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CA 2937490 A1 2018/01/29

(21) **2 937 490**

(12) **DEMANDE DE BREVET CANADIEN**
CANADIAN PATENT APPLICATION

(13) **A1**

(22) **Date de dépôt/Filing Date:** 2016/07/29

(41) **Mise à la disp. pub./Open to Public Insp.:** 2018/01/29

(51) Cl.Int./Int.Cl. *C09K 8/72* (2006.01), *C09K 3/00* (2006.01), *C09K 8/52* (2006.01), *C23G 1/02* (2006.01)

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

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

(57) Abrégé/Abstract:

A synthetic acid composition for use in oil industry activities, said composition comprising: lysine and hydrogen chloride in a molar ratio of not less than 1:12; it can also further comprise a metal iodide or iodate; an alcohol or derivative thereof. Said composition demonstrating advantageous properties over known acids at temperatures above 90°C.

ABSTRACT

A synthetic acid composition for use in oil industry activities, said composition comprising: lysine and hydrogen chloride in a molar ratio of not less than 1:12; it can also further comprise a metal iodide or iodate; an alcohol or derivative thereof. Said composition demonstrating advantageous properties over known acids at temperatures above 90°C.

USING SYNTHETIC ACID COMPOSITIONS AS ALTERNATIVES TO CONVENTIONAL ACIDS IN THE OIL AND GAS INDUSTRY

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 over a broad range of temperatures.

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 or remediation is used to 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. Acidizing is achieved by pumping acid into the well to dissolve typically limestone, dolomite and calcite cement between the sediment grains of the reservoir rocks or to treat scale accumulation.

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 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 formation and/or mud solids that are inhibiting the permeability of the rock, enlarging the natural pores of the reservoir (wormholing) and stimulating flow of hydrocarbons to the wellbore. 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. In some instances, a proppant is introduced into the fluid which assists in propping open the fractures, further enhancing the flow of hydrocarbons into the wellbore.

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.

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 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 (IDHL). At levels from 1300-2000 ppm death can occur in 2-3 minutes.

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 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 and a comprehensive, expensive to implement, emergency evacuation plan need to be in place prior to approval of such storage areas.. Because of its acidic nature, hydrogen chloride gas is also corrosive, particularly in the presence of moisture.

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 & some organic acids are harmful to humans/animals and are highly corrosive and/or produce potentially explosive vapours. Transportation and storage requirements for acids are restrictive and taxing in such that you must haul the products in acid 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.

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 fracturing 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 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.

Typically, acids are produced in industrial areas of countries located far from oil & gas applications, up to 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.

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 deeply penetrating an oil or gas formation to increase the wormhole or etched "pathway" effectively to allow the petroleum product to flow freely to the wellbore. As an example, hydrochloric acid can be utilized in an attempt to free stuck drill pipe in some situations. Prior to getting to the required depth to dissolve the formation that has caused the pipe/tubing to become stuck many acids spend or neutralize due to increased bottom hole temperatures and greatly 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.

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, 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.

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 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 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 much higher than that of spent HCl, reducing disposal costs/fees.

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 drilling operational functions (i.e. freeing stuck pipe, filter cake treatments). The associated dangers that come with using mineral acids are expansive and tasking to mitigate through controls whether they are chemically or mechanically engineered

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.

Several operations in the oil industry expose fluids to very high temperatures (some upward of 200°C/392°F), the compositions used in these various operations need to withstand these high temperatures without losing their overall effectiveness. These compositions must also be capable of being applied in operations over a wide range of temperatures while not or at least minimally affecting or corroding the equipment with which it comes in contact in comparison to a conventional mineral acid.

Offshore oil and gas operations are highly regulated due to the environmental concerns which arise from their operations and the potential for spills. The complexity of drilling and completing offshore wells is compounded by both safety issues for workers on such offshore oil rigs and production platforms as well as environmental concerns.

Many countries bordering the waters where offshore drilling and production is routinely carried out have put into play a number of regulations aimed at minimizing the environmental impact of this practice.

These regulations include the ban on certain types of chemicals which may be harmful to marine life and the environment. In order to overcome these very restrictive regulations, many oil companies employ very costly containment programs for the handling of certain chemicals such as acids which have a wide array of uses in the industry of oil and gas exploration and production.

Many of the issues related with offshore oil and gas exploration and production stem from the fact that the conditions under which this is carried out are substantially different than those encountered in the same types of operations carried out onshore.

Acids conventionally used in various oil and gas operations can reach temperatures of up to 200°C. At these temperatures, their reactivity is exponentially increased and as such their effectiveness is greatly decreased. They fully spend or react prior to reaching the target formation, scale or penetrate the wellbore in a sufficient manner. Corrosion is a major concern at high temperature and is difficult and expensive to control with additional chemistry.

Modified and synthetic acids developed and currently patented such as those containing a core of urea and hydrochloric acid are aimed at increasing personnel safety, reducing corrosion effects, slowing down the reaction rate and reducing the toxicity of HCl. However, it has been found that at temperatures above 90°C the urea component in a synthetic or modified acid containing such compound tends to ultimately decompose to ammonia and carbon dioxide. The ammonia component will neutralize the acidic component or HCl and render the product non-reactive or neutral. Additionally there is the risk of wellbore and/or formation damage due to uncontrolled solubilized mineral precipitation due to a high pH caused mainly by the formation of ammonia during the decomposition phase

CA patent application 2,865,855 discloses compositions comprising hydrochloric acid at a concentration between 8 wt% and 28 wt% inclusive and at least one amino acid. The amino acid/hydrochloric acid molar ratio is between 0.2 and 1.5, and sufficient water is present to dissolve the hydrochloric acid and the amino acid. The amino acid may comprise alanine, asparagines, aspartic acid, cysteine, glutamic acid, histidine, leucine, lysine, methonine, proline, serine, threonine or valine or combinations thereof. There is disclosed a composition which comprises lysine but which provides a limestone dissolution retardation factor (versus HCl) which is considered too high to measure.

US patent application US 20140041690 A1 teaches the use of glycine in the making of a synthetic acid that is said to obviate all the drawbacks of strong acids such as hydrochloric acid. The new compound is made by dissolving glycine in water, in a weight ratio of approximately 1:1 to 1:1.5. The description states that the solution is mixed until the glycine is essentially fully dissolved in the water. Once dissolution is complete, hydrogen chloride gas is dissolved in the solution to produce the new compound, which is referred to as hydrogen glycine.

Despite the prior art and in light of the substantial problems elicited by the use of acids in oil and gas operations at high temperatures, there still exists a critical need to find an alternative to known synthetic acids which will remain stable above temperatures of 90°C. The inventors have surprisingly and unexpectedly found that by combining an amino acid with hydrochloric acid in appropriate ratios one can obtain both a safer alternative to HCl all the while maintaining the properties which provide usefulness in oil and gas operations.

It was discovered that the compositions according to the present invention exhibit stability for operations at elevated temperature (above 90°C and in some cases up to 200°C) and therefore makes them useful in the oil and gas industry. The composition according to the present invention can ideally be used in various oilfield operations, such as: spearhead breakdown acid, acid fracturing operations, injection-disposal well treatments, scale removal treatments (surface and subsurface, equipment, pipelines, facilities), formation filter cake removal, tubing pickling, matrix acid squeezes, stimulations and soaks, cement squeeze breakdowns, fluid pH control, stuck pipe operations, and coiled tubing acid washes, soaks, squeezes.

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

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, reaction rates, toxicity levels, biodegradation tendencies and formation/fluid compatibilities.

It is an object of the present invention to provide a modified or complexed 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 -on oil and gas industry tubulars and 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 modified / complexed acid composition for use in the oil industry which has a controlled, more methodical spending (reacting) nature that is near linear as temperature increases, low-fuming/vapor pressure, low-toxicity, and has a highly controlled manufacturing process ensuring consistent end product strength and quality.

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 upon dilution or during the reaction process.

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 existing industry acid additives.

According to another aspect of the present invention, there is provided a synthetic acid composition for use in the oil industry which has higher salinity tolerance. A tolerance for high salinity fluids, or brines, is desirable for onshore and offshore acid applications. Conventional acids are normally 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 saline produced water or sea water greatly reducing the logistics requirement. A conventional acid system can precipitate salts/minerals heavily if blended with fluids of an excessive saline level resulting in formation plugging or ancillary damage, inhibiting production and substantially increasing costs. Brines are also 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 forming down-hole during or after product placement/spending (reaction) occurs.

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.

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 a more 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 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 rate throughout a broad range of temperatures.

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.

BRIEF DESCRIPTION OF THE FIGURES

The invention may be more completely understood in consideration of the following description of various embodiments of the invention in connection with the accompanying figure, in which:

Figure 1 is a graphical representation of the dissolution of $CaCO_3$ over time at 70°C by a control and two compositions according to preferred embodiment of the present invention;

Figure 2 is a graphical representation of the dissolution of $CaCO_3$ over time at 70°C by a control and two compositions according to preferred embodiment of the present invention;

Figure 3 is a graphical representation of the dissolution of $CaCO_3$ over time at 70°C by a control and two compositions according to preferred embodiment of the present invention; and

Figure 4 is a graphical representation of the dissolution of $CaCO_3$ over time at 70°C by a control and two compositions according to preferred embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

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 of the present invention. These examples are provided for the purposes of explanation, and not limitation, of those principles and of the invention.

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

- lysine & hydrogen chloride in a molar ratio of not less than 1:12; preferably in a molar ratio not less than 1:8, more preferably in a molar ratio of not less than 1:5, even more preferably in a molar ratio of not less than 1:3 and yet even more preferably in a molar ratio of not less than 1:2.5.

According to an aspect of the invention, there is provided a synthetic acid composition comprising lysine and hydrogen chloride in a molar ratio ranging from 1:2 to 1:12; preferably in a molar ratio ranging from 1:2.5 to 1:8, more preferably in a molar ratio ranging from 1:3 to 1:6, even more preferably in a molar ratio ranging from 1:3 to 1:5.

Lysine-HCl is the main component in terms of volume and weight percent of the composition of the present invention, and as an amino acid it contains at least one amino group, –NH_2, and one carboxyl group, –COOH. When added to hydrochloric acid a Lewis acid/base adduct is formed where the primary amino group acts as a Lewis base and the proton of the HCl as Lewis acid. The formed adduct greatly reduces the hazardous effects of the hydrochloric acid on its own, such as the fuming effect, the hygroscopicity, and the highly corrosive nature The excess nitrogen can also act as a corrosion inhibitor at higher temperatures. Lysine & hydrogen chloride in a molar ratio of not less than 1:12; preferably in a molar ratio not less than 1:8, and more preferably in a molar ratio not less than 1:3, even more preferably in a molar ratio of not less than 1:2.5. The Lysine-HCl ratio can be adjusted or determined depending on the intended application and the desired solubilizing ability. By increasing the ration of the HCl component the solubilizing ability will increase while still providing health, safety, environmental and operational advantages over hydrochloric acid.

It is preferable to add the lysine at a molar ratio less than 1:1 to the moles of HCl acid (or any acid). Tests have shown than even adding lysine to HCl in a molar ratio of around 1:2 would neutralize the hydrochloric acid to the point of almost completely removing all of its acidic character. Preferably, the composition according to the present invention comprises at most 1 mole of lysine per 2.0 moles of HCl. The lysine hydrochloride also allows for a reduced rate of reaction when in the presence of carbonate-based materials. This again is 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 lysine (which is naturally biodegradable), the product testing has shown that the lysine hydrochloride will maintain the same biodegradability function, something that hydrochloric acid will not on its own.

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 well at low concentrations. It is however a very toxic/flammable chemical to handle as a concentrate, so care must be taken when exposed to the concentrate. In the composition according to the present invention, it is preferred to use 2-Propyn-1-ol, complexed with methyloxirane, as this is a much safer derivative to handle. Basocorr® is an example of such a compound.

Metal iodides or iodates such as potassium iodide, sodium iodide, cuprous iodide and lithium 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 safe to handle. The iodide or iodate is preferably present in a weight percentage ranging from 0.1 to 5%, more preferably from 0.2 to 3%, yet even more preferably from 0.25 to 2%.

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 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 0.15%. Formic acid is the preferred compound.

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

Lysine mono-hydrochloride is used as starting reagent. To obtain a 1:2 molar ratio of lysine to HCl, 370 ml of 50 wt% lysine-HCl solution and 100 ml HCl aq. 36% (22 Baume) were combined. In the event that additives are used, they are added after thorough mixing. For example, propargyl alcohol, and potassium iodide can be added at this point. Circulation is maintained until all products have been solubilized. Additional products can now be added as required.

The resulting composition of Example 1 is an amber colored liquid with a fermentation like odour having shelf-life of greater than 1 year. It has a freezing point temperature of approximately minus 30°C 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.

The composition is biodegradable and is classified as a mild irritant according to the classifications for skin tests. The composition is substantially low fuming. Toxicity testing was calculated using surrogate information and the LD_{50} was determined to be greater than 2000mg/kg.

With respect to the corrosion impact of the composition on typical oilfield grade steel, it was established that it was clearly well below the acceptable corrosion limits set by industry for certain applications, such as spearhead applications or lower temperature scaling.

In preferred embodiments of the present invention, 2-Propyn-1-ol, complexed with methyloxirane can be present in a range of 0.05 – 5.0 wt %, preferably it is present in an amount ranging from 0.1 to 3 wt %, even more preferably from 0.5 to 2.0 % and yet even more preferably from 0.75 to 1.5 wt %. As a substitute for potassium iodide one could use sodium iodide, copper iodide and lithium iodide. However, potassium iodide is the most preferred. Formic Acid can be present in a range of 0.05 – 2.0 %, preferably it is present in an amount of approximately 0.15%. As a substitute for formic acid one could use acetic acid. However, formic acid is most preferred.

Corrosion testing

Compositions according to preferred embodiments of the present invention were exposed to corrosion testing. The results of the corrosion tests are reported in Tables 1 through 10. The controls used were compositions of urea-HCl and urea-HCl with additives. Coupons of N80 and J55 grade steel were exposed to the various listed compositions for a period of 6 hours at varying temperatures.

Table 1- **Corrosion testing comparison between Lysine-HCl using various additives Run time 6 hours on N-80 steel coupons at 90°C having a surface area of 28.0774 cm^2**

Fluid	Additives	Initial wt (g)	Final wt (g)	Wt loss (g)	Mils/yr	Mm/year	lb/ft2
HCl-Urea (control)		49.916	49.7989	0.117	304.9971	7.747	0.009

HCl-Urea + Seawater		49.6828	49.313	0.370	963.1762	24.465	0.027
Urea-HCl	1.0% CI-4A 0.4% CI-2 0.1% FA 0.25% CI-1A 0.2% NIS	46.8766	46.7886	0.088	229.2036	5.822	0.006
50% Lysine-HCl 1:1 + Seawater	0.3% CI-4A 0.4% CI-2 0.1% FA 0.25% CI-1A 0.2% NIS	48.713	46.6944	2.019	5257.619	133.544	0.147
50% Lysine-HCl 1:1 + Seawater	0.3% CI-4A 0.4% CI-2 0.1% FA 0.25% CI-1A 0.2% NIS	48.1662	46.6923	1.474	3838.9	97.508	0.108
50% Lysine-HCl 1:2 + Seawater	0.3% CI-4A 0.4% CI-2 0.1% FA 0.25% CI-1A 0.2% NIS	48.4238	48.2938	0.130	338.5963	8.600	0.009
50% Lysine-HCl 1:2 + Seawater	0.3% CI-4A 0.4% CI-2 0.1% FA 0.25% CI-1A 0.2% NIS	49.9128	49.7349	0.178	463.356	11.769	0.013
50% Lysine-HCl 1:2.5 + Seawater	0.3% CI-4A 0.4% CI-2 0.1% FA 0.25% CI-1A 0.2% NIS	48.9523	48.8292	0.123	320.6246	8.144	0.009
50% Lysine-HCl 1:3 + Seawater	0.3% CI-4A 0.4% CI-2 0.1% FA 0.25% CI-1A 0.2% NIS	49.0231	48.9082	0.115	299.267	7.601	0.008
50% Lysine-HCl 1:4 + Seawater	0.3% CI-4A 0.4% CI-2 0.1% FA 0.25% CI-1A 0.2% NIS	49.9415	49.7828	0.159	413.3479	10.499	0.012

Note: CI-4A refers to Basocorr PP; CI-2 is an ethoxylate-based film forming surfactant CI; FA refers to Formic Acid; CI-1A refers to potassium iodide; NIS refers to a non-ionic surfactant.

Table 2 – **Corrosion testing on N-80 steel coupons having a surface area of 28.0774 cm^2 at 90°C for a period of 6 hours**

Fluid	Additives	Initial wt (g)	Final wt (g)	Wt loss (g)	Mils/yr	Mm/year	lb/ft2
50% Lysine-HCl 1:5 + Seawater	0.3% CI-4A 0.4% CI-2 0.1% FA 0.25% CI-1A 0.2% NIS	50.2511	50.0832	0.168	437.3101	11.108	0.012

50% Lysine-HCl 1:6 + Seawater	0.3% CI-4A 0.4% CI-2 0.1% FA 0.25% CI-1A 0.2% NIS	47.1876	46.9962	0.191	498.5179	12.662	0.014

Table 3 – Corrosion testing on N-80 steel coupons having a surface area of 28.0774 cm^2 at 130°C for a period of 6 hours

Fluid	Additives	Initial wt (g)	Final wt (g)	Wt loss (g)	Mils/yr	Mm/year	lb/ft2
50% Lysine-HCl 1:2.5 + Seawater	0.3% CI-4A 0.4% CI-2 0.1% FA 0.25% CI-1A 0.2% NIS	50.2188	43.513	6.706	17465.84	443.632	0.490
50% Lysine-HCl 1:2.5 + Seawater	2.5% CI-4A 0.4% CI-2 0.1% FA 0.25% CI-1A 0.2% NIS	47.9322	47.6114	0.321	835.5514	21.223	0.023

Table 4 – Corrosion testing on refurbished N-80 steel coupons having a surface area of 28.0774 cm^2 at 90°C for a period of 6 hours

Fluid	Corrosion inhibitors	Initial Wt. (g)	Final wt. (g)	Loss wt. (g)	Mils/yr	mm/year	lb/ft2
50% Lysine-HCl 1:2.5 + Seawater	2% CI-4A 1% CI-1A	47.5778	47.5611	0.017	43.4966	1.105	0.001
50% Lysine-HCl 1:2.5 + Seawater	2% CI-4A 1% FA	48.0529	48.0289	0.024	62.51008	1.588	0.002
50% Lysine-HCl 1:2.5 + Seawater	2% CI-4A 1% CI-1A 1% FA	44.819	44.7978	0.021	55.21724	1.403	0.002

Table 5 – Corrosion testing on refurbished N-80 steel coupons having a density of 7.86g/ml and a surface area of 28.0774 cm^2 at 130°C for a period of 6 hours

Fluid	Additives	Initial wt (g)	Final wt (g)	Wt loss (g)	Mils/yr	mm/year	lb/ft2	Note
50% Lysine-HCl 1:2.5 + Seawater	2% CI-4A 1% CI-1A	48.485	47.8807	0.604	1573.9518	39.978	0.044	1
50% Lysine-HCl 1:2.5 + Seawater	2.5% CI-4A 1% CI-1A	52.1508	51.7599	0.391	1018.133	25.861	0.028	1
50% Lysine-HCl 1:2.5 + Seawater	2.5% CI-4A 1% CI-1A 1%FA	50.2415	49.8461	0.395	1029.8536	26.158	0.028	1

50% Lysine-HCl 1:3 + Seawater	2.5% CI-4A 1% CI-1A 1%FA	48.0069	47.7398	0.267	695.68513	17.670	0.019	2
50% Lysine-HCl 1:4 + Seawater	2.5% CI-4A 1% CI-1A 1%FA	47.456	46.2342	1.222	3182.2842	80.830	0.089	3
50% Lysine-HCl 1:3 + Seawater	2.5% CI-4A 1% CI-1A	47.3366	47.1584	0.178	464.13737	11.789	0.013	3
50% Lysine-HCl 1:2.5 + Seawater	2% CI-4A 0.5% CI-1A	44.3151	44.0538	0.261	680.57853	17.287	0.019	1
50% Lysine-HCl 1:3 + Seawater	2% CI-4A 0.5% CI-1A	47.6843	47.4897	0.195	506.85259	12.874	0.014	1

Note: 1: Few deep pitting 2: Two deep pitting 3: Two pitting

Table 6 – **Corrosion testing on refurbished J-55 steel coupons having a density of 7.86g/ml and a surface area of 28.922 cm^2 at 90°C for a period of 6 hours**

Fluid	additives	Initial wt (g)	Final wt (g)	Wt loss (g)	Mils/yr	mm/year	lb/ft2
HCl-Urea + Seawater		35.2002	35.0522	0.148	374.22183	9.505	0.010
50% Lysine HCl 1:1 + Seawater	0.3% CI-4A 0.4% CI-2 0.1% FA 0.25% CI-1A 0.2% NIS	35.8483	35.604	0.244	617.71887	15.690	0.018
50% Lysine HCl 1:2 + Seawater	0.3% CI-4A 0.4% CI-2 0.1% FA 0.25% CI-1A 0.2% NIS	35.8132	35.7047	0.108	274.34506	6.968	0.008
50% Lysine HCl 1:3 + Seawater	0.3% CI-4A 0.4% CI-2 0.1% FA 0.25% CI-1A 0.2% NIS	35.8368	35.7063	0.130	329.97263	8.381	0.009
50% Lysine HCl 1:4 + Seawater	0.3% CI-4A 0.4% CI-2 0.1% FA 0.25% CI-1A 0.2% NIS	33.3433	33.2151	0.128	330.03551	8.383	0.009

50% Lysine HCl 1:5 + Seawater	0.3% CI-4A 0.4% CI-2 0.1% FA 0.25% CI-1A 0.2% NIS	35.8887	35.7469	0.142	358.54497	9.107	0.010
50% Lysine HCl 1:6 + Seawater	0.3% CI-4A 0.4% CI-2 0.1% FA 0.25% CI-1A 0.2% NIS	33.2402	33.082	0.158	400.01279	10.160	0.011
50% Lysine HCl 1:2.5 + Seawater	1.0% CI-4A 0.4% CI-2 0.1% FA 0.25% CI-1A 0.2% NIS	48.825	48.7205	0.105	272.1793	6.913	0.008
50% Lysine HCl 1:2.5 + Seawater	4.0% CI-4A 0.4% CI-2 0.1% FA 0.25% CI-1A 0.2% NIS	49.725	49.6599	0.065	169.5586	4.307	0.005
50% Lysine HCl 1:1 + Seawater	0.3% CI-4A 0.4% CI-2 0.1% FA 0.25% CI-1A 0.2% NIS	35.8483	35.604	0.244	617.7189	15.690	0.017
50% Lysine HCl 1:2 + Seawater	0.3% CI-4A 0.4% CI-2 0.1% FA 0.25% CI-1A 0.2% NIS	35.8132	35.7047	0.108	274.3451	6.968	0.008
50% Lysine HCl 1:3 + Seawater	0.3% CI-4A 0.4% CI-2 0.1% FA 0.25% CI-1A 0.2% NIS	35.8368	35.7063	0.130	329.9726	8.381	0.009
50% Lysine HCl 1:4 + Seawater	0.3% CI-4A 0.4% CI-2 0.1% FA 0.25% CI-1A 0.2% NIS	33.3433	33.2151	0.128	330.0355	8.383	0.009
50% Lysine HCl 1:5 + Seawater	0.3% CI-4A 0.4% CI-2 0.1% FA 0.25% CI-1A 0.2% NIS	35.8887	35.7469	0.142	358.545	9.107	0.010

50% Lysine HCl 1:6 + Seawater	0.3% CI-4A 0.4% CI-2 0.1% FA 0.25% CI-1A 0.2% NIS	33.2402	33.082	0.158	400.0128	10.160	0.011

Table 7 – **Corrosion testing on refurbished N-80 steel coupons having a density of 7.86g/ml and a surface area of 28.0774 cm^2 at 110°C for a period of 6 hours**

Fluid	Additives	Initial wt (g)	Final wt (g)	Wt loss (g)	Mils/yr	mm/year	lb/ft2	note
28% HCl + Seawater	0.3% CI-4A 0.4% CI-2 0.25% CI-1A	48.8797	48.737	0.143	371.67454	9.441	0.010	1
50% Lysine HCl 1:8 + Seawater	1% CI-4A 1% CI-1A	49.5149	48.8421	0.673	1752.366	44.510	0.049	2
50% Lysine HCl 1:8 + Seawater	1% CI-2 1% CI-1A	45.1327	44.9849	0.148	384.95793	9.778	0.011	1
50% Lysine HCl 1:8 + Seawater	1% CI-4A 1% CI-2 1% CI-1A	48.2265	48.1564	0.070	182.58153	4.638	0.005	1
50% Lysine HCl 1:8 + Seawater	1% CI-4A 0.5 CI-2 1% CI-1A	49.5845	49.5103	0.074	193.26034	4.909	0.005	1
50% Lysine HCl 1:8 + Seawater	1% CI-4A 0.25% CI-2 1% CI-1A	49.1063	49.053	0.053	138.82448	3.526	0.004	1
50% Lysine HCl 1:8 + Seawater	0.5% CI-4A 1% CI-2 1% CI-1A	44.8107	44.7499	0.061	158.35888	4.022	0.004	1
50% Lysine HCl 1:8 + Seawater	0.5% CI-4A 0.5% CI-2 1% CI-1A	47.9499	47.8846	0.065	170.07952	4.320	0.005	1
50% Lysine HCl 1:8 + Seawater	0.3% CI-4A 0.4% CI-2 0.25% CI-1A	49.3101	49.2194	0.091	236.23602	6.000	0.007	1
50% Lysine HCl 1:8 + Seawater	0.3% CI-4A 0.4% CI-2 0.25% CI-1A	51.3474	51.1809	0.166	433.6637	11.015	0.012	1
50% Lysine HCl 1:8 + Seawater	0.3% CI-4A 0.4% CI-2 0.25% CI-1A	39.4476	39.3251	0.123	261.10254	6.632	0.007	1
50% Lysine HCl 1:8 + Seawater	0.3% CI-4A 0.4% CI-2	48.2935	48.0981	0.195	508.93626	12.927	0.014	1

1: slightly foamy coupon was greasy

2: some pitting

Table 8 – Corrosion testing on refurbished N-80 steel coupons having a density of 7.86g/ml and a surface area of 28.0774 cm^2 at 130°C for a period of 6 hours

Fluid	Additives	Initial wt (g)	Final wt (g)	Wt loss (g)	Mils/yr	mm/year	lb/ft2	note
50% Lysine HCl 1:8 + Seawater	0.3% CI-4A 0.4% CI-2 0.25% CI-1A	49.4458	49.0756	0.370	964.21803	24.491	0.027	1
50% Lysine - HCl 1:8 + Seawater	0.3% CI-4A 0.4% CI-2 1% CI-1A	49.8823	49.5507	0.332	863.68098	21.937	0.024	1
50% Lysine - HCl 1:8 + Seawater	0.5% CI-4A 0.6% CI-2 0.25% CI-1A	49.2333	48.9962	0.237	617.54753	15.686	0.017	1
50% Lysine - HCl 1:8 + Seawater	0.5% CI-4A 0.6% CI-2 1% CI-1A	48.5541	48.3619	0.192	500.60158	12.715	0.014	1
50% Lysine - HCl 1:3 + Seawater	2.5% CI-4A 1% CI-1A	48.768	48.7169	0.051	133.09439	3.381	0.004	2
50% Lysine - HCl 1:3 + Seawater	2.5% CI-4A 0.75% CI-1A	44.5581	44.5007	0.057	149.50328	3.797	0.004	2
50% Lysine- HCl 1:3 + Seawater	2.5% CI-4A 0.75% CI-1A	48.8124	48.7654	0.047	122.41558	3.109	0.003	4
50% Lysine - HCl 1:3 + Seawater	2.5% CI-4A 0.75% CI-1A	48.2122	48.0772	0.135	351.61922	8.931	0.010	5
50% Lysine - HCl 1:3 + Seawater	3% CI-4A 0.75% CI-1A	48.6493	48.538	0.111	289.89051	7.363	0.008	3
50% Lysine - HCl 1:8 + Seawater	0.5% CI-4A 0.6% CI-2 1% CI-1A	50.4895	50.0184	0.471	1227.0208	31.166	0.034	3
50% Lysine - HCl 1:3 + Seawater	3% CI-4A 0.75% CI-1A	50.9392	50.8362	0.103	268.27244	6.814	0.008	8
50% Lysine- HCl 1:3 + Seawater	3.5% CI-4A 0.75% CI-1A	51.2116	51.1125	0.099	258.11455	6.556	0.007	8
50% Lysine - HCl 1:3 + Seawater	3% CI-4A 0.5% CI-1A	50.7036	50.5856	0.118	307.34124	7.806	0.009	9
50% Lysine- HCl 1:3 + Seawater	3.5% CI-4A 0.5% CI-1A	50.5911	50.4468	0.144	375.84188	9.546	0.011	7

Note:
1: slightly foamy coupon was greasy
2: One pit long side, coupon stands
3: No pit
4: two pits long side
5: several pits long side
6: some pitting
7: one medium pit
8: more than one medium pit
9: many deep pits

Table 9 – **Corrosion testing on J-55 steel coupons having a density of 7.86g/ml and a surface area of 28.922 cm^2 at 70°C for a period of 6 hours**

Fluid	Additives	Initial wt (g)	Final wt (g)	Wt loss (g)	Mils/yr	mm/year	lb/ft2
100% Lysine-HCl 1:3	None	33.2827	30.8391	2.444	6178.7058	156.939	0.173
50% Lysine-HCl 1:3 + Distilled water	None	35.0081	34.4093	0.599	1514.0813	38.458	0.042
15% HCl	None	36.7962	34.6209	2.175	5500.3023	139.708	0.154
7.5% HCl	None	36.8248	35.4207	1.404	3550.3032	90.178	0.100

Corrosion Testing on QT-800 steel

Corrosion testing was carried out using a composition according to a preferred embodiment of the present invention at a temperature of 130°C with a QT-800 steel surface area of 34.31cm^2 and a steel density of 7.86 g/ml. The results of this corrosion testing series are reported in Table 10 below.

Table 10 – **Corrosion testing on QT-800 steel coupons having a density of 7.86g/ml and a surface area of 28.922 cm^2 at 130°C for a period of 6 hours**

Fluid	additives	Initial wt (g)	Final wt (g)	Wt loss (g)	Mils/yr	mm/year	lb/ft2	Notes
50% Lysine HCl 1:8 + Seawater	0.5% CI-4A 0.6% CI-2 1% CI-1A	39.3388	38.8587	0.480	1023.3088	25.992	0.027	No pits

The corrosion testing carried out 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) when exposed to a variety of temperatures.

The results obtained for the composition containing only HCl were used as a baseline to compare the other compositions when the temperatures of the testing were above 90°C, the temperature at which urea decomposition into ammonia and carbon dioxide starts to occur.

Additionally, compositions according to preferred embodiments of the present invention will allow the end user to utilize an alternative to conventional acids that have 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 an advantage of the present invention versus the use of HCl at temperatures above 90°C. The reduction in skin corrosiveness, the controlled spending nature, and the high salt tolerance are some other advantages of compositions according to the present invention.

Dissolution Testing

In order to assess the effectiveness of the synthetic acid according to a preferred embodiment of the present invention, dissolution testing was carried out to study the dissolution power of various compositions upon exposure to calcium carbonate. The tests were carried out at a temperature of 23°C and were compared to the efficacy of a solution of 15% HCl and 28% HCl. The results are reported in Table 11 below.

Table 11 – Dissolution results for various acid compositions and total solubility

Fluid	Initial Weight	Final Weight	Weight Loss / g	Acid Solubility %	Total Solubility - kg/m^3
HCl 15%	20.0142	9.3023	10.7119	53.52	214
HCl 15%	25.0018	15.4885	9.5133	38.05	190
HCl 28%	20.0032	0.9922	19.011	95.04	380
HCl 28%	25.0024	3.84442	21.15798	84.62	423
50% Lysine HCl 1:1	15.001	8.851	6.15	41.00	123
50% Lysine HCl 1:2	15.032	5.2723	9.7597	64.93	195
50% Lysine HCl 1:2.5	15.005	4.0452	10.9598	73.04	219
50% Lysine HCl 1:3	15.007	2.1423	12.8647	85.72	257
50% Lysine HCl 1:3 diluted with seawater	15.002	9.0221	5.9799	39.86	120
50% Lysine HCl 1:4	15.024	1.5857	13.4383	89.45	269
50% Lysine HCl 1:5	20.014	4.8421	15.1719	75.81	303
50% Lysine HCl 1:5 diluted with seawater	15.003	7.9723	7.0307	46.86	141
50% Lysine HCl 1:6	20.052	2.7721	17.2799	86.18	346
50% Lysine HCl 1:8	20.0023	2.2158	17.7865	88.92	356
50% Lysine HCl 1:8	25.0012	6.8558	18.1454	72.58	363
50% Lysine HCl 1:8 diluted with seawater	15.0023	6.8921	8.1102	54.06	162
50% Lysine HCl 1:11.5	20.0015	0.1516	19.8499	99.24	397
50% Lysine HCl 1:11.5	25.0024	4.5108	20.4916	81.96	410
50% Lysine HCl 1:11.5 diluted with seawater	15.0021	5.3341	9.668	64.44	193

STABILITY TESTING

Testing was carried out using pressurized ageing cell with Teflon liner in order to assess the stability of various Lysine-HCl compositions according to the present invention. The tests were conducted at a pressure of 300 psi (denoted by an asterisk) and at 400 psi (all other compositions). The results of the tests are reported in table 12 below.

In order to assess the stability of synthetic acids containing urea, the stability of urea was tested by only considering its exposure to higher temperature. Urea 50% diluted with 50% seawater @ 180C for 8h. The following information was gathered during this testing: pH before exposure to high temperature: 7.61; pH after exposure to high temperature: 9.44 and observation of a strong ammonia smell.

Table 12 - Stability Test Using Pressurized Ageing Cell with Teflon Liner

Fluid	Temp (°C)	Test Duration hours	pH before spending	pH after spending	pH after thermal treatment	Solubility before kg/m3	Precipitation
Spent 50% Lysine-HCl 1:2 + Seawater	130	18				195	No
Spent 50% Lysine-HCl 1:2.5 + Seawater *	150	18			2.19	219	No
Spent 50% Lysine-HCl 1:6 + Seawater *	150	18			1.85	346	No
Spent 50% Lysine-HCl 1:2.5 + Seawater *	180	8				219	No
Spent 50% Lysine-HCl 1:6 + Seawater *	180	8					No
Spent 50% Lysine-HCl 1:3 + Seawater	150	8	0.64	2.58	3.7		No
Spent 50% Lysine-HCl 1:5 + Seawater	150	8	0.45	2.33	2.29		No
Spent 50% Lysine-HCl 1:8 + Seawater	150	8	0.35	1.38	1.34		No
Spent 50% Lysine-HCl 1:3 + Seawater	180	8	0.65	2.46	2.42		No
Spent 50% Lysine-HCl 1:5 + Seawater	180	8	0.46	2.25	2.24		No
Spent 50% Lysine-HCl 1:8 + Seawater	180	8	0.34	1.93	1.97		No

Spent 50% Lysine-HCl 1:3 + Seawater	200	8	0.65	2.56	2.6		No
Spent 50% Lysine-HCl 1:5 + Seawater	200	8	0.46	2.36	2.39		No
Spent 50% Lysine-HCl 1:8 + Seawater	200	8	0.34	2.02	2.83		No

DERMAL TESTING

The objective of this study was to evaluate the dermal irritancy and corrosiveness of the composition of Example 2, following a single application to the skin of compositions of lysine-HCl 0f 1:2.5 molar ratio, 1:4 molar ratio and 1:6 molar ratio.

The test surface (human skin located on the back of the hand) was exposed to lysine-HCl compositions of varying ratios – 1:2.5, 1:4 and 1:6. Visual observation of the exposed areas was carried out over time intervals of 15, 30 45 and 60 minutes. The surface was washed after exposure and results were recorded as observations of the surface.

Observations recorded show that there was no blistering or redness effect with any of the 3 concentrations tested. With both higher concentrations the skin was smoothened after the test.

USES OF COMPOSITIONS ACCORDING TO PREFERRED EMBODIMENTS OF THE PRESENT INVENTION

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 treatments; matrix acid squeezes, soaks or bullheads; acid fracturing, acid washes; fracturing spearheads (breakdowns); pipeline scale treatments, cement breakdowns or perforation cleaning; pH control; and de-scaling applications.

Table 13 - Applications for which compositions according to the present invention can be used as well as proposed dilution ranges

Application:	**Suggested Dilution:**	**Benefits:**
Injection/Disposal Wells	50%	Compatible with mutual solvents and solvent blends, very cost effective.
Squeezes & Soaks	33% - 50%	Ease of storage & handling, cost effective compared to conventional acid stimulations. Ability to leave pump

- Bullhead - Annular		equipment in wellbore.
Acid Fracs	50% - 75%	Decreased shipping and storage compared to conventional acid, no blend separation issues, comprehensive spend rate encourages deeper formation penetration.
Frac Spearheads (Break-downs)	33% - 66%	Able to adjust concentrations on the fly. Decreased shipping and storage on location.
Cement Break-downs	50%	Higher concentrations recommended due to lower temperatures, and reduced solubility of aged cement.
pH Control	0.1% - 1.0%	Used in a variety of applications to adjust pH level of water based systems.
Liner De-Scaling, Heavy Oil	1% - 5%	Continuous injection/de-scaling of slotted liners, typically at very high temperatures.

The main advantages of the use of the synthetic acid composition included: the reduction of the total loads of acid, and the required number of tanks by delivering concentrated product to location and diluting with fluids available on location (with low to high salinity production water). Other advantages of the composition according to the present invention include: operational efficiencies which led to the elimination of having to periodically circulate tanks of HCl acid due to chemical separation; reduced potential corrosion to downhole tubulars; and reduced HCl acid exposure to personnel by having a non-low hazard, low fuming acid (lower vapour pressure) on location.

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 from the true scope of the invention in the appended claims.

CLAIMS

1. An aqueous synthetic acid composition comprising:
   - lysine and hydrogen chloride in a molar ratio of not less than 1:12.

2. The synthetic acid composition according to claim 1, wherein the lysine and hydrogen chloride are in a molar ratio of not less than 1:8.

3. The synthetic acid composition according to claim 2, wherein the lysine and hydrogen chloride are in a molar ratio of not less than 1:5.

4. The synthetic acid composition according to claim 2, wherein the lysine and hydrogen chloride are in a molar ratio of not less than 1:4.

5. The synthetic acid composition according to claim 2, wherein the lysine and hydrogen chloride are in a molar ratio of not less than 1:3.

6. The synthetic acid composition according to claim 2, wherein the lysine and hydrogen chloride are in a molar ratio of not less than 1:2.5.

7. The synthetic acid composition according to any one of claims 1 to 6, further comprising formic acid or derivative thereof.

8. The synthetic acid composition according to any one of claims 1 to 7, further comprising a metal iodide or iodate.

9. The synthetic acid composition according to any one of claims 1 to 8, further comprising an alcohol or derivative thereof.

10. The synthetic acid composition according to any one of claims 1 to 9, wherein the metal iodide or iodate is selected from the group consisting of: cuprous iodide; potassium iodide; sodium iodide; lithium iodide and combinations thereof.

11. The synthetic acid composition according to any one of claims 1 to 8, wherein the metal iodide or iodate is potassium iodide.

12. The synthetic acid composition according to any one of claims 1 to 12, wherein the alcohol or derivative thereof is an alkynyl alcohol or derivative thereof.

13. The synthetic acid composition according to claim 13, wherein the alkynyl alcohol or derivative thereof is propargyl alcohol or a derivative thereof.

14. The synthetic acid composition according to claim 13, wherein the alkynyl alcohol or derivative thereof is present in a concentration ranging from 0.01 to 5% w/w.

15. The synthetic acid composition according to claim 17, wherein the alkynyl alcohol or derivative thereof is present in a concentration of 0.2% w/w.

16. An aqueous synthetic acid composition for use in onshore oil and gas operations, said composition comprising:

- lysine and hydrochloric acid in a molar ratio of not less than 1:12;
- a surfactant;
- a corrosion inhibitor; and
- an intensifier.

17. An aqueous synthetic acid composition for use in offshore oil and gas operations, said composition comprising:

- lysine and hydrochloric acid in a molar ratio of not less than 1:12;
- a corrosion inhibitor; and
- an intensifier.

18. The synthetic acid composition according to any one of claims 1 to 17, wherein the metal iodide is present in a concentration ranging from 0.1 to 2% by weight of the total weight of the composition.

19. The synthetic acid composition according to any one of claims 7 to 18, wherein the formic acid or a derivative thereof is selected from the group consisting of: formic acid, acetic acid, ethylformate and butyl formate.

20. The synthetic acid composition according to claim 19, where the formic acid or derivative thereof is present in an amount ranging from 0.05 – 2.0% by weight of the composition.

21. The synthetic acid composition according to claim 20, where the formic acid or derivative thereof is present in an amount of approximately 0.15% by weight of the composition.

22. The synthetic acid composition according to any one of claims 7 to 21, where the formic acid or derivative thereof is formic acid.

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 industry to provide a product that is much less corrosive to aluminum.

25. The use of a synthetic acid composition according to any one of claims 1 to 22 in the oil industry to assist in reducing breakdown pressures during downhole pumping operations.

26. 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.

27. 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.

28. 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.

29. 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.

30. The use of a synthetic acid composition according to any one of claims 1 to 22 in the oil industry to lower the pH of fluids.

31. 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.

32. The use of a synthetic acid composition according to any one of claims 1 to 22 in the oil industry to fracture wells.

33. The use of a synthetic acid composition according to any one of claims 1 to 22 in the oil industry to complete matrix stimulations.

34. 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.

35. 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.

36. 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.

37. 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.

38. The use of a synthetic acid composition according to any one of claims 1 to 22 in the oil industry to clean perforations.

39. 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.

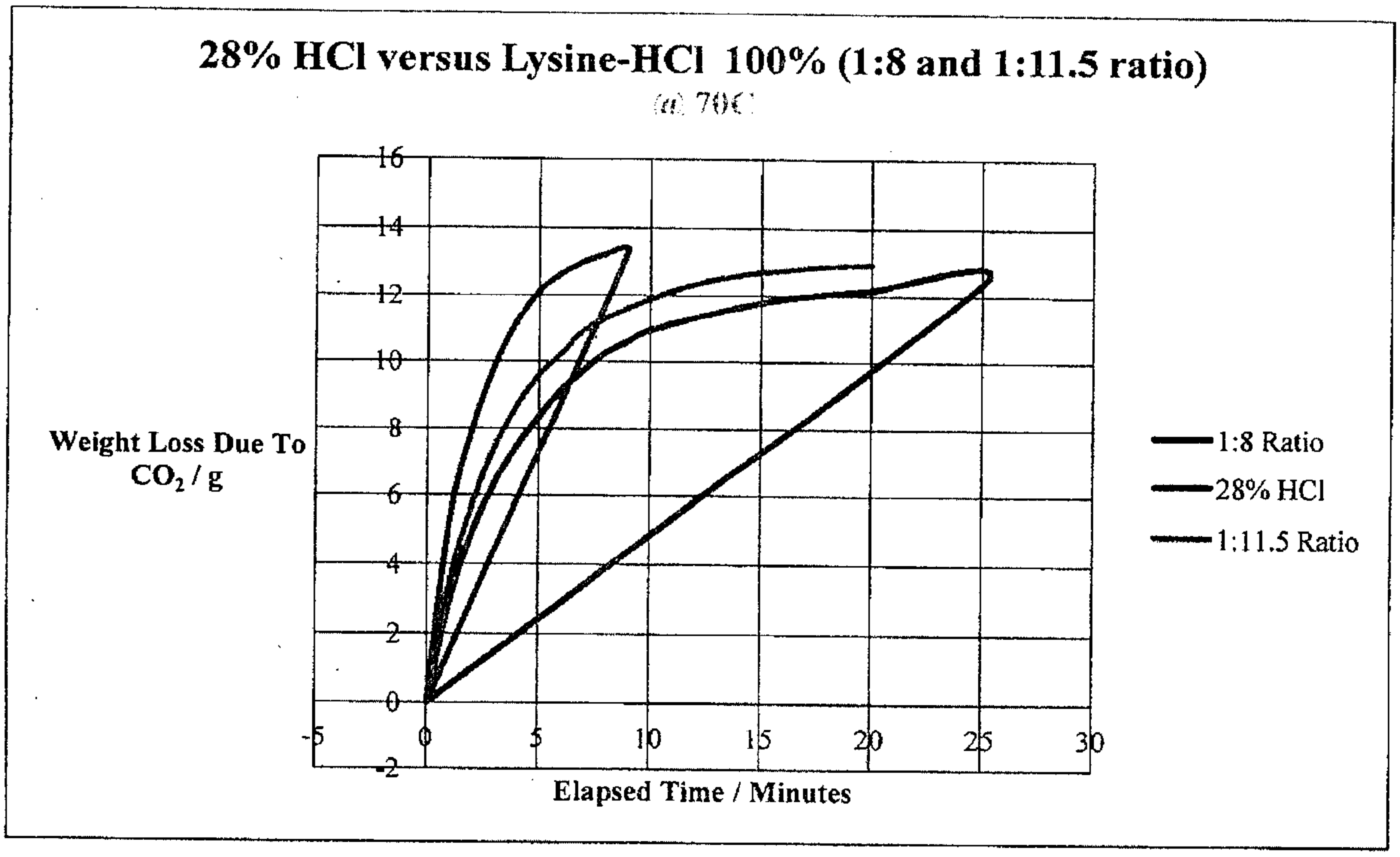
28% HCl versus Lysine-HCl 100% (1:8 and 1:11.5 ratio)
@ 70C
Weight Loss Due To CO₂ / g
16
14
12
10
8
6
4
2
0
-2
-5
0
5
10
15
20
25
30
Elapsed Time / Minutes
1:8 Ratio
28% HCl
1:11.5 Ratio

Figure 1

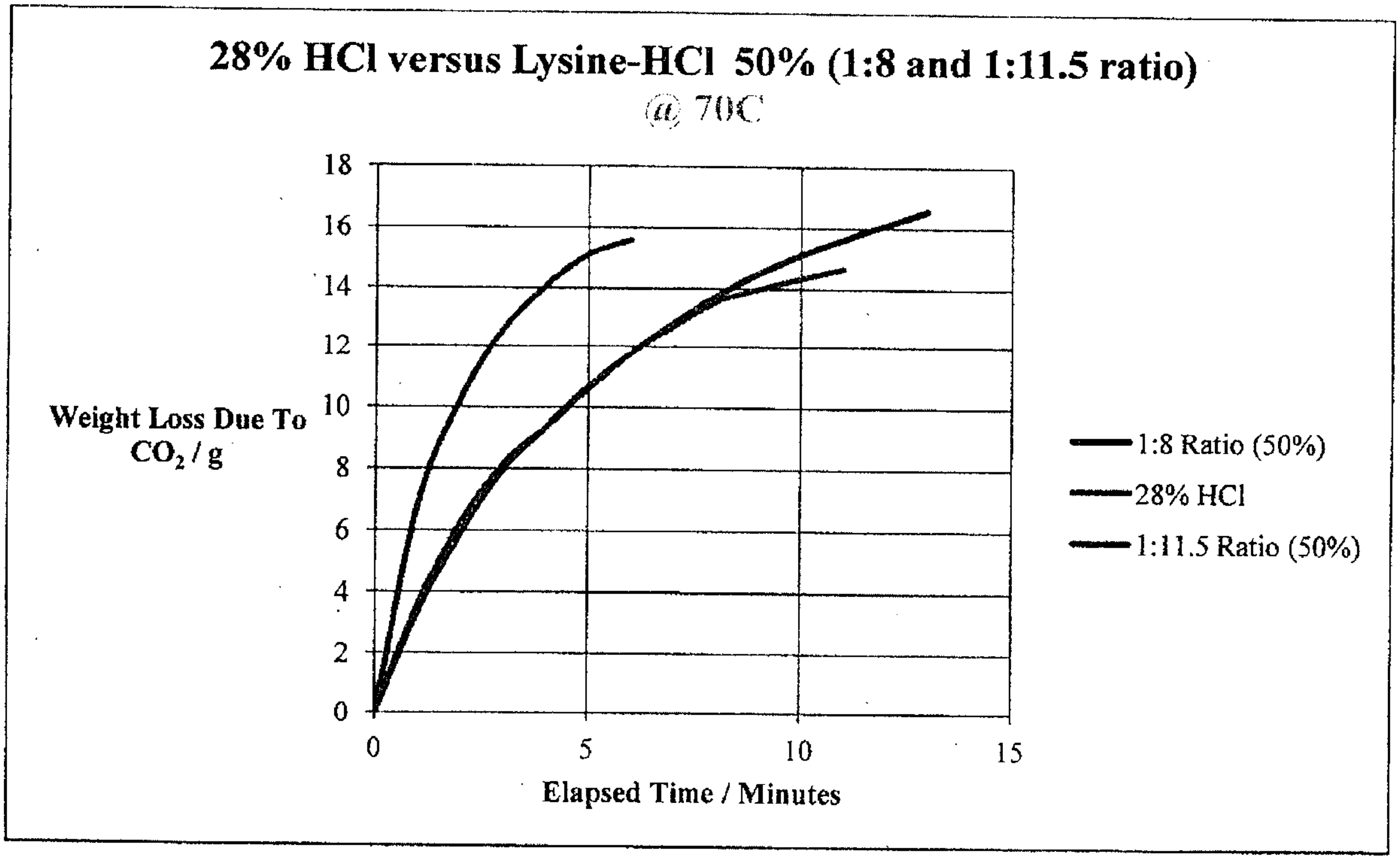
28% HCl versus Lysine-HCl 50% (1:8 and 1:11.5 ratio)
@ 70C
Weight Loss Due To CO2 / g
0
2
4
6
8
10
12
14
16
18
Elapsed Time / Minutes
0
5
10
15
1:8 Ratio (50%)
28% HCl
1:11.5 Ratio (50%)

Figure 2

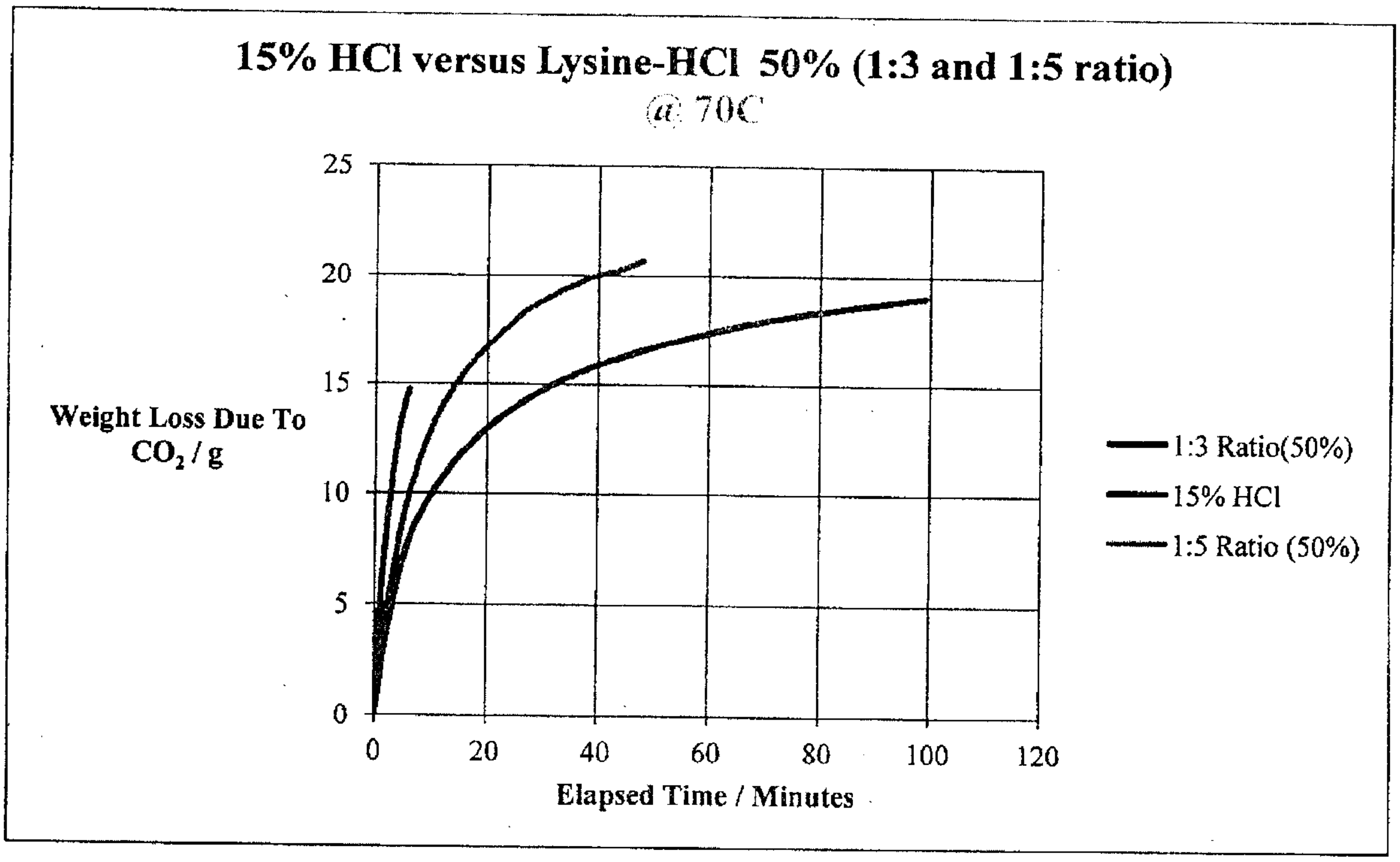
15% HCl versus Lysine-HCl 50% (1:3 and 1:5 ratio)
@ 70C
Weight Loss Due To CO_2 / g
25
20
15
10
5
0
0
20
40
60
80
100
120
Elapsed Time / Minutes
1:3 Ratio(50%)
15% HCl
1:5 Ratio (50%)

Figure 3

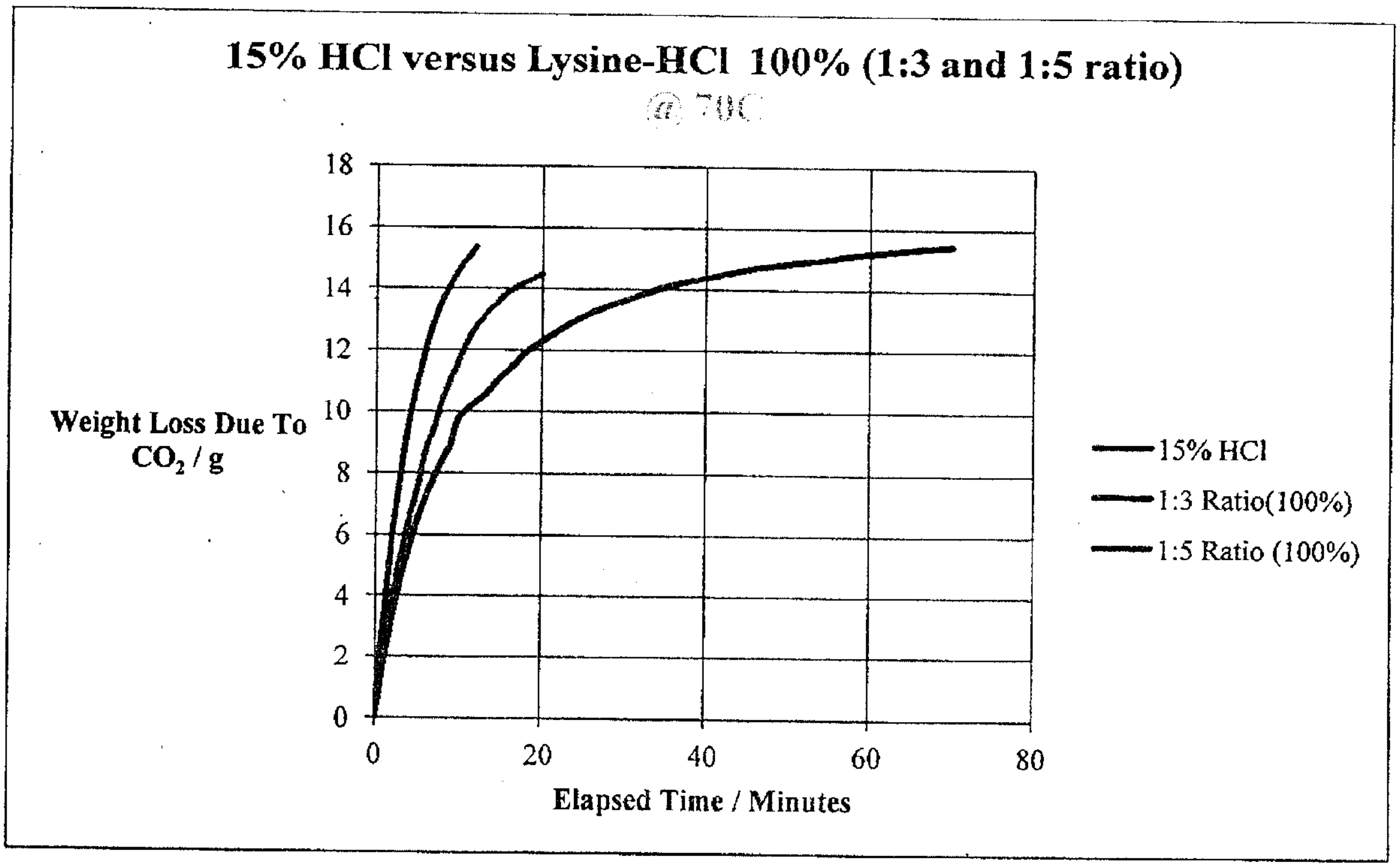
15% HCl versus Lysine-HCl 100% (1:3 and 1:5 ratio)
@ 70C
Weight Loss Due To CO2 / g
0
2
4
6
8
10
12
14
16
18
Elapsed Time / Minutes
0
20
40
60
80
15% HCl
1:3 Ratio(100%)
1:5 Ratio (100%)

Figure 4