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(54) Title: SURFACE DECONTAMINATION FORMULATION

(57) Abstract: An improved process for decontamination of surfaces using a tiered approach based on D7 formula having pathogen/agent/toxin mobilization followed by pathogen/agent/toxin destruction on the surface, wherein the D7 formula has SSDX-12 added with a ratio of 15: 1 equivalent dosage.

SURFACE DECONTAMINATION FORMULATION

Cross-Reference to Related Applications

[0001] This is a PCT international patent application of US provisional patent applications, serial number 62/618,095, 62/618,096, 62/618,098, 62/618,100, and 62/618,104 filed on January 17, 2018. This application further claims priority to a US nonprovisional patent application, serial number 16/209,960, filed on December 4, 2018, which is a continuation of a PCT international patent application, application number PCT/US18/37817, filed on June 15, 2018, which claims priority to a US provisional patent application, serial number 62/520,372, filed on June 15, 2017. The disclosures of the above applications are incorporated by reference in their entirety herein.

Background

[0002] The first necessity in decontamination is to facilitate exposure of the pathogen/agent/contaminant/toxin to the reactive mechanism designed to defeat it. On surfaces this necessitates:

[0003] inducing the ability to desorb a substance from the surface, or

[0004] enabling hydraulic mobility of the substance (displacement), or

[0005] forcing the substance into a hydraulically vulnerable state (dissolution)

[0006] A harmful substance may penetrate deeply into the reticulated grain structures of microscopic surfaces, making it difficult to displace. Simply using water or other solvent may not present the appropriate physiochemical environment sufficient to overcome the forces holding or shielding the substance in place.

Summary

[0007] Embodiments of the invention describe an enhanced chemical formulation and manner of practice administering two predicate patented products (DF-200 and SSDX-12) designed for the decontamination, disinfection and renewal of surfaces exposed to chemical, biological, toxic industrial contaminants and residues. These two products are standalone treatments for decontamination strategies. The combinations of the two in concert with one another presents a unique approach to decontamination and disinfection strategies.

[0008] SSDX-12 is a high potency decontamination soap specifically used for the safe decontamination of air craft. In order to achieve that claim, SSDX-12 was required to demonstrate resistance to corrosion on aircraft metal alloys and sensitive equipment. The product was also required to remove residues of chemical weapons down to an acceptable standard. While the product is demonstrably effective at treating the targeted surfaces, the challenge of remediating the now dissolved and mobile chemical agents remained. In many situations it is simply unacceptable to rinse the treatment off into the environment.

[0009] D7 formula (hereinafter "D7" or "D7 formula") is a high potency decontamination/disinfection agent used to treat surfaces contaminated with bacteria, viruses, mold, mildew, toxic industrial chemicals, chemical weapons and other pathogenic and harmful agents. D7 is able to promote the rapid chemical remediation of these threats by virtue of its unique ability to solubilize normally water insoluble targets and expose them to chemical oxidation directly or in the realm of a self assembled micellular structure embodied in the formula.

[0010] In one example, D7 formula extends the technology to include both oxidation reactions and reducing reactions. Additionally, D7 incorporates the treatment for toxic industrial chemicals. It also is the first reference to a bleaching activator.

[0011] In another example, D7 expands into the area of mold, disinfection and sterilization. The chemistry has not changed or been modified. In effect, D7 is closest to the utility the product enjoys today.

[0012] Moreover, D7 expands on the chemical landscape for DF-200. Additionally it incorporates data for rates of reaction against various toxic agents. It is also an improvement of the original DF-100 relative to performance against mustard agents in regard to reaction time and specificity. In one embodiment, D7 also integrates different bleaching activators.

[0013] The synergy of effectiveness of these two decontamination strategies is a step forward in the state of the art of decontamination and surface remediation providing a much needed improvement in these practices.

DETAILED DESCRIPTION

[0014] SSDX-12 is designed to achieve a safe, environmentally benign, low regret physiochemical agency capable of enabling conditions favorable toward the removal or deshielding of pathogens/agents/contaminant/toxins. With the application of SSDX-12, the offending substance can be hydraulically removed or rendered hydraulically vulnerable.

[0015] In one example, the SSDX-12 may include a cleaning composition such as a C.sub.8-22 alkyl dimethylamine oxide surfactant, a C.sub.6-12 alkyl dimethylamine

oxide surfactant, a C.sub.8-18 alkyl polyethylene glycol sorbitan fatty ester surfactant, and a C.sub.12-14 secondary alcohol ethoxylate surfactant. The C.sub.8-18 alkyl polyethylene glycol sorbitan fatty ester surfactant includes from 0 to about 20 ethoxylate groups per C.sub.8-18 alkyl polyethylene glycol sorbitan fatty ester surfactant molecule. The C.sub.12-14 secondary alcohol ethoxylate surfactant includes from about 14 to about 16 ethoxylate groups per C.sub.12-14 secondary alcohol ethoxylate surfactant molecule.

[0016] In yet another embodiment, a cleaning composition for cleaning exterior surfaces of a vehicle is provided. The cleaning composition includes from about 0.1% to about 5% by weight of a C.sub.8-16 alkyl dimethylamine oxide surfactant, from about 0.1% to about 5% by weight of a C.sub.6-10 alkyl dimethylamine oxide surfactant, from about 0.1% to about 5% by weight of a C.sub.10-14 alkyl polyethylene glycol sorbitan fatty ester surfactant, and from about 0.1% to about 5% by weight of a C.sub.12-14 secondary alcohol ethoxylate surfactant including from about 14 to about 16 ethoxylate groups per C.sub.12-14 secondary alcohol ethoxylate surfactant molecule. The C.sub.10-14 alkyl polyethylene glycol sorbitan fatty ester surfactant includes from 0 to about 6 ethoxylate groups per C.sub.8-18 alkyl polyethylene glycol sorbitan fatty ester surfactant molecule. The C.sub.12-14 secondary alcohol ethoxylate surfactant includes from about 14 to about 16 ethoxylate groups per C.sub.12-14 secondary alcohol ethoxylate surfactant molecule. The C.sub.8-16 alkyl dimethylamine oxide surfactant, the C.sub.6-10 alkyl dimethylamine oxide surfactant, the C.sub.10-14 alkyl polyethylene glycol sorbitan fatty ester surfactant, and the C.sub.12-14 secondary alcohol ethoxylate surfactant are provided in a 1:1:1:1 ratio in the cleaning composition. The cleaning composition is

effective to remove chemical warfare agents from the exterior surfaces of the vehicle upon application thereto.

[0017] In one application, a method for cleaning exterior surfaces of a vehicle using the above cleaning composition may be applied. The method includes providing a cleaning composition, applying the cleaning composition to the exterior surfaces of the vehicle, and rinsing the exterior surfaces of the vehicle with water.

[0018] However, once displaced from its microscopic perch, substances may then be exposed to the reactive spectrum (photoelectric radiation, oxidation, chemical modification by an external substance) that facilitates its chemical transformation. In other words, the fact that SSDX-12 was able to be applied as a cleaning composition to a surface of a vehicle, for example, does not mean the dissolved solution is not toxic or environmentally friendly. That is to say, in this state, a toxin becomes highly vulnerable to natural forces which promote its inevitable tumble to its lowest energy state.

[0019] A concrete surface may look solid from our perspective but when viewed microscopically, it can consist of a complex network of pathways. This is the same with any porous surface. Close inspection reveals a labyrinth in many cases. Delivering chemistry into this microscopic environment requires that significant surface tension forces be overcome. Surface tension is the property of a liquid that defines how it spreads out on a surface and how well it will penetrate into a surface. The proprietary formulation elements of D7 enable very low surface tension values to be obtained at a surface. These values are not equilibrium values but rather, dynamic values. A turbulent solution, made so by the effervescence of decomposing hydrogen peroxide, will continuously be refreshing itself at the leading edges of its penetration into a surface.

These transient ultra-low surface tension values enable a deeper penetration of the active chemistry embodied in D7. The cationic quaternary amine surfactants, coupled with the alkaline pH carbonated buffer system lay the pathway for a more effective penetrating delivery of the complex cleaning chemistry embodied in D7. The product behaves in ways similar to the mechanisms behind hydraulic fracturing without the high pressure pumps.

[0020] Alkali carbonates (potassium based) interact with the predominantly negatively biased surface

[0021] Quaternary amines adsorb strongly onto that negatively biased surface

[0022] Hydraulic channels are opened allowing delivery of the cleaning power in the form of water, peroxide, and other formulation nonionic species.

[0023] In its ability to penetrate/eradicate biofilms vs. traditional forms, D7 provides advantages over prior technologies as well. In one example, biofilms are comprised of a secreted chemical matrix that protects pathogen colonies from intruding threats. These films have nutrient causeways, respiration causeways and transpiration causeways and their precise nature is the subject of intense inquiry. The physiochemical solution properties of D7 interact in such a way as to efficiently and thoroughly disrupt those surfaces. The solvency properties and the oxidation from peroxide and peracetic acid species effectively “pry” open the surface of the film and in some cases aid in the defeat of the functional causeways resulting in terminal disruption. Biofilms effectively organize water in a secreted extracellular matrix that in many cases are disrupted by the D7 detergency mechanisms.

[0024] Embodiments of D7 describe an enhanced chemical formulation designed for the decontamination, disinfection and renewal of surfaces exposed to chemical, biological and toxic industrial contaminants and residues. This formula improves on prior art by expanding the efficacy spectrum, decreasing treatment time, modifying chemical properties allowing for lower effective dosage and broadening the roster of chemical agents remediated by it. The formulation described herein may also be applied in variable concentrations to achieve decontamination objectives (cleaning, sanitization, disinfection, high level disinfection, mold remediation, biofilm remediation, targeted decontamination).

[0025] Embodiments of D7 aim to incremental variants designed to perform particular tasks is the intent of this effort. In one embodiment, aspects of the invention may be formulated with a Generation 1 version of Quaternary amine (ADBAC). It is thought that broadening the type of quaternary amine may bring a benefit in either efficacy against a broader range pathogens or greater effectiveness against biofilms. Of the two, biofilm effectiveness is likely the prominent value proposition.

[0026] Furthermore, D7 provides a simple roster of ingredients. D7 is not made of exotic ingredients. It is assembled with common, benign, readily available materials. Their combination produces a net effect greater than the simple sum of each.

[0027] The physical properties embodied in D7 tell part of the story of its success. Things like dynamic surface tension, critical micelle concentration, micellar aggregation number, solvolytic potential and solution polarity all contribute to the enigmatic behavior of D7.

[0028] One of the more compelling actions of D7 arises from the micelle formations. These micelles act as miniature reaction factories where toxicants react with activated oxygen species rendering them neutralized or harmless.

[0029] As a starting point, the application of D7 in response to biofilm issues seems a valued efficacy for the customer. Defeating a biofilm protected bacteria colony virtually insures defeat of the prokaryotic bacteria itself. The roster of efficacy of D7 in relation to various organisms is listed below:

Disinfection Efficacy		
Eschericia Coli	Listeria Monocytogenes	Staphylococcus Aureus (MRSA, VRSA)
Klebsiella pneumoniae	*Stereptococcus epidermidis*	*Enterobacter cloacae*

[0030] Taking a view of the relationship of the quat generation, the following comparison is relevant.

[0031] Generation 5 Quaternary Amine. This category is a mixture of generation 1 and generation 4. The innovation options can rapidly multiply when one considers permutations of different generation 1 chemistries along with the generation 4 variants. In one embodiment, D7 formulation includes:

Vendor	Product	Description	Notes
Stepan Pilot	BTC-1210 Maquat 2420-80%	80% Active 32% CAS 68424-85-1 48% CAS 7173-51-5	Different foaming characteristics, different efficacy profile, different physiochemical performance, enhanced biofilm defeat efficacy,

			residual sanitation performance
Stepan Pilot	BTC-888 MQ-624M	80% Active 32% CAS 68424-85-1 48% Variable dialkyl, dimethyl	Different foaming characteristics, different efficacy profile, different physiochemical performance

Part A Formulation Ingredient	Prescribed amount
BTC 888 (80 % active) 32% (40% C12, 50% C14, 10% C16) + 48% DADMAC	**0.1 to 4.00%**
Octyl Decyl Dimethyl Ammonium Chloride (24%) MW=334.0273	0.024 to 0.960%
Di-n-Octyl Ammonium Chloride (12%) MW=270.5207	0.012 to 0.480%
Di-n-Decyl Ammonium Chloride (12%) MW=326.6279	0.012 to 0.480%
ADBAC C12 (40%) MW=339.9909	0.0128 to 0.512%
ADBAC C14 (50%) MW=368.0445	0.016 to 0.640%
ADBAC C16 (10%) MW=396.0981	0.0032 to 0.128%
Adogen 477D (50% Active)	**0.05 to 2.00%**
Glycol Ether DB	**0.4 to 1.60%**
Isobutanol	**0.025 to 1.00%**
Propylene Glycol	**0.5 to 20.00%**
Lauryl Alcohol	**0.02 to 0.80%**
Potassium Bicarb USP Anhyd	**0.3 to 12.00%**
Caustic Potash	**0.0425 to 1.70%**
Water	**56.90 to 98.56%**

Part B Formulation Ingredient	Prescribed amount
Hydrogen peroxide	**0.2 to 8.00%**
Inerts and stabilizers	
Water	**99.8 to 85%**

Part C Formulation Ingredient	Prescribed amount
Bleaching accelerator	**0.05 to 2.00%**

[0032] In one embodiment, the Generation 5 surfactants and dimethyl dialkyl quaternary amines present an enhanced structure to the micelles developed in the D7 formulation.

[0033] These surfactants may modify the Gouy-Chapman-Stern layer to the point of enhanced and improved ability to more rapidly solubilize agents into the micelle body.

[0034] In one example, the surfactants may modify the Gouy-Chapman-Stern layer that may be tied to the speed at which an agent is decontaminated, or it might be the extent of its decontamination.

[0035] This embodiment of the invention may have different physical properties. The efficacy profile of this version will also be different. The development of the efficacy profile should be from a dilute version, perhaps a 1 to 100 dilution of the final product, up to the full version. The dilute version might be considered for surfaces that are already clean and devoid of biofilm presence. In one embodiment, the concentrated

version would be considered for circumstances where gross filth is more prevalent (live animal facilities, processing plants, high biofilm potential places). Various embodiments of the invention for different dilutions (bacteria, biofilm, fogging efficacy) may enable various levels of applications in addition to those disclosed in FIG. 1.

[0036] This improvement upon prior art enables the contemplation of a full spectrum product capable of dealing with sensitive cleaning and sanitization situations like those encountered in food contact circumstances. In those circumstances, a product may be able to be applied to a target surface usually as a spray and wiped down distributing the cleaning/sanitization formulation over the entire surface. In one embodiment, aspects of the invention may need to receive approval from regulatory oversight agencies before use. In this case, this is commonly known as a "leave-on" product. There are statutory limits of labeled ingredients permissible for this type of use. It is an embodied intention of this improvement to enable this type of use. A full strength version of the product is intended for use in highly compromised environments like live animal barns where significant gross filth is anticipated. This represents the other end of the product spectrum. Regulatory oversight is also a requisite in relation to pesticidal embodiments. It is anticipated that there will be many situations in between these two extremes where a strength modulated product would serve the need. Examples of such situations are given in spectrum above.

[0037] It is often necessary to promote a speedier transition to a less harmful state. Pathogens, toxic industrial chemicals, or other undesirable substances exist unchallenged in ambient environments except by those reactive agents common to their surroundings. The natural remedies for treatment of infestations include predation by organisms,

hydrolysis by water, photolysis by electromagnetic radiation, absorption by the substrate and shielding of the pathogen by environmental film to name a few. If a pathogen is soluble in water, a simple rinse may suffice. The kinetic time frame for these actions can range from the immediate to very long periods of slow transition. Delivering reactive chemical activity in the form of oxidation or nucleophillic substitution is an effective treatment strategy well known in common practice. It is the route by which numerous agents deliver their efficacious dose. Once a substance is oxidized, it is generally more susceptible to environmental decay via one or more of the aforementioned mechanisms. Delivering oxidation activity to a target is not always straight forward. The use of bleach for instance is a common practice in many areas for disinfection and decontamination. Bleach is a water based solution whose ability to penetrate and engage pathogens is limited to the physiochemical barriers embodied on the substrate being treated. If the active cidal agent cannot come into reactive proximity with the target pathogen, nothing will happen. For this reason, disinfection and decontamination agents are formulated with substances that enable the ability overcome physiochemical barriers of interfacial tension and surface energy to deliver substances to reactive proximity. Additionally, substances that are not soluble in water may not be vulnerable to reaction based on the limited exposure to reactive conditions.

[0038] D7, as illustrated above, is a formula which overcomes physiochemical barriers to deliver reactive oxidation species to pathogenic targets and by virtue of its design, aid in the ability to bring resistant substances into solution where they are then vulnerable to oxidation by the mechanisms embodied in D7. This new version of the formula is an enhancement of previous versions and demonstrates a more robust and effective ability to

perform decontamination/disinfection tasks. By alteration of the surfactant characteristics of the formula, we are able to show faster decontamination times and more complete defeat of protective pathogenic layers leading to better remediation results.

[0039] D7 is a decontamination agent that delivers chemical oxidation energy in a safe, dilute form for the purpose of promoting oxidation of toxins to less harmful or totally benign breakdown products. D7 chemically treats toxins by promoting oxidation and by consequence speeding up the decontamination process. By itself, D7 will work to promote decontamination. The application of SSDX-12 before D7 enhances the net effect by enabling of the displacement of adsorbed substances.

[0040] In one embodiment, the ratio of 15:1 equivalent dosage of D7 with SSDX-12 is desirable to achieve the targeted results with the right properties and effects on surface decontamination.

[0041] The foregoing description and drawings merely explain and illustrate the invention and the invention is not limited thereto. While the specification is described in relation to certain implementation or embodiments, many details are set forth for the purpose of illustration. Thus, the foregoing merely illustrates the principles of the invention. For example, the invention may have other specific forms without departing from its spirit or essential characteristic. The described arrangements are illustrative and not restrictive. To those skilled in the art, the invention is susceptible to additional implementations or embodiments and certain of these details described in this application may be varied considerably without departing from the basic principles of the invention. It will thus be appreciated that those skilled in the art will be able to devise various

arrangements which, although not explicitly described or shown herein, embody the principles of the invention and, thus, within its scope and spirit.

[0042] While various embodiments have been described above, it should be understood that such disclosures have been presented by way of example only and are not limiting. Thus, the breadth and scope of the subject compositions and methods should not be limited by any of the above-described exemplary embodiments, but should be defined only in accordance with the following claims and their equivalents.

[0043] Having now fully described the subject compositions and methods, it will be understood by those of ordinary skill in the art that the same can be performed within a wide and equivalent range of conditions, formulations and other parameters without affecting their scope or any embodiment thereof. All cited patents, patent applications and publications are fully incorporated by reference in their entirety.

CLAIMS

What is claimed is:

1. An improved process for decontamination of surfaces using a tiered approach based on D7 formula having pathogen/agent/toxin mobilization followed by pathogen/agent/toxin destruction on the surface, wherein the D7 formula has SSDX-12 added with a ratio of 15:1 equivalent dosage.

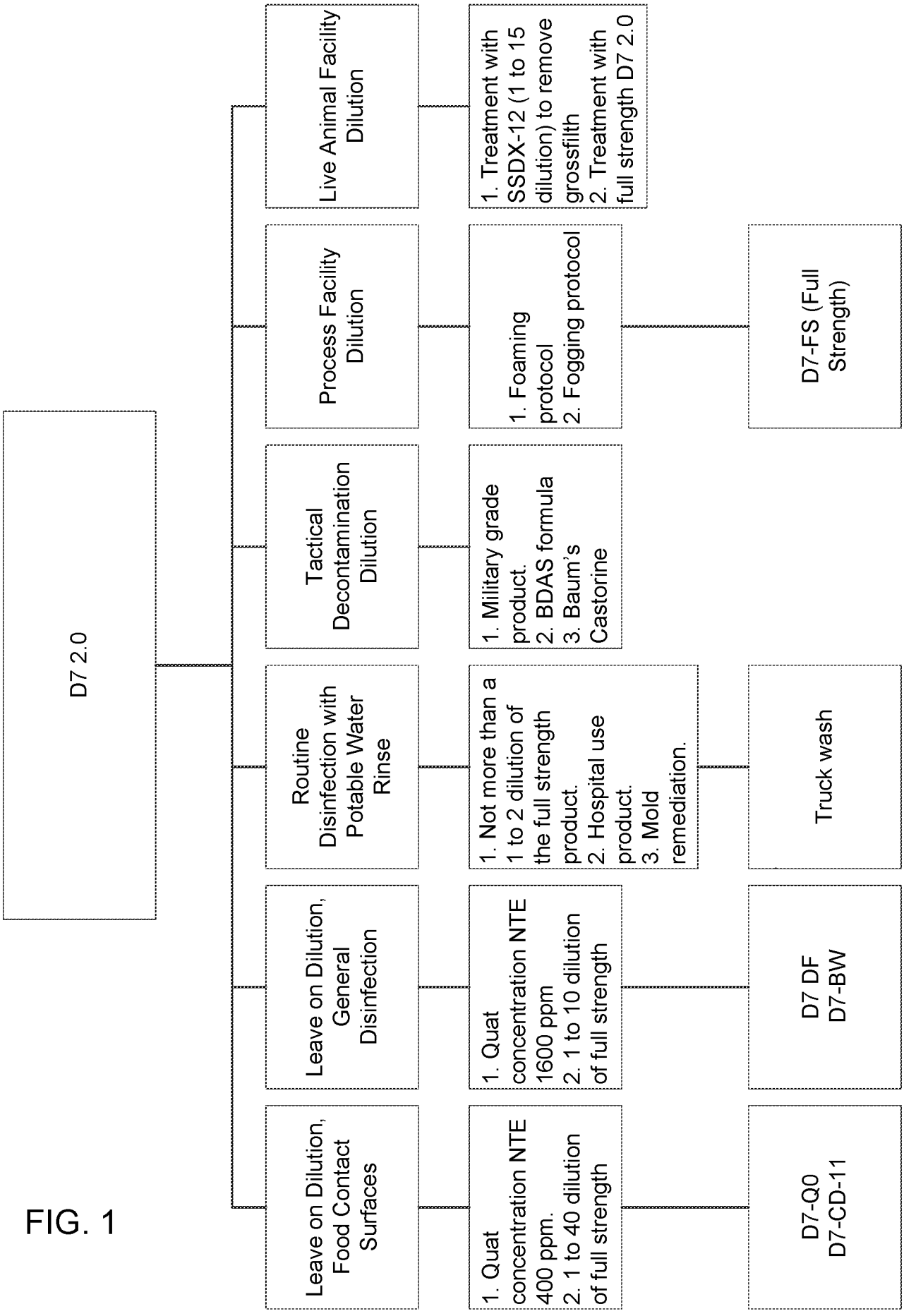
D7 2.0
Leave on Dilution, Food Contact Surfaces
1. Quat concentration NTE 400 ppm.
2. 1 to 40 dilution of full strength
D7-Q0
D7-CD-11
Leave on Dilution, General Disinfection
1. Quat concentration NTE 1600 ppm
2. 1 to 10 dilution of full strength
D7 DF
D7-BW
Routine Disinfection with Potable Water Rinse
1. Not more than a 1 to 2 dilution of the full strength product.
2. Hospital use product.
3. Mold remediation.
Truck wash
Tactical Decontamination Dilution
1. Military grade product.
2. BDAS formula
3. Baum's Castorine
Process Facility Dilution
1. Foaming protocol
2. Fogging protocol
D7-FS (Full Strength)
Live Animal Facility Dilution
1. Treatment with SSDX-12 (1 to 15 dilution) to remove grossfilth
2. Treatment with full strength D7 2.0

FIG. 1

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 19/14016

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - C11D 1/12, C11D 1/29, C11D 1/75 (2019.01)
CPC - C11D 1/12, C11D 1/29, C11D 1/75

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)
See Search History Document

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

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	FireRescue1, "Neutralize carcinogens and other hazards on the job with a decontamination solution", 02 January 2018 (02.01.2018), retrieved on 13 March 2019 from https://www.fireresCue1.com/fire-products/hazmat-equipment/articles/371201018-Neutralize-carcinogens-and-other-hazards-on-the-job-with-a-deconta%E2%80%A6/ ; entire document, especially pg 1 para 1, pg 2 para 5, pg 3 para 4	1
Y	US 2013/0338420 A1 (The Procter & Gamble Company) 19 December 2013 (19.12.2013); entire document, especially [0005], [0012]	1
A	WO 2016/202879 A1 (Faure et al.) 22 December 2016 (22.12.2016); entire document	1
A	US 7,125,497 B1 (Tucker et al.) 24 October 2006 (24.10.2006); entire document	1

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"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	Date of mailing of the international search report
14 March 2019	10 APR 2019

Name and mailing address of the ISA/US	Authorized officer:
Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	Lee W. Young PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774