



(51) International Patent Classification:

B05D 1/02 (2006.01) **B65D 83/14** (2006.01)
C09D 5/02 (2006.01)

MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ,
OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA,
SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN,
TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(21) International Application Number:

PCT/US2018/036379

(84) Designated States (unless otherwise indicated, for every

kind of regional protection available): ARIPO (BW, GH,
GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ,
UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ,
TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK,
EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV,
MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM,
TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW,
KM, ML, MR, NE, SN, TD, TG).

(22) International Filing Date:

07 June 2018 (07.06.2018)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

62/516,191 07 June 2017 (07.06.2017) US

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Declarations under Rule 4.17:

— of inventorship (Rule 4.17(iv))

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Published:

— with international search report (Art. 21(3))
— before the expiration of the time limit for amending the
claims and to be republished in the event of receipt of
amendments (Rule 48.2(h))

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(81) Designated States (unless otherwise indicated, for every
kind of national protection available): AE, AG, AL, AM,
AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ,
CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO,
DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN,
HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP,
KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME,

(54) Title: PRESSURIZED SPRAY SYSTEMS USING CARBON DIOXIDE

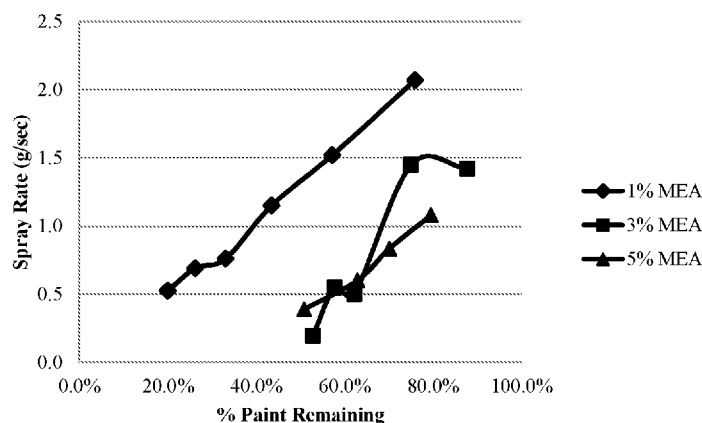


FIG. 2

(57) Abstract: A pressurized spray system is disclosed which includes a sealed container and an aqueous composition disposed inside the sealed container. The aqueous composition includes an amine solubilizer, and solubilized and gaseous carbon dioxide. Aerosol paint products and methods of making such systems and products are also disclosed.

PRESSURIZED SPRAY SYSTEMS USING CARBON DIOXIDE

REFERENCE TO RELATED APPLICATIONS

[0001] The present application claims the priority of U.S. provisional application Serial No. 62/516,191, entitled PRESSURIZED SPRAY SYSTEMS USING CARBON DIOXIDE, filed June 7, 2017, and hereby incorporates the same application herein by reference in its entirety.

TECHNICAL FIELD

[0002] The present disclosure generally relates to the use of carbon dioxide for pressurized spray systems including aerosol canisters.

BACKGROUND

[0003] Pressurized spray systems, such as aerosol canisters, are useful for the production of a fine dispersion of droplets, or particles, of a benefit agent using a pressurized gas system. Such systems can be useful to quickly apply benefit agents such as paints, cleaning agents, fuels, insecticides, and the like to a substrate and/or volume of air. Generally, the systems include a propellant system to generate the pressure differential necessary to deliver the benefit agent. Conventional propellant systems suffer from a number of drawbacks however. For example, conventional propellant systems operate using undesirable chemicals such as ozone-depleting chlorofluorocarbons or operate using flammable hydrocarbons. It would be advantageous to provide an improved pressurized spray system which matches, or exceeds, the performance of conventional systems while being both safer and environmentally friendly.

SUMMARY

[0004] In accordance with one embodiment, a pressurized spray system includes a sealed container and an aqueous composition disposed within the sealed container. The aqueous composition includes a solubilizer and solubilized carbon dioxide and gaseous carbon dioxide. The solubilizer includes one or more of a primary amine, a secondary amine, and a tertiary amine. The solubilized carbon dioxide is in equilibrium with the gaseous carbon dioxide.

[0005] In accordance with another embodiment, a method of forming a pressurized spray system includes adding a solubilizer to water to form a propellant mixture, sealing the propellant mixture inside a sealed container, and pressurizing the sealed container by adding carbon dioxide to the sealed container at a pressure of about 100 pounds per square inch ("psi") to about 140 psi.

[0006] In accordance with another embodiment, an aerosol paint product includes a sealed container and a propellant mixture and a water-based paint composition disposed within the sealed container. The container includes a can, a valve cup with a valve assembly, a dip tube, and an actuator. The propellant mixture includes water, a solubilizer, and carbon dioxide. The solubilizer includes one or more of a primary amine, a secondary amine, and a tertiary amine.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] FIG. 1 depicts a graph illustrating the quantity of carbon dioxide that can be dissolved in an aerosol canister including varying amounts of a solubilizer according to one embodiment.

[0008] FIG. 2 depicts a graph illustrating the spray rate of the aerosol canisters of FIG. 1.

[0009] FIG. 3 depicts a graph illustrating the spray performance of aerosol canisters including an organic solvent according to certain embodiments.

[0010] FIG. 4 depicts a graph illustrating the rheological profiles of propellant spray systems according to certain embodiments.

DETAILED DESCRIPTION

[0011] Pressurized spray systems, such as aerosol canisters, typically operate by pressurizing a container with a suitable propellant composition having a pressurized gas phase in equilibrium with a bulk liquid phase. As the pressurized gas phase is released to the lower pressure outside of the container, the liquid phase evaporates, or releases additional solubilized propellant, to maintain the pressure of the gas phase. As can be appreciated, conventional propellant compositions, typically formed from chlorofluorocarbons or hydrocarbons, are undesirable however due to detriments such as health concerns, ozone-depleting effects, and flammability.

[0012] An improved propellant system is described herein that obviates such concerns by including a pressurized gas phase formed of carbon dioxide gas. As can be appreciated, carbon dioxide is relatively safe for exposure to humans, is non-flammable, has low odor, and is less environmentally damaging than chlorofluorocarbons or other more potent greenhouse gases such as methane. It has been discovered that pressurization of the carbon dioxide gas phase can be maintained by dissolving excess carbon dioxide in a liquid solvent which can replenish any carbon dioxide gas released during use of the pressurized spray system.

[0013] According to certain embodiments, suitable liquid solvents for the pressurized spray systems described herein can include any liquid that can solubilize an appropriate amount of carbon dioxide including certain aqueous compositions and certain organic solvents.

[0014] As can be appreciated, water does not inherently solubilize large quantities of carbon dioxide and propellant systems including only carbon dioxide and water would suffer from immediate pressure drops. It has been discovered however, that suitable aqueous compositions can be formed by dissolving one or more solubilizers in water to enhance the quantity of carbon dioxide that can be dissolved in the composition. Generally, suitable solubilizers can enhance the solubility of carbon dioxide in water-based compositions by using hydrogen bonding interactions to stabilize the dissolved carbon dioxide molecules. As can be appreciated, a variety of polar compounds can exhibit such suitable hydrogen bonding interactions including compounds containing nitrogen or fluorine groups.

[0015] For example, in certain embodiments, suitable solubilizers for the described aqueous compositions can include primary, secondary, and tertiary amine compounds. Examples of such amine compounds can include triethanolamine, diethanolamine, monoethanolamine, aminomethanol, aminoethanol, aminopropanol, triisopropanolamine, trimethanolamine, and tripropanolamine. As can be further appreciated however, other compounds which can enhance the solubility of carbon dioxide in aqueous compositions can also be suitable. For example, certain polymers having polar side chains can also be suitable. In certain embodiments, suitable solubilizers can be selected from one or more of triethanolamine, diethanolamine, and monoethanolamine.

[0016] According to certain embodiments, suitable solubilizers can advantageously demonstrate additional properties which make such compounds particularly suitable for use in the disclosed pressurized spray systems. For example, suitable solubilizers can advantageously be a liquid over the entire expected operating temperatures of the pressurized spray systems. Such properties can prevent undesirable fluctuations in pressure and can improve the lifespan of the system by preventing the loss of carbon dioxide when the solubilizer undesirably freezes or evaporates. In certain embodiments, suitable solubilizers can be liquid at temperatures of about 5 °C to about 60 °C, in certain embodiments, liquid at temperatures of about 10 °C to about 45 °C, and in certain embodiments, liquid at about room temperature (e.g., at about 23 °C). As can be appreciated, solubilizers having different melting points and boiling points can be selected if the pressurized spray system is to be operated under different temperature profiles.

[0017] As can be appreciated, the performance of a solubilizer can also be enhanced by being readily miscible, or soluble, with the aqueous compositions. In certain embodiments, suitable solubilizers can have a water solubility, when measured at about 20 °C, of about 7.5 g/L or more, about 10 g/L or more in certain embodiments, and about 15 g/L or more in certain embodiments. Such solubility rates can facilitate the ready loading of adequate amounts of the solubilizer into the pressurized spray systems.

[0018] In certain embodiments, suitable solubilizers can additionally be modified to further improve the properties of a pressurized spray system. For example, in embodiments where the delivered benefit agent is a paint, it can be useful to increase the hydrophobicity of the solubilizer to improve both the quality and the lifespan of the painted substrates. Increasing the hydrophobicity of a solubilizer by inclusion of, for example, a silane coupling agent, can prevent softening, wrinkling, or discoloration of painted substrates when the painted substrate is exposed to water or moisture.

[0019] In certain embodiments, suitable silane treatment agents for the modification of the solubilizers can include alkylsilanes such as triethoxyoctylsilane, epoxy silanes, phenyl silanes, and amino silanes. As can be appreciated, silane treatment agents can also be commercially obtained from suppliers such as the Dow Chemical Company (Midland, MI) under such brands as Xiameter®. In certain embodiments including a silane treatment agent, the quantity of a silane

treatment agent can be selected based on a qualitative evaluation of the pressurized spray system. For example, the quantity of a silane treatment agent can be selected by evaluating the quality of paint films formed with varying quantities of a silane treatment agent after a 1-hour water exposure test. The amount of softening, wrinkling, and discoloration observed after a 1-hour water exposure test can vary depending on the quantity, and selection, of a silane treatment agent.

[0020] Additionally, ammonium hydroxide can optionally be included in pressurized spray systems to further enhance carbon dioxide solubility. For example, in certain embodiments, the aqueous composition can include about 0.03% to about 1.5%, by weight, ammonium hydroxide. As can be appreciated, the ammonium hydroxide can be provided in any suitable form. For example, ammonium hydroxide can be formed as a solution (e.g., as a 30% active solution) and can then be added to the aqueous composition of the pressurized spray system as a solution. In certain embodiments, a pressurized spray system can optionally include about 0.1% to about 5%, by weight of the aqueous composition, of a 30% active ammonium hydroxide solution.

[0021] As will be appreciated, the quantity of solubilizer included in a pressurized spray system is important. The inclusion of insufficient quantities of a solubilizer, for example, can lead to pressurized spray systems having insufficient carbon dioxide to maintain spray pressures and spray times over the desired life of the system. Conversely, the inclusion of excess solubilizer can stabilize and strongly bind carbon dioxide to an aqueous composition and can prevent sufficient replenishment of the pressurized carbon dioxide phase during use of the spray system. In certain embodiments, a solubilizer can be included in quantities sufficient to ensure that about 0.5% to about 15%, by weight, of the pressurized spray system is carbon dioxide; in certain embodiments, about 0.75% to about 10%, by weight, is carbon dioxide; in certain embodiments, about 1% to about 7%, by weight, is carbon dioxide; in certain embodiments, about 1.5% to about 4%, by weight, is carbon dioxide; and in certain embodiments, about 2% to about 3%, by weight, is carbon dioxide. In certain embodiments, the loading quantity of a solubilizer can be about 0.1% to about 10%, by weight of the aqueous composition, to achieve such carbon dioxide loading levels. In certain embodiments, the loading quantity of a solubilizer can be about 1% to about 3%, by weight of the aqueous composition.

[0022] In certain embodiments, the performance of a pressurized spray system including an aqueous solubilizer can be optionally enhanced through inclusion of a secondary propellant. Inclusion of a secondary propellant can improve atomization and can reduce, or eliminate, coarse spray emission, such as spitting. Generally, any known aerosol propellants can be useful as a secondary propellant such as, for example, dimethyl ether. As can be appreciated, inclusion of carbon dioxide reduces the amount of known propellants required for effective operation of a pressurized spray system. For example, in certain embodiments including a secondary propellant, the aqueous composition of a pressurized spray system can include about 1% to about 20%, by weight, of the secondary propellant. In certain embodiments, the pressurized spray systems described herein can be free of, or substantially free of, any conventional propellants.

[0023] In other certain embodiments, the liquid solvent can be an organic solvent. Similarly to the solubilizers of the aqueous compositions, suitable organic solvents can solubilize sufficient quantities of carbon dioxide through stabilization of carbon dioxide. For example, polar organic solvents can dissolve relatively large quantities of carbon dioxide through hydrogen bonding interactions with carbon dioxide molecules. Table 1 illustrates the propensity of polar organic solvents to dissolve carbon dioxide by comparing the liters of carbon dioxide that can be dissolved in 1 liter of various polar organic solvents and the liters that can be dissolved in a non-polar mineral oil.

TABLE 1

Solvent	Dissolved Carbon Dioxide (liters)
Dimethoxy methane	9.5
Ethanol	2.6
Amyl Acetate	4.1
Mineral Oil	0.8

[0024] As illustrated by Table 1, polar organic solvents can dissolve large quantities of carbon dioxide while aliphatic mineral oil can dissolve only about as much carbon dioxide as pure water which can dissolve 0.82 liters.

[0025] Suitable organic solvents can have a carbon dioxide mole fraction, at partial pressure 101.3 kPa, of about 0.005 or more, about 0.010 or more, about 0.015 or more, about 0.020 or more, and about 0.023 or more according to various embodiments. Examples of such organic solvents can include 2-propanone (acetone), methyl acetate, ethyl acetate, propyl acetate, 2-methyl propyl acetate, t-butyl acetate, and dimethoxy methane (methylal). The carbon dioxide mole fraction at partial pressure of 101.3 kPa of additional organic solvents is depicted in Table 2.

TABLE 2

Solvent	Mol Fraction Solubility of CO ₂
2-Propanone	0.0211
Cyclopentanone	0.01641
Cyclohexanone	0.0160
2,6-Dimethylcyclohexanone	0.0168
Benzaldehyde	0.0115
4-Methyl-1,3-dioxolan-2-one	0.01210
Acetic acid	0.01120
Propanoic acid	0.0123
Butanoic acid	0.0130
9-Octadecenoic acid	0.0157
Acetic anhydride	0.0199
Methyl acetate	0.0208
Ethyl acetate	0.0226
Propyl acetate	0.0230
2-Methylpropyl acetate	0.0245
Pentyl acetate	0.0250
Pentyl formate	0.02584
Pentyl formate	0.0212
Ethyl stearate	0.0190
Methyl oleate	0.0269
Ethyl oleate	0.0277
Butyl oleate	0.0279
1,2,3-Propanetriol triacetate	0.0284
	0.0222
1,1'-Oxybisethane	0.0233
Tetrahydrofuran	0.027
1,4-Dioxane	0.02272

Oxybispropanol	0.00826
Triethylene glycol	0.00846
2-Methoxyethanol	0.0100
Phenol	0.0047
3-Methylphenol	0.0059

[0026] According to certain embodiments, pressurized spray systems loaded with suitable organic solvents can dissolve about 3% to about 15%, by weight of the composition, carbon dioxide, about 5% to about 10%, by weight of the composition, carbon dioxide in certain embodiments, about 6% to about 9%, by weight of the composition, carbon dioxide in certain embodiments, about 7% to about 9%, by weight of the composition, carbon dioxide in certain embodiments, and about 7% to about 7.5%, by weight of the composition, carbon dioxide in certain embodiments.

[0027] At such carbon dioxide loading levels, advantageous pressurized spray system can be formed by filling about 30% to about 60% of a canister with the organic solvent, about 35% to about 50% of a canister with the organic solvent, and about 40% of a canister with the organic solvent. Loading of the canister at reduced volumes, such as a loading of about 40%, can be used to raise the pressure of a pressurized spray system.

[0028] As can be appreciated, the intended use of the pressurized spray system can influence the choice of the organic solvent. For example, in pressurized spray systems intended to deliver a paint benefit agent, the evaporation rate of the organic solvent can influence the quality of the paint coating formed. Fast evaporating solvents, such as acetone, can evaporate quickly and can cause the paint to exhibit diminished gloss characteristics, irregular application and leveling, and can cause the aerosol canister to exhibit uneven flow rates. Conversely, slowly evaporating solvents, such as methyal, can cause dripping or sagging of the paint after application due to excessive drying times.

[0029] The use of multiple organic solvents can obviate such detriments and can allow for the solvent evaporation time to be optimized for the particular benefit agent being delivered. For example, in embodiments including a paint benefit agent, a mixture of a fast evaporating and a slow evaporating solvent can allow for the formation of paint films of excellent quality and can allow the aerosol canister to deliver consistent spray performance.

[0030] The use of carbon dioxide and the liquid solvents described herein can allow pressurized spray systems to exhibit a number of beneficial qualities. For example, such solvents can allow for aerosol canisters to have linear temperature/pressure curves, be non-flammable, non-toxic, have low odors, and be volatile organic compound ("VOC") free. As used herein, VOC means an organic solvent capable of vaporizing at atmospheric pressure and temperatures of about 35 °F to about 140 °F. As can be appreciated, the release of carbon dioxide from a liquid solvent is not highly dependent upon temperature in contrast to conventional bulk liquid propellants. Such temperature independence can allow for a more consistent spray pressure to be maintained. Additionally, a paint sprayed by the system can be cleaned up using soap and water.

[0031] As can be appreciated, a large variety of benefit agents can be delivered via the pressurized spray systems described herein. For example, in embodiments including an aqueous composition for the loading of carbon dioxide, any type of aqueous-compatible benefit agent can be sprayed including cleaning products, lubricants, air fresheners, degreasers, insecticides, and water-based paints.

[0032] In certain embodiments, a water-based paint can be a latex paint such as a styrene acrylic latex paint, vinyl acrylic latex paint, ethylene vinyl acetate latex paint, or a polyurethane dispersion paint. As can be further appreciated however, additional suitable water-based paints can be prepared by polymerizing at least one ethylenically unsaturated monomer in water using surfactants and water soluble initiators. Typical ethylenically unsaturated monomers include vinyl monomers, acrylic monomers, allylic monomers, acrylamide monomers and mono- and dicarboxylic unsaturated acids. Vinyl esters include vinyl acetate, vinyl propionate, vinyl butyrates, vinyl isopropyl acetates, vinyl neodeconate and similar vinyl esters; vinyl halides include vinyl chloride, vinyl fluoride and vinylidene chloride; vinyl aromatic hydrocarbons include styrene, a-methyl styrene, and similar lower alkyl styrenes. Acrylic monomers include monomers such as lower alkyl esters of acrylic or methacrylic acid having an alkyl ester portion containing between 1 to 12 carbon atoms as well as aromatic derivatives or acrylic and methacrylic acid. Useful acrylic monomers include, for example, acrylic and methacrylic acid, methyl acrylate, and methacrylate, ethyl acrylate and methacrylate, butyl acrylate and methacrylate, propyl acrylate and methacrylate, 2-ethyl hexyl acrylate and methacrylate, cyclohexyl acrylate and methacrylate, decyl

acrylate and methacrylate, isodecylacrylate and methacrylate, and benzyl acrylate and methacrylate.

[0033] As can be appreciated, many additional benefit agents and variations are possible. For example, pressurized spray systems can also be used as “compressed air” cleaning system, or can be used as a plaster spraying system.

[0034] As can be appreciated, a pressurized spray system can include a number of additional components in certain embodiments. For example, one or more surface additives, rheology modifiers, defoamers, surfactants, flow/leveling additives, fillers, pH modifiers, extenders, and biocides can be included depending upon the requirements of the benefit agent to be delivered. Generally, such additives can be selected from known, or commercially obtainable, additives known for use in the aerosol or film coating industries.

[0035] For example, rheology modifiers, such as a hydrophobically modified ethylene oxide urethane, can be included to increase, or decrease, the viscosity of the compositions at specific shear rates. For example, in certain embodiments which provide a paint benefit agent, it can be useful to include a rheology modifier to decrease the shear rate and improve the quality of the paint coating. In certain embodiments, a rheology modifier can be included at about 0.5% to about 20%, by weight of the composition.

[0036] As can be appreciated, carbon dioxide reacts with water to acidify the solution through the formation of carbonic acid. In certain embodiments, the components of the pressurized spray system can be selected to operate across a range of pH values that can be encountered during use of the system. For example, in certain embodiments, a latex paint formulation can be selected that is functional at pH values of about 6 to about 11. In certain such embodiments, the pressurized spray system without carbon dioxide loading can have a pH of about 11. Upon pressurization with carbon dioxide, the pH of the system can be reduced to about 7. As the spray system is exhausted, the pH can rise as carbon dioxide is lost.

[0037] Generally, the described pressurized spray systems can be used in any type of sealed canister including both plastic and metallic canisters. For example, plastic canisters can be utilized to reduce material costs and weight. As can be appreciated however, metal canisters, such as

aluminum or steel canisters, can also, or alternatively, be utilized. In such embodiments, corrosion inhibitors can optionally be included to prevent damage and increase the lifespan of the canister. In certain embodiments however, the pressurized spray systems described herein can be substantially free of corrosion inhibitors. As used herein, the phrase “substantially free of” means that the component is included only as an incidental component of another added component. Without being bound by theory, it is believed that the alkaline pH of the pressurized spray system can minimize corrosion.

[0038] Advantageously, the pressurized spray system described herein can be used without requiring extensive modification to known components of pressurized spray systems. For example, known actuators, valve assemblies, dip tubes, and spray heads for aerosol canisters can be utilized in certain embodiments. Certain examples of suitable components are described in U.S. Patent Nos. 5,647,408 and 7,064,167 each of which are incorporated herein by reference.

[0039] According to certain embodiments, an aerosol canister loaded with a latex paint can be prepared from the pressurized spray systems described herein. For example, a latex paint aerosol canister can be prepared by the following process. 1) Providing a mixture of water and amine. 2) After agitation, adding a silane-coupling agent, such as epoxy silane, to the mixture of water and amine. 3) Adding additives including defoamers, and flow/leveling agents to the mixture. 4) Adding the resulting mixture to a latex paint mixture formed of styrene acrylic latex and a polyurethane dispersion. 5) Adding additional components such as rheology modifiers, pigments, and fillers to adjust the shear rate, color and sheen of the paint mixture. 6) Transferring the mixture to an aerosol can. And 7) Sealing the aerosol can and injecting carbon dioxide to pressurize the system. According to various embodiments, each of steps 1 to 5 can be interchangeable.

[0040] EXAMPLES

[0041] FIGS. 1 and 2 depict graphs illustrating the importance of solubilizer loading levels to the pressurized spray systems described herein. The components and weight percentages of the aqueous solution of FIGS. 1 and 2 are depicted in Table 3.

TABLE 3

Component	Weight Percent
Deionized Water	59.5%
Acrylic Emulsion	24.0%
Polyurethane Dispersion	6.0%
Silicone Defoamer	0.5%
Black Dispersion	1.5%
Dipropylene glycol methyl ether	0.5%
Benzisothiazolone (biocide)	0.05%
Polydimethylsiloxane	0.25%
Urethane	3.25%
Epoxy alkylsilane ester	1.5%
Monoethanolamine	Variable
Carbon Dioxide	Variable

[0042] FIG. 1, for example, depicts the amount of carbon dioxide which can be loaded into a 12oz aerosol can pressurized to 120 psi as the weight percentage of monoethanolamine is varied.

[0043] As illustrated by FIG. 1, increased weight percentages of monoethanolamine allow for increased loading quantities of carbon dioxide. FIG. 2 illustrates, however, that aerosol canisters with excess monoethanolamine levels can exhibit poor spray performance including the inability to evacuate all of the paint from the aerosol can.

[0044] Table 4 depicts organic solvent blends labeled as Samples 1 to 5. FIG. 3 depicts six Example pressurized spray systems formed using Samples 1 to 5 and illustrates the spray pressure of an aerosol canisters loaded with such Samples. The aerosol cans of FIG. 3 were filled with varying amounts of the Sample Blends. Examples 1 and 2 were filled with 75% and 50% respectively of Sample 1. Example 3 was filled with 50% Sample 2. Examples 4 to 6 were filled with 60% of Samples 3 to 5 respectively.

TABLE 4

Solvent (Weight Percent)	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5
Acetone	0	5	10	10	10
Methyl Acetate	72	67	56.5	51.5	61.5
Ethyl Acetate	0	0	5	10	0
Acrylic Resin	20.8	20.8	21	21	21
Carbon Dioxide	7.2	7.2	7.5	7.5	7.5

[0045] Example 6 depicted in Table 5, depicts the component weight ranges for a pressurized spray system formed with an aqueous-based propellant system.

TABLE 5

Component	Quantity
Water	5% to 50%
Triethanolamine, diethanolamine, or monoethanolamine optionally treated with an epoxy silane	0.1% to 10%
Hydrophobically modified ethylene oxide urethane rheology modifier	0.1% to 10%
Benefit Agent (polymer emulsion/dispersion)	5% to 50%
Carbon Dioxide	1% to 10%

[0046] FIG. 4 depicts a graph showing the rheological profile of Examples 6 to 9. The rheological profile of Ex. 9 is particularly suitable.

[0047] The dimensions and values disclosed herein are not to be understood as being strictly limited to the exact numerical values recited. Instead, unless otherwise specified, each such dimension is intended to mean both the recited value and a functionally equivalent range surrounding that value.

[0048] It should be understood that every maximum numerical limitation given throughout this specification includes every lower numerical limitation, as if such lower numerical limitations

were expressly written herein. Every minimum numerical limitation given throughout this specification will include every higher numerical limitation, as if such higher numerical limitations were expressly written herein. Every numerical range given throughout this specification will include every narrower numerical range that falls within such broader numerical range, as if such narrower numerical ranges were all expressly written herein.

[0049] Every document cited herein, including any cross-referenced or related patent or application, is hereby incorporated herein by reference in its entirety unless expressly excluded or otherwise limited. The citation of any document is not an admission that it is prior art with respect to any invention disclosed or claimed herein or that it alone, or in any combination with any other reference or references, teaches, suggests, or discloses any such invention. Further, to the extent that any meaning or definition of a term in this document conflicts with any meaning or definition of the same term in a document incorporated by reference, the meaning or definition assigned to that term in the document shall govern.

[0050] The foregoing description of embodiments and examples has been presented for purposes of description. It is not intended to be exhaustive or limiting to the forms described. Numerous modifications are possible in light of the above teachings. Some of those modifications have been discussed and others will be understood by those skilled in the art. The embodiments were chosen and described for illustration of various embodiments. The scope is, of course, not limited to the examples or embodiments set forth herein, but can be employed in any number of applications and equivalent articles by those of ordinary skill in the art. Rather it is hereby intended the scope be defined by the claims appended hereto.

WHAT IS CLAIMED IS:

1. A pressurized spray system comprising:

a sealed container; and

an aqueous composition disposed within the sealed container, the composition comprising:

a solubilizer comprising one or more of a primary amine, a secondary amine, and a tertiary amine; and

solubilized carbon dioxide and gaseous carbon dioxide, wherein the solubilized carbon dioxide is in equilibrium with the gaseous carbon dioxide.
2. The pressurized spray system of claim 1, wherein the solubilizer comprises one or more of triethanolamine, diethanolamine, and monoethanolamine.
3. The pressurized spray system of claim 1, wherein the solubilizer is a liquid at temperatures of about 10 °C to about 30 °C.
4. The pressurized spray system of claim 1, wherein the solubilizer has a water solubility of at least about 10 g/L at 20 °C.
5. The pressurized spray system of claim 1, wherein the solubilizer is modified by a silane treatment agent.
6. The pressurized spray system of claim 1, wherein the aqueous composition comprises about 2% or less of the solubilizer.
7. The pressurized spray system of claim 1, wherein the aqueous composition comprises about 1% to about 10%, by weight, carbon dioxide.
8. The pressurized spray system of claim 1, wherein the aqueous composition comprises about 2% to about 3%, by weight, carbon dioxide.
9. The pressurized spray system of claim 1, further comprising a benefit agent, and wherein the benefit agent comprises a water-based paint.

10. The pressurized spray system of claim 9, wherein the water-based paint comprises one or more of a styrene acrylic latex paint, vinyl acrylic latex paint, ethylene vinyl acetate latex paint, and a polyurethane dispersion paint.
11. The pressurized spray system of claim 1, further comprising one or more of a rheology modifier, a defoamer, a flow and leveling additive, and a filler.
12. The pressurized spray system of claim 1, further comprising about 1% to about 20%, by weight, of a secondary propellant comprising dimethyl ether.
13. The pressurized spray system of claim 1, further comprising about 0.03% to about 1.5%, by weight, of ammonium hydroxide.
14. The pressurized spray system of claim 1, wherein the aqueous composition comprises about 5% to about 50% water.
15. A method of forming a pressurized spray system comprising:
 - adding a solubilizer to water to form a propellant mixture, wherein the solubilizer comprises one or more of a primary amine, a secondary amine, and a tertiary amine;
 - sealing the propellant mixture inside a sealed container; and
 - pressurizing the sealed container by adding carbon dioxide to the sealed container at a pressure of about 100 pounds per square inch ("psi") to about 140 psi.
16. The method of claim 15, wherein the solubilizer comprises one or more of a primary amine, a secondary amine, and a tertiary amine.
17. The method of claim 15, wherein the contents of the sealed container comprise about 1% to about 10%, by weight, carbon dioxide.
18. The method of claim 15, further comprising the step of including a benefit agent in the sealed container, and wherein the benefit agent is a latex paint.

19. The method of claim 15, further comprising the step of adding one or more of a rheology modifier, a defoamer, a flow and leveling additive, and a filler to the sealed container.

20. An aerosol paint product comprising:

a sealed container comprising a can, a valve cup with a valve assembly, a dip tube, and an actuator; and

a propellant mixture and a water-based paint composition disposed within the sealed container; wherein the propellant mixture comprises water, a solubilizer, and carbon dioxide, and wherein the solubilizer comprises one or more of a primary amine, a secondary amine, and a tertiary amine.

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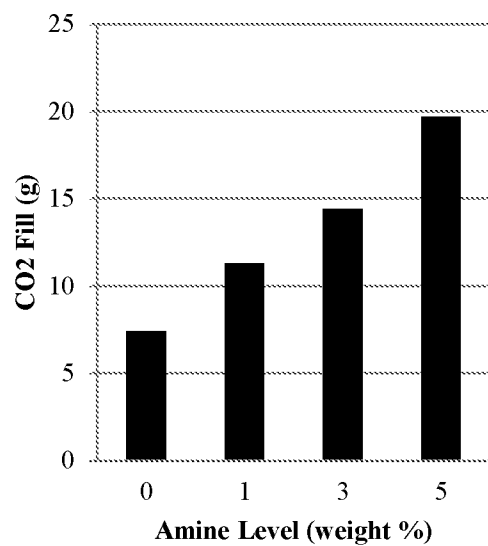


FIG. 1

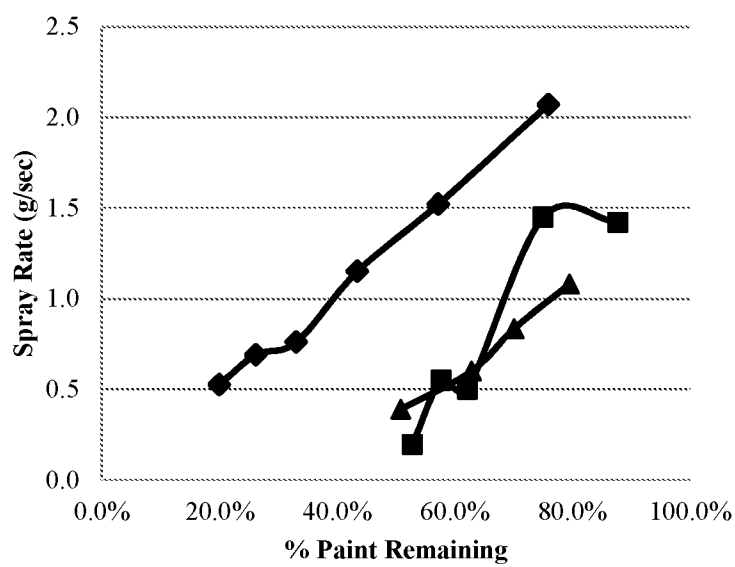


FIG. 2

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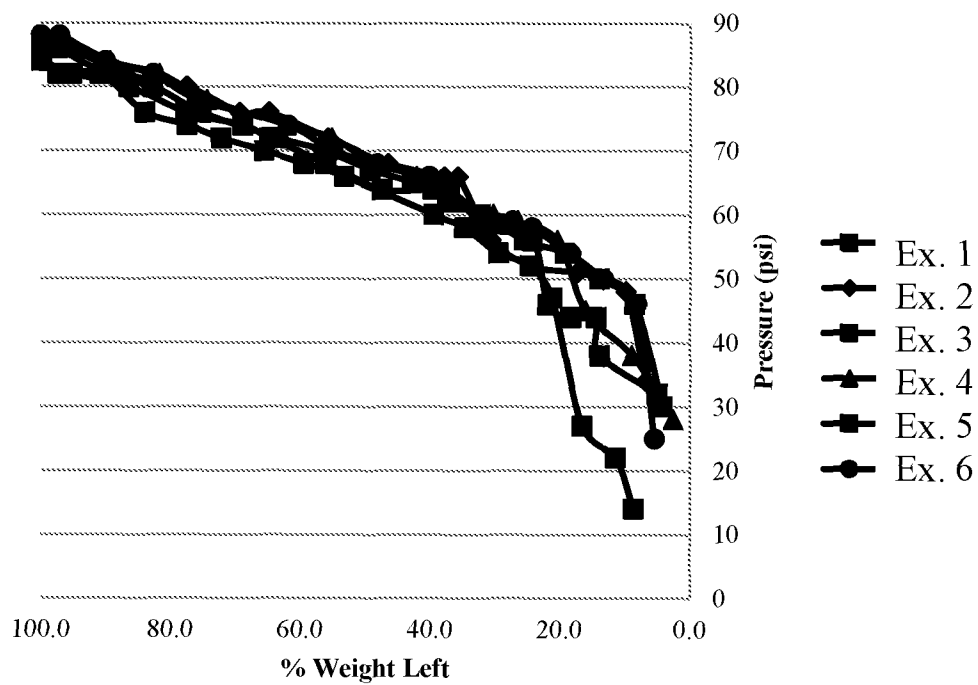


FIG. 3

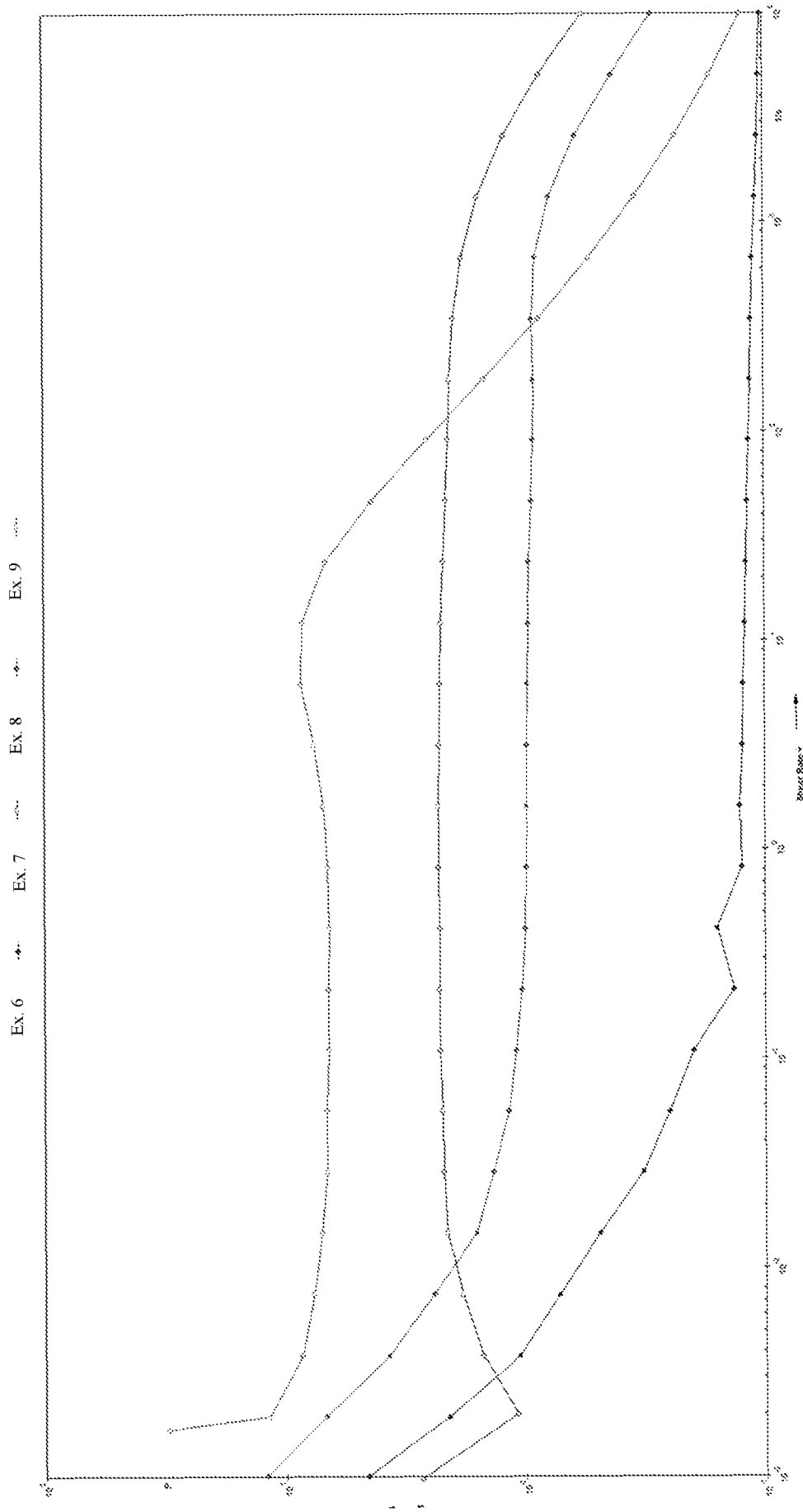


FIG. 4

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2018/036379

A. CLASSIFICATION OF SUBJECT MATTER
INV. B05D1/02 C09D5/02 B65D83/14
ADD.

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B05D C09D B65D

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

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

EPO-Internal

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X	WO 2010/138266 A2 (ELC MAN LLC [US]; LENTINI PETER J [US]; SYED ISMAIL A [US]; TCHINNIS P) 2 December 2010 (2010-12-02) page 3, line 9 - page 5, line 2 -----	1-19
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Further documents are listed in the continuation of Box C.



See patent family annex.

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

31 August 2018

Date of mailing of the international search report

15/10/2018

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INTERNATIONAL SEARCH REPORT

International application No

PCT/US2018/036379

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
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Information on patent family members

International application No

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