

(19)



(11)

EP 4 541 875 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
23.04.2025 Bulletin 2025/17

(51) International Patent Classification (IPC):
C11D 3/04 (2006.01) C11D 7/10 (2006.01)

(21) Application number: **23204949.4**

(52) Cooperative Patent Classification (CPC):
C11D 7/10; C11D 3/046; C11D 2111/20

(22) Date of filing: **20.10.2023**

(84) Designated Contracting States:
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL
NO PL PT RO RS SE SI SK SM TR**
Designated Extension States:
BA
Designated Validation States:
KH MA MD TN

(71) Applicant: **BÜFA GmbH & Co. KG**
26125 Oldenburg (DE)

(72) Inventor: **SPECHT, Sebastian**
26125 Oldenburg (DE)

(74) Representative: **Eisenführ Speiser**
Patentanwälte Rechtsanwälte PartGmbH
Gollierstraße 4
80339 München (DE)

(54) **USE OF AN AQUEOUS SOLUTION CONTAINING DISSOLVED FERRATE (VI) IONS FOR
CLEANING A SOLID SURFACE, RESPECTIVE METHODS, RESPECTIVE WASHING AND/OR
CLEANING AGENTS, RESPECTIVE SOLUTIONS AND/OR SUSPENSIONS, RESPECTIVE
CLEANING MACHINE AND/OR WASHING MACHINE, RESPECTIVE KIT AND RESPECTIVE
USES**

(57) Use of an aqueous solution containing dissolved ferrate (VI) ions for cleaning a solid surface.

EP 4 541 875 A1

Description

[0001] The invention relates to the use of an aqueous solution containing dissolved ferrate (VI) ions for cleaning a solid surface.

[0002] The invention also relates to respective methods for cleaning a solid surface. The invention also relates to the respective use of an aqueous solution containing dissolved ferrate (VI) ions as a demulsifier. The invention also relates to the respective washing agent and/or cleaning agent comprising an aqueous solution and/or suspension containing dissolved ferrate (VI) ions. The invention also relates to the respective method for producing a respective washing agent and/or cleaning agent. The invention also relates to the respective solutions. The invention also relates to a respective cleaning machine. The invention also relates to a respective kit. The invention also relates to the use of a respective kit.

[0003] Document DE 10 2017 127 160 A1 discloses a cleaning and/or spin-drying device for cleaning and/or drying crates, comprising a crate inlet for receiving crates to be cleaned and/or dried, a crate outlet for dispensing crates, a rotating device arranged between the crate inlet and the crate outlet and having a substantially vertical rotary shaft and a rotary plate arranged on the upper side thereof, and optionally a spraying device, in order to spray a crate to be cleaned with a cleaning fluid, the cleaning and/or spin-drying device being designed in such a way that a crate to be cleaned and/or spin-dried is placed with an inner side of the crate base on the turntable, the turntable being arranged at a distance below the crate outlet in a spin-drying position of the crate in which the crate is subjected to a cleaning and/or spin-drying process.

[0004] In the state of the art at least the following problems and disadvantages and the following demands exist: Frequently high temperatures and high energy consumption is needed for cleaning solid surfaces. This is frequently regarded as significant disadvantage and a demand for cleaning with lower energy consumption exists.

[0005] Cleaning results, especially at low temperatures are often disadvantageous. A demand for better cleaning results when cleaning at lower temperatures especially at temperatures below 40 °C, below 35 °C and below 30 °C. Overall, a demand for cleaning solid surfaces with minimal use of energy input exists.

[0006] Storage of cleaning agents often takes up an undesirable high amount of space for storage. For transportation of cleaning agents, large amounts are undesirable. A demand for smaller amounts of cleaning agents in transportation and storage exists. A demand for cleaning agents and cleaning methods exists that lead to the same cleaning results as known from the state of the art or better cleaning results than known from the state of the art with a lesser amount of cleaning agent preferably a lesser amount with regard to less volume and/or less weight, more preferably with regard to less volume and less weight.

[0007] Surfactants used in solid surface cleaning methods are frequently released into the environment, together with the wastewater, after cleaning. The release of surfactants into wastewater and into the environment is frequently undesirable. Removal of surfactants from wastewater is frequently associated with an undesirably high technical effort. From the prior art, a demand results, for cleaning methods that use as little surfactants as possible, preferably no surfactants.

[0008] Cleaning agents for solid surface cleaning methods frequently comprise bleach that releases chlorine. The release of chlorine is frequently regarded as disadvantageous in solid surface cleaning, especially due to the negative environmental aspects associated therewith. From the prior art a need exists for cleaning methods that use cleaning agents which do not release chlorine during and/or after use.

[0009] From the prior art, a need exists for cleaning methods that use cleaning agents which do not react to form adsorbable organic halides (AOX) during and/or after use.

[0010] In many cases, the presence of foam in solid surface cleaning methods is unwanted. There is a demand in the prior art for solid surface cleaning methods with little foaming during the cleaning process, preferably no foaming during the cleaning process.

[0011] A demand exists for solid surface cleaning methods employing solid surface cleaning agents that are environmentally harmless.

[0012] The present invention is defined in the claims and described in detail hereinafter.

[0013] The present invention relates, in its categories, to the use of an aqueous solution containing dissolved ferrate (VI) ions for cleaning a solid surface, to a method for cleaning a solid surface, to a use of an aqueous solution containing dissolved ferrate (VI) ions as a demulsifier, to a washing agent and/or cleaning agent comprising an aqueous solution containing dissolved ferrate (VI) ions, to a method for producing a respective washing agent and/or cleaning agent, to a solution, to a cleaning machine and to a kit. Embodiments, aspects or properties that are described in connection with one of these categories or described as preferred are each correspondingly or analogously applicable to the respective other categories, and vice versa.

[0014] Unless stated otherwise, preferred aspects or embodiments of the invention and their various categories can be combined with other aspects or embodiments of the invention and their various categories, especially with other preferred aspects or embodiments. The combination of respectively preferred aspects or embodiments with one another again results in preferred aspects or embodiments of the invention.

[0015] In a primary aspect of the present invention, the above-specified objectives are achieved and the above-specified

problems are solved in whole or in part by the use of an aqueous solution containing dissolved ferrate (VI) ions for cleaning a solid surface, preferably for cleaning solid surfaces.

[0016] The term "ferrate(VI) ion" refers to the inorganic anion with the chemical formula $[\text{FeO}_4]^{2-}$.

[0017] Within the context of the current invention, the term "cleaning" means the process of removing unwanted substances, such as dirt and other impurities, from an object; in the technical field of the invention, such unwanted substances are also referred to as soiling.

[0018] In many cases, it is preferred that the use of the aqueous solution containing dissolved ferrate (VI) ions for cleaning a solid surface does not involve the additional use of surfactants.

[0019] Especially when used without surfactants, the use of the aqueous solution containing dissolved ferrate (VI) ions for cleaning a solid surface is associated with favourably low foaming.

[0020] No chlorine is released during and/or after the use of the aqueous solution containing dissolved ferrate (VI) ions for cleaning a solid surface.

[0021] No part of the aqueous solution containing dissolved ferrate (VI) ions reacts to form adsorbable organic halides (AOX) during and/or after the use of the aqueous solution containing dissolved ferrate (VI) ions for cleaning a solid surface.

[0022] The aqueous solution containing dissolved ferrate (VI) ions is environmentally harmless.

[0023] Document NL2029165B1 discloses a method for manufacturing ferrate, the method comprising the steps of: - providing an electrochemical cell having an anode containing iron, and a cathode that is placed at a distance from the anode; - inserting an alkaline solution into the electrochemical cell; - applying, by a power supply, an electric potential between the iron containing anode and the cathode; including the step - inducing a current density on one or more surfaces of the anode in the range of 1 A/cm² to 500 A/cm².

[0024] The present invention, with its various aspects, especially and preferably relates to a use (as described above, preferably as identified above as preferred),

- whereby the solid surfaces are selected from the group consisting of:

- glass, ceramic, plastic, metal, wood and/or stone, each coated or uncoated,
- fibres and/or textiles, each coated or uncoated;

and/or

- whereby the use preferably occurs in the areas selected from the group consisting of:

- household, industry, commerce and institutions, ships, port facilities, sports and leisure facilities;

and/or

- whereby the solid surfaces are selected from surfaces of

- boxes,
- glass bottles and non-glass bottles,
- crockery, especially bowls, cups, plates, and serving dishes,
- cutlery,
- drinking glasses
- cookware,
- cars,
- Textiles, especially
 - clothing, especially clothing items for men, women and children, nightwear, sportswear, lingerie, undergarments, swimsuits; caps, socks, gloves, and handbags;

- agro-textile, especially shade net, thermal insulation and sunscreen material, windshield material, antibird net, covering livestock protection material, weed suppressing textile, and insect control textile;
- furnishing textile, especially upholstery, curtain, drapery, carpet, and towel;
- geotextile;
- bedding, especially bed sheet, khes, blanket, and pillow;
- automotive textile, especially airbag, seat belt, headliner, upholstery, car carpet, and door card;
- Medical textile, especially implant, suture, dressing, bandage, medical gown, face mask;
- Further textiles, especially shower curtain, conveyor belt, drive belt, rope, filtration device and cloth, especially decatizing cloth and bolting cloth;
- workwear;
- personal protective equipment and
- pallets.

[0025] In many cases it is especially preferred that the use occurs in food processing plants and/or feed processing plants.

[0026] The use of the aqueous solution containing dissolved ferrate (VI) ions for cleaning other solid surfaces than those specified above is also possible but the use for the above specified surfaces is in many cases preferred.

[0027] The present invention, with its various aspects, especially and preferably relates to a use (as described above, preferably as identified above as preferred), whereby the aqueous solution of ferrate (VI) additionally comprises:

- dissolved calcium ions, preferably dissolved Ca(II), and/or, preferably "and"
- dissolved magnesium ions, preferably dissolved Mg(II), preferably in an amount of 1 mg/L to 950 mg/L, more preferably in an amount of 2 mg/L to 100 mg/L, even more preferably in an amount of 3 mg/L to 40 mg/L.

[0028] Methods to determine these amounts are known to the skilled person.

[0029] The present invention, with its various aspects, especially and preferably relates to a use (as described above, preferably as identified above as preferred), whereby

- the concentration of dissolved ferrate (VI) ions in the aqueous solution containing dissolved ferrate (VI) ions is in the range from 0.0002 wt.-% to 1.10 wt.-%, preferably in the range from 0.0006 wt.-% to 0.07 wt.-%, more preferably in the range from 0.0008 wt.-% to 0.034 wt.-%, with regard to the total mass of the aqueous solution containing dissolved ferrate (VI) ions; and/or
- within the aqueous solution containing dissolved ferrate (VI) ions, the ratio of
 - the amount of dissolved sodium ions, preferably dissolved Na(I), to
 - the amount of dissolved ferrate (VI) ions is in the range from 30:0.3 to 1:1, preferably in the range from 28.75:0.34 to 27.6:1.02, more preferably in the range from 27.6:1.02 to 25:1;
 and/or

- within the aqueous solution containing dissolved ferrate (VI) ions, the ratio of

- the amount of dissolved potassium ions, preferably dissolved K(I), to
- the amount of dissolved ferrate (VI) ions

is in the range from 35.03:0.3 to 33.408:1.02, preferably in the range from 34.8:0.34 to 34.8:1.02.

[0030] Methods to determine these amounts and ranges are known to the skilled person.

[0031] In many cases, the concentration of dissolved ferrate (VI) ions is significantly lower (in many cases approximately 10 times lower) than the concentration of surfactants applied in comparable cleaning processes.

[0032] The present invention, with its various aspects, especially and preferably relates to a use (as described above, preferably as identified above as preferred), whereby the aqueous solution containing dissolved ferrate (VI) ions is used for cleaning surfaces soiled with a soil selected from the group consisting of:

- solvent-based adhesive, solvent-free adhesive, aftershave, alcoholic beverages, animal excrement, ash, baby food, balsamic vinegar, bark mulch, berries, beverages containing coffee, bird droppings, blood, body lotion, butter, cane, canned milk, chalk, chewing gum, chocolate, clay, coal, cocoa, coffee, cola, cream, curd, deodorant, diesel, dips, edible fat, edible oil, egg liqueur, eyeliner, eye shadow, finger paint, flyspeck, fruit, gel, glaze, Glue, preferably wood glue, grass, grease, ice cream, ink, iodine, jam, juice, preferable fruit juice and/or vegetable juice, ketchup, lemonade, lipstick, liquorice, make-up, margarine, marmalade, mayonnaise, milk, mould, mud, mustard, nail varnish, nicotine, nut nougat cream, nuts, oil, oil paint, ointment, opaque white, paint, perfume, pesto, petrol, plasticine, pollen, porridge, powder, printer's ink, pudding, pus, red wine, resin, rouge, rubber solution, rust, salad sauces, salad dressings, saliva, sauces, shoe polish, slaughterhouse waste, sludge, soot, sperm, spices, starch, street dirt, sun cream, suntan oil, sweat marks, sweat, syrup, tar, tea, text markers, toner, tomato, tomato sauce, tsatsiki, urine, varnish, vaseline, vegetables, vomit, wax, whiteboard markers and yoghurt.

[0033] The present invention, with its various aspects, especially and preferably relates to a use (as described above, preferably as identified above as preferred), whereby during the use the temperature of the aqueous solution containing dissolved ferrate (VI) ions never exceeds a temperature of 85 °C, preferably 60 °C, more preferably 50 °C, even more preferably 30 °C, most preferably 25 °C.

[0034] The present invention, with its various aspects, especially and preferably relates to a use (as described above, preferably as identified above as preferred), whereby

- the aqueous solution containing dissolved ferrate (VI) ions additionally contains ethaneperoxoic acid, and/or
- the cleaning comprises a disinfection.

[0035] The substance termed "ethaneperoxoic acid" is known to the skilled person and is frequently also designated by the terms "peracetic acid" or "peroxyacetic acid".

[0036] The above described combined use of the aqueous solution containing dissolved ferrate (VI) ions with ethaneperoxoic acid is especially preferred to achieve both, cleaning and disinfection. The abovementioned effects and advantages of the present invention are also achieved here.

[0037] The present invention, with its various aspects, especially and preferably relates to a use (as described above, preferably as identified above as preferred), whereby the aqueous solution containing dissolved ferrate (VI) ions

- additionally comprises surfactants,
 - independently selected from:
 - anionic surfactants, preferably soaps, amine oxides, alkylbenzene sulfonates, alkane sulfonates, alkyl sulfates and alkylethersulfates; and/or
 - non-ionic surfactants, preferably fatty alcohol ethoxylates, alkylphenol ethoxylates, sorbitan fatty acid esters, alkylpolyglucosides, and N-methylglucamides; and/or
 - cationic surfactants, preferably quaternary ammonium compounds and salts of C₁₀ to C₂₂ primary amines;

and/or

- amphoteric surfactants, preferably amidoalkyl betaines.

5 **[0038]** Suitable surfactants of these types are known to the skilled person and such surfactants are commercially available.

[0039] The skilled person knows suitable surfactants from common general knowledge.

10 **[0040]** It is preferred that the use of the aqueous solution containing dissolved ferrate (VI) ions for cleaning a solid surface, preferably for cleaning solid surfaces, does not lead to an unacceptable amount of foaming during the use. The skilled person is aware that especially foaming behaviour depends on type, combination and amount of surfactants used and thus chooses to apply surfactants or mixtures thereof depending on the requirements of the individual case.

[0041] The skilled person is aware of the environmental effects of different surfactants and accounts for such consequences when using surfactants.

15 **[0042]** In many cases, when surfactants are used in a cleaning process together with the aqueous solution containing dissolved ferrate (VI) ions, lower amounts of surfactants are needed to achieve the same cleaning result compared to the same cleaning process using surfactants only (but no aqueous solution containing dissolved ferrate (VI) ions).

[0043] The present invention, with its various aspects, especially and preferably relates to a use (as described above, preferably as identified above as preferred), whereby the aqueous solution containing dissolved ferrate (VI) ions is essentially free of surfactants, preferably completely free of surfactants.

20 **[0044]** In many cases, particularly positive results are obtained by the use of an aqueous solution containing dissolved ferrate (VI) ions for cleaning a solid surface, preferably for cleaning solid surfaces, whereby the aqueous solution containing dissolved ferrate (VI) ions is essentially free of surfactants, preferably completely free of surfactants.

[0045] In these cases, positive cleaning results are achieved without the well-known disadvantages associated with the use of surfactants.

25 **[0046]** The present invention, with its various aspects, especially and preferably relates to a use (as described above, preferably as identified above as preferred), whereby during the use the pH of the aqueous solution containing dissolved ferrate (VI) ions is never below pH 7, preferably never below pH 8, more preferably never below pH 8.5, even more preferably never below pH 9, most preferably never below pH 9.5.

30 **[0047]** In many cases particularly positive cleaning results are achieved with the use according to the present invention, preferably in combination with particularly low concentrations of cleaning agent, when the use occurs at an pH as defined above.

[0048] The present invention, with its various aspects, especially and preferably relates to a use (as described above, preferably as identified above as preferred), whereby the aqueous solution containing dissolved ferrate (VI) ions

35 - is essentially free of chlorine bleach, preferably completely free of chlorine bleach;
and/or

- is essentially free of hydrochloric acid, preferably completely free of hydrochloric acid;
and/or

40 - is essentially free of sulfuric acid, preferably completely free of sulfuric acid;
and/or

45 - is essentially free of nitric acid, preferably completely free of nitric acid;
and/or

- is essentially free of ethylenediaminetetraacetic acid (EDTA) and salts thereof, preferably completely free of ethylenediaminetetraacetic acid (EDTA) and salts thereof;
and/or

50 - is essentially free of nitrilotriacetic acid (NTA) and salts thereof, preferably completely free of nitrilotriacetic acid (NTA) and salts thereof;
and/or

55 - is essentially free of diethylenetriaminepentaacetic acid (DTPA) and salts thereof, preferably completely free of diethylenetriaminepentaacetic acid (DTPA) and salts thereof;
and/or

- is essentially free of methylglycinediacetic acid (MGDA) and salts thereof, preferably completely free of methylglycinediacetic acid (MGDA) and salts thereof;
and/or
- 5 - is essentially free of β -alanine diacetic acid (β -ADA) and salts thereof, preferably completely free of β -alanine diacetic acid (β -ADA) and salts thereof.

[0049] In the field of the current invention, the use of chlorine bleach is frequently undesirable.

[0050] In the field of the current invention, the use of hydrochloric acid is frequently undesirable.

10 [0051] In the field of the current invention, the use of sulfuric acid is frequently undesirable.

[0052] In the field of the current invention, the use of nitric acid is frequently undesirable.

[0053] In the field of the current invention, the use of ethylenediaminetetraacetic acid (EDTA) and salts thereof is frequently undesirable.

[0054] In the field of the current invention, the use of nitrilotriacetic acid (NTA) and salts thereof is frequently undesirable.

15 [0055] In the field of the current invention, the use of diethylenetriaminepentaacetic acid (DTPA) and salts thereof is frequently undesirable.

[0056] In the field of the current invention, the use of methylglycinediacetic acid (MGDA) and salts thereof is frequently undesirable.

20 [0057] In the field of the current invention, the use of β -alanine diacetic acid (β -ADA) and salts thereof is frequently undesirable.

[0058] The positive results and effects achieved with the present invention are preferably achieved without the above substances.

25 [0059] The present invention, with its various aspects, especially and preferably relates to a use (as described above, preferably as identified above as preferred), whereby during the use of the aqueous solution containing dissolved ferrate (VI) ions for cleaning surfaces,

- wherein the surface is a soiled surface
and/or, preferably "and"

30 - wherein

- at least a fraction of dissolved ferrate (VI) ions
reacts with

35 - at least a fraction of soil
so that dissolved iron (III) ions result.

[0060] In many cases, preferably cases wherein the surface is a soiled surface, the effects and advantages associated with the present invention are achieved in a particularly positive extent, if the above-defined reaction between dissolved ferrate (VI) ions and soil resulting in dissolved iron (III) ions occurs.

[0061] The invention also relates to a method for cleaning a solid surface, comprising the following steps:

S1 preparing or providing an aqueous solution containing dissolved ferrate (VI) ions;

45 preferably preparing or providing a predefined quantity of an aqueous solution containing dissolved ferrate (VI) ions, more preferably preparing or providing a predefined quantity of an aqueous solution containing dissolved ferrate (VI) ions in a predefined quantity;

S2 preparing or providing a soiled surface.

50 [0062] The advantages and effects associated with the use of the present invention are particularly well achieved in cases where the use of the present invention is according to the method of the present invention.

[0063] The present invention, with its various aspects, especially and preferably relates to a method (as described above, preferably as identified above as preferred), whereby

55 the aqueous solution containing dissolved ferrate (VI) ions is prepared or provided in step S1 in a predefined quantity;
and

- the following additional steps are carried out after preparing or providing an aqueous solution containing dissolved ferrate (VI) ions in step S1:

S1-1 preparing or providing a predefined quantity of water;
and

S1-2 contacting intermixing of

- the predefined quantity of the aqueous solution containing dissolved ferrate (VI) ions, prepared or provided in step S1;
and
- the predefined quantity of water prepared or provided in step S1-1;
so that a diluted aqueous solution containing dissolved ferrate (VI) ions results.

[0064] With method according to the present invention including steps S1-1 and S1-2 desirably small amounts of aqueous solution containing dissolved ferrate (VI) ions are needed for transportation and storage whilst, in combination therewith, desirably positive cleaning results are achieved.

[0065] The present invention, with its various aspects, especially and preferably relates to a method (as described above, preferably as identified above as preferred), comprising the following step:

S3 contacting

- the soiled surface prepared or provided in step S2
and
- the soil on soiled surface prepared or provided in step S2
with
- the aqueous solution containing dissolved ferrate (VI) ions prepared or provided in step S1,
or
the diluted aqueous solution containing dissolved ferrate (VI) ions resulting in step S1-2,
so that at least a fraction of the soil is dissolved in the aqueous solution containing dissolved ferrate (VI) ions
or in the diluted aqueous solution containing dissolved ferrate (VI) ions
and
so that a partially cleaned solid surface or a cleaned solid surface results.

[0066] In many cases, particularly positive cleaning results are achieved by contacting the soil and the soiled surface with an aqueous solution containing dissolved ferrate (VI) ions (diluted or undiluted, preferably as defined above) so that at least a fraction of the soil is dissolved in the aqueous solution containing dissolved ferrate (VI) ions (diluted or undiluted, preferably as defined above) and so that a partially cleaned solid surface or a cleaned solid surface results. The further advantages and effects of the present invention (as described herein, preferably as described herein as preferred) are achieved.

[0067] The present invention, with its various aspects, especially and preferably relates to a method (as described above, preferably as identified above as preferred), comprising

- the following additional step after the contacting in step S3:
S4-1 cleaning of the solid surface with water so that a further partially cleaned solid surface or a cleaned solid surface results;
and/or
- the following additional step after the contacting in step S3:
S4-2 final rinsing of the solid surface with water, preferably with water and a rinsing agent, so that a cleaned solid surface results;
and/or
- the following additional step after the contacting in step S3:
S5 drying the cleaned solid surface so that a dried cleaned solid surface results;
and/or

- the following additional step before preparing or providing the soiled surface in step S2:
S2a pre-cleaning the solid surface with water or with an aqueous solution so that the solid surface prepared or provided in step S2 is a pre-cleaned solid surface.

[0068] In many cases it is disadvantageous if significant amounts of soil, ferrate (VI) ions and/or surfactants are attached to the solid surface, after cleaning, In such cases, step S4-1 (carried out after step S3) and/or step S4-2 (carried out after step S3, preferably also carried out after step S4-1) is carried out.

[0069] In many cases it is disadvantageous if the surface of the solid surface after cleaning remains wet for undesirably long period of time. In such cases, step S5 (carried out after step S3, preferably also carried out after step S4-1, more preferably also carried out after step S4-2) is carried out.

[0070] In many cases when the solid surface to be cleaned is covered with particularly large amounts of soil, step S2a (carried out after step S2) is carried out to improve the overall cleaning result.

[0071] A further cleaned solid surface can be a cleaned solid surface.

[0072] In cases where the method is carried out in an embodiment comprising step S4, step S5 is carried out after step S3 and after step S4.

[0073] In cases where the method is carried out in an embodiment comprising step S4-1 and/or step S4-2, step S5 is carried out after step S3 and after step S4-1 and/or after step S4-2.

[0074] The present invention, with its various aspects, especially and preferably relates to a method (as described above, preferably as identified above as preferred), wherein

- during step S3, the temperature of the aqueous solution containing dissolved ferrate (VI) ions always within the range of 15 °C to 80 °C, preferably always within the range of 20 °C to 60 °C, more preferably always within the range of 25 °C to 50 °C, yet more preferably always within the range of 27 °C to 35 °C;
and/or

- the temperature of the aqueous solution containing dissolved ferrate (VI) ions never exceeds 80 °C, preferably never exceeds 40 °C, more preferably never exceeds 35 °C, yet more preferably never exceeds 30 °C.

[0075] The advantages associated with low temperature cleaning are combined here with very advantageous cleaning results. In many cases highly advantageous cleaning results are achieved at temperatures so low that equally advantageous cleaning results cannot be achieved at these low temperatures (under otherwise equal conditions) with surfactants instead of the aqueous solution containing dissolved ferrate (VI) ions. As a consequence, in such cases the method according to the present invention is carried out with favourably low use of energy input.

[0076] The present invention, with its various aspects, especially and preferably relates to a method (as described above, preferably as identified above as preferred), wherein

- the aqueous solution containing dissolved ferrate (VI) ions prepared or provided in step S1 contains dissolved ferrate (VI) ions in an amount of 0.0002 wt.-% to 1.2 wt.-%, preferably from 0.0006 wt.-% to 1.1 wt.-%, more preferably from 0.0034 wt.-% to 1.02 wt.-% with regard to the total mass of the aqueous solution containing dissolved ferrate (VI) ions prepared or provided in step S1;
and/or

- the diluted aqueous solution containing dissolved ferrate (VI) ions resulting in step S1-2 contains dissolved ferrate (VI) ions in an amount of 0.0002 wt.-% to 0.025 wt.-%, preferably from 0.0006 wt.-% to 0.022 wt.-%, more preferably from 0.0008 wt.-% to 0.020 wt.-% with regard to the total mass of the diluted aqueous solution containing dissolved ferrate (VI) ions resulting in step S1-2;
and/or

- the volume ratio of

- the predefined quantity of the aqueous solution containing dissolved ferrate (VI) ions, prepared or provided in step S1
to

- the predefined quantity of water prepared or provided in step S1-1;
is in the range of 1:1 to 1:2500, preferably in the range of 1:1.1 to 1:2000, more preferably in the range of 1:1.2 to 1:1500, yet more preferably in the range of 1:5 to 1:1000.

[0077] With the above-defined amounts and ratios, particularly positive combinations of the advantages and effects associated with the present invention are achieved.

[0078] The present invention, with its various aspects, especially and preferably relates to a method (as described above, preferably as identified above as preferred), wherein

- the contacting in step S3,
and/or
- the further cleaning of the solid surface with water in step S4-1
and/or
- the final rinsing of the solid surface with water, preferably with water and a rinsing agent, in step S4-2
and/or
- the pre-cleaning of the solid surface with water or with an aqueous solution in step S2a
is carried out using spray nozzles as means of application.

[0079] In many cases, step S3, step S4-1, step S4-2, step S2a and/or the overall method of the present invention are carried out favourably fast and energy efficient using spray nozzles as means of application.

[0080] The present invention, with its various aspects, especially and preferably relates to a method (as described above, preferably as identified above as preferred), wherein

- wherein the solid surfaces are selected from the group consisting of:
 - glass, ceramic, plastic, metal, wood and/or stone, each coated or uncoated,
 - fibres and/or textiles, each coated or uncoated;and/or
- wherein the method is carried out in the areas selected from the group consisting of:
 - household, industry, commerce and institutions, ships, port facilities, sports and leisure facilities;and/or
- wherein the solid surfaces are selected from surfaces of
 - boxes,
 - glass bottles and non-glass bottles,
 - crockery, especially bowls, cups, plates, and serving dishes,
 - cutlery,
 - drinking glasses
 - cookware,
 - cars,
 - Textiles, especially
 - clothing, especially clothing items for men, women and children, nightwear, sportswear, lingerie, undergarments, swimsuits; caps, socks, gloves, and handbags;
 - agro-textile, especially shade net, thermal insulation and sunscreen material, windshield material, antibird

net, covering livestock protection material, weed suppressing textile, and insect control textile;

- furnishing textile, especially upholstery, curtain, drapery, carpet, and towel;
- geotextile;
- bedding, especially bed sheet, khes, blanket, and pillow;
- automotive textile, especially airbag, seat belt, headliner, upholstery, car carpet, and door card;
- Medical textile, especially implant, suture, dressing, bandage, medical gown, face mask;
- Further textiles, especially shower curtain, conveyor belt, drive belt, rope, filtration device and cloth, especially decatizing cloth and bolting cloth;
- workwear;
- personal protective equipment and
- pallets.

[0081] The effects and advantages of the present invention are particularly well achieved with the solid surfaces defined above.

[0082] The present invention, with its various aspects, especially and preferably relates to a method (as described above, preferably as identified above as preferred), wherein

- the aqueous solution containing dissolved ferrate (VI) ions prepared or provided in step S1 additionally comprises:

- dissolved calcium ions, preferably dissolved Ca(II), and
- dissolved magnesium ions, preferably dissolved Mg(II),

preferably in a combined total amount of 1 mg/L to 950 mg/L, more preferably in an amount of 2 mg/L to 100 mg/L, even more preferably in an amount of 3 mg/L to 40 mg/L; and/or, preferably "and"

- the diluted aqueous solution containing dissolved ferrate (VI) ions resulting in step S1-2 additionally comprises:

- dissolved calcium ions, preferably dissolved Ca(II), and/or, preferably "and"
- dissolved magnesium ions, preferably dissolved Mg(II),

preferably in a combined total amount of 1 mg/L to 950 mg/L, more preferably in an amount of 2 mg/L to 100 mg/L, even more preferably in an amount of 3 mg/L to 40 mg/L.

[0083] In many cases it is preferred to use water containing the above-defined amounts of dissolved calcium ions, preferably dissolved Ca(II), and dissolved magnesium ions, preferably dissolved Mg(II), to produce both, the aqueous solution containing dissolved ferrate (VI) ions the diluted aqueous solution containing dissolved ferrate (VI) ions. In many cases tap water is used. In these cases, the method according to the present invention is carried out in a favourably efficient and low cost manner.

[0084] The present invention, with its various aspects, especially and preferably relates to a method (as described above, preferably as identified above as preferred), wherein

- the concentration of dissolved ferrate (VI) ions in
 - the aqueous solution containing dissolved ferrate (VI) ions, prepared or provided in step S1, and/or
 - the diluted aqueous solution containing dissolved ferrate (VI) ions resulting in step S1-2,

is in the range from 0.0002 wt.-% to 1.10 wt.-%, preferably in the range from 0.0006 wt.-% to 0.07 wt.-%, more preferably in the range from 0.0008 wt.-% to 0.034 wt.-%, with regard to the total mass of the aqueous solution containing dissolved ferrate (VI) ions;

and/or

- within

- the aqueous solution containing dissolved ferrate (VI) ions, prepared or provided in step S1, and/or

- the diluted aqueous solution containing dissolved ferrate (VI) ions resulting in step S1-2, the ratio of

- the amount of dissolved sodium ions, preferably dissolved Na(I), to

- the amount of dissolved ferrate (VI) ions is in the range from 30:0.3 to 1:1, preferably in the range from 28.75:0.34 to 27.6:1.02, more preferably in the range from 27.6:1.02 to 25:1;

and/or

- within

- the aqueous solution containing dissolved ferrate (VI) ions, prepared or provided in step S1, and/or

- the diluted aqueous solution containing dissolved ferrate (VI) ions resulting in step S1-2, the ratio of

- the amount of dissolved potassium ions, preferably dissolved K(I), to

- the amount of dissolved ferrate (VI) ions

is in the range from 35.03:0.3 to 33.408:1.02, preferably in the range from 34.8:0.34 to 34.8:1.02.

[0085] The present invention, with its various aspects, especially and preferably relates to a method (as described above, preferably as identified above as preferred), wherein the solid surface is soiled with a soil selected from the group consisting of:

- solvent-based adhesive, solvent-free adhesive, aftershave, alcoholic beverages, animal excrement, ash, baby food, balsamic vinegar, bark mulch, berries, beverages containing coffee, bird droppings, blood, body lotion, butter, cane, canned milk, chalk, chewing gum, chocolate, clay, coal, cocoa, coffee, cola, cream, curd, deodorant, diesel, dips, edible fat, edible oil, egg liqueur, eyeliner, eye shadow, finger paint, flyspeck, fruit, gel, glaze, Glue, preferably wood glue, grass, grease, ice cream, ink, iodine, jam, juice, preferable fruit juice and/or vegetable juice, ketchup, lemonade, lipstick, liquorice, make-up, margarine, marmalade, mayonnaise, milk, mould, mud, mustard, nail varnish, nicotine, nut nougat cream, nuts, oil, oil paint, ointment, opaque white, paint, perfume, pesto, petrol, plasticine, pollen, porridge, powder, printer's ink, pudding, pus, red wine, resin, rouge, rubber solution, rust, salad sauces, salad dressings, saliva, sauces, shoe polish, slaughterhouse waste, sludge, soot, sperm, spices, starch, street dirt, sun cream, suntan oil, sweat marks, sweat, syrup, tar, tea, text markers, toner, tomato, tomato sauce, tsatsiki, urine, varnish, vaseline, vegetables, vomit, wax, whiteboard markers and yoghurt.

[0086] The effects and advantages of the present invention are achieved.

[0087] Also solid surfaces soiled with other soils can be cleaned with the method according to the present invention.

[0088] The present invention, with its various aspects, especially and preferably relates to a method (as described above, preferably as identified above as preferred), wherein the temperature

EP 4 541 875 A1

- of the aqueous solution containing dissolved ferrate (VI) ions during preparing or providing an aqueous solution containing dissolved ferrate (VI) ions in step S1;
and/or
- 5 - of the soiled surface, during preparing or providing a soiled surface in step S2;
and/or
- of the predefined quantity of water during preparing or providing a predefined quantity of water in step S1-1;
and/or
- 10 - of the predefined quantity of water during contacting intermixing in step S1-2;
and/or
- of the predefined quantity of the aqueous solution containing dissolved ferrate (VI) ions during contacting intermixing
15 in step S1-2;
and/or
- of the diluted aqueous solution containing dissolved ferrate (VI) ions upon resulting in step S1-2;
and/or
- 20 - of the soiled surface during contacting in step S3;
and/or
- of the soil on soiled surface during contacting in step S3;
25 and/or
- of the soil on soiled surface during contacting in step S3;
and/or
- 30 - of the aqueous solution containing dissolved ferrate (VI) ions during contacting in step S3;
and/or
- of the diluted aqueous solution containing dissolved ferrate (VI) ions during contacting in step S3;
and/or
- 35 - of the partially cleaned solid surface and the cleaned solid surface during cleaning of the solid surface with water in
step S4-1;
and/or
- 40 - of the cleaned solid surface during final rinsing of the solid surface with water in step S4-2;
and/or
- of the cleaned solid surface and the dried cleaned solid surface during drying the cleaned solid surface in step S5;
and/or
- 45 - of the pre-cleaned solid surface during pre-cleaning the solid surface with water or with an aqueous solution in step
S2a;

50 never exceeds a temperature of 80 °C, preferably 60 °C, more preferably 40 °C, even more preferably 35 °C, yet more preferably 30 °C.

[0089] It is especially preferably that the temperature of solid surface and of the aqueous solution containing dissolved ferrate (VI) ions never exceeds a temperature of 80 °C, preferably 60 °C, more preferably 40 °C, even more preferably 35 °C, yet more preferably 30 °C whilst carrying out the method (as described above, preferably as identified above as preferred).

55 **[0090]** With the method according to the present invention, good cleaning results are also achieved at low temperatures, especially temperatures as defined above. These good cleaning results at low temperatures are achieved in combination with a favourably low amount of cleaning agent.

[0091] In many cases these effects and advantages are achieved in further combination with favourably little foaming.

[0092] The present invention, with its various aspects, especially and preferably relates to a method (as described above, preferably as identified above as preferred), wherein

- the cleaned solid surface
and/or
- the dried cleaned solid surface
is a disinfected solid surface.

[0093] In many cases, disinfection is achieved or improved by the additional use of ethaneperoxoic acid in the method according to the present invention. Depending on the requirements of the individual case, the skilled person choses alternative disinfectants and/or further disinfectants from his common general knowledge and tests their suitability (for disinfection and/or for use together with the aqueous solution containing dissolved ferrate (VI) ions) in simple routine experiments without undue burden.

[0094] The present invention, with its various aspects, especially and preferably relates to a method (as described above, preferably as identified above as preferred),

- wherein

- the aqueous solution containing dissolved ferrate (VI) ions, prepared or provided in step S1,
and/or
- the diluted aqueous solution containing dissolved ferrate (VI) ions resulting in step S1-2,
additionally comprise surfactants,
- independently selected from:
 - anionic surfactants, preferably soaps, amine oxides, alkylbenzene sulfonates, alkane sulfonates, alkyl sulfates and alkylethersulfates;
and/or
 - non-ionic surfactants, preferably fatty alcohol ethoxylates, alkylphenol ethoxylates, sorbitan fatty acid esters, alkylpolyglucosides, and N-methylglucamides;
and/or
 - cationic surfactants, preferably quaternary ammonium compounds and salts of C₁₀ to C₂₂ primary amines;
and/or
 - amphoteric surfactants, preferably amidoalkyl betaines.

or

- wherein

- the aqueous solution containing dissolved ferrate (VI) ions, prepared or provided in step S1,
and/or
- the diluted aqueous solution containing dissolved ferrate (VI) ions resulting in step S1-2,
are essentially free of surfactants, preferably completely free of surfactants.

[0095] The skilled person knows suitable surfactants from common general knowledge. The effects and advantages discussed hereinabove with regard to the use according to the present invention are achieved and the relevant teachings apply.

[0096] The present invention, with its various aspects, especially and preferably relates to a method (as described above, preferably as identified above as preferred), wherein the pH of

- the aqueous solution containing dissolved ferrate (VI) ions, prepared or provided in step S1,
and/or

- the diluted aqueous solution containing dissolved ferrate (VI) ions resulting in step S1-2,

is never below pH 7, preferably never below pH 8, more preferably never below pH 8.5, even more preferably never below pH 9, most preferably never below pH 9.5.

[0097] Carrying out the method according to the present invention with a pH as defined above leads, in many cases, to particularly positive cleaning results, preferably in combination with particularly low concentrations of cleaning agent.

[0098] The present invention, with its various aspects, especially and preferably relates to a method (as described above, preferably as identified above as preferred), wherein

- the aqueous solution containing dissolved ferrate (VI) ions, prepared or provided in step S1, and/or

- the diluted aqueous solution containing dissolved ferrate (VI) ions resulting in step S1-2, is

- essentially free of chlorine bleach, preferably completely free of chlorine bleach; and/or

- essentially free of hydrochloric acid, preferably completely free of hydrochloric acid; and/or

- essentially free of sulfuric acid, preferably completely free of sulfuric acid; and/or

- essentially free of nitric acid, preferably completely free of nitric acid; and/or

- essentially free of ethylenediaminetetraacetic acid (EDTA) and salts thereof, preferably completely free of ethylenediaminetetraacetic acid (EDTA) and salts thereof; and/or

- essentially free of nitrilotriacetic acid (NTA) and salts thereof, preferably completely free of nitrilotriacetic acid (NTA) and salts thereof; and/or

- essentially free of diethylenetriaminepentaacetic acid (DTPA) and salts thereof, preferably completely free of diethylenetriaminepentaacetic acid (DTPA) and salts thereof; and/or

- essentially free of methylglycinediacetic acid (MGDA) and salts thereof, preferably completely free of methylglycinediacetic acid (MGDA) and salts thereof; and/or

- essentially free of β -alanine diacetic acid (β -ADA) and salts thereof, preferably completely free of β -alanine diacetic acid (β -ADA) and salts thereof; and/or

- is essentially free of nitrates, preferably completely free of nitrates; and/or

- is essentially free of phosphates, preferably completely free of phosphates; and/or

- is essentially free of adsorbable organic halogen compounds, preferably completely free of adsorbable organic halogen compounds.

[0099] In the field of the current invention, methods comprising the use of chlorine bleach are frequently undesirable.

[0100] In the field of the current invention, methods comprising the use of hydrochloric acid are frequently undesirable.

[0101] In the field of the current invention, methods comprising the use of sulfuric acid are frequently undesirable.

[0102] In the field of the current invention, methods comprising the use of nitric acid are frequently undesirable.

[0103] In the field of the current invention, methods comprising the use of ethylenediaminetetraacetic acid (EDTA) and salts thereof are frequently undesirable.

[0104] In the field of the current invention, methods comprising the use of nitrilotriacetic acid (NTA) and salts thereof are frequently undesirable.

[0105] In the field of the current invention, methods comprising the use of diethylenetriaminepentaacetic acid (DTPA) and salts thereof are frequently undesirable.

[0106] In the field of the current invention, methods comprising the use of methylglycinediacetic acid (MGDA) and salts thereof are frequently undesirable.

[0107] In the field of the current invention, methods comprising the use of β -alanine diacetic acid (β -ADA) and salts thereof are frequently undesirable.

[0108] In the field of the current invention, methods comprising the use of cleaning agents comprising nitrates are frequently undesirable.

[0109] In the field of the current invention, methods comprising the use of cleaning agents comprising phosphates are frequently undesirable.

[0110] In the field of the current invention, methods comprising the use of cleaning agents comprising adsorbable organic halides (AOX) are frequently undesirable.

[0111] The positive results and effects achieved with the present invention are preferably achieved without the above substances.

[0112] The present invention, with its various aspects, especially and preferably relates to a method (as described above, preferably as identified above as preferred),

- wherein

- the aqueous solution containing dissolved ferrate (VI) ions, prepared or provided in step S1, and/or

- the diluted aqueous solution containing dissolved ferrate (VI) ions resulting in step S1-2, contains ferrate (VI) ions in an amount in the range from 0.0002 wt.-% to 1.10 wt.-%, preferably in the range from 0.0006 wt.-% to 0.07 wt.-%, more preferably in the range from 0.0008 wt.-% to 0.034 wt.-%, with regard to the total mass of the respective solution;

and/or

- wherein during the contacting in step S3

- at least a fraction of dissolved ferrate (VI) ions reacts with

- at least a fraction of soil so that dissolved ferrate (III) ions result.

[0113] In many cases, favourably good cleaning results are achieved in combination with favourably low amount of cleaning agent when the method of the present invention is carried out with ferrate (VI) ions present in the above-defined amounts. The aforementioned effects and advantages associated with the present invention are achieved.

[0114] The present invention, with its various aspects, especially and preferably relates to a method (as described above, preferably as identified above as preferred),

- wherein the aqueous solution containing dissolved ferrate (VI) ions is provided as predefined quantity of an aqueous solution containing dissolved ferrate (VI) ions by means of automated dosing, preferably automated dosing utilizing conductivity.

[0115] That the aqueous solution containing dissolved ferrate (VI) ions is provided as predefined quantity means that the quantity is a defined quantity based on a recipe or a defined measurement value.

[0116] Automatic dosing is known to the person skilled in the field of the present invention and the skilled person chooses suitable methods depending on the demands of the specific case. Parameters on which automatic dosing can be based, are known to the skilled person and include result of spectroscopic measurements and results of conductivity measurements.

[0117] In many cases, the method according to the present invention is carried out in a favourably efficient way if

automated dosing is used for providing the aqueous solution containing dissolved ferrate (VI) ions is provided as predefined quantity of an aqueous solution containing dissolved ferrate (VI) ions.

[0118] The invention also relates to a use of an aqueous solution containing dissolved ferrate (VI) ions as a demulsifier, preferably in a method for cleaning a solid surface, more preferably in a method for cleaning a solid surface (as described above, preferably as identified above as preferred).

[0119] The aforementioned effects and advantages are in many cases achieved in a particularly positive manner when an aqueous solution containing dissolved ferrate (VI) ions is used as a demulsifier in a method according to the present invention (as described above, preferably as identified above as preferred).

[0120] Demulsifiers, or emulsion breakers, are a class of specialty chemicals used to separate emulsions, for example, water in oil. They are commonly used in the processing of crude oil, which is typically produced along with significant quantities of saline water. Demulsifiers and their demulsifying properties are known to the skilled person. The skilled person thus knows when a demulsifying property is observed. Demulsifiers are commercially available.

[0121] The invention also relates to a washing agent and/or cleaning agent comprising an aqueous solution containing dissolved ferrate (VI) ions.

[0122] The washing and/or cleaning agent according to the present invention is particularly well suited for the use according to the present invention and for use in the method according to the present invention.

[0123] The effects and advantages mentioned in connection with the use according to the present invention and/or the method according to the present invention are achieved particularly well with a washing agent according to the present invention and/or cleaning agent according to the present invention.

[0124] Washing agent and/or cleaning agent comprising an aqueous solution containing dissolved ferrate (VI) ions are in many cases capable of washing and/or cleaning solid surfaces at lower temperatures and/or with lower amounts of washing agent and/or cleaning agent (active amounts respectively) than washing agents and/or cleaning agents based on surfactants.

[0125] The advantages associated with the invention are especially well fulfilled with a washing agent according to the present invention.

[0126] The present invention, with its various aspects, especially and preferably relates to a washing agent and/or cleaning agent (as described above, preferably as identified above as preferred), comprising an aqueous solution of alkali ions, preferably K(I) ions and/or Na(I) ions, more preferably Na (I) ions.

[0127] The effects and advantages described herein with regard to the presence of alkali ions are achieved.

[0128] The present invention, with its various aspects, especially and preferably relates to a washing agent and/or cleaning agent (as described above, preferably as identified above as preferred),

- having a pH of pH 7 or more, preferably of pH 8 or more, more preferably of pH 8.5 or more, even more preferably of pH 9 or more, most preferably of pH 9.5 or more.

[0129] The effects and advantages described herein with regard to pH are achieved.

[0130] The invention also relates to a method for producing a washing agent and/or cleaning agent, preferably a washing agent and/or cleaning agent (as described above, preferably as identified above as preferred), comprising the following step:

- preparing or providing an aqueous solution comprising dissolved ferrate (VI) ions and preferred additionally comprising an aqueous solution of alkali ions, preferably K(I) ions and/or Na(I) ions, more preferred Na (I) ions and even more preferred additionally having a pH of pH 7 or more, preferably of pH 8 or more, more preferably of pH 8.5 or more, even more preferably of pH 9 or more, most preferably of pH 9.5 or more.

[0131] The washing agent according to the present invention and/or cleaning agent according to the present invention are preferably and particularly efficiently produced in a method for producing a washing agent and/or cleaning agent according to the present invention.

[0132] The invention also relates to a solution and/or suspension, preferably washing fleet and/or wastewater, more preferably washing fleet, comprising

- dissolved ferrate (VI) ions, preferably in an amount of 0.0002 wt.-% to 1.2 wt.-%, more preferably from 0.0006 wt.-% to 1.1 wt.-%, even more preferably from 0.0034 wt.-% to 1.02 wt.-% with regard to the total mass of the solution and/or suspension;
and
- one two or more substances selected from the group consisting of:

- plant cell
- animal cell
- lipid
- protein
- starch
- and
- sugar.

[0133] The effects and advantages described herein with regard to various aspects of the present invention are achieved.

[0134] The invention also relates to a cleaning machine and/or washing machine,

- comprising one, two or more a storage tanks for or containing an aqueous solution comprising dissolved ferrate (VI) ions
and/or
- comprising one, two or more tubings for or containing an aqueous solution comprising dissolved ferrate (VI) ions
and/or
- comprising one, two or more dosing devices for or containing an aqueous solution comprising dissolved ferrate (VI) ions
and/or
- comprising one, two or more cleaning chambers and/or washing chambers
 - for washing and/or cleaning with an aqueous solution comprising dissolved ferrate (VI) ions
and/or
 - containing an aqueous solution comprising dissolved ferrate (VI) ions
and/or
 - containing an aqueous solution comprising dissolved ferrate (VI) ions
and/or
- suitable for washing and/or cleaning at least one, preferably at least ten, more preferably all, of the objects selected from the group consisting of:
 - boxes,
 - glass bottles and non-glass bottles,
 - crockery, especially bowls, cups, plates, and serving dishes,
 - cutlery,
 - drinking glasses
 - cookware,
 - cars,
 - Textiles, especially

EP 4 541 875 A1

- clothing, especially clothing items for men, women and children, nightwear, sportswear, lingerie, undergarments, swimsuits; caps, socks, gloves, and handbags;
- agro-textile, especially shade net, thermal insulation and sunscreen material, windshield material, antibird net, covering livestock protection material, weed suppressing textile, and insect control textile;
- furnishing textile, especially upholstery, curtain, drapery, carpet, and towel;
- geotextile;
- bedding, especially bed sheet, khes, blanket, and pillow;
- automotive textile, especially airbag, seat belt, headliner, upholstery, car carpet, and door card;
- Medical textile, especially implant, suture, dressing, bandage, medical gown, face mask;
- Further textiles, especially shower curtain, conveyor belt, drive belt, rope, filtration device and cloth, especially decatizing cloth and bolting cloth;

- workwear;

- personal protective equipment
and

- pallets;

and/or

- for industrial use.

[0135] The method according to the present invention is preferably and advantageously carried out by means of a washing machine according to the present invention and/or a cleaning machine according to the present invention.

[0136] The effects and advantages described herein with regard to various aspects of the present invention are achieved.

[0137] The invention also relates to a kit of parts comprising:

- ferrate (VI) ions
and

- alkali hydroxide, preferably sodium hydroxide and/or potassium hydroxide, more preferably sodium hydroxide preferably comprising

- ferrate (VI) ions,

- alkali hydroxide, preferably sodium hydroxide and/or potassium hydroxide, more preferably sodium hydroxide
and

- water;

more preferably comprising

- ferrate (VI) ions

- alkali hydroxide, preferably sodium hydroxide and/or potassium hydroxide, more preferably sodium hydroxide

- water,

and

- a soiled object selected from the group consisting of:

EP 4 541 875 A1

- boxes,
 - glass bottles and non-glass bottles,
 - 5 - crockery, especially bowls, cups, plates, and serving dishes,
 - cutlery,
 - drinking glasses
 - 10 - cookware,
 - cars,
 - 15 - Textiles, especially
 - clothing, especially clothing items for men, women and children, nightwear, sportswear, lingerie, undergarments, swimsuits; caps, socks, gloves, and handbags;
 - 20 - agro-textile, especially shade net, thermal insulation and sunscreen material, windshield material, antibird net, covering livestock protection material, weed suppressing textile, and insect control textile;
 - furnishing textile, especially upholstery, curtain, drapery, carpet, and towel;
 - 25 - geotextile;
 - bedding, especially bed sheet, khes, blanket, and pillow;
 - automotive textile, especially airbag, seat belt, headliner, upholstery, car carpet, and door card;
 - 30 - Medical textile, especially implant, suture, dressing, bandage, medical gown, face mask;
 - Further textiles, especially shower curtain, conveyor belt, drive belt, rope, filtration device and cloth, especially decatizing cloth and bolting cloth;
 - 35 - workwear;
 - personal protective equipment and
 - 40 - pallets;
- even more preferably comprising
- 45 - ferrate (VI) ions
 - alkali hydroxide, preferably sodium hydroxide and/or potassium hydroxide, more preferably sodium hydroxide
 - water,
 - 50 - a soiled object selected from the group consisting of:
 - boxes,
 - 55 - glass bottles and non-glass bottles,
 - crockery, especially bowls, cups, plates, and serving dishes,

EP 4 541 875 A1

- cutlery,
- drinking glasses
- 5 - cookware,
- cars,
- 10 - Textiles, especially
 - clothing, especially clothing items for men, women and children, nightwear, sportswear, lingerie, undergarments, swimsuits; caps, socks, gloves, and handbags;
 - 15 - agro-textile, especially shade net, thermal insulation and sunscreen material, windshield material, antibird net, covering livestock protection material, weed suppressing textile, and insect control textile;
 - furnishing textile, especially upholstery, curtain, drapery, carpet, and towel;
 - 20 - geotextile;
 - bedding, especially bed sheet, khes, blanket, and pillow;
 - automotive textile, especially airbag, seat belt, headliner, upholstery, car carpet, and door card;
 - 25 - Medical textile, especially implant, suture, dressing, bandage, medical gown, face mask;
 - Further textiles, especially shower curtain, conveyor belt, drive belt, rope, filtration device and cloth, especially decatizing cloth and bolting cloth;
 - 30 - workwear;
 - personal protective equipment and
 - 35 - pallets;
- and
- 40 - a cleaning machine and/or washing machine, suitable for washing and/or cleaning at least one of the objects selected from the group consisting of:
 - boxes,
 - 45 - glass bottles and non-glass bottles,
 - crockery, especially bowls, cups, plates, and serving dishes,
 - cutlery,
 - 50 - drinking glasses
 - cookware,
 - cars,
 - 55 - Textiles, especially
 - clothing, especially clothing items for men, women and children, nightwear, sportswear, lingerie,

undergarments, swimsuits; caps, socks, gloves, and handbags;

- agro-textile, especially shade net, thermal insulation and sunscreen material, windshield material, antibird net, covering livestock protection material, weed suppressing textile, and insect control textile;

- furnishing textile, especially upholstery, curtain, drapery, carpet, and towel;

- geotextile;

- bedding, especially bed sheet, khes, blanket, and pillow;

- automotive textile, especially airbag, seat belt, headliner, upholstery, car carpet, and door card;

- Medical textile, especially implant, suture, dressing, bandage, medical gown, face mask;

- Further textiles, especially shower curtain, conveyor belt, drive belt, rope, filtration device and cloth, especially decatizing cloth and bolting cloth;

- workwear;

- personal protective equipment
and

- pallets.

[0138] With the kit according to the present invention the method according to the present invention is carried out in a particularly efficient and advantageous way. With the kit according to the present invention the use of an aqueous solution containing dissolved ferrate (VI) ions for cleaning a solid surface according to the present invention is realised in a particularly efficient and advantageous way.

[0139] The effects and advantages described herein with regard to various aspects of the present invention are achieved.

[0140] The invention also relates to a use of a kit (as described above, preferably as identified above as preferred) for cleaning hard surfaces,

- preferably selected from the group consisting of:

- glass, ceramic, plastic, metal, wood and/or stone, each coated or uncoated,

- fibres and/or textiles, each coated or uncoated;
and/or

- from the group consisting of:

- boxes,

- glass bottles and non-glass bottles,

- crockery, especially bowls, cups, plates, and serving dishes,

- cutlery,

- drinking glasses

- cookware,

- cars,

- Textiles, especially

EP 4 541 875 A1

- clothing, especially clothing items for men, women and children, nightwear, sportswear, lingerie, undergarments, swimsuits; caps, socks, gloves, and handbags;
- 5 - agro-textile, especially shade net, thermal insulation and sunscreen material, windshield material, antibird net, covering livestock protection material, weed suppressing textile, and insect control textile;
- furnishing textile, especially upholstery, curtain, drapery, carpet, and towel;
- 10 - geotextile;
- bedding, especially bed sheet, khes, blanket, and pillow;
- automotive textile, especially airbag, seat belt, headliner, upholstery, car carpet, and door card;
- 15 - Medical textile, especially implant, suture, dressing, bandage, medical gown, face mask;
- Further textiles, especially shower curtain, conveyor belt, drive belt, rope, filtration device and cloth, especially decatizing cloth and bolting cloth;
- 20 - workwear;
- personal protective equipment and
- 25 - pallets.

[0141] With the use of the kit according to the present invention the method according to the present invention is carried out in a particularly efficient and advantageous way.

30 **[0142]** With the use of the kit according to the present invention the use of an aqueous solution containing dissolved ferrate (VI) ions for cleaning a solid surface according to the present invention is realised in a particularly efficient and advantageous way.

[0143] The effects and advantages described herein with regard to various aspects of the present invention are achieved.

35 **Examples:**

Example 1: washing of euroboxes

40 **[0144]** Cleaning experiments were carried out in a cleaning system of the type Contino CWD 1503 3-2-2 BD5, commercially available from the company KITZINGER Maschinenbau GmbH, Handewitt, Germany.

[0145] The system works according to the counterflow principle. This means that the water from zone 4 (see below) flows into zone 3 (see below). From zone 3, the water flows via overflows into zone 2 (see below) and zone 1 (see below). The overflow in zone 1 (see below) leads into the sewage system. Thus, during operation, the water volume is fed through the rinsing in zone 4.

45 **[0146]** The goods to be cleaned were solid surfaces of euroboxes (crates) in sizes E1, E2 and E3 made of polypropylene, soiled with fat, meat, and blood from the slaughter of pigs, cattle, chickens and turkeys as well as marinades and seasoning salts.

[0147] Unless specified differently, the usual operating parameters of the cleaning system as suggested by the manufacturer were used.

50

1-1 Solutions

[0148] The following solutions were prepared:

55

Solution A:

[0149] An aqueous solution containing dissolved ferrate (VI) ions with the following composition was prepared as solution A:

EP 4 541 875 A1

- dissolved ferrate (VI) ions at a concentration of 2 wt.-% with respect to the total mass of solution A;
and
- dissolved sodium hydroxide at a concentration of 50 wt.-% with respect to the total mass of solution A.

[0150] No further additives were added to solution A, but account for source of water as defined in this present example.

Solution B:

[0151] An aqueous solution containing dissolved ferrate (VI) ions with the following composition was prepared as solution B by suitable dilution of solution A (see hereinabove) with water:

- dissolved ferrate (VI) ions at a concentration of 0.0008 wt.-% with respect to the total mass of solution B;
and
- dissolved sodium hydroxide at a concentration of 0.02 wt.-% with respect to the total mass of solution B.

[0152] No further additives were added to Solution B, but account for source of water as defined in this present example. After preparation, Solution B was used directly after preparation.

Solution C:

[0153] An aqueous solution containing ethaneperoxoic acid (CAS Number 79-21-0) was prepared as solution C so that solution C contained 0.03 wt.-% of ethaneperoxoic acid with respect to the total mass of solution C. No further additives were added to Solution C but account for source of water as defined in this present example. Solution C was used directly after preparation.

1-2 Procedure

[0154] The euroboxes were transported through the machine by means of a conveyor belt and pass through the following five zones:

1. First the euroboxes pass through the "pre-cleaning" zone in which the euroboxes are pre-cleaned by application of water at ca. 20 °C via spray nozzles with a pressure of 2 bar. No heating is applied in this zone.

2. After the "pre-cleaning" zone, the conveyor belt transports the euroboxes to the second zone, the "main washing" zone. In the "main washing" zone, the euroboxes are washed by application of Solution B (as described hereinabove) at ca. 30 °C via spray nozzles with a pressure of 2 bar.

3. After the "main washing" zone, the conveyor belt transports the euroboxes to the third zone, the "clear washing with spray pressure" zone. In the "clear washing with spray pressure" zone, the euroboxes are washed by application water at ca. 20 °C via spray nozzles with a pressure of 2 bar. No heating is applied in this zone.

4. After the "clear washing with spray pressure" zone, the conveyor belt transports the euroboxes to the fourth zone, the "rinsing" zone, where the euroboxes are rinsed with of Solution C (as described hereinabove) at ca. 20 °C (500 L/h)

5. After the "rinsing" zone, the conveyor belt transports the euroboxes to the fifth zone, the "drying" zone, where the boxes are dried by a fan.

[0155] In cases where small residues of ethaneperoxoic acid on the cleaned euroboxes are problematic, solution C can alternatively be used for washing in the "clear washing with spray pressure" zone (third zone) instead of water and with pure water being used in the rinsing zone (fourth zone), instead of solution C.

Comparative example A

[0156] Cleaning experiments in comparative example A were carried out in the same cleaning system, with the same solutions, the same parameters and according to the same procedure as in Example 1 of the present text with the only exception that Ferrate (VI) was not present in the solutions and instead suitable mixtures of surfactants were used.

Specifically this means that the same temperatures were used and that the total mass concentration of surfactants in comparative example A was equal to the total mass concentration of dissolved ferrate (VI) ions in Example 1 (hereinafter).

[0157] The goods to be cleaned were solid surfaces of euroboxes (crates) in sizes E1, E2 and E3 made of polypropylene, soiled with fat, meat, and blood from the slaughter of pigs, cattle, chickens and turkeys as well as marinades and seasoning salts.

Example 2: Optical evaluation of cleaning results

[0158] Euroboxes (crates) in sizes E1, E2 and E3 made of polypropylene, soiled with fat, meat, and blood from the slaughter of pigs, cattle, chickens and turkeys as well as marinades and seasoning salts were cleaned according to example 1 of the present text and according to comparative example A of the current text.

[0159] After drying (after exiting the drying zone), the euroboxes were visually inspected and the cleaning results were assessed in a blind test by a panel of 10 people, each with several years of experience with industrial cleaning.

[0160] In all cases, the cleaning results for the euroboxes cleaned according to example 1 were assessed to be better than the cleaning results for the euroboxes cleaned according to comparative example A.

Example 3:

[0161] Euroboxes (crates) in sizes E1, E2 and E3 made of polypropylene, soiled with fat, meat, and blood from the slaughter of pigs, cattle, chickens and turkeys as well as marinades and seasoning salts were cleaned according to example 1 of the present text and according to comparative example A of the current text.

[0162] After drying (after exiting the drying zone), an ATP swab-test was made on a cleaned surface of each eurobox using an "Lumitester SMART", commercially available from the company Zeller GmbH, Austria. The ATP-value is a well-accepted indicator of the quantitative load of organic residues in industrial cleaning.

[0163] For the euroboxes cleaned according to example 1, all ATP-values were below 1000 RLU (Relative Light Units) which is regularly considered as limit value for the cleanliness of cleaned surfaces. For the euroboxes cleaned according to comparative example A, all ATP-values were above 1000 RLU.

Example 4:

[0164] Euroboxes (crates) in sizes E1, E2 and E3 made of polypropylene, soiled with fat, meat, and blood from the slaughter of pigs, cattle, chickens and turkeys as well as marinades and seasoning salts were cleaned according to example 1 of the present text and according to comparative example A of the current text.

[0165] After drying (after exiting the drying zone), a swab-sample was taken from a cleaned surface of each eurobox, transferred to suitable cell culture media. Then the media were incubated in an incubator for 48 h at 37°C and the number of colony-forming units (CFU) was counted.

[0166] For the euroboxes cleaned according to example 1, all ATP-values were below 10 CFU/ 10 cm². For the euroboxes cleaned according to comparative example A, all ATP-values were above 10 CFU/ 10cm².

Claims

1. Use of an aqueous solution containing dissolved ferrate (VI) ions for cleaning a solid surface.

2. Use according to claim 1,

- whereby the solid surfaces are selected from the group consisting of:

- glass, ceramic, plastic, metal, wood and/or stone, each coated or uncoated,
- fibres and/or textiles, each coated or uncoated;

and/or

- whereby the use preferably occurs in the areas selected from the group consisting of:

- household, industry, commerce and institutions, ships, port facilities, sports and leisure facilities;

and/or

- whereby the solid surfaces are selected from surfaces of

- boxes,
- glass bottles and non-glass bottles,
- crockery, especially bowls, cups, plates, and serving dishes,
- cutlery,
- drinking glasses
- cookware,
- cars,
- Textiles, especially

- clothing, especially clothing items for men, women and children, nightwear, sportswear, lingerie, undergarments, swimsuits; caps, socks, gloves, and handbags;
- agro-textile, especially shade net, thermal insulation and sunscreen material, windshield material, antibird net, covering livestock protection material, weed suppressing textile, and insect control textile;
- furnishing textile, especially upholstery, curtain, drapery, carpet, and towel;
- geotextile;
- bedding, especially bed sheet, khes, blanket, and pillow;
- automotive textile, especially airbag, seat belt, headliner, upholstery, car carpet, and door card;
- Medical textile, especially implant, suture, dressing, bandage, medical gown, face mask;
- Further textiles, especially shower curtain, conveyor belt, drive belt, rope, filtration device and cloth, especially decatizing cloth and bolting cloth;

- workwear;
- personal protective equipment
- and
- pallets;

and/or

- whereby the aqueous solution of ferrate (VI) additionally comprises:

- dissolved calcium ions, preferably dissolved Ca(II),
- and/or
- dissolved magnesium ions, preferably dissolved Mg(II) ;
- preferably in an amount of 1 mg/L to 950 mg/L, more preferably in an amount of 2 mg/L to 100 mg/L, even more preferably in an amount of 3 mg/L to 40 mg/L;

and/or

- whereby

- the concentration of dissolved ferrate (VI) ions in the aqueous solution containing dissolved ferrate (VI) ions is in the range from 0.0002 wt.-% to 1.10 wt.-%, preferably in the range from 0.0006 wt.-% to 0.07 wt.-%, more preferably in the range from 0.0008 wt.-% to 0.034 wt.-%, with regard to the total mass of the aqueous solution containing dissolved ferrate (VI) ions;

and/or

- within the aqueous solution containing dissolved ferrate (VI) ions, the ratio of

- the amount of dissolved sodium ions, preferably dissolved Na(I), to
- the amount of dissolved ferrate (VI) ions
- is in the range from 30:0.3 to 1:1, preferably in the range from 28.75:0.34 to 27.6:1.02, more preferably in the range from 27.6:1.02 to 25:1;

and/or

- within the aqueous solution containing dissolved ferrate (VI) ions, the ratio of

- the amount of dissolved potassium ions, preferably dissolved K(I), to
- the amount of dissolved ferrate (VI) ions
- is in the range from 35.03:0.3 to 33.408:1.02, preferably in the range from 34.8:0.34 to 34.8:1.02.

3. Use according to any of the preceding claims,

- whereby the aqueous solution containing dissolved ferrate (VI) ions is used for cleaning surfaces soiled with a soil selected from the group consisting of:

- solvent-based adhesive, solvent-free adhesive, aftershave, alcoholic beverages, animal excrement, ash, baby food, balsamic vinegar, bark mulch, berries, beverages containing coffee, bird droppings, blood, body lotion, butter, cane, canned milk, chalk, chewing gum, chocolate, clay, coal, cocoa, coffee, cola, cream, curd, deodorant, diesel, dips, edible fat, edible oil, egg liqueur, eyeliner, eye shadow, finger paint, flyspeck, fruit, gel, glaze, Glue, preferably wood glue, grass, grease, ice cream, ink, iodine, jam, juice, preferable fruit juice and/or vegetable juice, ketchup, lemonade, lipstick, liquorice, make-up, margarine, marmalade, mayonnaise, milk, mould, mud, mustard, nail varnish, nicotine, nut nougat cream, nuts, oil, oil paint, ointment, opaque white, paint, perfume, pesto, petrol, plasticine, pollen, porridge, powder, printer's ink, pudding, pus, red wine, resin, rouge, rubber solution, rust, salad sauces, salad dressings, saliva, sauces, shoe polish, slaughterhouse waste, sludge, soot, sperm, spices, starch, street dirt, sun cream, suntan oil, sweat marks, sweat, syrup, tar, tea, text markers, toner, tomato, tomato sauce, tsatsiki, urine, varnish, vaseline, vegetables, vomit, wax, whiteboard markers and yoghurt;

and/or

- whereby during the use the temperature of the aqueous solution containing dissolved ferrate (VI) ions never exceeds a temperature of 85 °C, preferably 60 °C, more preferably 50 °C, even more preferably 30 °C, most preferably 25 °C;

and/or

- whereby

- the aqueous solution containing dissolved ferrate (VI) ions additionally contains ethaneperoxoic acid,

and/or

- the cleaning comprises a disinfection.

4. Use according to any of the preceding claims,

- whereby the aqueous solution containing dissolved ferrate (VI) ions

- additionally comprises surfactants,

- independently selected from:

- anionic surfactants, preferably soaps, amine oxides, alkylbenzene sulfonates, alkane sulfonates, alkyl sulfates and alkylethersulfates;

and/or

- non-ionic surfactants, preferably fatty alcohol ethoxylates, alkylphenol ethoxylates, sorbitan fatty acid esters, alkylpolyglucosides, and N-methylglucamides;

and/or

- cationic surfactants, preferably quaternary ammonium compounds and salts of C₁₀ to C₂₂ primary amines;

and/or

- amphoteric surfactants, preferably amidoalkyl betaines;

and/or

- whereby the aqueous solution containing dissolved ferrate (VI) ions is essentially free of surfactants, preferably completely free of surfactants;

and/or

- whereby during the use the pH of the aqueous solution containing dissolved ferrate (VI) ions is never below pH 7, preferably never below pH 8, more preferably never below pH 8.5, even more preferably never below pH 9, most preferably never below pH 9.5;

and/or

- whereby the aqueous solution containing dissolved ferrate (VI) ions

- is essentially free of chlorine bleach, preferably completely free of chlorine bleach;
and/or
- is essentially free of hydrochloric acid, preferably completely free of hydrochloric acid;
and/or
- 5 - is essentially free of sulfuric acid, preferably completely free of sulfuric acid;
and/or
- is essentially free of nitric acid, preferably completely free of nitric acid;
and/or
- 10 - is essentially free of ethylenediaminetetraacetic acid (EDTA) and salts thereof, preferably completely free of ethylenediaminetetraacetic acid (EDTA) and salts thereof;
and/or
- is essentially free of nitrilotriacetic acid (NTA) and salts thereof, preferably completely free of nitrilotriacetic acid (NTA) and salts thereof;
and/or
- 15 - is essentially free of diethylenetriaminepentaacetic acid (DTPA) and salts thereof, preferably completely free of diethylenetriaminepentaacetic acid (DTPA) and salts thereof;
and/or
- is essentially free of methylglycinediacetic acid (MGDA) and salts thereof, preferably completely free of methylglycinediacetic acid (MGDA) and salts thereof;
and/or
- 20 - is essentially free of β -alanine diacetic acid (β -ADA) and salts thereof, preferably completely free of β -alanine diacetic acid (β -ADA) and salts thereof;
- and/or
- 25 - whereby during the use of the aqueous solution containing dissolved ferrate (VI) ions for cleaning surfaces,
 - the surface is a soiled surface
and/or,
 - at least a fraction of dissolved ferrate (VI) ions
30 reacts with
 - at least a fraction of soil
so that dissolved iron (III) ions result.

35 **5.** Method for cleaning a solid surface, comprising the following steps:

- S1 preparing or providing an aqueous solution containing dissolved ferrate (VI) ions;
preferably preparing or providing a predefined quantity of an aqueous solution containing dissolved ferrate (VI) ions, more preferably preparing or providing a predefined quantity of an aqueous solution containing dissolved
40 ferrate (VI) ions in a predefined quantity;
- S2 preparing or providing a soiled surface.

6. Method according to claim 5,

- 45 - whereby
the aqueous solution containing dissolved ferrate (VI) ions is prepared or provided in step S1 in a predefined quantity;
and
- 50 - the following additional steps are carried out after preparing or providing an aqueous solution containing dissolved ferrate (VI) ions in step S1:
 - S1-1 preparing or providing a predefined quantity of water;
and
 - 55 S1-2 contacting intermixing of
 - the predefined quantity of the aqueous solution containing dissolved ferrate (VI) ions, prepared or provided in step S1;

and

- the predefined quantity of water prepared or provided in step S1-1;
so that a diluted aqueous solution containing dissolved ferrate (VI) ions results;

and/or

- whereby the method comprises the following step:
S3 contacting

- the soiled surface prepared or provided in step S2

and

- the soil on soiled surface prepared or provided in step S2 with
- the aqueous solution containing dissolved ferrate (VI) ions prepared or provided in step S1,
or
the diluted aqueous solution containing dissolved ferrate (VI) ions resulting in step S1-2,

so that at least a fraction of the soil is dissolved in the aqueous solution containing dissolved ferrate (VI) ions or in the diluted aqueous solution containing dissolved ferrate (VI) ions

and

so that a partially cleaned solid surface or a cleaned solid surface results.

7. Method according to claim 6, comprising

- the following additional step after the contacting in step S3:

S4-1 cleaning of the solid surface with water so that a further partially cleaned solid surface or a cleaned solid surface results;

and/or

- the following additional step after the contacting in step S3:

S4-2 final rinsing of the solid surface with water, preferably with water and a rinsing agent, so that a cleaned solid surface results;

and/or

- the following additional step after the contacting in step S3:

S5 drying the cleaned solid surface so that a dried cleaned solid surface results;

and/or

- the following additional step before preparing or providing the soiled surface in step S2:

S2a pre-cleaning the solid surface with water or with an aqueous solution so that the solid surface prepared or provided in step S2 is a pre-cleaned solid surface.

8. Method according to any of the preceding claims 5 to 7,

- wherein

- during step S3, the temperature of the aqueous solution containing dissolved ferrate (VI) ions always within the range of 15 °C to 80 °C, preferably always within the range of 20 °C to 60 °C, more preferably always within the range of 25 °C to 50 °C, yet more preferably always within the range of 27 °C to 35 °C;

and/or

- the temperature of the aqueous solution containing dissolved ferrate (VI) ions never exceeds 80 °C, preferably never exceeds 40 °C, more preferably never exceeds 35 °C, yet more preferably never exceeds 30 °C;

and/or

- wherein

- the aqueous solution containing dissolved ferrate (VI) ions prepared or provided in step S1 contains dissolved ferrate (VI) ions in an amount of 0.15 wt.-% to 1.2 wt.-%, preferably from 0.2 wt.-% to 1.1 wt.-%, more preferably from 0.34 wt.-% to 1.02 wt.-% with regard to the total mass of the aqueous solution containing dissolved ferrate (VI) ions prepared or provided in step S1;

and/or

- the diluted aqueous solution containing dissolved ferrate (VI) ions resulting in step S1-2 contains dissolved

EP 4 541 875 A1

ferrate (VI) ions in an amount of 0.0015 wt.-% to 0.025 wt.-%, preferably from 0.002 wt.-% to 0.022 wt.-%, more preferably from 0.0034 wt.-% to 0.020 wt.-% with regard to the total mass of the diluted aqueous solution containing dissolved ferrate (VI) ions resulting in step S1-2;

and/or

- the volume ratio of

- the predefined quantity of the aqueous solution containing dissolved ferrate (VI) ions, prepared or provided in step S1

to

- the predefined quantity of water prepared or provided in step S1-1;

is in the range of 1:1 to 1:2500, preferably in the range of 1:1.1 to 1:2000, more preferably in the range of 1:1.2 to 1:1500, yet more preferably in the range of 1:5 to 1:1000;

and/or

- wherein

- the contacting in step S3,

and/or

- the further cleaning of the solid surface with water in step S4-1 and/or

- the final rinsing of the solid surface with water, preferably with water and a rinsing agent, in step S4-2

and/or

- the pre-cleaning of the solid surface with water or with an aqueous solution in step S2a

is carried out using spray nozzles as means of application;

and/or

- wherein

- the solid surfaces are selected from the group consisting of:

- glass, ceramic, plastic, metal, wood and/or stone, each coated or uncoated,

- fibres and/or textiles, each coated or uncoated;

and/or

- wherein the method is carried out in the areas selected from the group consisting of:

- household, industry, commerce and institutions, ships, port facilities, sports and leisure facilities;

and/or

- wherein the solid surfaces are selected from surfaces of

- boxes,

- glass bottles and non-glass bottles,

- crockery, especially bowls, cups, plates, and serving dishes,

- cutlery,

- drinking glasses

- cookware,

- cars,

- Textiles, especially

- clothing, especially clothing items for men, women and children, nightwear, sportswear, lingerie, undergarments, swimsuits; caps, socks, gloves, and handbags;

- agro-textile, especially shade net, thermal insulation and sunscreen material, windshield material, antibird net, covering livestock protection material, weed suppressing textile, and insect control textile;

- furnishing textile, especially upholstery, curtain, drapery, carpet, and towel;

- geotextile;

- bedding, especially bed sheet, khes, blanket, and pillow;

- automotive textile, especially airbag, seat belt, headliner, upholstery, car carpet, and door card;

EP 4 541 875 A1

- Medical textile, especially implant, suture, dressing, bandage, medical gown, face mask;
- Further textiles, especially shower curtain, conveyor belt, drive belt, rope, filtration device and cloth, especially decatizing cloth and bolting cloth;

- 5
- workwear;
 - personal protective equipment
- and
- pallets;

- 10
- and/or
- wherein

- the aqueous solution containing dissolved ferrate (VI) ions prepared or provided in step S1 additionally comprises:

- 15
- dissolved calcium ions, preferably dissolved Ca(II),
- and/or
- dissolved magnesium ions, preferably dissolved Mg(II),

- 20
- preferably in an amount of 1 mg/L to 950 mg/L, more preferably in an amount of 2 mg/L to 100 mg/L, even more preferably in an amount of 3 mg/L to 40 mg/L;

and/or

- the diluted aqueous solution containing dissolved ferrate (VI) ions resulting in step S1-2 additionally comprises:

- 25
- dissolved calcium ions, preferably dissolved Ca(II)
- and/or
- dissolved magnesium ions, preferably dissolved Mg(II),

- 30
- preferably in an amount of 1 mg/L to 950 mg/L, more preferably in an amount of 2 mg/L to 100 mg/L, even more preferably in an amount of 3 mg/L to 40 mg/L;

and/or

- wherein

- 35
- the concentration of dissolved ferrate (VI) ions in

- the aqueous solution containing dissolved ferrate (VI) ions, prepared or provided in step S1,
- and/or

- 40
- the diluted aqueous solution containing dissolved ferrate (VI) ions resulting in step S1-2, is in the range from 0.0002 wt.-% to 1.10 wt.-%, preferably in the range from 0.0006 wt.-% to 0.07 wt.-%, more preferably in the range from 0.0008 wt.-% to 0.034 wt.-%, with regard to the total mass of the aqueous solution containing dissolved ferrate (VI) ions;

- 45
- and/or
- within

- the aqueous solution containing dissolved ferrate (VI) ions, prepared or provided in step S1,
- and/or

- 50
- the diluted aqueous solution containing dissolved ferrate (VI) ions resulting in step S1-2, the ratio of

- the amount of dissolved sodium ions, preferably dissolved Na(I),
- to

- the amount of dissolved ferrate (VI) ions

- 55
- is in the range from 30:0.3 to 1:1, preferably in the range from 28.75:0.34 to 27.6:1.02, more preferably in the range from 27.6:1.02 to 25:1;

and/or

- within

- the aqueous solution containing dissolved ferrate (VI) ions, prepared or provided in step S1, and/or

- the diluted aqueous solution containing dissolved ferrate (VI) ions resulting in step S1-2, the ratio of

- the amount of dissolved potassium ions, preferably dissolved K(I), to

- the amount of dissolved ferrate (VI) ions

is in the range from 35.03:0.3 to 33.408:1.02, preferably in the range from 34.8:0.34 to 34.8:1.02.

9. Method according to any of the preceding claims 5 to 8,

- wherein the solid surface is soiled with a soil selected from the group consisting of:

- solvent-based adhesive, solvent-free adhesive, aftershave, alcoholic beverages, animal excrement, ash, baby food, balsamic vinegar, bark mulch, berries, beverages containing coffee, bird droppings, blood, body lotion, butter, cane, canned milk, chalk, chewing gum, chocolate, clay, coal, cocoa, coffee, cola, cream, curd, deodorant, diesel, dips, edible fat, edible oil, egg liqueur, eyeliner, eye shadow, finger paint, flyspeck, fruit, gel, glaze, Glue, preferably wood glue, grass, grease, ice cream, ink, iodine, jam, juice, preferable fruit juice and/or vegetable juice, ketchup, lemonade, lipstick, liquorice, make-up, margarine, marmalade, mayonnaise, milk, mould, mud, mustard, nail varnish, nicotine, nut nougat cream, nuts, oil, oil paint, ointment, opaque white, paint, perfume, pesto, petrol, plasticine, pollen, porridge, powder, printer's ink, pudding, pus, red wine, resin, rouge, rubber solution, rust, salad sauces, salad dressings, saliva, sauces, shoe polish, slaughterhouse waste, sludge, soot, sperm, spices, starch, street dirt, sun cream, suntan oil, sweat marks, sweat, syrup, tar, tea, text markers, toner, tomato, tomato sauce, tsatsiki, urine, varnish, vaseline, vegetables, vomit, wax, whiteboard markers and yoghurt;

and/or

- wherein the temperature

- of the aqueous solution containing dissolved ferrate (VI) ions during preparing or providing an aqueous solution containing dissolved ferrate (VI) ions in step S1;

and/or

- of the soiled surface, during preparing or providing a soiled surface in step S2;

and/or

- of the predefined quantity of water during preparing or providing a predefined quantity of water in step S1-1;

and/or

- of the predefined quantity of water during contacting intermixing in step S1-2;

and/or

- of the predefined quantity of the aqueous solution containing dissolved ferrate (VI) ions during contacting intermixing in step S1-2;

and/or

- of the diluted aqueous solution containing dissolved ferrate (VI) ions upon resulting in step S1-2;

and/or

- of the soiled surface during contacting in step S3;

and/or

- of the soil on soiled surface during contacting in step S3;

and/or

- of the soil on soiled surface during contacting in step S3;

and/or

- of the aqueous solution containing dissolved ferrate (VI) ions during contacting in step S3;

and/or

- of the diluted aqueous solution containing dissolved ferrate (VI) ions during contacting in step S3;

and/or

- of the partially cleaned solid surface and the cleaned solid surface during cleaning of the solid surface with water in step S4-1;

and/or

- of the cleaned solid surface during final rinsing of the solid surface with water in step S4-2;
and/or
- of the cleaned solid surface and the dried cleaned solid surface during drying the cleaned solid surface in step S5;
and/or
- of the pre-cleaned solid surface during pre-cleaning the solid surface with water or with an aqueous solution in step S2a;
never exceeds a temperature of 80 °C, preferably 60 °C, more preferably 40 °C, even more preferably 35 °C, yet more preferably 30 °C;
especially preferred the temperature of solid surface and of the aqueous solution containing dissolved ferrate (VI) ions never exceeds a temperature of 80 °C, preferably 60 °C, more preferably 40 °C, even more preferably 35 °C, yet more preferably 30 °C whilst carrying out the method;
- and/or
- wherein
 - the cleaned solid surface
and/or
 - the dried cleaned solid surface
is a disinfected solid surface;
- and/or
- wherein
 - the aqueous solution containing dissolved ferrate (VI) ions, prepared or provided in step S1,
and/or
 - the diluted aqueous solution containing dissolved ferrate (VI) ions resulting in step S1-2,

- additionally comprise surfactants, independently selected from:
 - anionic surfactants, preferably soaps, amine oxides, alkylbenzene sulfonates, alkane sulfonates, alkyl sulfates and alkylethersulfates;
and/or
 - non-ionic surfactants, preferably fatty alcohol ethoxylates, alkylphenol ethoxylates, sorbitan fatty acid esters, alkylpolyglucosides, and N-methylglucamides;
and/or
 - cationic surfactants, preferably quaternary ammonium compounds and salts of C₁₀ to C₂₂ primary amines;
and/or
 - amphoteric surfactants, preferably amidoalkyl betaines;
 - or
 - wherein
 - the aqueous solution containing dissolved ferrate (VI) ions, prepared or provided in step S1,
and/or
 - the diluted aqueous solution containing dissolved ferrate (VI) ions resulting in step S1-2,
- are essentially free of surfactants, preferably completely free of surfactants;
- and/or
- wherein the pH of
 - the aqueous solution containing dissolved ferrate (VI) ions, prepared or provided in step S1,
and/or
 - the diluted aqueous solution containing dissolved ferrate (VI) ions resulting in step S1-2,
- is never below pH 7, preferably never below pH 8, more preferably never below pH 8.5, even more preferably

never below pH 9, most preferably never below pH 9.5;

and/or

- wherein

- the aqueous solution containing dissolved ferrate (VI) ions, prepared or provided in step S1, and/or
- the diluted aqueous solution containing dissolved ferrate (VI) ions resulting in step S1-2, is

- essentially free of chlorine bleach, preferably completely free of chlorine bleach; and/or

- essentially free of hydrochloric acid, preferably completely free of hydrochloric acid; and/or

- essentially free of sulfuric acid, preferably completely free of sulfuric acid; and/or

- essentially free of nitric acid, preferably completely free of nitric acid; and/or

- essentially free of ethylenediaminetetraacetic acid (EDTA) and salts thereof, preferably completely free of ethylenediaminetetraacetic acid (EDTA) and salts thereof; and/or

- essentially free of nitrilotriacetic acid (NTA) and salts thereof, preferably completely free of nitrilotriacetic acid (NTA) and salts thereof; and/or

- essentially free of diethylenetriaminepentaacetic acid (DTPA) and salts thereof, preferably completely free of diethylenetriaminepentaacetic acid (DTPA) and salts thereof; and/or

- essentially free of methylglycinediacetic acid (MGDA) and salts thereof, preferably completely free of methylglycinediacetic acid (MGDA) and salts thereof; and/or

- essentially free of β -alanine diacetic acid (β -ADA) and salts thereof, preferably completely free of β -alanine diacetic acid (β -ADA) and salts thereof.

10. Method according to any of the preceding claims 5 to 9,

- wherein

- the aqueous solution containing dissolved ferrate (VI) ions, prepared or provided in step S1, and/or

- the diluted aqueous solution containing dissolved ferrate (VI) ions resulting in step S1-2,

contains ferrate (VI) ions in an amount in the range from 0.0002 wt.-% to 1.10 wt.-%, preferably in the range from 0.0006 wt.-% to 0.07 wt.-%, more preferably in the range from 0.0008 wt.-% to 0.034 wt.-%, with regard to the total mass of the respective solution; and/or

- wherein during the contacting in step S3

- at least a fraction of dissolved ferrate (VI) ions reacts with

- at least a fraction of soil

so that dissolved ferrate (III) ions result;

and/or

- wherein the aqueous solution containing dissolved ferrate (VI) ions is provided as predefined quantity of an aqueous solution containing dissolved ferrate (VI) ions by means of automated dosing, preferably automated dosing utilizing conductivity.

11. Use of an aqueous solution containing dissolved ferrate (VI) ions as a demulsifier, preferably in a method for cleaning a solid surface, more preferably in a method for cleaning a solid surface as defined in any of claims 5 to 10.

12. Washing agent and/or cleaning agent comprising an aqueous solution containing dissolved ferrate (VI) ions.

13. Washing agent and/or cleaning agent according to claim 12,

- comprising an aqueous solution of alkali ions, preferably K(I) ions and/or Na(I) ions, more preferably Na (I) ions; and/or
- having a pH of pH 7 or more, preferably of pH 8 or more, more preferably of pH 8.5 or more, even more preferably of pH 9 or more, most preferably of pH 9.5 or more.

14. Method for producing a washing agent and/or cleaning agent, preferably a washing agent and/or cleaning agent according to any of the preceding claims 12 to 13, comprising the following step:

- preparing or providing an aqueous solution comprising dissolved ferrate (VI) ions and preferred additionally comprising an aqueous solution of alkali ions, preferably K(I) ions and/or Na(I) ions, more preferred Na (I) ions and even more preferred additionally having a pH of pH 7 or more, preferably of pH 8 or more, more preferably of pH 8.5 or more, even more preferably of pH 9 or more, most preferably of pH 9.5 or more.

15. Solution and/or suspension, preferably washing fleet and/or wastewater, more preferably washing fleet, comprising

- dissolved ferrate (VI) ions, preferably in an amount of 0.0002 wt.-% to 1.2 wt.-%, more preferably from 0.0006 wt.-% to 1.1 wt.-%, even more preferably from 0.0034 wt.-% to 1.02 wt.-% with regard to the total mass of the solution and/or suspension;
- and
- one two or more substances selected from the group consisting of:

- plant cell
- animal cell
- lipid
- protein
- starch
- and
- sugar.

16. Cleaning machine and/or washing machine,

- comprising one, two or more a storage tanks for or containing an aqueous solution comprising dissolved ferrate (VI) ions
- and/or
- comprising one, two or more tubings for or containing an aqueous solution comprising dissolved ferrate (VI) ions
- and/or
- comprising one, two or more dosing devices for or containing an aqueous solution comprising dissolved ferrate (VI) ions
- and/or
- comprising one, two or more cleaning chambers and/or washing chambers
- and/or
- for washing and/or cleaning with an aqueous solution comprising dissolved ferrate (VI) ions
- and/or
- containing an aqueous solution comprising dissolved ferrate (VI) ions

- and/or
- containing an aqueous solution comprising dissolved ferrate (VI) ions
- and/or
- suitable for washing and/or cleaning at least one, preferably at least ten, more preferably all, of the objects selected from the group consisting of:

- boxes,
- glass bottles and non-glass bottles,
- crockery, especially bowls, cups, plates, and serving dishes,

- cutlery,
- drinking glasses
- cookware,
- cars,
- 5 - Textiles, especially
 - clothing, especially clothing items for men, women and children, nightwear, sportswear, lingerie, undergarments, swimsuits; caps, socks, gloves, and handbags;
 - 10 - agro-textile, especially shade net, thermal insulation and sunscreen material, windshield material, antibird net, covering livestock protection material, weed suppressing textile, and insect control textile;
 - furnishing textile, especially upholstery, curtain, drapery, carpet, and towel;
 - geotextile;
 - bedding, especially bed sheet, khes, blanket, and pillow;
 - automotive textile, especially airbag, seat belt, headliner, upholstery, car carpet, and door card;
 - 15 - Medical textile, especially implant, suture, dressing, bandage, medical gown, face mask;
 - Further textiles, especially shower curtain, conveyor belt, drive belt, rope, filtration device and cloth, especially decatizing cloth and bolting cloth;
- workwear;
- 20 - personal protective equipment
- and
- pallets;
- and/or
- 25 - for industrial use.

17. Kit of parts comprising:

- ferrate (VI) ions
- 30 and
- alkali hydroxide, preferably sodium hydroxide and/or potassium hydroxide, more preferably sodium hydroxide preferably comprising
 - ferrate (VI) ions,
 - 35 - alkali hydroxide, preferably sodium hydroxide and/or potassium hydroxide, more preferably sodium hydroxide
 - and
 - water;
- 40 more preferably comprising
 - ferrate (VI) ions
 - alkali hydroxide, preferably sodium hydroxide and/or potassium hydroxide, more preferably sodium hydroxide
 - 45 - water,
- and
- 50 - a soiled object selected from the group consisting of:
 - boxes,
 - glass bottles and non-glass bottles,
 - crockery, especially bowls, cups, plates, and serving dishes,
 - cutlery,
 - 55 - drinking glasses
 - cookware,
 - cars,
 - Textiles, especially

EP 4 541 875 A1

- 5 - clothing, especially clothing items for men, women and children, nightwear, sportswear, lingerie, undergarments, swimsuits; caps, socks, gloves, and handbags;
 - agro-textile, especially shade net, thermal insulation and sunscreen material, windshield material, antibird net, covering livestock protection material, weed suppressing textile, and insect control textile;
 - furnishing textile, especially upholstery, curtain, drapery, carpet, and towel;
 - geotextile;
 - bedding, especially bed sheet, khes, blanket, and pillow;
10 - automotive textile, especially airbag, seat belt, headliner, upholstery, car carpet, and door card;
 - Medical textile, especially implant, suture, dressing, bandage, medical gown, face mask;
 - Further textiles, especially shower curtain, conveyor belt, drive belt, rope, filtration device and cloth, especially decatizing cloth and bolting cloth;
- 15 - workwear;
 - personal protective equipment
 and
 - pallets;
- 20 even more preferably comprising
- ferrate (VI) ions
 - alkali hydroxide, preferably sodium hydroxide and/or potassium hydroxide, more preferably sodium hydroxide
 - water,
25 - a soiled object selected from the group consisting of:
- boxes,
 - glass bottles and non-glass bottles,
 - crockery, especially bowls, cups, plates, and serving dishes,
30 - cutlery,
 - drinking glasses
 - cookware,
 - cars,
 - Textiles, especially
- 35 - clothing, especially clothing items for men, women and children, nightwear, sportswear, lingerie, undergarments, swimsuits; caps, socks, gloves, and handbags;
 - agro-textile, especially shade net, thermal insulation and sunscreen material, windshield material, antibird net, covering livestock protection material, weed suppressing textile, and insect control textile;
40 - furnishing textile, especially upholstery, curtain, drapery, carpet, and towel;
 - geotextile;
 - bedding, especially bed sheet, khes, blanket, and pillow;
 - automotive textile, especially airbag, seat belt, headliner, upholstery, car carpet, and door card;
45 - Medical textile, especially implant, suture, dressing, bandage, medical gown, face mask;
 - Further textiles, especially shower curtain, conveyor belt, drive belt, rope, filtration device and cloth, especially decatizing cloth and bolting cloth;
- 50 - workwear;
 - personal protective equipment
 and
 - pallets;
- 55 and
 - a cleaning machine and/or washing machine, suitable for washing and/or cleaning at least one of the objects selected from the group consisting of:
- boxes,

EP 4 541 875 A1

- glass bottles and non-glass bottles,
- crockery, especially bowls, cups, plates, and serving dishes,
- cutlery,
- drinking glasses
- cookware,
- cars,
- Textiles, especially

- clothing, especially clothing items for men, women and children, nightwear, sportswear, lingerie, undergarments, swimsuits; caps, socks, gloves, and handbags;
- agro-textile, especially shade net, thermal insulation and sunscreen material, windshield material, antibird net, covering livestock protection material, weed suppressing textile, and insect control textile;
- furnishing textile, especially upholstery, curtain, drapery, carpet, and towel;
- geotextile;
- bedding, especially bed sheet, khes, blanket, and pillow;
- automotive textile, especially airbag, seat belt, headliner, upholstery, car carpet, and door card;
- Medical textile, especially implant, suture, dressing, bandage, medical gown, face mask;
- Further textiles, especially shower curtain, conveyor belt, drive belt, rope, filtration device and cloth, especially decatizing cloth and bolting cloth;

- workwear;
- personal protective equipment
- and
- pallets.

18. Use of a kit according to claim 17 for cleaning hard surfaces, preferably selected from the group consisting of:

- boxes,
- glass bottles and non-glass bottles,
- crockery, especially bowls, cups, plates, and serving dishes,
- cutlery,
- drinking glasses
- cookware,
- cars,
- Textiles, especially

- clothing, especially clothing items for men, women and children, nightwear, sportswear, lingerie, undergarments, swimsuits; caps, socks, gloves, and handbags;
- agro-textile, especially shade net, thermal insulation and sunscreen material, windshield material, antibird net, covering livestock protection material, weed suppressing textile, and insect control textile;
- furnishing textile, especially upholstery, curtain, drapery, carpet, and towel;
- geotextile;
- bedding, especially bed sheet, khes, blanket, and pillow;
- automotive textile, especially airbag, seat belt, headliner, upholstery, car carpet, and door card;
- Medical textile, especially implant, suture, dressing, bandage, medical gown, face mask;
- Further textiles, especially shower curtain, conveyor belt, drive belt, rope, filtration device and cloth, especially decatizing cloth and bolting cloth;

- workwear;
- personal protective equipment
- and
- pallets.



EUROPEAN SEARCH REPORT

Application Number

EP 23 20 4949

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	WO 2008/112657 A1 (BATTELLE MEMORIAL INSTITUTE [US]; MONZYK BRUCE F [US] ET AL.) 18 September 2008 (2008-09-18) * example 2 * * page 36, line 22 - line 34 * * claims 1, 2 *	1-18	INV. C11D3/04 C11D7/10
X	CN 103 756 802 A (ZHONGSHAN TORCH POLYTECHNIC; LIU YINGCHUN; HUANG YONG) 30 April 2014 (2014-04-30) * example 1 * * paragraph [0047] *	1-15,17,18	
X	Anonymous: "Cleaning trial at virus-filled greenhouses shows strength of new cleaning agent", , 13 July 2023 (2023-07-13), pages 1-3, XP093165534, Retrieved from the Internet: URL:https://www.floraldaily.com/article/9544293/cleaning-trial-at-virus-filled-greenhouses-shows-strength-of-new-cleaning-agent/ * page 2 - page 3 *	1-15,17,18	
A	CN 115 975 735 A (NINGBO TOPCENTRAL NEW MAT CO LTD) 18 April 2023 (2023-04-18) * the whole document *	1-18	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC) C11D
Place of search The Hague		Date of completion of the search 14 June 2024	Examiner Placke, Daniel
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.

EP 23 20 4949

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

14 - 06 - 2024

10	Patent document cited in search report	Publication date	Patent family member(s)	Publication date
	WO 2008112657 A1	18-09-2008	US 2011268672 A1	03-11-2011
			WO 2008112657 A1	18-09-2008
15	-----			
	CN 103756802 A	30-04-2014	NONE	

	CN 115975735 A	18-04-2023	NONE	
20	-----			
25				
30				
35				
40				
45				
50				
55				

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- DE 102017127160 A1 [0003]
- NL 2029165 B1 [0023]

Non-patent literature cited in the description

- CHEMICAL ABSTRACTS, 79-21-0 [0153]