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(54) Titre : COMPOSITIONS D'ACIDE SYNTHETIQUE DE REMPLACEMENT DES ACIDES CONVENTIONNELS
DESTINEES A L'INDUSTRIE DU PETROLE ET DU GAZ

(54) Title: SYNTHETIC ACID COMPOSITIONS ALTERNATIVES TO CONVENTIONAL ACIDS FOR USE IN THE OIL
AND GAS INDUSTRY

(57) **Abrégé/Abstract:**

A synthetic acid composition for use in oil industry activities, said composition comprising: urea and hydrogen chloride in a molar ratio of not less than 0.1:1 and formic acid or a derivative thereof.



ABSTRACT

A synthetic acid composition for use in oil industry activities, said composition comprising: urea and hydrogen chloride in a molar ratio of not less than 0.1:1 and formic acid or a derivative thereof.

**SYNTHETIC ACID COMPOSITIONS ALTERNATIVES
TO CONVENTIONAL ACIDS FOR USE
IN THE OIL AND GAS INDUSTRY**

5 **FIELD OF THE INVENTION**

This invention relates to compositions for use in performing various applications in the oil & gas industry, more specifically to synthetic acid compositions as alternatives to conventional acids.

10 **BACKGROUND OF THE INVENTION**

In the oil & gas industry, stimulation with an acid is performed on a well to increase or restore production. In some instances, a well initially exhibits low permeability, and stimulation is employed to commence production from the reservoir. In other instances, stimulation is used to
15 further encourage permeability and flow from an already existing well that has become under-productive.

Acidizing is a type of stimulation treatment which is performed above or below the reservoir fracture pressure in an effort to restore or increase the natural permeability of the reservoir rock.
20 Acidizing is typically achieved by pumping acid into the well to dissolve limestone, dolomite and calcite cement between the sediment grains of the reservoir rocks.

There are three major types of acid applications: matrix acidizing, fracture acidizing, and breakdown acidizing (pumped prior to a fracturing pad or cement operation in order to assist with
25 formation breakdown (reduce fracture pressures, increased feed rates), as well as clean up left over cement in the well bore or perforations. A matrix acid treatment is performed when acid is pumped into the well and into the pores of the reservoir formation below the fracture pressure. In this form of acidization, the acids dissolve the sediments and mud solids that are inhibiting the permeability of the rock, enlarging the natural pores of the reservoir (wormholing) and stimulating flow of
30 hydrocarbons. While matrix acidizing is done at a low enough pressure to keep from fracturing the reservoir rock, fracture acidizing involves pumping highly pressurized acid into the well, physically fracturing the reservoir rock and etching the permeability inhibitive sediments. This type of acid treatment forms channels or fractures through which the hydrocarbons can flow, in addition to forming a series of wormholes.

There are many different mineral and organic acids used to perform an acid treatment on wells. The most common type of acid employed on wells to stimulate production is hydrochloric acid (HCl), which is useful in stimulating carbonate reservoirs.

- 5 Some of the major challenges faced in the oil & gas industry from using hydrochloric acid include the following: extremely high levels of corrosion (which is countered by the addition of 'filming' type corrosion inhibitors that are typically themselves toxic and harmful to humans, the environment and equipment) reactions between acids and various types of metals can vary greatly but softer metals, such as aluminum and magnesium, are very susceptible to major effects causing
- 10 immediate damage. Hydrochloric acid produces Hydrogen chloride gas which is toxic (potentially fatal) and corrosive to skin, eyes and metals. At levels above 50 ppm (parts per million) it can be Immediately Dangerous to Life and Health (IDLH). At levels from 1300-2000 ppm death can occur in 2-3 minutes.
- 15 The inherent environmental effects (organic sterility, poisoning of wildlife etc.) of acids in the event of an unintended or accidental release on surface or downhole into water aquifers or other sources of water are devastating which can cause significant pH reduction of such and can substantially increase the toxicity and could potentially cause a mass culling of aquatic species and potential poisoning of humans or livestock and wildlife exposed to/or drinking the water. An unintended
- 20 release at surface can also cause a hydrogen chloride gas cloud to be released, potentially endangering human and animal health. This is a common event at large storage sites when tanks split or leak. Typically if near the public, large areas need to be evacuated post event. Because of its acidic nature, hydrogen chloride gas is also corrosive, particularly in the presence of moisture.
- 25 The inability for acids and blends of such to biodegrade naturally without neutralizing the soil results in expensive cleanup-reclamation costs for the operator should an unintended release occur. Moreover, the toxic fumes produced by mineral & organic acids are harmful to humans/animals and are highly corrosive/flammable and/or potentially explosive. Transportation and storage requirements for acids are restrictive and taxing in such that you must haul the products in acid
- 30 approved tankers or intermediate bulk containers (IBC) that are rated to handle such corrosive

products. As well, the dangers surrounding exposure by personnel handling the blending of such corrosive/dangerous products limits their use/implementation.

5 Another concern is the potential for exposure incidents on locations due to high corrosion levels of acids causing storage container failures and/or deployment equipment failures i.e. coiled tubing or treatment iron failures caused by high corrosion rates (pitting, cracks, pinholes and major failures). Other concerns include: downhole equipment failures from corrosion causing the operator to have to execute a work-over and replace down hole pumps, tubing, cables, packers etc.; inconsistent strength or quality level of mineral & organic acids; potential supply issues based on industrial
10 output levels; high levels of corrosion on surface pumping equipment resulting in expensive repair and maintenance levels for operators and service companies; the requirement of specialized equipment that is purpose built to pump acids greatly increasing the capital expenditures of operators and service companies; and the inability to source a finished product locally or very near its end use; transportation and onsite storage difficulties.

15 Typically, acids are produced in industrial areas of countries located far from oil & gas applications, more than 10 additives can be required to control various aspects of the acids properties adding to complications in the handling and shipping logistics. Having an alternative that requires minimal additives is very advantageous.

20 Large price fluctuations of conventional mineral and organic acids based on industrial output capacity causes end users the inability to establish long term cost controls of their respective budgets.

25 Extremely high corrosion and reaction rates with temperature increase causes conventional acids to “spend/react or become neutral” prior to achieving its desired effect such as penetrating an oil or gas formation to increase the wormhole “pathway” effectively to allow the petroleum product to flow freely to the surface. As an example, hydrochloric acid or a “mud acid” can be utilized in an attempt to free stuck drill pipe in some situations. Prior to getting to the required depth to dissolve
30 the formation that has caused the pipe/tubing to become stuck many acids spend or neutralize due to increased bottom hole temperatures and increased reaction rate, so it is advantageous to have an

alternative that spends or reacts more methodically allowing the slough to be treated with a solution that is still active, allowing the pipe/tubing to be pulled free.

5 When used to treat scaling issues on surface due to water contamination, conventional acids are exposed to human and mechanical devices as well as expensive pumping equipment causing increased risk for the operator and corrosion effects that damage equipment and create hazardous fumes. When mixed with bases or higher pH fluids, acids will create a large amount of thermal energy (exothermic reaction) causing potential safety concerns and equipment damage, acids typically need to be blended with fresh water (due to their intolerance of highly saline water,
10 causing potential precipitation of minerals) to the desired concentration requiring companies to pre-blend off-site as opposed to blending on-site with field/produced water thereby increasing costs associated with transportation.

15 Conventional mineral acids used in a pH control situation can cause rapid degradation of certain polymers/additives requiring increased loadings or chemicals to be added to counter these negative effects. Many offshore areas of operations have very strict regulatory rules regarding the transportation/handling and deployment of acids causing increased liability and costs for the operator. When using an acid to pickle tubing or pipe, very careful attention must be paid to the process due to high levels of corrosion, as temperatures increase, the typical additives used to
20 control corrosion levels in acid systems begin to degrade very quickly (due to the inhibitors "plating out" on the steel) causing the acids to become very corrosive and resulting in damage to downhole equipment/tubulars. Conventional acids are also very destructive to most elastomers found in the oil & gas industry such as those found in blow out preventers (BOP's)/downhole tools/packers/submersible pumps/seals etc. Having to deal with spent acid during the back flush
25 process is also very expensive as these acids typically are still at a low pH and remain toxic. It is advantageous to have an acid blend that can be exported to production facilities through pipelines that once spent or applied, is commonly close to a neutral pH greatly reducing disposal costs/fees.

30 Acids perform many actions in the oil & gas industry and are considered necessary to achieve the desired production of various petroleum wells, maintain their respective systems and aid in certain

functions (i.e. freeing stuck pipe). The associated dangers that come with using acids are expensive and tasking to mitigate through controls whether they are chemically or mechanically engineered

5 Eliminating or even simply reducing the negative effects of acids while maintaining their usefulness is a struggle for the industry. As the public demand for the use of cleaner/safer/greener products increases, companies are looking for alternatives that perform the required function without all or most of the drawbacks associated with the use of conventional acids.

10 US patent no. 4,402,852 discloses compositions containing 5 to 75% of urea, 5 to 85% of sulfuric acid and from 5 to 75% of water. These compositions are said to have reduced corrosivity to carbon steels.

15 US patent no. 6,147,042 discloses compositions comprising a polyphosphoric acid-urea condensate or polymer which results from the reaction of orthophosphoric acid and urea used in the removal of etching residue containing organometal residues.

20 US patent no. 7,938,912 discloses compositions containing hydrochloric acid, urea, a complex substituted keto-amine-hydrochloride, an alcohol, an ethoxylate and a ketone for use to clean surfaces having cementitious compositions. US patent no. 8,430,971 and 8,580,047 disclose and claim compositions containing specific amounts of hydrochloric acid (55% by wt); urea (42% by wt), a complex substituted keto-amine-hydrochloride (0.067% by wt); propargyl alcohol (0.067% by wt); an ethoxylated nonylphenyl (0.022% by wt); methyl vinyl ketone (0.022% by wt); acetone (0.0022% by wt); and acetophenone (0.0022% by wt) for use in specific oil industry applications, namely oil drilling and hydraulic fracturing.

25 US patent no. 5,672,279 discloses a composition containing urea hydrochloride prepared by mixing urea and hydrochloric acid. Urea hydrochloride is used to remove scale in hot water boilers and other industrial equipment such as papermaking equipment. Scale is caused by the presence of calcium carbonate which is poorly soluble in water and tends to accumulate on surfaces and affect
30 equipment exposed to it.

US patent no. 3,779,935 discloses a composition for use in the inhibition of corrosion caused by the use of acids on ferrous metals. It is said that the essential components of the invention are at least one acetylenic alcohol which may have 3 to 10 carbon atoms, the quaternary ammonium compound and the formic acid compound all of which cooperate to reduce the corrosivity of corrosive acids.

5 The alkanols perform the function of a solvent. The ethoxylated compounds function as a surfactant. The compositions disclosed do contain chemicals which are highly reactive and can cause skin irritation, serious eye irritation and respiratory irritation.

US patent no. 4,028,268 discloses compositions for use in the reduction of metal corrosion
10 comprising be prepared by blending at least four unique specially selected components which interact together to provide metal corrosion inhibition, the components include custom-made specific quarternized cyclic nitrogen base, a specific acetylenic alcohol, a surface active agent and a formic acid derivative.

15 US Patent no. 4,466,893 teaches gelled acid compositions comprising a gelling agent selected from the group consisting of galactomannans such as guar gum, gum karaya, gum tragacanth, gum ghatti, gum acacia, gum konjak, shariz, locus, psyllium, tamarind, gum tara, carrageenan, gum kauri, modified guaras such as hydroxypropyl guar, hydroxyethyl guar, carboxymethyl hydroxyethyl guar, carboxymethyl hydroxypropyl guar and alkoxyated amines. This patent teaches that presence of
20 urea has a marked impact on the viscosity of the gelled acid and the gelled acid compositions are used in fracking activities.

EP 276 879 discloses corrosion inhibitor compositions to be added to an aqueous acid. The compositions disclosed combine at least one iodide salt, at least one compound selected from the
25 group of formic acid compounds, formic acid derivatives, and formate esters, together with at least one nitrogen compound or at least one oxygen-containing compound, as described in the patent. Tested compositions contained a mixture of 2-benzoyl-3-methoxy-1-propene and 2-benzoyl-1,3-dimethoxy-propane (PK), a quinolinium compound, namely naphthylmethyl-quinolium chloride (NMQCl), potassium iodide, and formic acid. The NMQCl was prepared by refluxing equimolar
30 amounts of quinoline and chloromethylnaphthylene in methanol at 70 to 75°C for six hours.

Consequently, there is still a need for compositions for use in the oil industry which can be used over a range of applications which can decrease a number of the associated dangers/issues typically associated with acid applications to the extent that these acid compositions are considered much safer for handling on worksites and which uses compounds which are more widely available and safe.

SUMMARY OF THE INVENTION

Compositions according to the present invention have been developed for the oil & gas industry and its associated applications, by targeting the problems of corrosion, logistics/handling, human/environmental exposure and formation/fluid compatibilities.

It is an object of the present invention to provide a synthetic acid composition which can be used over a broad range of applications in the oil and gas industry and which exhibit advantageous properties over known compositions.

According to one aspect of the present invention, there is provided a synthetic acid composition which, upon proper use, results in a very low corrosion rate of oil and gas industry tubulars/equipment.

According to another aspect of the present invention, there is provided a synthetic acid composition for use in the oil industry which is biodegradable.

According to another aspect of the present invention, there is provided a synthetic acid composition for use in the oil industry which has a methodically spending (reacting) nature that is linear as temperature increases, minimizes or eliminates fuming, non-toxic, and highly controlled manufacturing process.

According to another aspect of the present invention, there is provided a synthetic acid composition for use in the oil industry which has a pH below 1.

According to another aspect of the present invention, there is provided a synthetic acid composition for use in the oil industry which has minimal exothermic reactivity.

5 According to another aspect of the present invention, there is provided a synthetic acid composition for use in the oil industry which is compatible with most existing industry additives.

10 According to another aspect of the present invention, there is provided a synthetic acid composition for use in the oil industry which has high salinity tolerance. A tolerance for high salinity fluids, or brines, is desirable for onshore and offshore acid applications. Typical acids are blended with fresh water and additives, typically far offsite, and then transported to the area of treatment as a finished blend. It is advantageous to have an alternative that can be transported as a concentrate safely to the treatment area, then blended with a high salinity produced water or sea water greatly reducing the logistics requirement typical with conventional acid systems. A typical acid system could precipitate salts heavily if blended with fluids of an excessive salinity level. Brines are also
15 typically present in formations, thus having an acid system that has a high tolerance for brines greatly reduces the potential for formation damage or emulsions.

20 According to another aspect of the present invention, there is provided a synthetic acid composition for use in the oil industry which is immediately reactive upon contact/application.

25 According to another aspect of the present invention, there is provided a synthetic acid composition for use in the oil industry which results in less unintended near wellbore erosion due to the controlled reaction rate. This, in turn, results in deeper formation penetration, increased permeability, and reduces the potential for zonal communication during a typical 'open hole' mechanical isolation application treatment. As a highly reactive acid, such as hydrochloric acid, is deployed into a well that has open hole packers for isolation (without casing) there is a potential to cause a loss of near-wellbore compressive strength resulting in communication between zones or sections of interest as well as potential sand production, and fines migration. It is advantageous to have an alternative that will react with a much more controlled rate or speed, thus greatly reducing
30 the potential for zonal communication and the above potential negative side effects of traditional acid systems.

According to another aspect of the present invention, there is provided a synthetic acid composition for use in the oil industry which provides a controlled and comprehensive reaction throughout a broad range of temperatures.

5

Accordingly, the product would overcome many of the drawbacks found in the use of compositions of the prior art related to the oil & gas industry.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

10

It will be appreciated that, numerous specific details have provided for a thorough understanding of the exemplary embodiments described herein. However, it will be understood by those of ordinary skill in the art that the embodiments described herein may be practiced without these specific details. In other instances, well-known methods, procedures and components have not been described in detail so as not to obscure the embodiments described herein. Furthermore, this description is not to be considered so that it may limit the scope of the embodiments described herein in any way, but rather as merely describing the implementation of the various embodiments described herein.

15

20 The description that follows, and the embodiments described therein, are provided by way of illustration of an example, or examples, of particular embodiments of the principles of the present invention. These examples are provided for the purposes of explanation, and not limitation, of those principles and of the invention.

25 According to an aspect of the invention, there is provided a synthetic acid composition comprising:

- urea & hydrogen chloride in a molar ratio of not less than 0.1:1; preferably in a molar ratio not less than 0.5:1, more preferably in a molar ratio not less than 1:1; and
- formic acid or a derivative thereof such as acetic acid, ethylformate and butyl formate are present in an amount ranging from 0.05 – 2.0 %, preferably in an amount of

30 approximately 0.1%; formic acid is the preferred compound.

Optionally, a phosphonic acid or derivatives can be incorporated, preferably alkylphosphonic acid or derivatives thereof and more preferably amino tris methylene phosphonic acid and derivatives thereof. Also optionally, a metal iodide or iodates can be incorporated, preferably cupric iodide, potassium iodide, sodium iodide or lithium iodide; and also optionally, an alcohol or derivatives
5 thereof can be added, preferably alkynyl alcohol or derivatives thereof, more preferably propargyl alcohol (or a derivative of).

Urea is the main component in terms of volume and weight percent of the composition of the present invention, and consists basically of a carbonyl group connecting with nitrogen and
10 hydrogen. When added to hydrochloric acid, there is a reaction that results in urea hydrochloride, which basically traps the chloride ion within the molecular structure. This reaction greatly reduces the hazardous effects of the hydrochloric acid on its own, such as the fuming effects, the hygroscopic effects, and the highly corrosive nature (the Cl^- ion will not readily bond with the Fe ion). The excess nitrogen can also act as a corrosion inhibitor at higher temperatures. Urea and
15 hydrogen chloride in a molar ratio of not less than 0.1:1; preferably in a molar ratio not less than 0.5:1, and more preferably in a molar ratio not less than 1.0:1. However, this ratio can be increased depending on the application.

The urea (hydrochloride) also allows for a reduced rate of reaction when in the presence of
20 carbonate-based materials. This again due to the stronger molecular bonds associated over what hydrochloric acid traditionally displays. Further, since the composition according to the present invention is mainly comprised of urea (which is naturally biodegradable), the product testing has shown that the urea hydrochloride will maintain a similar biodegradability function, something that hydrochloric acid will not.

25 The use of formic acid as corrosion inhibitor has been known for decades. However, the high concentrations in which its use has been reported along with the compounds it has been intermixed with have not made it a desirable compound in many applications. Prior art compositions containing formic acid require the presence of quinoline containing compounds or derivatives thereof, which
30 render their use, in an increasingly environmentally conscious world, quite restricted.

In the present invention, formic acid or a derivative thereof such as formic acid, acetic acid, ethylformate and butyl formate are present in an amount ranging from 0.05 – 2.0 %, preferably in an amount of approximately 0.1%. Formic acid is the preferred compound

- 5 Phosphonic acids and derivatives such as amino tris methylene phosphonic acid (ATMP) have some value as scale inhibitors. In fact, ATMP is a chemical traditionally used as an oilfield scale inhibitor, it has been found, when used in combination with urea/HCl, to increase the corrosion inhibition. It has a good environmental profile, is readily available and reasonably priced.
- 10 Amino tris (methylenephosphonic acid) (ATMP) and its sodium salts are typically used in water treatment operations as scale inhibitors. They also find use as detergents and in cleaning applications, in paper, textile and photographic industries and in off-shore oil applications. Pure ATMP presents itself as a solid but it is generally obtained through process steps leading to a solution ranging from being colourless to having a pale yellow colour. ATMP acid and some of its
- 15 sodium salts may cause corrosion to metals and may cause serious eye irritation to a varying degree dependent upon the pH/degree of neutralization.

ATMP must be handled with care when in its pure form or not in combination with certain other products. Typically, ATMP present in products intended for industrial use must be maintained in

20 appropriate conditions in order to limit the exposure at a safe level to ensure human health and environment.

Amino tris (methylenephosphonic acid) and its sodium salts belong to the ATMP category in that all category members are various ionized forms of the acid. This category includes potassium and

25 ammonium salts of that acid. The properties of the members of a category are usually consistent. Moreover, certain properties for a salt, in ecotoxicity studies, for example, can be directly appreciated by analogy to the properties of the parent acid. Amino tris (methylenephosphonic acid) may specifically be used as an intermediate for producing the phosphonates salts. The salt is used in situ (usually the case) or stored separately for further neutralization. One of the common uses of

30 phosphonates is as scale inhibitors in the treatment of cooling and boiler water systems. In

particular, for ATMP and its sodium salts are used in to prevent the formation of calcium carbonate scale.

Alcohols and derivatives thereof, such as alkyne alcohols and derivatives and preferably propargyl alcohol and derivatives thereof can be used as corrosion inhibitors. Propargyl alcohol itself is traditionally used as a corrosion inhibitor which works extremely well at low concentrations. It is a toxic/flammable chemical to handle as a concentrate, so care must be taken during handling the concentrate. In the composition according to the present invention, the toxic effect does not negatively impact the safety of the composition.

Metal iodides or iodates such as potassium iodide, sodium iodide and cuprous iodide can potentially be used as corrosion inhibitor intensifier. In fact, potassium iodide is a metal iodide traditionally used as corrosion inhibitor intensifier, however it is expensive, but works extremely well. It is non-regulated and friendly to handle.

Example 1 - Process to prepare a composition according to a preferred embodiment of the invention

Start with a 50% by weight solution of urea. Add a 36% by weight solution of hydrogen chloride while circulating until all reactions have completely ceased. The formic acid is then added. Circulation is maintained until all products have been solubilized. Additional products can then be added as required. Table 1 lists the components of the composition of Example 1, including their weight percentage as compared to the total weight of the composition and the CAS numbers of each component.

Table 1 - Composition of a preferred embodiment of the present invention

Chemical	% Wt Composition	CAS#
Water	60.9%	7732-18-5
Urea Hydrochloride	39.0%	506-89-8
Formic acid	0.10%	64-18-6

The resulting composition of Example 1 is a clear, odourless liquid having shelf-life of greater than 1 year. It has a freezing point temperature of approximately minus 30oC and a boiling point

temperature of approximately 100°C. It has a specific gravity of 1.15±0.02. It is completely soluble in water and its pH is less than 1.

Corrosion testing

- 5 The composition according to the present invention of Example 1 was exposed to corrosion testing. The results of the corrosion tests are reported in Table 2.

10 Samples of J55 grade steel were exposed to various synthetic acid solutions for periods of time ranging up to 24 hours at 90°C temperatures. All of the tested compositions contained HCl and urea in a 1:1.05 ratio at a 100% concentration.

Table 2 - Corrosion testing comparison between HCl-Urea and the composition of Example 1 of the present invention

Inhibitor (%)	Initial wt. (g)	Final wt. (g)	Loss wt. (g)	Surface area (cm ²)	Density (g/cc)	Run time (hours)	Mils/yr	Mm/year	Lb/ft ²
HCl-Urea	37.616	34.524	3.092	28.922	7.86	6	7818.20	198.582	0.222
HCl-Urea	37.616	31.066	6.550	28.922	7.86	24	4140.46	105.168	0.470
HCl-Urea + 0.1% formic acid	37.679	35.059	2.620	28.922	7.86	6	6624.738	168.268	0.186
HCl-Urea + 0.1% formic acid	37.679	32.277	5.402	28.922	7.86	24	3414.774	86.735	0.383

15 This type of corrosion testing helps to determine the impact of the use of such synthetic replacement acid composition according to the present invention compared to the industry standard (HCl blends or any other mineral or organic acid blends). The results obtained for the composition containing only HCl and urea were used as a baseline to compare the other compositions. Additionally, the

20 compositions according to the present invention will allow the end user to utilize an alternative to conventional acids that has the down-hole performance advantages, transportation and storage advantages as well as the health, safety and environmental advantages. Enhancement in short/long term corrosion control is one of the key advantages of the present invention. The reduction in skin corrosiveness, the elimination of corrosive fumes, the controlled spending nature, and the high salt

tolerance are some other advantages of compositions according to embodiments of the present invention.

5 The composition is biodegradable and is classified as a non-irritant according to the classifications for skin.. The composition minimizes or eliminates fuming and has no volatile organic compounds nor does it have any BTEX levels above the drinking water quality levels. BTEX refers to the chemicals benzene, toluene, ethylbenzene and xylene. Toxicity testing was calculated using surrogate information and the LD₅₀ was determined to be greater than 2000mg/kg.

10 With respect to the corrosion impact of the composition on typical oilfield grade steel, it was established that it enhances the corrosion resistance compared to the HCl-urea composition alone.

The compositions according to the present invention can be used directly (ready-to-use) or be diluted with water depending on their use.

15 The uses (or applications) of the compositions according to the present invention upon dilution thereof ranging from approximately 1 to 75% dilution, include, but are not limited to: injection/disposal in wells; squeezes and soaks or bullheads; acid fracturing, acid washes or matrix stimulations; fracturing spearheads (breakdowns); pipeline scale treatments, cement breakdowns or
20 perforation cleaning; pH control; and de-scaling applications.

While the foregoing invention has been described in some detail for purposes of clarity and understanding, it will be appreciated by those skilled in the relevant arts, once they have been made familiar with this disclosure that various changes in form and detail can be made without departing
25 from the true scope of the invention in the appended claims.

CLAIMS

1. A synthetic acid composition for use in oil industry activities, said composition comprising:
- urea and hydrogen chloride in a molar ratio of not less than 0.1:1; and
5 - formic acid or a derivative thereof.
2. The synthetic acid composition according to claim 1, wherein the formic acid or a derivative thereof is selected from the group consisting of: formic acid, acetic acid, ethylformate and butyl formate.
10
3. The synthetic acid composition according to claim 1 or 2, wherein the formic acid or a derivative thereof is present in an amount ranging from 0.05 – 2.0 % w/w of the total composition.
4. The synthetic acid composition according to claim 3, wherein the formic acid or a derivative
15 thereof is present in an amount of approximately 0.1% w/w of the total composition.
5. The synthetic acid composition according to any one of claims 1 to 4, wherein the urea and hydrogen chloride are in a molar ratio of not less than 0.5:1.
- 20 6. The synthetic acid composition according to claim 5, wherein the urea and hydrogen chloride are in a molar ratio of not less than 1.0:1.
7. The synthetic acid composition according to any one of claims 1 to 6, further comprising a phosphonic acid derivative.
25
8. The synthetic acid composition according to claim 7, wherein the phosphonic acid derivative is aminoalkylphosphonic salt.
9. The synthetic acid composition according to claim 8, wherein the aminoalkylphosphonic salt
30 is amino tris methylene phosphonic acid.

10. The synthetic acid composition according to any one of claims 1 to 9, further comprising a metal iodide or iodate selected from the group consisting of: potassium iodide, sodium iodide, cuprous iodide and lithium iodide.
- 5 11. The synthetic acid composition according to claim 10, wherein the metal iodide or iodate is cuprous iodide.
12. The synthetic acid composition according claim 10, wherein the metal iodide or iodate is potassium iodide.
- 10 13. The synthetic acid composition according claim 10, wherein the metal iodide or iodate is sodium iodide.
14. The synthetic acid composition according claim 10, wherein the metal iodide or iodate is
- 15 lithium iodide.
15. The synthetic acid composition according to any one of claims 1 to 14, further comprising an alcohol or derivative thereof.
- 20 16. The synthetic acid composition according to claim 15, wherein the alcohol or derivative thereof is an alkynyl alcohol or derivative thereof.
17. The synthetic acid composition according to claim 16, wherein the alkynyl alcohol or derivative thereof is propargyl alcohol or a derivative thereof.
- 25 18. The synthetic acid composition according to claim 8, wherein the aminoalkylphosphonic salt is present in a concentration ranging from 0.25 to 1.0% w/w of the total composition.
19. The synthetic acid composition according to claim 18, wherein the aminoalkylphosphonic
- 30 salt is present in a concentration of 0.5% w/w of the total composition.

20. The synthetic acid composition according to claim 16 wherein the alkynyl alcohol or derivative thereof is present in a concentration ranging from 0.01 to 0.25% w/w of the total composition.
- 5 21. The synthetic acid composition according to claim 20, wherein the alkynyl alcohol or derivative thereof is present in a concentration of 0.1% w/w of the total composition.
22. The synthetic acid composition according to any one of claims 10 to 14, wherein the metal iodide is present in a concentration ranging from 100 to 1000 ppm.
- 10 23. The use of a synthetic acid composition according to any one of claims 1 to 22 in the oil industry to stimulate formations.
24. The use of a synthetic acid composition according to any one of claims 1 to 22 in the oil
15 industry to assist in reducing breakdown pressures during downhole pumping operations.
25. The use of a synthetic acid composition according to any one of claims 1 to 22 in the oil industry to treat wellbore filter cake post drilling operations.
- 20 26. The use of a synthetic acid composition according to any one of claims 1 to 22 in the oil industry to assist in freeing stuck pipe.
27. The use of a synthetic acid composition according to any one of claims 1 to 22 in the oil industry to descale pipelines and/or production wells.
- 25 28. The use of a synthetic acid composition according to any one of claims 1 to 22 in the oil industry to increase injectivity of injection wells.
29. The use of a synthetic acid composition according to any one of claims 1 to 22 in the oil
30 industry to lower the pH of fluids.

30. The use of a synthetic acid composition according to any one of claims 1 to 22 in the oil industry to remove undesirable scale in surface equipment, wells and related equipment and/or facilities.
- 5 31. The use of a synthetic acid composition according to any one of claims 1 to 22 in the oil industry to fracture wells.
32. The use of a synthetic acid composition according to any one of claims 1 to 22 in the oil industry to complete matrix stimulations.
- 10 33. The use of a synthetic acid composition according to any one of claims 1 to 22 in the oil industry to conduct annular and bullhead squeezes & soaks.
34. The use of a synthetic acid composition according to any one of claims 1 to 22 in the oil industry to pickle tubing, pipe and/or coiled tubing.
- 15 35. The use of a synthetic acid composition according to any one of claims 1 to 22 in the oil industry to increase effective permeability of formations.
- 20 36. The use of a synthetic acid composition according to any one of claims 1 to 22 in the oil industry to reduce or remove wellbore damage.
37. The use of a synthetic acid composition according to any one of claims 1 to 22 in the oil industry to clean perforations.
- 25 38. The use of a synthetic acid composition according to any one of claims 1 to 22 in the oil industry to solubilize limestone, dolomite, calcite and combinations thereof.
- 30