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(54) **DEVELOPMENT OF ADDITIVE FOR MITIGATING AMMONIUM CHLORIDE CORROSION ISSUES IN HYDROTREATER**

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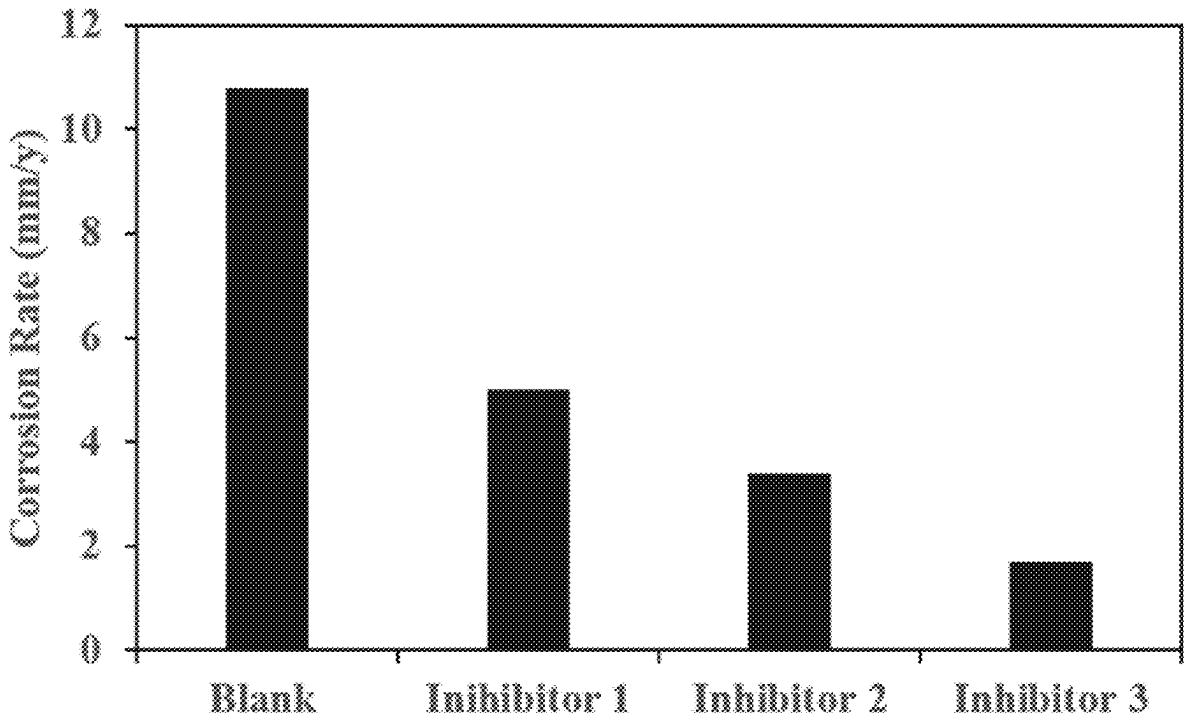
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(57) **ABSTRACT**

A composition for mitigating corrosion due to ammonium chloride salt, said composition includes (a) 1.0 wt. % to 15 wt. % of an aliphatic amine selected from the group consisting of hydroxy (C<sub>1</sub> to C<sub>10</sub> alkyl)amines, amino (C<sub>1</sub> to C<sub>10</sub> alkyl)amines, (C<sub>1</sub> to C<sub>10</sub> alkyl)amines substituted with the group amino (C<sub>1</sub> to C<sub>10</sub> alkyl)amino, (C<sub>1</sub> to C<sub>10</sub> alkyl)amines substituted with the group N,N-di(C<sub>1</sub> to C<sub>4</sub> alkyl)amino, phenyl (C<sub>1</sub> to C<sub>10</sub> alkyl)amines and heterocyclic substituted (C<sub>1</sub> to C<sub>10</sub> alkyl)amines; (b) 1.0 wt. % to 10.0 wt. % of an antioxidant; (c) 1.0 wt. % to 10.0 wt. % of a neutralizer and/or pH adjusting agent; and (d) rest being a solvent, wherein the wt. % is based on the total weight of the composition. Teachings include composition for mitigating corrosion (a) due to ammonium chloride salt and (b) adding the composition in an ammonium chloride salt environment or in a reactor effluent air cooler unit in hydroprocessing unit.



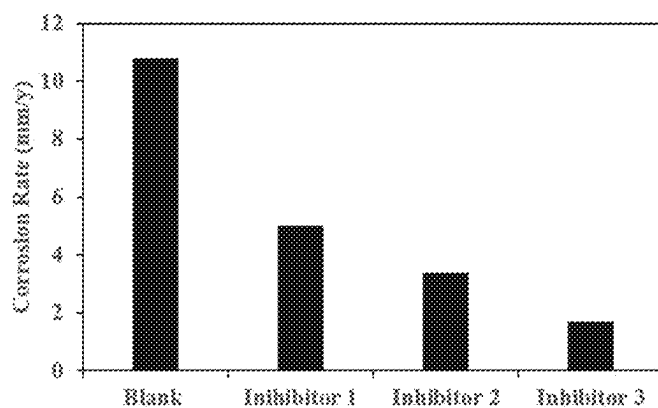


Figure 1

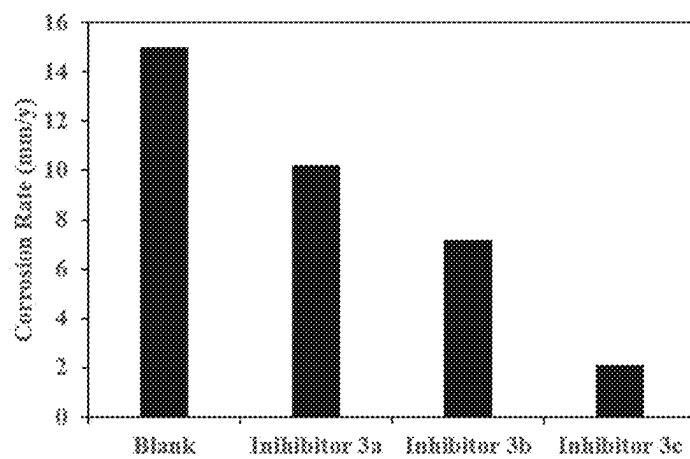


Figure 2

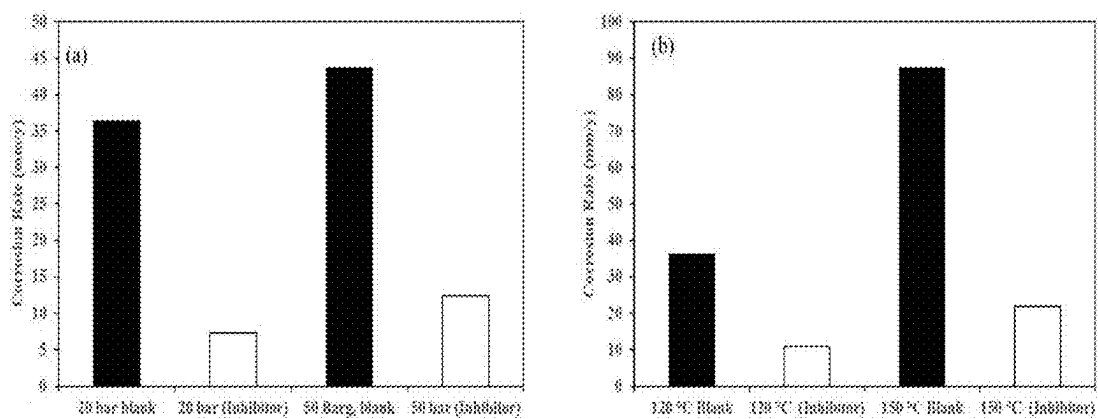


Figure 3

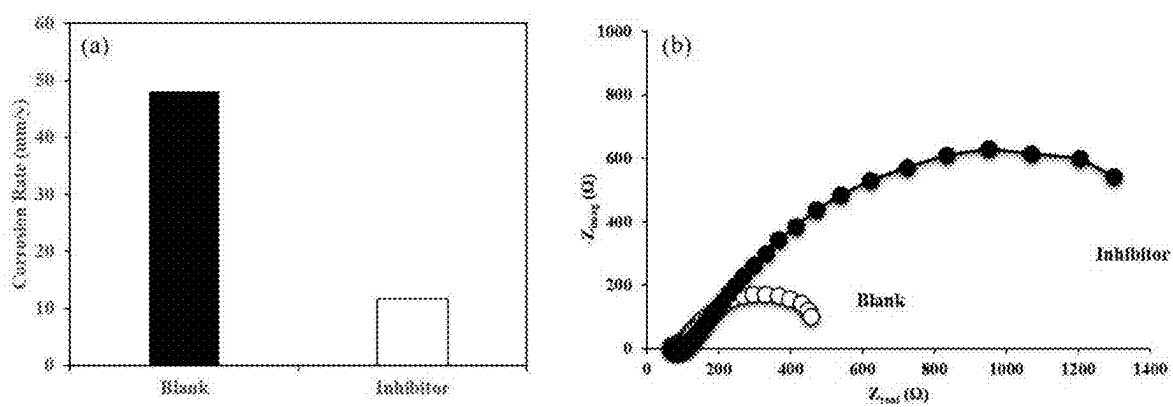


Figure 4

## DEVELOPMENT OF ADDITIVE FOR MITIGATING AMMONIUM CHLORIDE CORROSION ISSUES IN HYDROTREATER

### CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims priority to Indian Patent Application number 202441008683 filed on Feb. 8, 2024, the entire contents of which are incorporated by reference herein.

### FIELD OF INVENTION

[0002] The present invention relates to a composition for mitigating corrosion due to ammonium chloride salt. In particular, the present invention relates to mitigating corrosion due to ammonium chloride salt in a reactor effluent air cooler unit in a hydroprocessing unit.

### BACKGROUND OF THE INVENTION

[0003] Background description includes information that may be useful in understanding the present invention. It is not an admission that any of the information provided herein is prior art or relevant to the presently claimed invention, or that any publication specifically or implicitly referenced is prior art.

[0004] Hydroprocessing is a refining process employed in the petroleum industry to treat hydrocarbon feedstocks for the production of refined products. Hydroprocessing involves the use of hydrogen and catalysts under elevated temperature and pressure conditions to effect various chemical reactions and transformations. The hydroprocessing process encompasses a range of refining operations, including but not limited to hydrocracking, hydrotreating, and hydrodesulfurization. These operations aim to upgrade the quality of the feedstock by removing impurities, such as sulfur, nitrogen, oxygen, metals, and unsaturated compounds, while enhancing desirable product properties, such as cetane number, octane number, and stability.

[0005] During hydroprocessing, the hydrocarbon feedstock is subjected to hydrogenation reactions, where hydrogen is selectively added to unsaturated bonds and reactive sites within the molecules. This hydrogenation process facilitates the removal or transformation of undesirable components, such as sulfur compounds, nitrogen compounds, and olefins, resulting in cleaner and higher-quality products.

[0006] Hydroprocessing is typically carried out in reaction vessels or units, such as hydrocrackers, hydrotreaters, or hydrodesulfurization units, equipped with suitable catalysts and process conditions to optimize the desired reactions. REAC unit is an essential unit of hydroprocessing, particularly hydrocracking and hydrotreating. REAC refers to Reactor Effluent Air Cooler unit. The primary purpose of a REAC unit is to cool the hot effluent that emerges from the reactor after the hydroprocessing reactions have taken place. The effluent, consisting of a mixture of hydrocarbons, hydrogen, and reaction products, typically exits the reactor at high temperatures and pressures. The REAC unit plays a critical role in the overall process by efficiently cooling the effluent to a temperature suitable for downstream separation and further processing steps. It accomplishes this through

the use of air coolers or heat exchangers, where the hot effluent exchanges heat with ambient air or a cooling medium.

[0007] The presence of impurities in the feedstock for hydroprocessing unit result in formation of various unwanted byproducts. Impurities such as  $H_2S$ ,  $NH_3$ , and  $HCl$  are a major contributor towards these byproducts. While operating a hydroprocessing unit containing these impurities, formation of ammonium chloride and ammonium bisulfide is inevitable. In fact, both ammonium chloride and ammonium bisulfide condense as solids from vapor phase and cause blockage of the flow path. To solubilize the blockage, water wash is introduced. Unfortunately, the resulting aqueous solution is extremely corrosive unless substantially diluted and is in fact the cause of corrosion problems in the REAC units.

[0008] The severity and extent of ammonium chloride corrosion depends on various factors, such as concentration of ammonium chloride, temperature, moisture levels, exposure time, and the specific materials of construction. To mitigate the risk of ammonium chloride corrosion, various strategies have been employed. Proper feedstock treatment, such as removal of ammonia and hydrochloric acid contaminants, can minimize the formation of ammonium chloride. Choosing corrosion resistant material, such as stainless steel or alloyed steels with higher resistance to chloride induced corrosion, can minimize the susceptibility to ammonium chloride corrosion. Maintaining appropriate operating conditions, including controlling temperature and minimizing the presence of moisture or water vapor, can help reduce the likelihood and severity of ammonium chloride corrosion. Additionally, there have been several modifications in the REAC unit itself to minimize the effects of ammonium chloride corrosion.

[0009] Apart from the aforementioned strategies, corrosion inhibitors may also be employed. The use of corrosion inhibitors can help protect susceptible materials by forming a protective film on the metal surface, reducing the corrosive attack by ammonium chloride and other corrosive species. However, this has not been explored to a larger extent due to the challenges associated thereto. Generally, corrosion inhibitors are mixture of various ingredients in specific amounts or ratios. Owing to the prevalent pressure and temperature conditions in the REAC unit, it becomes a challenge for these formulations to remain stable, thereby resulting in an inefficient mitigation of the corrosive effects of ammonium chloride. More often, the efficiency is increased by selecting premium ingredients, which results in the formulation being expensive. Furthermore, it is always possible that these ingredients alter the properties of hydrocarbons being carried in the REAC unit.

[0010] On the design aspect, since the REAC unit has several dead areas, bends, and low flow areas, corrosion due to acidic under-deposit is inevitable. Water washing the infected areas is an immediate solution. However, the results in formation of highly concentrated and viscous salt solution. Additionally, the excessive use of wash water results in carry over of these solutions to preheat exchangers, which needs treatment separately.

[0011] Overall, the existing solutions in the state-of-the-art do not provide for a long-lasting and cost-effective solution without compromising the operation of a hydroprocessing unit, particularly the REAC unit.

[0012] In view of the aforementioned challenges, there is a need in the art for an improved composition for mitigating corrosion due to ammonium chloride salt, which alleviates, at least in part, one or more disadvantages or shortcomings of conventional formulations.

#### OBJECTS OF THE INVENTION

[0013] The primary objective of the present invention is to provide a composition for mitigating corrosion due to ammonium chloride salt in a hydroprocessing unit, particularly in a REAC unit.

[0014] Another objective of the present invention is to provide a composition which requires minimum dosing and yet results in excellent corrosion resistance.

[0015] Still another object of the present invention is to provide a composition with zero or acceptable miscibility with the hydrocarbons and which does not alter the properties and/or performance of the hydroprocessing unit.

[0016] Yet another object of the present invention is to provide a process for production of a composition that is facile, economical and industrially applicable.

[0017] Still further object of the present invention is to provide a method for mitigating corrosion due to ammonium chloride salt environment or in a REAC unit that enhances the life of the treated surface without compromising its mechanical properties.

#### SUMMARY

[0018] This summary is provided to introduce a selection of concepts in a simplified form that are further described below in Detailed Description section. This summary is not intended to identify key features or essential features of the claimed subject matter, nor is it intended to be used as an aid in determining the scope of the claimed subject matter.

[0019] An aspect of the present disclosure is to provide a composition for mitigating corrosion due to ammonium chloride salt. The composition comprises:

[0020] (a) 1.0 wt. % to 15 wt. % of an aliphatic amine selected from the group consisting of hydroxy ( $C_1$  to  $C_{10}$  alkyl)amines, amino ( $C_1$  to  $C_{10}$  alkyl)amines, ( $C_1$  to  $C_{10}$  alkyl)amines substituted with the group amino ( $C_1$  to  $C_{10}$  alkyl)amino, ( $C_1$  to  $C_{10}$  alkyl)amines substituted with the group N,N-di( $C_1$  to  $C_4$  alkyl) amino, phenyl ( $C_1$  to  $C_{10}$  alkyl)amines and heterocyclic substituted ( $C_1$  to  $C_{10}$  alkyl)amines;

[0021] (b) 1.0 wt. % to 10.0 wt. % of an antioxidant;

[0022] (c) 1.0 wt. % to 10.0 wt. % of a neutralizer and/or pH adjusting agent; and

[0023] (d) rest being a solvent,

[0024] wherein the wt. % is based on the total weight of the composition.

[0025] Another aspect of the present invention relates to a process for preparing a composition for mitigating corrosion due to ammonium chloride salt comprising: i) mixing of 1.0 wt. % to 15 wt. % of an aliphatic amine selected from the group consisting of hydroxy ( $C_1$  to  $C_{10}$  alkyl)amines, amino ( $C_1$  to  $C_{10}$  alkyl)amines, ( $C_1$  to  $C_{10}$  alkyl)amines substituted with the group amino ( $C_1$  to  $C_{10}$  alkyl)amino, ( $C_1$  to  $C_{10}$  alkyl)amines substituted with the group N,N-di( $C_1$  to  $C_4$  alkyl)amino, phenyl ( $C_1$  to  $C_{10}$  alkyl)amines and heterocyclic substituted ( $C_1$  to  $C_{10}$  alkyl)amines in a solvent to obtain a first mixture; ii) adding 1.0 wt. % to 10.0 wt. % of an antioxidant to the first mixture to obtain a second mixture;

and iii) adding 1.0 wt. % to 10.0 wt. % of a neutralizer and/or pH adjusting agent to the second mixture to obtain a composition for mitigating corrosion due to ammonium chloride salt.

[0026] Still another aspect of the present invention relates to a method for mitigating corrosion. The method comprises adding the above composition in an ammonium chloride salt environment or in a reactor effluent air cooler unit in a hydroprocessing unit.

[0027] Yet another aspect of the present invention relates to the use of the above composition as a corrosion inhibitor in an ammonium chloride salt environment or in a reactor effluent air cooler unit in a hydroprocessing unit.

[0028] Various objects, features, aspects and advantages of the present disclosure will become more apparent from the following detailed description of preferred embodiments, along with the accompanying drawing figures in which like numerals represent like features.

#### BRIEF DESCRIPTION OF THE DRAWINGS

[0029] The accompanying drawing(s) are included to provide a further understanding of the present disclosure and are incorporated in and constitute a part of this specification. The drawings illustrate exemplary embodiments of the present disclosure and, together with the description, serve to explain the principles of the present disclosure. The diagrams are for illustration only, which thus is not a limitation of the present disclosure.

[0030] FIG. 1 illustrates a pictorial representation of the corrosion rate using hot air oven test of carbon steel in  $NH_4Cl$  medium and with different additive formulations.

[0031] FIG. 2 illustrates a pictorial representation of the corrosion rate using dynamic wheel test of carbon steel in  $NH_4Cl$  medium and with different additive formulations.

[0032] FIG. 3 illustrates (a) Pictorial representation of the corrosion rate at 20 & 50 bar pressure, (b) 120 & 150° C. temperature carbon steel in  $NH_4Cl$  medium.

[0033] FIG. 4 illustrates (a) Corrosion rate and (b) Electrochemical impedance spectrum of carbon steel exposed in autoclave in Diesel+ $NH_4Cl$  medium (2 wt %) at 150° C. and 50 bar in the presence and absence of inhibitor.

#### DETAILED DESCRIPTION OF THE INVENTION

[0034] The following is a detailed description of embodiments of the disclosure. The embodiments are in such detail as to clearly communicate the disclosure. However, the amount of detail offered is not intended to limit the anticipated variations of embodiments; on the contrary, the intention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the present disclosure as defined by the appended claims.

[0035] All publications herein are incorporated by reference to the same extent as if each individual publication or patent application were specifically and individually indicated to be incorporated by reference. Where a definition or use of a term in an incorporated reference is inconsistent or contrary to the definition of that term provided herein, the definition of that term provided herein applies and the definition of that term in the reference does not apply.

[0036] Reference throughout this specification to “one embodiment” or “an embodiment” means that a particular feature, structure or characteristic described in connection

with the embodiment is included in at least one embodiment. Thus, the appearances of the phrases “in one embodiment” or “in an embodiment” in various places throughout this specification are not necessarily all referring to the same embodiment. Furthermore, the particular features, structures, or characteristics may be combined in any suitable manner in one or more embodiments.

**[0037]** In some embodiments, numbers have been used for quantifying weights, percentages, ratios, and so forth, to describe and claim certain embodiments of the invention and are to be understood as being modified in some instances by the term “about.” Accordingly, in some embodiments, the numerical parameters set forth in the written description and attached claims are approximations that can vary depending upon the desired properties sought to be obtained by a particular embodiment. In some embodiments, the numerical parameters should be construed in light of the number of reported significant digits and by applying ordinary rounding techniques. Notwithstanding that the numerical ranges and parameters setting forth the broad scope of some embodiments of the invention are approximations, the numerical values set forth in the specific examples are reported as precisely as practicable.

**[0038]** The numerical values presented in some embodiments of the invention may contain certain errors necessarily resulting from the standard deviation found in their respective testing measurements.

**[0039]** Unless the context requires otherwise, throughout the specification which follows, the word “comprise” and variations thereof, such as “comprises” and “comprising” are to be construed in an open, inclusive sense that is as “including, but not limited to.”

**[0040]** As used in the description herein and throughout the claims that follow, the meaning of “a,” “an,” and “the” includes plural reference unless the context clearly dictates otherwise. Also, as used in the description herein, the meaning of “in” includes “in” and “on” unless the context clearly dictates otherwise.

**[0041]** The recitation of ranges of values herein is merely intended to serve as a shorthand method of referring individually to each value falling within the range. Unless otherwise indicated herein, each individual value is incorporated into the specification as if it were individually recited herein. Furthermore, the ranges defined throughout the specification include the end values as well, i.e., a range of 1 to 10 implies that both 1 and 10 are included in the range. For the avoidance of doubt, the applicant shall be entitled to any equivalents according to applicable law.

**[0042]** All methods described herein can be performed in a suitable order unless otherwise indicated herein or otherwise clearly contradicted by context. The use of any and all examples or exemplary language (e.g., “such as”) provided with respect to certain embodiments herein is intended merely to better illuminate the invention and does not pose a limitation on the scope of the invention otherwise claimed. No language in the specification should be construed as indicating any non-claimed element essential to the practice of the invention.

**[0043]** Groupings of alternative elements or embodiments of the invention disclosed herein are not to be construed as limitations. Each group member can be referred to and claimed individually or in any combination with other members of the group or other elements found herein. One or more members of a group can be included in, or deleted

from, a group for reasons of convenience and/or patentability. When any such inclusion or deletion occurs, the specification is herein deemed to contain the group as modified.

**[0044]** The description that follows, and the embodiments described therein, is provided by way of illustration of an example, or examples, of particular embodiments of the principles and aspects of the present disclosure. These examples are provided for the purposes of explanation, and not of limitation, of those principles and of the disclosure.

**[0045]** It should also be appreciated that the present disclosure can be implemented in numerous ways, including as a system, a method or a device. In this specification, these implementations, or any other form that the invention may take, may be referred to as processes. In general, the order of the steps of the disclosed processes may be altered within the scope of the invention.

**[0046]** The headings and abstract of the invention provided herein are for convenience only and do not interpret the scope or meaning of the embodiments.

**[0047]** The following discussion provides many example embodiments of the inventive subject matter. Although each embodiment represents a single combination of inventive elements, the inventive subject matter is considered to include all possible combinations of the disclosed elements. Thus, if one embodiment comprises elements A, B, and C, and a second embodiment comprises elements B and D, then the inventive subject matter is also considered to include other remaining combinations of A, B, C, or D, even if not explicitly disclosed.

**[0048]** Various terms are used herein to the extent a term used is not defined below, it should be given the broadest definition persons in the pertinent art have given that term as reflected in printed publications and issued patents at the time of filing.

**[0049]** In the present context, a “hydroprocessing unit” refers to a system or facility utilized in the petroleum refining industry for the treatment and conversion of hydrocarbon feedstocks. The hydroprocessing unit encompasses various processing steps and equipment aimed at improving the quality, stability, and value of the feedstock, including but not limited to hydrocracking, hydrotreating, and hydrodesulfurization processes. A typical hydroprocessing unit encompasses various auxiliary components and systems, including heat exchangers, separators, fractionation columns, compressors, and pumps, among others. These components are strategically integrated to facilitate the necessary process conditions, separation of reaction products, and the recycling of hydrogen gas.

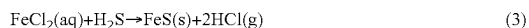
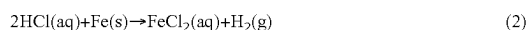
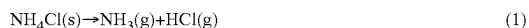
**[0050]** As described herein, a “REAC unit” refers to the Reactor Effluent Air Cooler unit, which forms an integral part of the overall system. Typically, a REAC unit includes several heat exchangers to facilitate the heat transfer process. These heat exchangers are designed to efficiently transfer the heat from hot effluent stream to a cooling medium, such as air or water, by maximizing the surface area for heat exchange. Various types of heat exchangers, including shell and tube, plate and frame, or finned tube designs may be employed depending on the specific application and process requirements.

**[0051]** The REAC unit in hydroprocessing operates by cooling the hot effluent stream that exits the reactor after hydroprocessing reactions. The hot effluent, consisting of hydrocarbons, hydrogen, and reaction products, enters the REAC unit through inlet lines. Inside the REAC unit, the hot

effluent undergoes a heat exchange process with a cooling medium, typically air or water. Cooling fans or blowers facilitate the airflow over heat exchanger surfaces, effectively transferring heat from the effluent to the cooling medium. As a result, the temperature of the effluent decreases, and the cooled effluent exits the REAC unit through outlet lines. The cooled effluent is then ready for further downstream processing and separation.

**[0052]** Presence of impurities in the feedstock for hydroprocessing unit results in formation of various unwanted byproducts. Impurities such as  $H_2S$ ,  $NH_3$ , and  $HCl$  are a major contributor towards these byproducts. While operating a hydroprocessing unit containing these impurities, formation of ammonium chloride and ammonium bisulfide is inevitable. In fact, both ammonium chloride and ammonium bisulfide condense as solids from vapor phase and cause blockage of the flow path. To solubilize the blockage, water wash is introduced. Unfortunately, the resulting aqueous solution is extremely corrosive unless substantially diluted and is in fact the cause of corrosion problems in the REAC units.

**[0053]** The primary concern for corrosion is with ammonium chloride ( $NH_4Cl$ ) salts. Typical site locations concerned with ammonium chloride salt corrosion include upstream and downstream of water injection point upstream of the REAC unit.  $NH_3$  and  $HCl$  enter the hydroprocessing unit through feedstock. The formation of ammonium chloride is dependent on temperature, concentration of  $HCl$ , and concentration of  $NH_3$ . Ammonium chloride issues are often missed because evidence may come in the form of iron sulphide ( $FeS$ ) deposited in the equipment.  $FeS$ , in turn, may actually come from wet  $NH_4Cl$  under deposit corrosion via the reaction scheme shown below:



**[0054]** As the partial pressures of  $NH_3$  and  $HCl$  increase and temperature decreases, the potential for ammonium chloride fouling increases. Under-deposit pitting corrosion is predominantly caused by ammonium chloride salt, due to its hygroscopic nature. Chloride ions react with iron to form iron chloride which results in severe localized corrosion. Refineries sometimes face the problem of amine chloride salt formation ( $RNH_3Cl$ ) due to overdosing of amine to meet the pH of overhead condensed water, thereby resulting in localized under-deposit corrosion. An insufficient or poorly designed wash water system can lead to increased corrosion. Dead areas, bends, and low flow areas are particularly prone to acidic under-deposit corrosion if the wash water is not sufficient. However, this leads to the formation of highly concentrated thick and viscous salt solutions. Additionally, the excessive use of wash water might cause water carry over and deposition of salts at preheat exchangers. Hence, it becomes necessary to employ better mitigation strategy which is cost-effective, reliable, and which requires minimum dosing and yet results in excellent corrosion resistance. Further, it is also important that the composition has zero or acceptable miscibility with the hydrocarbons without altering the properties and/or performance of the hydroprocessing unit.

**[0055]** The present invention provides a solution which meets the aforementioned objectives and is capable of

mitigating the corrosion issues prevalent in an ammonium chloride salt environment, commonly found in hydroprocessing units. Accordingly, an aspect of the present disclosure relates to a composition for mitigating corrosion due to ammonium chloride salt.

**[0056]** An embodiment of the present disclosure provides a composition for mitigating corrosion due to ammonium chloride salt, said composition comprising: (a) 1.0 wt. % to 15 wt. % of an aliphatic amine selected from the group consisting of hydroxy ( $C_1$  to  $C_{10}$  alkyl)amines, amino ( $C_1$  to  $C_{10}$  alkyl)amines, ( $C_1$  to  $C_{10}$  alkyl)amines substituted with the group amino ( $C_1$  to  $C_{10}$  alkyl)amino, ( $C_1$  to  $C_{10}$  alkyl)amines substituted with the group  $N,N$ -di( $C_1$  to  $C_4$  alkyl)amino, phenyl ( $C_1$  to  $C_{10}$  alkyl)amines and heterocyclic substituted ( $C_1$  to  $C_{10}$  alkyl)amines; (b) 1.0 wt. % to 10.0 wt. % of an antioxidant; (c) 1.0 wt. % to 10.0 wt. % of a neutralizer and/or pH adjusting agent; and (d) rest being a solvent, wherein the wt. % is based on the total weight of the composition.

**[0057]** In an embodiment, the composition comprises aliphatic amines. The aliphatic amines provide a strong and sturdy passive film over salt deposition sites to prevent metal dissolution due to higher concentrations of ammonium chloride. The salt deposition sites are local areas in the REAC unit or hydroprocessing unit wherein ammonium chloride salt has deposited over a period of time. The presence of aliphatic amine results in erosion/erosion-corrosion in gas-solid phase and liquid-solid phase. Suitable aliphatic amines are selected from the group consisting of hydroxy ( $C_1$  to  $C_{10}$  alkyl)amines, amino ( $C_1$  to  $C_{10}$  alkyl)amines, ( $C_1$  to  $C_{10}$  alkyl)amines substituted with the group amino ( $C_1$  to  $C_{10}$  alkyl)amino, ( $C_1$  to  $C_{10}$  alkyl)amines substituted with the group  $N,N$ -di( $C_1$  to  $C_4$  alkyl)amino, phenyl ( $C_1$  to  $C_{10}$  alkyl)amines and heterocyclic substituted ( $C_1$  to  $C_{10}$  alkyl)amines.

**[0058]** Examples of preferred substituted aliphatic amines include: hydroxy ( $C_1$  to  $C_{10}$  alkyl)amines such as ethanolamine and 3-hydroxypropylamine; amino ( $C_1$  to  $C_{10}$  alkyl)amine such as aminoethylamine; ( $C_1$  to  $C_{10}$  alkyl)amines substituted with the group amino ( $C_1$  to  $C_{10}$  alkyl)amino-such as diethylenetriamine, triethanolamine, triethylenetetramine, tetraethylenepentamine, isopropylamine; ( $C_1$  to  $C_{10}$  alkyl)amine substituted with the group  $N,N$ -di( $C_1$  to  $C_4$  alkyl)amino such as dimethylaminopropylamine; phenyl ( $C_1$  to  $C_{10}$  alkyl)amines such as benzylamine.

**[0059]** In a preferred embodiment, the aliphatic amine is ( $C_1$  to  $C_{10}$  alkyl)amines substituted with the group amino ( $C_1$  to  $C_{10}$  alkyl)amino. The ( $C_1$  to  $C_{10}$  alkyl)amines substituted with the group amino ( $C_1$  to  $C_{10}$  alkyl)amino is selected from a group consisting of diethylenetriamine, triethanolamine, triethylenetetramine, tetraethylenepentamine, isopropylamine and combination thereof. Preferably, ( $C_1$  to  $C_{10}$  alkyl)amines substituted with the group amino ( $C_1$  to  $C_{10}$  alkyl)amino is diethylenetriamine.

**[0060]** In another embodiment, the aliphatic amine is a substituted aliphatic amine is selected from the group consisting of ethanolamine, 3-hydroxypropylamine, aminoethylamine, diethylenetriamine, dimethylaminopropylamine, and benzylamine. Preferably, the aliphatic amine is diethylenetriamine.

**[0061]** In an embodiment, the aliphatic amine is added in an amount ranging between 1.0 wt. % to 12 wt. %, or 2.0 wt. % to 12 wt. %, or 2.0 wt. % to 10 wt. %. In another

embodiment, the amount ranges between 3.0 wt. % to 10 wt. %, or 3.0 wt. % to 8.0 wt. %.

**[0062]** Accordingly, in an embodiment, the composition comprises:

**[0063]** (a) 3.0 wt. % to 8.0 wt. % of ( $C_1$  to  $C_{10}$  alkyl)amines substituted with the group amino ( $C_1$  to  $C_{10}$  alkyl)amino;

**[0064]** (b) 1.0 wt. % to 10.0 wt. % of the antioxidant;

**[0065]** (c) 1.0 wt. % to 10.0 wt. % of the neutralizer and/or pH adjusting agent; and

**[0066]** (d) rest being a solvent.

**[0067]** In another embodiment, the composition comprises:

**[0068]** (a) 3.0 wt. % to 8.0 wt. % of substituted aliphatic amine selected from the group consisting of ethanolamine, 3-hydroxypropylamine, aminoethylamine, diethylenetriamine, dimethylaminopropylamine, and benzylamine;

**[0069]** (b) 1.0 wt. % to 10.0 wt. % of the antioxidant;

**[0070]** (c) 1.0 wt. % to 10.0 wt. % of the neutralizer and/or pH adjusting agent; and

**[0071]** (d) rest being a solvent.

**[0072]** Antioxidants provide resistance to inevitable oxidation reaction. In a typical operating scenario, the salt deposition site is first washed with wash water and/or the composition is mixed with water and fed to the site. The use of wash water at the prevalent conditions lead to inevitable oxidation reactions. In order to suppress these oxidation reactions, it is essential that antioxidants be added. Accordingly, the composition comprises 1.0 wt. % to 10.0 wt. % of antioxidant.

**[0073]** In an embodiment, the antioxidant is selected from the group consisting of isosorbide dimethyl ether, ascorbic acid, 2'-methylenebis-(4-methyl-6-tert-butylphenol), thiodipropionic acid didodecyl ester, and sodium nitrite and combination thereof. In a preferred embodiment, the antioxidant is selected from the group consisting of isosorbide dimethyl ether, ascorbic acid, and 2'-methylenebis-(4-methyl-6-tert-butylphenol). In a more preferred embodiment, the antioxidant is ascorbic acid.

**[0074]** In an embodiment, the antioxidant is added in an amount ranging between 1.0 wt. % to 9.0 wt. %, or 2.0 wt. % to 9.0 wt. %, or 2.0 wt. % to 8.0 wt. %. In another embodiment, the antioxidant is added in amounts ranging between 2.0 wt. % to 7.0 wt. %, or 2.0 wt. % to 6.0 wt. %.

**[0075]** Accordingly, in an embodiment the composition comprises:

**[0076]** (a) 1.0 wt. % to 15 wt. % of an aliphatic amine selected from the group consisting of hydroxy ( $C_1$  to  $C_{10}$  alkyl)amines, amino ( $C_1$  to  $C_{10}$  alkyl)amines, ( $C_1$  to  $C_{10}$  alkyl)amines substituted with the group amino ( $C_1$  to  $C_{10}$  alkyl)amino, ( $C_1$  to  $C_{10}$  alkyl)amines substituted with the group N,N-di( $C_1$  to  $C_4$  alkyl)amino, phenyl ( $C_1$  to  $C_{10}$  alkyl)amines and heterocyclic substituted ( $C_1$  to  $C_{10}$  alkyl) amines;

**[0077]** (b) 2.0 wt. % to 6.0 wt. % of ascorbic acid;

**[0078]** (c) 1.0 wt. % to 10.0 wt. % of the neutralizer and/or pH adjusting agent; and

**[0079]** (d) rest being a solvent.

**[0080]** Neutralizer and/or pH adjusting agent, as the name suggests, regulate the pH of the blend with wash water. Since ammonium chloride salt formation makes the medium acidic in nature, it is essential that suitable amounts of the neutralizer and/or pH adjusting agents be added.

**[0081]** In an embodiment, the neutralizer and/or pH adjusting agent is selected from the group consisting of triethanolamine, aminomethyl propanol, ammonium hydroxide, sodium hydroxide, other alkali hydroxides, borates, phosphates, pyrophosphates, cocamine, oleamine, diisopropanolamine, diisopropylamine, dodecylamine, PEG-15 cocamine, morpholine, tetrakis(hydroxypropyl)ethylenediamine, triamylamine, triethanolamine, triethylamine, and tromethamine 2-amino-2-(hydroxymethyl)-1,3-propanediol and combination thereof.

**[0082]** In another embodiment, the neutralizer and/or pH adjusting agent is selected from the group consisting of triethanolamine, aminomethyl propanol, ammonium hydroxide, sodium hydroxide, other alkali hydroxides, borates, phosphates, pyrophosphates, cocamine, oleamine, diisopropanolamine, diisopropylamine, dodecylamine, PEG-15 cocamine, morpholine, and tetrakis(hydroxypropyl)ethylenediamine.

**[0083]** In still another embodiment, the neutralizer and/or pH adjusting agent is selected from the group consisting of borates, phosphates, pyrophosphates, cocamine, oleamine, diisopropanolamine, diisopropylamine, dodecylamine, PEG-15 cocamine, morpholine, and tetrakis(hydroxypropyl)ethylenediamine.

**[0084]** In yet another embodiment, the neutralizer and/or pH adjusting agent is selected from the group consisting of dodecylamine, PEG-15 cocamine, morpholine, and tetrakis(hydroxypropyl)ethylenediamine. Preferably, the neutralizer and/or pH adjusting agent is morpholine.

**[0085]** In an embodiment, the neutralizer and/or pH adjusting agent is added in an amount ranging between 1.0 wt. % to 9.0 wt. %, or 2.0 wt. % to 9.0 wt. %, or 2.0 wt. % to 8.0 wt. %. In another embodiment, the antioxidant is added in amounts ranging between 2.0 wt. % to 7.0 wt. %, or 2.0 wt. % to 6.0 wt. %.

**[0086]** Accordingly, in an embodiment the composition comprises:

**[0087]** (a) 1.0 wt. % to 15 wt. % of an aliphatic amine selected from the group consisting of hydroxy ( $C_1$  to  $C_{10}$  alkyl)amines, amino ( $C_1$  to  $C_{10}$  alkyl)amines, ( $C_1$  to  $C_{10}$  alkyl)amines substituted with the group amino ( $C_1$  to  $C_{10}$  alkyl)amino, ( $C_1$  to  $C_{10}$  alkyl)amines substituted with the group N,N-di( $C_1$  to  $C_4$  alkyl)amino, phenyl ( $C_1$  to  $C_{10}$  alkyl)amines and heterocyclic substituted ( $C_1$  to  $C_{10}$  alkyl) amines;

**[0088]** (b) 1.0 wt. % to 10.0 wt. % of the antioxidant;

**[0089]** (c) 2.0 wt. % to 6.0 wt. % of morpholine; and

**[0090]** (d) rest being a polar solvent in which ingredients are dissolved.

**[0091]** In an embodiment, the solvent is selected from a group consisting of polar solvent, hydrocarbon solvent and combination thereof. In some embodiment, the polar solvent is selected from the group consisting of acetone, methanol, ethanol, ethylacetate, butanol, isopropyl alcohol, methyl ethyl ketone, and mixtures thereof. In another embodiment, the hydrocarbon-based solvent is selected from a group consisting of kerosene, toluene, xylene, hexane, petroleum ether, heptane, and combinations thereof.

**[0092]** Another aspect of the present disclosure relates to a process for preparing the above composition. Accordingly, the embodiments described hereinabove in respect of the composition are applicable here as well.

**[0093]** In an embodiment, the process for preparing a composition for mitigating corrosion due to ammonium



chloride salt comprising: i) mixing of 1.0 wt. % to 15 wt. % of an aliphatic amine selected from the group consisting of hydroxy ( $C_1$  to  $C_{10}$  alkyl)amines, amino ( $C_1$  to  $C_{10}$  alkyl) amines, ( $C_1$  to  $C_{10}$  alkyl)amines substituted with the group amino ( $C_1$  to  $C_{10}$  alkyl)amino, ( $C_1$  to  $C_{10}$  alkyl)amines substituted with the group N,N-di( $C_1$  to  $C_4$  alkyl)amino, phenyl ( $C_1$  to  $C_{10}$  alkyl)amines and heterocyclic substituted ( $C_1$  to  $C_{10}$  alkyl)amines in a solvent to obtain a first mixture; ii) adding 1.0 wt. % to 10.0 wt. % of an antioxidant to the first mixture to obtain a second mixture; and iii) adding 1.0 wt. % to 10.0 wt. % of a neutralizer and/or pH adjusting agent to the second mixture to obtain a composition for mitigating corrosion due to ammonium chloride salt.

**[0094]** In the present context, the term “mixing” refers to the process of combining the ingredients of the composition to achieve a homogenous or uniform mixture. The term “mixing” is used interchangeably with the term “stirring” in the context of this specification. Further, the “mixing” process as defined herein may involve the use of mixing equipment, such as mixers, blenders, agitators, or other similar apparatuses, which facilitate the efficient and effective blending or dispersion of the ingredients. These mixing techniques can be conducted under specific conditions, such as temperature, pressure, or time, as necessary for achieving the desired homogeneity and consistency of the mixture.

**[0095]** In an embodiment, the condition includes temperature in the range of 10 to 40° C. for a period in the range of 10 to 40 minutes at a stirring speed in the range of 20 to 100 rpm.

**[0096]** Yet another embodiment of the present disclosure relates to a method for mitigating corrosion by adding the above composition in an ammonium chloride salt environment or in a REAC unit in hydroprocessing unit. Accordingly, the embodiments described hereinabove in respect of the composition are applicable here as well.

**[0097]** In an embodiment, the composition is mixed along with wash water and flushed in the environment wherein ammonium salts have accumulated or are likely to accumulate. Suitable examples of such environments include hydroprocessing units, particularly diesel hydrotreater units (DHT), diesel hydrodesulfurization units (DHDS), diesel isotherming units (DIU), and ISOM hydrotreater units. The REAC circuits or units in each of the aforementioned hydroprocessing units is also prone to accumulation of ammonium salts, thereby increasing the maintenance frequency and associated costs.

**[0098]** Still further aspect of the present invention relates to the use of the above composition as a corrosion inhibitor in an ammonium chloride salt environment or in REAC unit in a hydroprocessing unit. Accordingly, the embodiments described hereinabove in respect of the composition are applicable here as well.

**[0099]** While the present invention formulation is used along with wash water and flushed in the affected environment, it is also possible that the formulation be employed as a coating on a surface of the affected hydroprocessing unit or REAC unit. In such embodiment, the coating may be applied as a single-layer or multi-layer on the surface, and may optionally include addition layers of other ingredients as well.

**[0100]** The present invention composition has been found to be effective in mitigating corrosion due to ammonium chloride salts. Since the composition can be mixed with wash water and flushed in the system, the efficacy and extent

of corrosion inhibition in difficult areas such as dead areas, bends, and low flow areas has been found to be higher than the existing solutions. Moreover, the composition prevents or minimizes corrosion due to acidic under-deposit in the affected areas. Furthermore, since the composition has excellent corrosion resistance, requires minimum dosage levels, and is miscible with wash water, it finds application in treating the REAC unit, thereby increasing the life of the unit and costs associated thereto.

**[0101]** To summarize, the composition provides for the following advantages:

**[0102]** Effective mitigating of corrosion due to ammonium chloride salts, particularly in REAC units

**[0103]** Due to the inventive selection of readily available ingredients, the affected surface does not require substantial pre-treatment or modification before application of the composition. The composition does not employ any ingredient that might release harmful substances or volatile organic compounds (VOCs) during application, thereby ensuring worker safety as well as environmental protection.

**[0104]** Cost effectiveness of the composition ensures that the REAC unit is washed frequently or at regular intervals, thereby enhancing the life of the equipment.

**[0105]** Since there is no requirement of specific techniques to prepare or apply, the composition is easy to use and economical.

**[0106]** The mechanical properties of the affected surface remain intact despite frequent washing with the composition.

**[0107]** While the foregoing describes various embodiments of the disclosure, other and further embodiments of the disclosure may be devised without departing from the basic scope thereof. The invention is not limited to the described embodiments, versions or examples, which are included to enable a person having ordinary skill in the art to make and use the invention when combined with information and knowledge available to the person skilled in the art.

#### Examples

**[0108]** The present invention is further explained in the form of following examples. However, it is to be understood that the following examples are merely illustrative and are not to be taken as limitations upon the scope of the invention.

#### General Method of Preparation of Composition

**[0109]** The amount of ingredients for the preparation of compositions as mentioned in Table 1 and Table 2. The aliphatic amine was mixed with a solvent to obtain a first mixture followed by addition of antioxidant to obtain a second mixture. A neutralizer and/or pH adjusting agent was added in the second mixture to obtain the composition for mitigating corrosion due to ammonium chloride salt. The process was carried out at temperature in the range of 10 to 40° C. for a period in the range of 10 to 40 minutes at a stirring speed in the range of 20 to 100 rpm.

#### Performance Evaluation of the Composition

**[0110]** The performance evaluation of the inhibitor was tested through three different exposure conditions. The formulations were optimized using static, dynamic and high

temperature-high pressure rotating cage set ups using Hot air oven test, Dynamic Wheel tests and Rotating cage autoclaves. The formulation which passed in the static condition with comparatively lower corrosion rates was considered for dynamic wheel test where the solution was in continuous rotating condition. Finally, the formulation which passed the dynamic wheel test was analyzed in auto clave in high temperature and pressure, which replicates the conditions of different reactor effluent air fin coolers in the Hydrotreaters.

#### Hot Air Oven Test

[0111] The carbon steel coupons were mechanically polished using different grades of sand paper and sonicated using ethanol, acetone and water. After measuring the initial weight of the coupons, it was dipped in the solution (5 wt %  $\text{NH}_4\text{Cl}$ ) and the studies were carried out in the hot air oven. Hot air oven test was performed in Carbolite hot air oven at  $120^\circ\text{C}$ . for 3 days. After the test completion, samples were taken out and cleaned. The change in weight was converted to the corrosion rate. The experimental values of the corrosion rate were calculated based on the weight loss measured during the experiment using the carbon steel. The composition of inhibitor 1, inhibitor 2 and inhibitor 3 are given in Table 1.

TABLE 1

Initial Composition of Inhibitor 1, Inhibitor 2 and Inhibitor 3.				
Inhibitors	aliphatic amine %	Antioxidant %	Neutralizer and/or pH adjusting agent %	Solvent %
1	0.1-0.5 wt %	0.2-0.8 wt %	0.1-0.7 wt %	99.6-98%
2	0.1-0.5 wt %	0.1-0.7 wt %	0.2-0.8 wt %	99.6-98%
3	0.1-0.5 wt %	0.3-0.9 wt %	0.3-0.9 wt %	99.3-97.7%

[0112] The bars in FIG. 1 showed that the corrosion rate was lower in the Inhibitors having aliphatic amine, antioxidant and neutralizer and/or pH adjusting agent as compared to blank. These were the initial screening results. The formulation with lower corrosion rates which were further considered for the next set of studies. The best formulation of this oven test was further modified for the next set of studies i.e. wheel test and autoclave studies.

#### Dynamic Wheel Test Apparatus

[0113] The wheel test is a dynamic test performed by hanging the carbon steel in a 250 ml bottle filled with a corrosive medium (2 wt %  $\text{NH}_4\text{Cl}$ ). The bottle with ammonium chloride solution was heated at  $120^\circ\text{C}$ . for three days continuously. At the end of this time, the metal test specimen was removed and cleaned and the weight loss was measured. The same procedure was followed and repeated for the inhibitor with different concentration. The formulations which were able to pass the oven test have been used in the dynamic wheel test for further evaluation. The composition of Inhibitor 3a, Inhibitor 3b and Inhibitor 3c are given in Table 2. FIG. 2 represents the corrosion rate using Inhibitor 3a, Inhibitor 3b and Inhibitor 3c. FIG. 2 showed that the corrosion rate was lower in Inhibitor 3a, Inhibitor 3b and Inhibitor 3c as compared to blank. Inhibitor 3c showed least corrosion rate.

TABLE 2

Composition of Inhibitor 3a, Inhibitor 3b and Inhibitor 3c of the present disclosure.				
Inhibitors	aliphatic amine %	Antioxidant %	Neutralizer and/or pH adjusting agent %	Solvent %
3a	2-6 wt %	3-9 wt %	2-8 wt %	77-93%
3b	3-6 wt %	3-9 wt %	2-8 wt %	77-92%
3c	4-8 wt %	3-9 wt %	2-8 wt %	75-91%

#### High Temperature and Pressure Reactor (Autoclave Test)

[0114] To study the temperature and pressure effect of the formulated corrosion inhibitor, PARR autoclave was used. Herein metal samples (carbon steel) were placed in the sample cage (holder). In all autoclave experiments, three coupons were used and the average values of the weight loss was used for calculating the corrosion rate. The sample cage was immersed in the corrosive  $\text{NH}_4\text{Cl}$  medium in the absence and presence of inhibitor. The desired temperature was set using heating controller and the required pressure was set up by nitrogen purging. After the test was completed, the samples were taken out and cleaned in Clarke's solution. The weight loss of the samples was found out from the difference between the initial and final weight of the sample. The formulation which provides the least corrosion rate (Inhibitor 3c) was used for further optimization. FIG. 3 represents the experimental corrosion rate of at different pressure and the observed and corrosion rate.

#### Effect of Pressure and Temperature

[0115] The final formulation (Inhibitor 3c) was subjected to temperature and pressure study using 2 wt %  $\text{NH}_4\text{Cl}$  solution. The effect of pressure was evaluated at two different pressures, i.e., low (20 bar) and high (50 bar) pressure at  $120^\circ\text{C}$ . The experimental corrosion rate values are illustrated in FIG. 3 (a). 20 bar pressure conditions represent the ISOM Naphtha Hydrotreaters whereas 50 bar pressures can be considered as the representative condition for Diesel Hydrotreaters. Higher pressure shows higher corrosion rate values. On the other hand, the inhibitor provided better protection to metal from dissolution with 80% efficiency towards corrosion protection at 20 bar pressure and 72% efficiency for 50 bar pressures.

[0116] Similarly, the effect of temperature was studied at constant pressure (50 bar) in the autoclave. The histograms of corrosion rate at  $120$  and  $150^\circ\text{C}$ . is shown in FIG. 3 (b). The increase in temperature causes rapid increase in the corrosion rate, however, using the formulation along with wash water brings down the corrosion rate values even at higher temperature conditions. The formulation provides passivation over the metal surfaces which contribute in metal protection in high temperature and pressure. The formulation shows 73% increase in the corrosion mitigation efficiency at  $120^\circ\text{C}$ . and 75% increase at  $150^\circ\text{C}$ .

#### Effectiveness of the Additive in the REAC Operating Conditions

[0117] The REAC circuit in DHT unit was represented by immersing the coupons in a medium consisting of wash

water injection and 2 wt %  $\text{NH}_4\text{Cl}$  solution. The operating conditions were 50 bar pressures and 150° C. temperature (representative operating conditions in a typical refinery). Here the blank solution histogram represents the 2 wt %  $\text{NH}_4\text{Cl}$  corrosion with wash water injection and inhibitor shows the corrosion rate in 2 wt %  $\text{NH}_4\text{Cl}$  corrosion with wash water injection along with the inhibitor. For crudes with higher amounts of nitrogen and chlorine, the formulation of the present disclosure can be used for preventing the ammonium chloride salt deposition and improve asset integrity.

#### Electrochemical Impedance Spectroscopy (EIS) (ASTM G106)

**[0118]** To understand the nature of the film on corrosion coupons with the inhibitor, electrochemical characterization was performed. The observed impedance spectroscopy values for the (blank medium) without inhibitor and with the inhibitor 3c. This sample was analyzed to find the electrochemical behavior and its properties in 2 wt %  $\text{NH}_4\text{Cl}$  medium. Impedance study was carried out at 100 kHz to 0.01 Hz at room temperature with 10 mV AC perturbation. The electrolyte medium used for the measurements were 2 wt %  $\text{NH}_4\text{Cl}$  solution, with autoclave coupons as working electrode, Ag/AgCl as reference electrode and Pt as the working electrode. The value of the charge transfer resistance ( $R_{ct}$ ) is calculated from the electrical equivalent circuit fitting (EEC). Higher charge transfer resistance indicates higher corrosion rate.

**[0119]** The  $R_{ct}$  values observed for the sample which was dipped in inhibitor medium was higher, which shows higher corrosion resistance due to the presence of inhibitor. This infers that the present formulation is effective in mitigating corrosion in the  $\text{NH}_4\text{Cl}$  solution.

Field Condition: Diesel+2 wt %  $\text{NH}_4\text{Cl}$   
Medium+Wash Water

**[0120]** In order to simulate the exact REAC circuit in DHT unit along with wash water practice, an experiment was designed by immersing the coupons in the medium consisting of diesel, wash water injection and 2 wt %  $\text{NH}_4\text{Cl}$  solution. The operating conditions were 50 bar pressure and 150° C. temperature. Inhibited medium showed the corrosion rate in 2 wt %  $\text{NH}_4\text{Cl}$  corrosion with wash water injection+diesel and additive formulation FIG. 4 (a). The additive formulation (Inhibitor 3c) shows 75.75% increase in corrosion mitigation, compared to the case where only wash water was being used. The electrochemical impedance spectra shown in FIG. 4 (b) shows considerable increase in the charge transfer resistance by 74.3%. Results of both these tests indicate increased corrosion prevention due to the formulation. The corrosion rate and impedance study is shown in FIGS. 4 (a) and (b) and parameters are tabulated in Table 3 below.

TABLE 3

Electrochemical parameter values from EIS		
Parameters (Technique)	Blank solution	Inhibited solution ( $\Omega\text{cm}^2$ )
Solution Resistance, $R_{sof}$ (EIS)	784.90	107.6
Charge Transfer Resistance, $R_{ct}$ (EIS)	503.9	1960
Polarization Resistance ( $R_p$ ) (EIS)	25.82	841.4

#### Synergistic Effect

**[0121]** The inhibitors were designed as per the weight percentage of the ingredient mentioned in the Table 4. Formula A, Formula B, Formula C and Formula D were prepared by mixing of ingredients as mentioned in Table 1 and rest being a solvent. The corrosion rate of these Formulas as shown in Table 4. The Formula B showed lesser corrosion rate of the metal in highly aggressive medium as compared to Formula A, Formula C and Formula D. The corrosion rate of Formula B showed synergistic effect.

TABLE 4

Corrosion rate and ingredients of the different formulas A, B, C and D.		
Formula	Ingredients (wt %)	Corrosion rate (mm/y)
Formula A	Amine-0.1-0.5 wt % Neutralizer- 0.1-0.7 wt %	9.47
Formula B	Amine- 1-15 wt % Neutralizer-1-10 wt % Anti-Oxidant- 1-10 wt %	4.78
Formula C	Amine-0.1-0.5 wt % Anti-Oxidant-0.2-0.8 wt %	8.25
Formula D	Neutralizer-0.1-0.7 wt % Anti-Oxidant-0.2-0.8 wt %	11.84

**[0122]** The foregoing examples are merely illustrative and are not to be taken as limitations upon the scope of the invention. Various changes and modifications to the disclosed embodiments will be apparent to those skilled in the art. Such changes and modifications may be made without departing from the scope of the invention.

We claim:

1. A composition for mitigating corrosion due to ammonium chloride salt, said composition comprising:

- 1.0 wt. % to 15 wt. % of an aliphatic amine selected from the group consisting of hydroxy ( $\text{C}_1$  to  $\text{C}_{10}$  alkyl) amines, amino ( $\text{C}_1$  to  $\text{C}_{10}$  alkyl)amines, ( $\text{C}_1$  to  $\text{C}_{10}$  alkyl)amines substituted with the group amino ( $\text{C}_1$  to  $\text{C}_{10}$  alkyl)amino, ( $\text{C}_1$  to  $\text{C}_{10}$  alkyl)amines substituted with the group  $\text{N,N-di}(\text{C}_1$  to  $\text{C}_4$  alkyl)amino, phenyl ( $\text{C}_1$  to  $\text{C}_{10}$  alkyl)amines and heterocyclic substituted ( $\text{C}_1$  to  $\text{C}_{10}$  alkyl)amines;
- 1.0 wt. % to 10.0 wt. % of an antioxidant;
- 1.0 wt. % to 10.0 wt. % of a neutralizer and/or pH adjusting agent; and
- rest being a solvent,

wherein the wt. % is based on the total weight of the composition.

2. The composition as claimed in claim 1, wherein the aliphatic amine is ( $\text{C}_1$  to  $\text{C}_{10}$  alkyl)amines substituted with the group amino ( $\text{C}_1$  to  $\text{C}_{10}$  alkyl)amino.

3. The composition as claimed in claim 2, wherein the ( $\text{C}_1$  to  $\text{C}_{10}$  alkyl)amines substituted with the group amino ( $\text{C}_1$  to  $\text{C}_{10}$  alkyl)amino is selected from a group consisting of diethylenetriamine, triethanolamine, triethylenetetramine, tetraethylenepentamine, isopropylamine and combination thereof.

4. The composition as claimed in claim 1, wherein the antioxidant is selected from the group consisting of isosorbide dimethyl ether, ascorbic acid, 2'-methylenebis-(4-methyl-6-tert-butylphenol), thiopropionic acid didodecyl ester, sodium nitrite and combination thereof.

**5.** The composition as claimed in claim **1**, wherein the neutralizer and/or pH adjusting agent is selected from the group consisting of triethanolamine, aminomethyl propanol, ammonium hydroxide, sodium hydroxide, other alkali hydroxides, borates, phosphates, pyrophosphates, cocamine, oleamine, diisopropanolamine, diisopropylamine, dodecylamine, PEG-15 cocamine, morpholine, tetrakis(hydroxypropyl)ethylenediamine, triamylamine, triethanolamine, triethylamine, tromethamine 2-amino-2-(hydroxymethyl)-1,3-propanediol and combination thereof.

**6.** The composition as claimed in claim **1**, wherein the solvent is selected from a group consisting of polar solvent, hydrocarbon solvent and combination thereof.

**7.** A process for preparing a composition for mitigating corrosion due to ammonium chloride salt comprising:

- i) mixing of 1.0 wt. % to 15 wt. % of an aliphatic amine selected from the group consisting of hydroxy ( $C_1$  to  $C_{10}$  alkyl)amines, amino ( $C_1$  to  $C_{10}$  alkyl)amines, ( $C_1$  to  $C_{10}$  alkyl)amines substituted with the group amino ( $C_1$  to  $C_{10}$  alkyl)amino, ( $C_1$  to  $C_{10}$  alkyl)amines substituted with the group N,N-di( $C_1$  to  $C_4$  alkyl)amino, phenyl ( $C_1$  to  $C_{10}$  alkyl)amines and heterocyclic substituted ( $C_1$  to  $C_{10}$  alkyl)amines in a solvent to obtain a first mixture;
- ii) adding 1.0 wt. % to 10.0 wt. % of an antioxidant to the first mixture to obtain a second mixture; and
- iii) adding 1.0 wt. % to 10.0 wt. % of a neutralizer and/or pH adjusting agent to the second mixture to obtain a composition for mitigating corrosion due to ammonium chloride salt.

**8.** The process as claimed in claim **7**, wherein the condition includes temperature in the range of 10 to 40° C. for a period in the range of 10 to 40 minutes at a stirring speed in the range of 20 to 100 rpm.

**9.** A method for mitigating corrosion by adding the composition as claimed in claim **1** in an ammonium chloride salt environment or in a reactor effluent air cooler unit in a hydroprocessing unit.

**10.** The method as claimed in claim **9**, wherein the condition includes temperature in the range of 80 to 150° C. at a pressure in the range of 10 to 100 bar.

**11.** A method for mitigating corrosion by adding the composition as claimed in claim **2** in an ammonium chloride salt environment or in a reactor effluent air cooler unit in a hydroprocessing unit.

**12.** A method for mitigating corrosion by adding the composition as claimed in claim **3** in an ammonium chloride salt environment or in a reactor effluent air cooler unit in a hydroprocessing unit.

**13.** A method for mitigating corrosion by adding the composition as claimed in claim **4** in an ammonium chloride salt environment or in a reactor effluent air cooler unit in a hydroprocessing unit.

**14.** A method for mitigating corrosion by adding the composition as claimed in claim **5** in an ammonium chloride salt environment or in a reactor effluent air cooler unit in a hydroprocessing unit.

**15.** A method for mitigating corrosion by adding the composition as claimed in claim **6** in an ammonium chloride salt environment or in a reactor effluent air cooler unit in a hydroprocessing unit.

**16.** A method for mitigating corrosion by adding the composition as claimed in as obtained according to the process claimed in claim **7**, in an ammonium chloride salt environment or in a reactor effluent air cooler unit in a hydroprocessing unit.

**17.** The method as claimed in claim **16**, wherein the condition includes temperature in the range of 80 to 150° C. at a pressure in the range of 10 to 100 bar.

**18.** Use of a composition comprising:

- (a) 1.0 wt. % to 15 wt. % of an aliphatic amine selected from the group consisting of hydroxy ( $C_1$  to  $C_{10}$  alkyl)amines, amino ( $C_1$  to  $C_{10}$  alkyl)amines, ( $C_1$  to  $C_{10}$  alkyl)amines substituted with the group amino ( $C_1$  to  $C_{10}$  alkyl)amino, ( $C_1$  to  $C_{10}$  alkyl)amines substituted with the group N,N-di( $C_1$  to  $C_4$  alkyl)amino, phenyl ( $C_1$  to  $C_{10}$  alkyl)amines and heterocyclic substituted ( $C_1$  to  $C_{10}$  alkyl)amines;
- (b) 1.0 wt. % to 10.0 wt. % of an antioxidant;
- (c) 1.0 wt. % to 10.0 wt. % of a neutralizer and/or pH adjusting agent; and
- (d) rest being a solvent,

the wt. % is based on the total weight of the composition, as a corrosion inhibitor in an ammonium chloride salt environment or in reactor effluent air cooler unit in a hydroprocessing unit.

\* \* \* \* \*