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An agency of Industry Canada

CA 2361741 A1 2003/05/14

(21) 2 361 741

(12) DEMANDE DE BREVET CANADIEN
CANADIAN PATENT APPLICATION

(13) A1

(22) Date de dépôt/Filing Date: 2001/11/14

(41) Mise à la disp. pub./Open to Public Insp.: 2003/05/14

(51) Cl.Int.^{7}/Int.Cl.^{7} C11D 17/08, C11D 3/20, C11D 7/18, C11D 7/10, C11D 3/02

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(54) Titre : FORMULATION PEU MOUSSANTE A BASE DE PEROXYDE D'HYDROGENE POUR LE NETTOYAGE DE SOLS ORGANIQUES

(54) Title: LOW-FOAMING HYDROGEN PEROXIDE CLEANING FORMULATION FOR ORGANIC SOILS

(57) Abrégé/Abstract:
An alkaline low-foaming cleaning formulation for the removal of organic soils from hard surfaces. The formulation is available in ready-to-use liquid form, or in concentrated liquid or granular form to be used after dilution. The formulation is particularly suitable for cleaning jobs where foam build-up is objectionable, such as the in-place cleaning of fluid handling systems, and the cleaning of medical, veterinary and dental instruments in automatic washing machines. The formulation includes (i) a component providing hydrogen peroxide in an effective concentration of between about 0.005 % and about 50 % (wt./wt.) of the total formulation; (ii) a cation sequestering agent in a concentration of between about 0.01 % and about 50% (wt./wt.) of the total formulation; and (iii) at least one anionic surfactant selected from the group consisting of short chain (C_3-C_8) alkane sulfonates and short chain (less than C_5) alkylarenesulfonates in a concentration of between about 0.005 % and about 40% (wt./wt.) of the total formulation.

ABSTRACT

An alkaline low-foaming cleaning formulation for the removal of organic soils from hard surfaces. The formulation is available in ready-to-use liquid form, or in concentrated liquid or granular form to be used after dilution. The formulation is particularly suitable for cleaning jobs where foam build-up is objectionable, such as the in-place cleaning of fluid handling systems, and the cleaning of medical, veterinary and dental instruments in automatic washing machines. The formulation includes (i) a component providing hydrogen peroxide in an effective concentration of between about 0.005 % and about 50 % (wt./wt.) of the total formulation; (ii) a cation sequestering agent in a concentration of between about 0.01% and about 50% (wt./wt.) of the total formulation; and (iii) at least one anionic surfactant selected from the group consisting of short chain (C_3-C_8) alkane sulfonates and short chain (less than C_5) alkylarenesulfonates in a concentration of between about 0.005 % and about 40% (wt./wt.) of the total formulation.

LOW-FOAMING HYDROGEN PEROXIDE CLEANING FORMULATION FOR ORGANIC SOILS

FIELD OF THE INVENTION

The present invention relates to cleaning formulations and, more particularly, to low-foaming cleaning formulations for removing organic soils from hard surfaces.

BACKGROUND TO THE INVENTION

Low-foaming cleaning formulations useful in removing organic soils, including protein and glyceride-based deposits, are commonly used to clean equipment or utensils in the food processing, dairy, health care, dental and veterinary industries. Equipment used in the food and dairy industries are often cleaned "in-place" by circulating cleaning solution repeatedly through liquid-carrying pipes of the equipment. In the cleaning of medical, veterinary and dental utensils, items are enclosed in a washing chamber of a washing machine and sprayed with a wash solution which is collected from the washing chamber and recirculated to be sprayed again onto the utensils. This cycle repeats continuously for a predetermined period of time or number of cycles. Foam buildup is objectionable in the above circumstances as it will increase the amount of entrapped air in the recirculating solution. This results in cavitation at the pump or in the recirculating pump losing its prime.

Known low-foaming cleaning solutions include chlorine-based cleaners of high alkalinity, or formulations containing one or more enzymes in a basic solution. Chlorine-based cleaners and enzyme-based cleaners work by breaking large protein, linked amino-acid, glyceride or fatty acid molecules through oxidation and enzymatic action, respectively. The chlorine-based cleaners are based on the high oxidative power of chlorine in combination with an alkaline medium to reduce these large soil particles to smaller units easily dissolved or emulsified by the surface active species present. Similarly, enzymatic cleaners rely on high alkalinity and the chemical breakdown of peptide bonds in proteins for dissolution of soils. In both cases, alkaline conditions result in saponification of fats in the soil, further contributing to the detergency process. Though the actual mechanisms for removing soils differ in both types of cleaning solutions, the effects are similar, namely, large particles are broken down into smaller more water soluble units that are eventually dissolved in the wash liquor.

Drawbacks of chlorine-based cleaners are that their use produces large amounts of

waste water containing high amounts of free chlorine. Furthermore, these cleaners are hazardous if mixed with acid solutions (commonly used in two-step cleaning/sanitizing procedures in certain applications) to produce highly poisonous chlorine gas. Also, these cleaners tend to have very pungent odors, may cause skin and eye irritations, and may permanently damage the substrates to which they are applied.

Enzyme-based cleaners, although quite effective in combating protein and lipid-based soils, generally require high temperatures for effective cleaning. Furthermore, the cost of enzyme-based compositions is considerably higher than the cost of most cleaning chemicals. As a consequence, the cost of cleaning with enzymatic-based compositions is generally prohibitive for large-scale applications, and is largely reserved for specialty applications in health, veterinary and dental care.

Hydrogen peroxide based cleaners have become favored more recently because they are odorless, non-corrosive at concentration levels typically employed for cleaning, safe to material substrates, their breakdown products (oxygen and water) are innocuous, and they can be made at low costs. However, the current art does not contemplate a low-foaming, cleaning solution containing hydrogen peroxide which would be useful in the applications discussed herein.

Until now, it has been necessary to add high detergency surfactants to boost the cleaning power of hydrogen peroxide based solutions, in order to achieve the same levels of cleaning efficiency as that of conventional hypochlorite and enzymatic cleaners. Surfactants (or surface active agents) work to decrease the interfacial tension in a solution to facilitate detachment and emulsification of soils. Unfortunately, surfactants which exhibit good detergency will also result in highly foaming solutions, whereas the use of non- or low-foaming surfactants generally leads to poor cleaning compositions. A common solution to this problem is to add silicone-based foam reducing agents to the wash solution. However, these materials tend to allocate and build up in difficult to reach places in the equipment and instruments which facilitates proliferation of microorganisms.

There is therefore a need for a low-foaming cleaning solution which is effective against organic-based soils, exhibits favorable environmental profiles, and possesses a minimal or no risk to the user or to the substrates being cleaned. The present invention is intended to meet these needs.

DESCRIPTION OF THE PRIOR ART

US 3,969,258 to Carandang et al. discloses an acidic, low-foaming sanitizing solution designed for use in recirculating systems in the food and milk industries. The solution is based on highly foaming anionic surfactants known for their antimicrobial properties, and foam suppressing agents consisting of a C_8-C_{18} aliphatic alcohol, or a C_9-C_{12} alkyl phenol, in combination with a polyvalent metal compound. The cleaning efficiency of the solution is not discussed and the use of hydrogen peroxide as a cleaning agent is not taught or suggested.

US 4,878,951 to Pochard et al. teaches alkaline cleaning formulations which are low foaming and therefore suitable for the cleaning in-place of equipment which circulates food or dairy products. The formulations contain a source of chlorine (e.g. hypochlorite) and a mixture of surfactants, one of which is a high-foaming C_4-C_8 alkylated diphenyloxide sulfonate and the other of which is a nonionic surfactant which is stable in the formulation within certain concentration ranges and which acts to suppress foaming. The nonionic surfactant is selected from the group of polyoxyethylene/polyoxypropylene block copolymers and polyalkoxylated linear or branched aliphatic alcohols. The reported solutions are highly alkaline with caustic soda used at the rate of 10% wt./wt. of the total solution composition. This reference does not disclose or suggest the use of alternate non-chlorine based oxidizers, such as hydrogen peroxide.

US 5,855,217 to John describes a device, process and formulation for cleaning heavily soiled surfaces in the food industry. The device mixes a caustic detergent solution and an aqueous solution of hydrogen peroxide to form an unstable, high foaming cleaning formulation which is ejected, under pressure, towards the surface to be cleaned before the hydrogen peroxide breaks down. The process is based on the generation of a cleaning foam containing hydrogen peroxide in an amount between 0.1-1.0 % wt./wt.. The formulation taught clearly does not have application to recirculating systems where the presence of foam cannot be tolerated.

WO 93/14183 discloses a detergent composition which is stable and remains colorless over time. This is achieved by adding hydrogen peroxide and a metal sequestering agent to high detergency, high foaming anionic and/or nonionic surfactants. These surfactants do not include low-foaming small chain alkane sulfonates and alkylarenesulfonates.

Numerous hydrogen-peroxide based cleaning compositions have been proposed, none of which appear suitable for applications involving substrates highly soiled with protein,

carbohydrate and lipids, where both high detergency and low or no foaming are required. For example, US 5,602,090 to Melikyan et al. describes a hard surface cleaning solution comprising hydrogen peroxide, D-limonene, two anionic surfactants, a non-ionic surfactant, and deionized water. Although the low-foaming sodium 1-octane sulfonate (sold under the commercial name Bioterge PAS-8S) is listed as a possible one of the anionic surfactants, the other surfactant components are high-foaming.

US 5,891,392 to Monticello et al. teaches an acidic hard surface cleaning and disinfecting composition based on hydrogen peroxide as an active disinfecting constituent, a monohydric alcohol, a glycol ether or butoxypropanol or propoxypropanol, a nonionic surfactant, and an organic acid. All the non-ionic surfactants listed in this reference are high foaming.

US 6,110,883 to Petri et al. discloses a hydrogen peroxide-based composition suitable for use as a hard surface cleaner or in laundry applications. The composition further comprises a surfactant selected from a group of high detergency/foaming anionic, nonionic or amphoteric surfactants.

SUMMARY OF THE INVENTION

Formulations according to the present invention incorporate hydrogen peroxide and specific anionic surfactants which exhibit low-foaming properties. The formulations are designed for cleaning jobs where foam build up is objectionable and where the control of microbial population is important.

More specifically, in accordance with a first aspect, the invention provides an alkaline low-foaming cleaning formulation for the removal of organic soils from hard surfaces comprising: (i) hydrogen peroxide in an effective concentration of between about 0.005 % and about 50 % (wt./wt.) of the total formulation; (ii) a cation sequestering agent in a concentration of between about 0.01% and about 50% (wt./wt.) of the total formulation; and (iii) at least one anionic surfactant selected from the group consisting of short chain (C_3-C_8) alkane sulfonates and short chain (less than C_5) alkylarenesulfonates in a concentration of between about 0.005 % and about 40% (wt./wt.) of the total formulation.

Formulations according to the invention are available in ready-to-use liquid form, or in concentrated liquid or granular form to be used after dilution. When in the liquid form, the formulation includes a diluent which may be water or deionized water. The pH of the

formulation is above 7 and preferably between about 9 and about 11.5.

In the concentrated liquid form, the hydrogen peroxide may be present in an effective concentration of from about 1% to about 20% (wt./wt.) and, more preferably, from about 2% to about 7% (wt./wt.) of the total formulation. The cation sequestering agent may be present in a concentration of from about 0.5% to about 20% (wt./wt.) and, more preferably, from about 0.5% to about 7% (wt./wt.) of the total formulation. Furthermore, the surfactant may be present in a concentration of from about 0.005% to about 3% (wt./wt.) and, more preferably, from about 0.01% to about 2% (wt./wt.) of the total formulation.

When the formulation is in the ready-to-use liquid form, the hydrogen peroxide may be present in an effective concentration of from about 0.005% to about 2% (wt./wt.) and, more preferably, from about 0.01% to about 1% (wt./wt.) of the total formulation. The cation sequestering agent may be present in a concentration of from about 0.01% to about 2% (wt./wt.) and, more preferably, from about 0.01% to about 1% (wt./wt.) of the total formulation. Finally, the surfactant may be present in a concentration of from about 0.005% to about 3% (wt./wt.) and, more preferably, from about 0.01% to about 2% (wt./wt.) of the total formulation.

When in the granular form, hydrogen peroxide is supplied by a component which may be selected from the group consisting of sodium percarbonate, sodium perborate monohydrate, and sodium perborate tetrahydrate, and mixtures thereof. Furthermore, the effective concentration of hydrogen peroxide within the component may be between about 5% and about 30% (wt./wt.) and, more preferably, between about 15% and about 25% (wt./wt.) of the total formulation. The cation sequestering agent may be present in a concentration of from about 5% to about 50% (wt./wt.) and, more preferably, from about 10% to about 20% (wt./wt.) of the total formulation. Thirdly, the surfactant may be present in a concentration of from about 2% to about 20% (wt./wt.) and, more preferably, from about 2% to about 10% (wt./wt.) of the total formulation. Furthermore, the formulation may contain a diluent in the form of an inert filler selected from the group consisting of sulfate salts, phosphate salts, silicate salts, carbonate salts, and mixtures thereof.

The anionic surfactant is preferably selected from the group consisting of the alkali metal and ammonium salts of octane sulfonic acid, the alkali metal and ammonium salts of cumene, toluene, and xylene sulfonic acids and mixtures thereof.

The cation sequestering agent is preferably selected from the group consisting of citric

acid, glycolic acid, polyphosphates obtained by the thermal treatment of monosodium phosphate, amino phosphonate compounds with 1 to 5 phosphonic acid moieties and amino-carboxylic acid analogues thereof, and mixtures thereof.

The polyphosphates are preferably selected from the group consisting of tetrasodium pyrophosphate, sodium tripolyphosphate, sodium tetraphosphate and sodium hexametaphosphate, and mixtures thereof.

The amino phosphonate compounds are preferably selected from the group consisting of amino tri(methylene phosphonic acid), 1- hydroxyethylidene,1,-diphosphonic acid, diethylenetriaminepenta (methylene phosphonic acid), ethylene diamine tetra(methylene phosphonic acid), and mixtures thereof.

Furthermore, the amino-carboxylic compounds are preferably selected from the group consisting of ethylenediaminetetraacetic acid, diethylenetriaminepentaacetic acid, nitrilotriacetic acid and mixtures thereof.

The cleaning formulation may further include a corrosion inhibitor or inhibitors in a concentration of between about 0.01% to about 5% wt./wt. of the total formulation. The corrosion inhibitor is preferably selected from the group consisting of triazoles, nitrites, molybdates, benzoates, gluconates, and mixtures thereof. More preferably, the corrosion inhibitor is selected from the group consisting of 1,2,3-Benzotriazole, sodium nitrite, sodium molybdate, and mixtures thereof.

The corrosion inhibitor may also be at least one short chain (C_2-C_5) polyhydric alcohol, preferably propylene glycol, in a concentration of from about 0.1% to about 5% (wt./wt.) of the formulation for inhibiting corrosion of metallic substrates upon drying.

The formulation may contain from about 0.25 to about 4 parts by weight cation sequestering agent for every one part by weight hydrogen peroxide.

In accordance with a second aspect, the invention provides a method of cleaning equipment used to circulate food products, in place, comprising:

(1) providing a ready-to-use formulation according to the first aspect of the invention; and

(2) circulating the ready-to-use formulation through the equipment to be cleaned at a temperature above 20°C.

Surprisingly, cleaning solutions according to the present invention are as or more

effective in breaking down and solubilizing protein, carbohydrate and lipid soils from hard surfaces than conventional hypochlorite or enzyme-based cleaners. The results are unexpected since known hydrogen peroxide cleaning solutions have had to rely on high detergency surfactants and higher pH levels to achieve the same level of cleaning efficiency as the present cleaning solution or formulation.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Without being limited by any theory herein, it is believed that several mechanisms are responsible for the cleaning performance of the solution. Hydrogen peroxide oxidizes protein, carbohydrate and lipid molecules and destroys sulfhydryl and double bonds to break the molecules down into smaller units.

Cation sequestering agents (i.e. chelating agents) are believed to play an important role in the emulsification and break-up of soil particles. The cation sequestering agents are relied upon for enhancing detergency by (i) increasing the negative zeta potentials between soil aggregates and substrates, thereby creating an electrostatic repulsive force, and (ii) breaking down soil aggregates which are linked together by mutual cation bridges. Furthermore, chelating agents sequester dissolved cations, thereby minimizing the decomposition rate of the hydrogen peroxide in solution.

The alkaline conditions are believed to have the following effects. First, the rate of reaction of the hydrogen peroxide with organic soils is enhanced at the pH levels of the invention. Second, these conditions contribute to the development of a greater zeta-potential difference between substrate and soil and amongst soil particles, thereby facilitating detachment of the soil from the substrate and its emulsification in solution. Third, fatty acids present in many of these soils undergo saponification, thus greatly enhancing their solubility and further providing additional detergent action to, or increasing the surface activity of, the solution as a whole. Reducing the interfacial tension of the solution through surfactants results in better wetting of the soil-substrate and soil-soil interstices, thereby facilitating detachment and break-up.

It will be appreciated that the pH of the invention may be achieved by the addition of caustic salts such as sodium hydroxide, potassium hydroxide or ammonium hydroxide. Furthermore, the surface active agents employed should have a high hydrotroping capacity, should produce a reduction of the interfacial tension of the wash liquor, and should not

produce substantial amounts of foam.

The invention will be better understood by reference to the following examples:

Example 1:

A liquid formulation IA of the present invention was prepared as shown in Table I. The ingredients were mixed in the order shown with hydrogen peroxide being the final ingredient added. The formulation pH was adjusted with caustic potash to a value of 9.0.

TABLE I

COMPONENT (% actives)	Example IA Wt.%
Deionized water	q.s. to 100
Propylene Glycol (100%)	0.5
Bioterge PAS-8S (38%)	4.5
Briquest ADPA-60AW (60%)	7.0
Citric Acid (100%)	1.0
Caustic Potash (45%)	Adjust to pH=9.0
Hydrogen Peroxide (50%)	10.0

The formulation IA of Table I includes hydrogen peroxide from a 50% aqueous technical grade commercial solution from Degussa-Hüls, a short chain alkane sulfonate consisting of Bioterge PAS-8S (trade-mark) which is a 38% active sodium octane sulfonate manufactured by Stepan, and two cation sequestering agents consisting of Briquest ADPA-60AW (trade-mark) which is a 60% active 1-hydroxyethylidene-1,1,-diphosphonic acid manufactured by Allbright and Wilson, and citric acid. The composition also includes deionized water as the solvent and a short chain polyhydric alcohol consisting of propylene glycol for inhibiting corrosion of metal substrates upon drying of the formulation.

The cleaning performance of the formulation was evaluated by measuring the mass of soil removed from aged soiled panels carefully prepared in the laboratory. Between 10 to 15 milligrams of dried milk was deposited on each 2" x 2" glass slide. The soiled glass slides were immersed in the cleaning formulation for a period of 5 minutes without any mechanical action. Experiments were run at two different formulation temperatures, 20 °C and 45 °C. After immersion for the desired contact time, the slides were rinsed with tap water (200 ppm

hardness as $CaCO_3$) and allowed to dry for several minutes before being weighed. A cleaning efficiency was defined as:

$$C.E. = (M_i - M_f) \times 100/M_i$$

where M_i is the initial mass of deposited soil, and M_f is the mass of soil remaining after immersion in the detergent for the specified time period. A commercial detergent solution (Example IB), commonly known by its trademark, Metriclean 2, manufactured by Metrex Research Corporation, and based on enzymes, was utilized for comparison. The results are included in Table I-1. Example IA was diluted in water of 200 ppm hardness as $CaCO_3$ in the ratio 1:70, while the commercial enzymatic detergent solution IB was used in its recommended dilution rate of 1:140. It is clear that example IA offers a considerable improvement over the commercial detergent solution in dissolving lipids and proteins, particularly at an ambient temperature of 20°C.

TABLE I-1

	Example 1A		Example 1B	
	20°C	45°C	20°C	45°C
C. E. [%]	97 ± 2	98 ± 2	32 ± 1	72 ± 3

Example II:

A more concentrated formulation IIA may be made for use at higher dilution ratios with the added benefit of the composition exhibiting bactericidal properties. The composition IIA of Table II can be diluted in the ratio 1:140 and will show similar cleaning efficiency to a commercial hypochlorite-based cleaner IIB (at its recommended dilution of 1:512), as seen from the experimental results of Table II-1. The higher temperatures in these experiments are more typical of applications in the food and dairy industry, where pipelines and storage tanks are cleaned and sanitized regularly with a detergent solution circulated throughout liquid carrying pipes thereof at elevated temperatures of above 20°C. Moreover, at the dilution ratio of 1:140, the composition IIA is quite effective in reducing the viable counts of vegetative bacteria. Reduction in the viable counts of *Staphylococcus aureus* greater than 99.99% were observed in a suspension of organisms of 1.85×10^6 organisms per ml, at a contact time of 5 minutes, and a temperature of 54 °C.

TABLE II

COMPONENT (% actives)	Example IIA Wt. %
Deionized water	q.s. to 100
Bioterge PAS-8S (38%)	4.5
Briquest ADPA-60AW (60%)	7.0
Citric Acid (100%)	1.0
Caustic Potash (45%)	Adjust to pH = 9.0
Hydrogen Peroxide (50%)	14.0

TABLE II-1

	Example IIA		Hypochlorite cleaner IIB	
	45 °C	60 °C	45 °C	60 °C
C. E. [%]	86 ± 11	98 ± 1	76 ± 10	71 ± 7

Example III:

A formulation IIIA of the present invention was prepared as shown in Table III, and tested in accordance to the methodology described in Example I. In formulation IIIA, hydrogen peroxide is introduced by a component, sodium percarbonate. Examples IIIB and IIIC are included to show that although the single components do indeed possess certain cleaning ability, their simultaneous presence results in unexpected cleaning performance.

TABLE III

Component (% active)	IIIA	IIIB	IIIC
Sodium Percarbonate ($Na_2CO_3 \bullet 1.5H_2O_2$)	0.13	---	0.13
Sodium Tripolyphosphate	0.06	0.06	---
Bioterge PAS-8S (38%)	0.03	---	---
Water	q.s. to 100	q.s. to 100	q.s. to 100
pH	10.4	8.9	10.4
Cleaning Efficacy at 45 ° C	96.6	58.8	66.8

0.33 gr of hydrogen peroxide is liberated per gram of sodium percarbonate. Thus, in the present case, the resulting concentration of hydrogen peroxide will be 0.042% wt./wt.. The above formulation includes a cation sequestering agent consisting of sodium tripolyphosphate.

In the above example, the cleaning formulations were prepared by adding each component directly to the wash water; however, in practice a dry powdered mixture could be prepared involving the above components. This dry mixture would then be dissolved in the appropriate dilution rate (say 1 oz/4-6 gallons) to obtain the cleaning formulation.

The foaming characteristics of the above embodiments of the invention were tested. They all exhibit an instantaneous foam height of less than 6 ml after 30 inversions on a stoppered standard 250 ml graduated cylinder. In the tests, foam dissipation occurred within a period of 5 seconds or less after termination of the inversion cycle. Thus, formulations according to the present invention were demonstrated to be low-foaming.

Furthermore, all of the present formulations have been subjected to accelerated stability testing as described by Steiner in US Pat No. 5,736,497. The samples were subjected to a temperature of 96°C for a period of 16 hours to simulate storage at 20°C for one year. In all cases, the peroxide loss was less than 50%, which is generally accepted as good in this extreme temperature test.

While the invention is susceptible to modification, it is to be understood that specific embodiments thereof have been shown by way of examples which are not intended to limit the invention to the particular forms disclosed. On the contrary, the intention is to cover all modifications, equivalents and alternatives falling within the scope and spirit of the invention as defined in the appended claims.

CLAIMS

1. An alkaline low-foaming cleaning formulation for the removal of organic soils from hard surfaces comprising: (i) hydrogen peroxide in an effective concentration of between about 0.005 % and about 50 % (wt./wt.) of the total formulation; (ii) a cation sequestering agent in a concentration of between about 0.01% and about 50% (wt./wt.) of the total formulation; and (iii) at least one anionic surfactant selected from the group consisting of short chain (C_3-C_8) alkane sulfonates and short chain (less than C_5) alkylarenesulfonates in a concentration of between about 0.005 % and about 40% (wt./wt.) of the total formulation.

2. A cleaning formulation according to claim 1 in concentrated liquid form comprising a diluent consisting of water or deionized water and wherein hydrogen peroxide is present in an effective concentration of from about 1% to about 20% (wt./wt.) of the total formulation, the cation sequestering agent is present in a concentration of from about 0.5% to about 20% (wt./wt.) of the total formulation, and the surfactant is present in a concentration of from about 0.005% to about 3% (wt./wt.) of the total formulation.

3. A cleaning formulation according to claim 2 in concentrated liquid form wherein hydrogen peroxide is present in an effective concentration of from about 2% to about 7% (wt./wt.) of the total formulation, the cation sequestering agent is present in a concentration of from about 0.5% to about 7% (wt./wt.) of the total formulation, and the surfactant is present in a concentration of from about 0.01% to about 2% (wt./wt.) of the total formulation.

4. A cleaning formulation according to claim 1 in ready-to-use liquid form further comprising a diluent consisting of water or deionized water and wherein hydrogen peroxide is present in an effective concentration of from about 0.005% to about 2% (wt./wt.) of the total formulation, the cation sequestering agent is present in a concentration of from about 0.01% to about 2% (wt./wt.) of the total formulation, and the surfactant is present in a concentration of from about 0.005% to about 3% (wt./wt.) of the total formulation.

5. A cleaning formulation according to claim 4 in ready-to-use liquid form wherein hydrogen peroxide is present in an effective concentration of from about 0.01% to about 1%

(wt./wt.) of the total formulation, the cation sequestering agent is present in a concentration of from about 0.01% to about 1% (wt./wt.) of the total formulation, and the surfactant is present in a concentration of from about 0.01% to about 2% (wt./wt.) of the total formulation.

6. A cleaning formulation according to claim 1 in granular form wherein hydrogen peroxide is present in an effective concentration of between about 5% and about 30% (wt./wt.) of the total formulation, the cation sequestering agent is present in a concentration of from about 5% to about 50% (wt./wt.) of the total formulation, and the surfactant is present in a concentration of from about 2% to about 20% (wt./wt.) of the total formulation.

7. A cleaning formulation according to claim 6 in granular form wherein hydrogen peroxide is present in an effective concentration of between about 15% and about 25% (wt./wt.) of the total formulation, the cation sequestering agent is present in a concentration of from about 10% to about 20% (wt./wt.) of the total formulation, and the surfactant is present in a concentration of from about 2% to about 10% (wt./wt.) of the total formulation.

8. A cleaning formulation according to claim 6 or 7 in granular form further comprising a diluent in the form of an inert filler selected from the group consisting of sulfate salts, phosphate salts, silicate salts, carbonate salts, and mixtures thereof.

9. A liquid cleaning formulation according to any one of claims 2 to 5 wherein the pH is between about 9 and about 11.5.

10. A cleaning formulation according to any one of claims 1 to 9 wherein the hydrogen peroxide is supplied by a component selected from the group consisting of sodium percarbonate, sodium perborate monohydrate, and sodium perborate tetrahydrate, and mixtures thereof.

11. A cleaning formulation according to any one of claims 1 to 10 wherein the surfactant is selected from the group consisting of the alkali metal and ammonium salts of octane sulfonic acid, the alkali metal and ammonium salts of cumene, toluene, and xylene sulfonic acids and mixtures thereof.

12. A cleaning formulation according to any one of claims 1 to 11 wherein the cation sequestering agent is selected from the group consisting of citric acid, glycolic acid, polyphosphates obtained by the thermal treatment of monosodium phosphate, amino phosphonate compounds with 1 to 5 phosphonic acid moieties and amino-carboxylic acid analogues thereof, and mixtures thereof.

13. A cleaning formulation according to claim 12 wherein the polyphosphates are selected from the group consisting of tetrasodium pyrophosphate, sodium tripolyphosphate, sodium tetraphosphate and sodium hexametaphosphate, and mixtures thereof.

14. A cleaning formulation according to claim 12 or 13 wherein the amino phosphonate compounds are selected from the group consisting of amino tri(methylene phosphonic acid), 1-hydroxyethylidene,1,-diphosphonic acid, diethylenetriaminepenta (methylene phosphonic acid), ethylene diamine tetra(methylene phosphonic acid), and mixtures thereof.

15. A cleaning formulation according to claim 12, 13 or 14 wherein the amino-carboxylic compounds are selected from the group consisting of ethylenediaminetetraacetic acid, diethylenetriaminepentaacetic acid, nitrilotriacetic acid and mixtures thereof.

16. A cleaning formulation according to any one of claims 1 to 15 further comprising a corrosion inhibitor in a concentration of between about 0.01% to about 5% wt./wt. of the formulation.

17. A cleaning formulation according to claim 16 wherein the corrosion inhibitor is selected from the group consisting of triazoles, nitrites, molybdates, benzoates, gluconates, and mixtures thereof.

18. A cleaning formulation according to claim 17 wherein the corrosion inhibitor is selected from the group consisting of 1,2,3-Benzotriazole, sodium nitrite, sodium molybdate, and mixtures thereof.

19. A cleaning formulation according to claim 16 wherein the corrosion inhibitor

0.1% to about 5% (wt./wt.) of the formulation for inhibiting corrosion of metallic substrates upon drying.

20. A cleaning formulation according to claim 19 wherein the polyhydric alcohol is propylene glycol.

21. A cleaning formulation according to any one of claims 1 to 20 wherein, for every one part by weight hydrogen peroxide, there is from about 0.25 to about 4 parts by weight cation sequestering agent.

22. A method of cleaning equipment used to circulate food products, in place, comprising:

(1) providing a ready-to-use formulation according to claim 4 or 5, and

(2) circulating the ready-to-use formulation through the equipment to be cleaned at a temperature above 20°C.