 51 mg of 1,3,5-trimethylhexahydro-1,3,5-triazine in 34 mg propylene glycol. A control sample B was prepared by dispersing 51 mg of MA-triazine and 3 mg of alkyl benzyl ammonium chloride (ARQUAD DMCB-80 from Akzo-Nobel) in 34 mg propylene glycol. Control sample A was added to 578 g of an asphalt (from Conoco Phillips, West Lake, LA refinery) containing over 350 ppm hydrogen sulfide. Control sample B was added to 821 g of the asphalt. The concentration of the hydrogen sulfide in the vapor phase was determined at frequent intervals as shown in Figure 2. The data scatter can be attributed to a +/- 15% error in determining $\text{H}_2\text{S}$ vapor concentrations.

Figure 2 shows that the catalyst (ARQUAD DMCB-80) has no impact on the efficacy of hydrogen sulfide scavenging when using an organic-based MA-Triazine. The data in Figure 2 also shows that the overall scavenging of the control samples is not as effective as the scavenging for samples 1 and 2 in Figure 1.

While typical embodiments have been set forth for the purpose of illustration, the foregoing descriptions should not be deemed to be a limitation on the scope herein. Accordingly, various modifications, adaptations and alternatives may occur to one skilled in the art without departing from the spirit and scope herein.
WHAT IS CLAIMED IS:

1. A method for reducing hydrogen sulfide in asphalt, comprising adding a hydrogen sulfide scavenger composition to the asphalt, wherein the hydrogen sulfide scavenger comprises a polyaliphatic amine having formula I:

   \[ \text{H}_2\text{NRN}-\text{(RNH)}_n\text{-H} \quad \text{I} \]

   wherein R is an aliphatic radical and n is from about 0 to about 15.

2. The method of claim 1, wherein the aliphatic radical is a C1-C30 alkyl, C2-C30 alkenyl or C1-C30 alkoxy.

3. The method of claim 1, wherein the polyaliphatic amine is a polyalkyleneamine.

4. The method of claim 3, wherein the polyalkyleneamine is selected from the group consisting of ethylenediamine, diethylenetriamine, triethylenetetraamine, tetraethylenepentamine, propylethylenediamine, tetrabutylenepentamine, hexaethylenheptamine, hexapentyleneheptamine, heptaethylenoctamine, octaethylenonamine, nonaethylenedecamine, decaethylenundecamine, decahexyleneundecamine, undecaethylenedodecamine, dodecaethylenetridecamine, tridecaethylenedodecamine, dodecaethylenetetradecamine, tridecaethylenetetradecamine and N-tallow propylenediamine.

5. The method of claim 1, wherein the scavenger composition is added in an amount of from about 50 ppm to about 3000 ppm by weight, based on the weight of the asphalt.
6. The method of claim 1, wherein the hydrogen sulfide scavenger composition further comprises a solvent.

7. The method of claim 1, wherein the hydrogen sulfide scavenger composition further comprises a catalyst.

8. The method of claim 7, wherein the catalyst has formula II:

\[ R_1R_2R_3R_4N^+X^- \]  

wherein \( R_1, R_2, R_3 \) and \( R_4 \) are each independently alkyl groups having from 1 to 20 carbon atoms, hydroxyalkyl groups having from 1 to 20 carbon atoms or an aryl group having from 6 to 20 carbon atoms; and \( X \) is a halide or methyl sulfate.

9. The method of claim 8, wherein the catalyst is selected from the group consisting of dicocodimethylammonium chloride, ditallowdimethylammonium chloride, di(hydrogenated tallow alkyl) dimethyl quaternary ammonium methyl chloride, methyl bis (2-hydroxyethyl cocoalkyl quaternary ammonium chloride, dimethyl(2-ethyl) tallow ammonium methyl sulfate and hydrogenated tallow alkyl (2-ethylhydroxyethyl) dimethyl quaternary ammonium methylsulfate.

10. The method of claim 7, wherein the scavenger composition comprises from about 20 to about 98 percent by weight polyaliphatic amine, from about 2 to about 20 percent by weight catalyst and from 0 to about 78 percent by weight of a solvent, based on the weight of the composition.

11. A method for treating asphalt comprising adding a hydrogen sulfide scavenger composition to the asphalt products, wherein the hydrogen sulfide scavenger composition comprises a polyaliphatic amine having the formula I:

\[ H_2NRNH-(RNH)_n^-H \]  

wherein \( R \) is an aliphatic radical and \( n \) is from about 0 to about 15.
12. The method of claim 11, wherein the aliphatic radical is a C1-C30 alkyl, C2-C30 alkenyl or C1-C30 alkoxy.

13. The method of claim 11, wherein the polyaliphatic amine is a polyalkyleneamine.

14. The method of claim 13, wherein the polyalkyleneamine is selected from the group consisting of ethylenediamine, diethylenetriamine, triethylenetetraamine, tetraethylenepentamine, propylethlenediamine, tetrabutylenepentamine, hexaethyleneheptamine, hexapentyleneheptamine, heptaethylenooctamine, octaethylenenonamine, nonaethylenedecamine, decaethylenundecamine, decahexylenundecamine, undecaethylenedodecamine, dodecaethylenetridecamine, tridecaethylenedodecamine, dodecaethylenetriamine, tridecaethylenetetradecamine and N-tallow propylenediamine.

15. The method of claim 11, wherein the scavenger composition is added in an amount of from about 50 ppm to about 3000 ppm by weight, based on the weight of the asphalt.

16. The method of claim 11, wherein the hydrogen sulfide scavenger composition further comprises a solvent.

17. The method of claim 11, wherein the hydrogen sulfide scavenger composition further comprises a catalyst.

18. The method of claim 17, wherein the catalyst has formula II:

\[ R_1R_2R_3R_4N^+X^- \quad \text{II} \]

wherein \( R_1, R_2, R_3 \) and \( R_4 \) are each independently alkyl groups having from 1 to 30 carbon atoms, hydroxyalkyl groups having from 1 to 30 carbon atoms or an aryl group having from 6 to 30 carbon atoms; and \( X \) is a halide or methyl sulfate.
19. The method of claim 18, wherein the catalyst is selected from the group consisting of dicocodimethylammonium chloride, ditallowdimethylammonium chloride, di(hydrogenated tallow alkyl) dimethyl quaternary ammonium methyl chloride, methyl bis (2-hydroxyethyl cocoalkyl quaternary ammonium chloride, dimethyl(2-ethyl) tallow ammonium methyl sulfate and hydrogenated tallow alkyl (2-ethylhyexyl) dimethyl quaternary ammonium methylsulfate.

20. The method of claim 17, wherein the scavenger composition comprises from about 20 to about 98 percent by weight polyaliphatic amine, from about 2 to about 20 percent by weight catalyst and from 0 to about 78 percent by weight of a solvent, based on the weight of the composition.

21. A hydrogen sulfide scavenger composition comprising a polyaliphatic amine and a catalyst, said polyaliphatic amine having the formula I:

\[ \text{H}_2\text{NRNH-(RNH)}_n \text{H} \]

wherein \( R \) is an aliphatic radical and \( n \) is from about 0 to about 15.

22. The scavenger composition of claim 21, wherein the aliphatic radical is a \( \text{C}_1\text{-C}_{30} \) alkyl, \( \text{C}_2\text{-C}_{30} \) alkenyl or \( \text{C}_1\text{-C}_{30} \) alkoxy.

23. The scavenger composition of claim 21, wherein the polyaliphatic amine is a polyalkyleneamine.

24. The scavenger composition of claim 23, wherein the polyalkyleneamine is selected from the group consisting of ethylenediamine, diethylenetriamine, triethylenetetraamine, tetaethylenepentamine, propylethylenediamine, tetrabutylenepentamine, hexaethyleneheptamine, hexapentyleneheptamine, heptaethylenoctamine, octaethylenonamine, nonaethylenedecamine, decaethylenoundecamine, decahexylenoundecamine, undecaethylenedodecamine,
dodecaethylenetridecamine, tridecaethylenedodecamine, dodecaethylenetriamine, tridecaethylenetetradecamine and N-tallow propylenediamine.

25. The scavenger composition of claim 21, wherein the catalyst has formula II:

\[ R_1R_2R_3R_4N^+X^- \quad \text{II} \]

wherein \( R_1, R_2, R_3 \) and \( R_4 \) are each independently alkyl groups having from 1 to 30 carbon atoms, hydroxyalkyl groups having from 1 to 30 carbon atoms or an aryl group having from 6 to 30 carbon atoms; and \( X \) is a halide or methyl sulfate.

26. The scavenger composition of claim 25, wherein the catalyst is selected from the group consisting of dicocodimethylammonium chloride, ditallowdimethylammonium chloride, di(hydrogenated tallow alkyl) dimethyl quaternary ammonium methyl chloride, methyl bis (2-hydroxyethyl cocalkyl quaternary ammonium chloride, dimethyl(2-ethyl) tallow ammonium methyl sulfate and hydrogenated tallow alkyl (2-ethylhyexyl) dimethyl quaternary ammonium methylsulfate.

27. The scavenger composition of claim 21, wherein the composition further comprises a solvent.

28. The scavenger composition of claim 27, wherein the scavenger composition comprises from about 20 to about 98 percent by weight polyaliphatic amine, from about 2 to about 20 percent by weight catalyst and from 0 to about 78 percent by weight of a solvent, based on the weight of the composition.

29. The method of claim 7 wherein the polyaliphatic amine is diethylene triamine and the catalyst is alkyl benzyl ammonium chloride.

30. The method of claim 29 wherein the scavenger composition further comprises a solvent having a flashpoint of at least about 200°F.
Figure 1

![Bar chart showing concentration of H_2S (ppm) over time (min) for Sample 1 and Sample 2.]

Figure 2

![Bar chart showing concentration of H_2S (ppm) over time (min) for Control Sample A and Control Sample B.]

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2009/033995

A. CLASSIFICATION OF SUBJECT MATTER

According to International Patent Classification (IPC) into both national classification and IPC:

INV.  C08K5/17

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by clarification symbols):

C08K  C08L  ClOL

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched:

Electronic data base consulted during the international search (name of data base and where practical search terms used):

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Further documents are listed in the continuation of Box C

See patent family annex

Date of the actual completion of the international search
11 May 2009

Date of mailing of the international search report
19/05/2009

Name and mailing address of the ISA/
European Patent Office, P B 5818 Patententaal 2
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Russel, Graham

Form PCT/ISA/210 (second sheet) (April 2005)
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