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An agency of Industry Canada

CA 2475443 A1 2003/06/17

(21) 2 475 443

(12) DEMANDE DE BREVET CANADIEN
CANADIAN PATENT APPLICATION

(13) A1

(86) Date de dépôt PCT/PCT Filing Date: 2003/01/14
(87) Date publication PCT/PCT Publication Date: 2003/06/17
(85) Entrée phase nationale/National Entry: 2004/08/05
(86) N° demande PCT/PCT Application No.: EP 2003/000298
(87) N° publication PCT/PCT Publication No.: 2003/058009
(30) Priorité/Priority: 2002/01/14 (102 01 089.7) DE

(51) Cl.Int.$^{7}$/Int.Cl.$^{7}$ E04H 4/12, B01D 24/46, B01D 53/02

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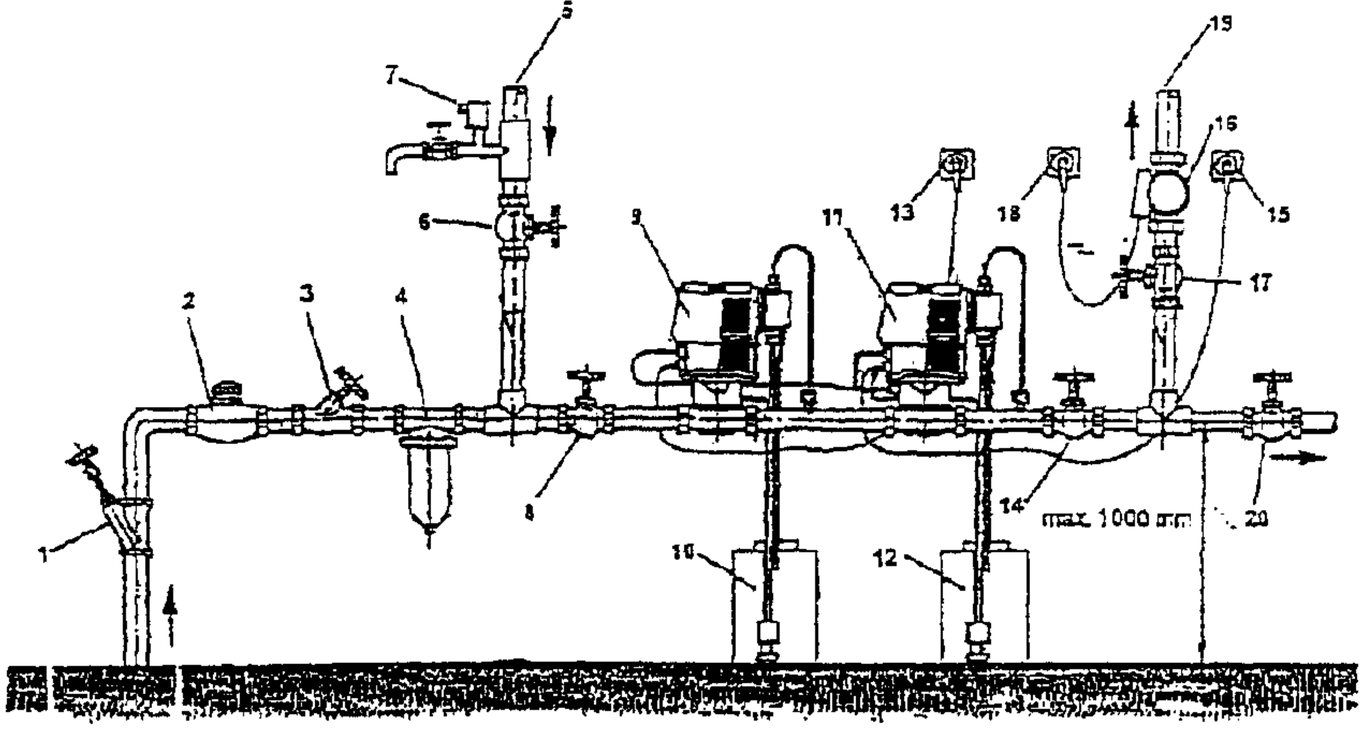
(54) Titre : PROCEDE DE DEGERMAGE ET DE NETTOYAGE DE SYSTEMES D'ALIMENTATION EN EAU, NOTAMMENT DANS LES INSTALLATIONS DE PISCINES ET BASSINS DE BAIN, ET DISPOSITIF CORRESPONDANT

(54) Title: METHOD FOR STERILISATION AND CLEANING OF WATER SUPPLY SYSTEMS, IN PARTICULAR IN SWIMMING AND BATHING POOL UNITS AND DEVICE FOR CARRYING OUT THE SAME




1 shut off feed line
2 water meter
3 shut off tap
4 dirt filter
5 return circulation line
6 shut off tap
7 draining tap with air vent
8 shut off tap
9 dosing pump 1
10 dosing container 1
11 dosing pump 2
12 dosing container 2
13 power point for dosing pump 1
14 shut off tap
15 power point for dosing pump 2
16 circulation pump (cleaning circuit)
17 shut off tap
18 power point for circulation pump
19 feed (cleaning circuit) or supply lines
20 shut off tap

(57) Abrégé/Abstract:
A method for sterilisation and cleaning of water supply systems and areas, in particular in treatment plants, pipe systems and in swimming and bathing pool units and a device for carrying out the same are disclosed. An embodiment of said method is characterised by the steps: (1) establishment of a closed circuit between two points of the water supply system or the water supply area, (2) introduction of a given amount of a disinfecting material in the form of an aqueous rinsing solution comprising a chlorine oxide, a halogen and/or a peroxide for disinfection and cleaning, (3) disinfection and cleaning of the pipes, filters and filtration materials in the system including charcoal filters with or without adsorptive properties, with periodic circulation of the rinsing solution in the closed circuit at defined time intervals, (4) draining and disposal of the aqueous rinsing solution and (5) re-establishment of the original water circuit.

(12) NACH DEM VERTRAG ÜBER DIE INTERNATIONALE ZUSAMMENARBEIT AUF DEM GEBIET DES PATENTWESENS (PCT) VERÖFFENTLICHTE INTERNATIONALE ANMELDUNG

(19) Weltorganisation für geistiges Eigentum
Internationales Büro

(43) Internationales Veröffentlichungsdatum
17. Juli 2003 (17.07.2003)

PCT

(10) Internationale Veröffentlichungsnummer
WO 03/058009 A1

(51) Internationale Patentklassifikation[7]: B01D 53/02, 24/46 E04H 4/12,

(21) Internationales Aktenzeichen: PCT/EP03/00298

(22) Internationales Anmeldedatum: 14. Januar 2003 (14.01.2003)

(25) Einreichungssprache: Deutsch

(26) Veröffentlichungssprache: Deutsch

(30) Angaben zur Priorität:
102 01 089.7 14. Januar 2002 (14.01.2002) DE

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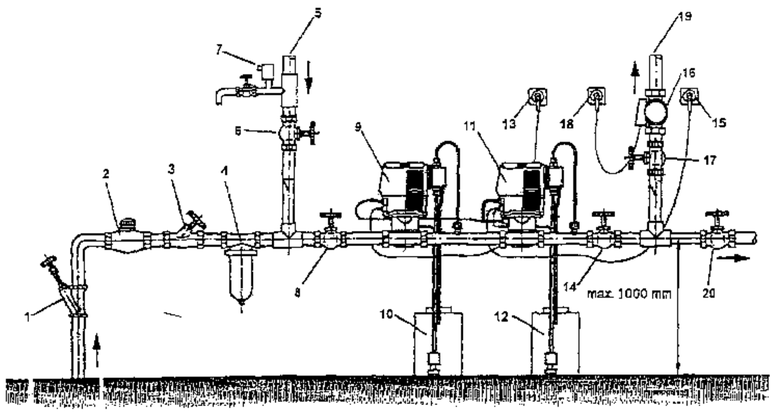
(81) Bestimmungsstaaten *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR,

*[Fortsetzung auf der nächsten Seite]*

(54) Title: METHOD FOR STERILISATION AND CLEANING OF WATER SUPPLY SYSTEMS, IN PARTICULAR IN SWIMMING AND BATHING POOL UNITS AND DEVICE FOR CARRYING OUT THE SAME

(54) Bezeichnung: VERFAHREN ZUM ENTKEIMEN UND REINIGEN VON WASSERFÜHRENDEN SYSTEMEN, INSBESONDERE IN SCHWIMM- UND BADEBECKENANLAGEN, UND VORRICHTUNG FÜR DESSEN DURCHFÜHRUNG




1 Absperrung Zulaufleitung
2 Wasserzähler
3 Absperrarmatur
4 Schmutzfilter
5 Rücklauf Zirkulationsleitung
6 Absperrarmatur
7 Entleerungsarmatur mit Entlüftung
8 Absperrarmatur
9 Dosierpumpe 1
10 Dosierbehälter 1
11 Dosierpumpe 2
12 Dosierbehälter 2
13 Stromanschluß Dosierpumpe 1
14 Absperrarmatur
15 Stromanschluß Dosierpumpe 2
16 Zirkulationspumpe (Reinigungskreislauf)
17 Absperrarmatur
18 Stromanschluß Zirkulationspumpe
19 Zulauf (Reinigungskreislauf) bzw. Versorgungsleitungen
20 Absperrarmatur

1:- STOPCOCK IN INLET LINE
2:- WATER COUNTER
4:- STRAINER
5:- RETURN LINE FOR CIRCULATING SYSTEM
7: DRAIN FITTING WITH AIR BLEED
9:- DOSING PUMP 1
10:- DOSING RESERVOIR 1
11:- DOSING PUMP 2
12:- DOSING RESERVOIR 2
13:- POWER SUPPLY DOSING PUMP 1
15:- POWER SUPPLY DOSING PUMP 2
16:- CIRCULATION PUMP (CLEANING CIRCUIT)
18:- POWER SUPPLY CIRCULATION PUMP
19:- INLET (CLEANING CIRCUIT) OR SUPPLY LINES
3, 6, 8, 14, 17, 20:- STOPCOCK

(57) **Abstract:** A method for sterilisation and cleaning of water supply systems and areas, in particular in treatment plants, pipe systems and in swimming and bathing pool units and a device for carrying out the same are disclosed. An embodiment of said method is characterised by the steps: (1) establishment of a closed circuit between two points of the water supply system or the water supply area, (2) introduction of a given amount of a disinfecting material in the form of an aqueous rinsing solution comprising a chlorine oxide, a halogen and/or a peroxide for disinfection and cleaning, (3) disinfection and cleaning of the pipes, filters and filtration materials in the system including charcoal filters with or without adsorptive properties, with periodic circulation of the rinsing solution in the closed circuit at defined time intervals, (4) draining and disposal of the aqueous rinsing solution and (5) re-establishment of the original water circuit.

(57) **Zusammenfassung:** Beschrieben wird ein Verfahren zum Entkeimen und Reinigen von wasserführenden Systemen und Flächen, insbesondere in Aufbereitungsanlagen, Rohrsystemen sowie Schwimm- und Badebeckenanlagen, sowie eine Vorrichtung für dessen Durchführung. Eine erfindungsgemässe Verfahrensvariante ist durch die Schritte gekennzeichnet: (1) Aufbauen

*[Fortsetzung auf der nächsten Seite]*

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CU, CZ, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

**(84) Bestimmungsstaaten** *(regional)*: ARIPO-Patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), eurasisches Patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), europäisches Patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, SE, SI, SK, TR), OAPI-Patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

**Veröffentlicht:**
— *mit internationalem Recherchenbericht*

*Zur Erklärung der Zweibuchstaben-Codes und der anderen Abkürzungen wird auf die Erklärungen ("Guidance Notes on Codes and Abbreviations") am Anfang jeder regulären Ausgabe der PCT-Gazette verwiesen.*

eines geschlossen Kreislaufs zwischen zwei Punkten des wasserführenden Systems bzw. der wasserführenden Fläche, (2) Zugeben einer vorbestimmten Menge eines desinfizierenden Wirkstoffs in Form einer chloroxid-, halogen- und/oder peroxidhaltigen wässerigen Spüllösung zum Entkeimen und Reinigen, (3) Entkeimen und Reinigen der im System vorhandenen Rohre, Filter und Filtermaterialien, einschliesslich Filterkohlen mit und ohne adsorptive Eigenschaften, unter periodischem Umwälzen der Spüllösung im geschlossenen Kreislauf in definierten Zeitintervallen, (4) Ablassen und Verwerfen der wässerigen Spüllösung und (5) Wiederherstellen des ursprünglichen Wasserkreislaufs.

# METHOD FOR STERILISATION AND CLEANING OF WATER SUPPLY SYSTEMS, IN PARTICULAR IN SWIMMING AND BATHING POOL UNITS AND DEVICE FOR CARRYING OUT THE SAME

The invention relates to a method for sterilization and cleaning of water supply systems, especially in swimming and bathing pool units, and to a device for carrying out the same.

The treatment of water, especially in swimming pools, already needs to meet stringent requirements with respect to treatment and disinfection. Hygiene is of very crucial importance in swimming and bathing pool water. This also relates, for example, to biogenic deposits (biofilms) in the filter bed - which inevitably occur in water supply systems - and contamination of the water supply system (pipes) and the filters with a wide variety of germs, such as pathogens, sporogens, microorganisms etc., so that effective cleaning and disinfection which can be performed in a technically straightforward way - further to the mandatory disinfection of the water, i.e. swimming and bathing pool water - has to be carried out at regular time intervals.

It is therefore necessary to ensure a consistently high water quality, with the need to provide a sufficient germicidal capacity for disinfection or killing germs and microorganisms, on the one hand, but at the same time the bather should in no way be harmed by chemical or microbiological levels in the bathing water.

Improper water treatment and disinfection may lead to significant risks of infection and therefore health risks for the bathers, for example due to pathogenic germs, sporogens or viruses etc.

Studies have shown that about 80 to 90% of the various filter materials, especially in the lower region, carry high levels of germs - including human pathogens such as Pseudomonas aeruginosa or Legionella pneumophilia. Besides the filter material, this also affects the filter chamber walls, the filter nozzles and the entire pipeline of the water supply system of a swimming and bathing pool unit.

Known methods of water treatment and disinfection have the disadvantage that apart from the customary disinfection of the bathing water, the water supply systems are only cleaned and disinfected insufficiently. This is true even when large amounts of chlorine are used. The disadvantages of this are readily apparent, so that increasing contamination by water constituents, and therefore biogenetic deposits (biofilms) in the water supply system, cannot be avoided even with high concentrations.

It has recently become known in the technical world that the biofilms create their own living space for microorganisms, which is supplied correspondingly well with water, substrates and nutrition. A variety of microorganisms, such as bacteria, protozoa or viruses, live in this "self-contained living space". The microorganisms not only have nutrition in this living community, but also protection for further proliferation. The biofilms includes corresponding channels for feeding the microorganisms (inhabitants).

The danger with this is that the bacteria themselves can actively separate and therefore enter the water in an aggregate form. These aggregates are relatively insensitive to levels of disinfectant such as those prescribed for swimming and bathing pool water.

Disinfectant-free regions are then particularly dangerous, as occur in swimming pool units - when using absorptive materials that contain carbon - in the lower region of the filter material and the filter chamber and the filter line. Undesirable growth of biofilms therefore occurs relatively rapidly.

Not least the pipe materials, which are predominantly made of plastic, play a significant part in this.

The older these biofilms are, the more difficult they are to break down. The levels of chlorine customarily used in swimming pools, for example, do not remove existing biofilms. The breakdown of biofilms by means of suitable methods will become even more important in the future because of the recently identified risks to human health.

According to one example from the prior art, DE-32 29 219 describes the use of a surface-active substance as a backwash medium for backwashable filter beds containing particles, for water treatment in swimming pool, drinking and waste water treatment units. The cleaning effect of this method, however, is only moderate against solid deposits. In particular, only a minor effect is achieved against contamination of the filter by microorganisms. The surface-active substance furthermore needs to be used in high concentrations, which leads to high costs and high levels in the waste water.

It is therefore an object of the present invention to provide a method which does not have the disadvantages explained above. In particular, besides a high cleaning and sterilizing effect - to tackle the problem of biofilms - the method according to the invention should also facilitate effective

decontamination of the entire water supply system or the entire water supply area, for example a swimming or bathing unit, and in particular dispose of microorganisms, pathogenic germs, sporogens, viruses, fungi and all types of contamination. The method should also be cost-effective, that is to say permit economically viable operation, and lead to only minor levels in the waste water.

According to the invention, this object is achieved by a method for sterilization and cleaning of water supply systems and areas, with the following steps:

(1) setting up a closed circuit between two points of the water supply system, or the water supply area,

(2) adding a predetermined amount of a disinfecting agent in the form of an aqueous rinsing solution containing chlorine oxide, halogen and/or peroxide, for sterilization and cleaning,

(3) sterilizing and cleaning the pipes, filters and filter materials contained in the system, including filter carbon with or without adsorptive properties, while periodically circulating the rinsing solution in the closed circuit at defined time intervals,

(4) discharging and disposing of the aqueous rinsing solution, and

(5) re-establishing the original water circuit.

The method is preferably used for sterilizing and cleaning a swimming or bathing pool unit.

According to a first variant of the method according to the invention, therefore, a closed circuit is first set up in step (1) between the outlet of the overflow water tank and the inlet immediately before the clean water enters the swimming or bathing pool.

This may be done by the person skilled in the art using known means according to the swimming or bathing bath unit involved, and will depend on the structural situation in question. This is followed in step (2) by the addition of a predetermined amount of a disinfecting agent selected from an aqueous rinsing solution containing chlorine oxide, halogen and/or peroxide, for sterilization and cleaning. The amount of rinsing solution and its composition may be modified according to requirements, and should be determined appropriately with reference to the water supply system in question, its size, capacity, degree of contamination and the time available for the cleaning.

Step (3) involves the sterilization and cleaning of the pipes, filters and filter materials contained in the system, including filter carbon with or without adsorptive properties, with periodic circulation of the rinsing solution in the closed circuit at defined time intervals. In other words, the rinsing solution does not need to be circulated continuously, and prolonged working times in which it is not circulated may also be included.

It has proved expedient for the rinsing solution to be circulated from a few minutes to a several hours, for example about 3 to 10 minutes, or about 3 to 12 h, preferably about 4 to 8 h, and in particular about 4 to 6 h, in which case the circulation may be interrupted one or more times. The circulation is therefore initiated from so-called resting phases, in which the rinsing solution is left to stand for a particular working time. The circulation is preferably carried out in a privileged direction, or it may be carried out alternately in one of the two directions.

After the sterilization and cleaning, the aqueous rinsing solution is discharged and disposed of in step (4) of the first variant of the method according to the invention. The rinsing solution may be used repeatedly after testing for the presence of unconsumed active agent (quantitative test).

Lastly, the original water circuit of the swimming or bathing unit is restored in step (5) by simply dismantling or removing the extra lines, devices or systems installed temporarily, so that normal operation can be resumed.

It is recommendable to repeat this first variant of the method with steps (1) to (5), that is to say carry it out at regular time intervals, in order to maintain an appropriate cleaning and sterilization effect, i.e. to avoid undesired contamination for a prolonged period of time.

In another preferred embodiment, the water supply system is a hot tub, in particular a hot whirlpool or a whirl tub. The method, however, may also be used to good effect for a drinking water supply system in a household installation, in particular in a shower system. For use in a shower system, it is particularly preferable to set up a closed circuit in step (1) between the hot water boiler and the shower head. Good results are also achieved when the method is applied to a process water treatment system in the industrial sector.

Another particularly preferred variant of the method according to the invention, provides a method for sterilization and cleaning of water supply systems and areas, especially in treatment units, pipe systems and swimming and bathing pool units, with the following steps:

(a) isolating a defined section inside the water supply system,

(b) introducing a highly concentrated rinsing solution, containing at least one disinfectant agent,

(c) flushing the defined section with the rinsing agent, optionally with circulation,

(d) collecting the rinsing solution,

(e) checking for the presence of the active agent and/or the concentration of the active agent and/or the sterilizing and cleaning effect,

(f) optionally repeating steps (c) to (e),

(g) discharging and disposing of the aqueous rinsing solution, and

(h) re-establishing the original water circuit of the swimming and bathing pool unit.

According to the second variant according to the invention, a defined section in the water supply system is first isolated in step (a), that is to say a particular region is selected and two delimitations are provided. According to step (b), a highly concentrated rinsing solution containing at least one disinfectant agent is then introduced in this defined region.

The defined section is then flushed with the rinsing solution (step (c)). The expression "flushing" is intended to be understood in the broad sense in the present invention. According to one option, this may be done by introducing a gas and moving the rinsing solution through the defined section by using pressure. Compressed air is preferably used. According to another embodiment, the pipe inner walls, filters and filter materials may also be sprayed with the rinsing solution. Optionally, the rinsing solution may also be circulated as described above.

After collection of the rinsing solution in step (d), a check is carried out as to whether any disinfectant agent is still present. The disinfecting effect may be inferred from the amount of active agent consumed (also referred to as depletion). Complete disinfection is obtained when no more disinfectant is consumed. Another more accurate check may be carried out by determining the concentration of the active agent before and after the disinfecting rinse, and subsequently comparing the two concentration values. An appropriate method for checking the disinfecting effect may be selected according to requirements.

According to the invention, the sterilization and cleaning effect is preferably checked by using the known Bart a test (biological activity reaction test), although this may also be done by using other known tests relating to adsorption activity or other biological studies, depending on the filter materials involved. Such checking methods, quick tests and the like are known to the person skilled in the art, so they do not need to be explained in detail.

Steps (c) to (e) for sterilizing and cleaning the water supply system may be repeated according to requirements.

According to the invention, the aforementioned first and second variants of the method may also be coupled so that sections of a process path which are particularly difficult to clean may additionally be subjected to separate cleaning and disinfection. In order to clean and disinfect process paths in which the central treatment stage - the filtration - is carried out with filter materials that have adsorptive properties (for example granular activated carbon or particular types of lignite), for example, it is

advantageous to initially treat these filter materials separately by first of all introducing the requisite amount of rinsing solution, which is needed in order to clean (chemically and microbiologically) carbon-type materials with adsorptive properties and allow it to act (first variant of the method of the invention).

The overall cleaning process may then be carried out by circulation of the rinsing solution either in only a part of a given process path (repetition of the first variant of the invention), or the entire process path may undergo the cleaning and disinfection (second variant of the method of the invention).

For example, it is possible for a granular activated carbon filter contaminated to an undesirably high degree, which is for example connected downstream of a sand filter, to be specially treated periodically with this cleaning system. Very specific sections of pipeline, for example the filtrate line and the clean water line, may thus be deliberately cleaned and disinfected in a process path circuit by the method according to the invention.

According to particularly preferred embodiment of the invention, an aqueous solution containing chlorine oxide is used as the aqueous rinsing solution. Among the oxides of chlorine, chlorine dioxide has been found to be particularly preferred both for reasons of efficacy and availability. Since chlorine dioxide is a chemically unstable substance which is difficult to handle, it is advantageous for a large part of the chlorine dioxide in the solution not to be present in a free form, but to be chemically bound in the form of a chemical species from which chlorine dioxide is constantly reformed. One such substance is the

tetrachloride decaoxide complex dianion $[Cl_4O_{10}]^{2-}$. This complex dianion, which is documented under the ELINCS number 420-970-2, reacts in aqueous solution according to the following two reactions:

(1) $[Cl_4O_{10}]^{2-} \leftrightarrow 4ClO_2 + O_2 + 2e^-$ (continuous phase)

(2) $[Cl_4O_{10}]^{2-} + 2e^- \rightarrow 5O_2 + 4Cl^-$ (balanced overall equation)

The tetrachloride decaoxide complex dianion is thus in an equilibrium with the chlorine oxide, so that the solution of the dianion always contains a certain amount of chlorine dioxide which is obtained as an intermediate product from breakdown of the complex, and which is replenished as it is consumed. The TCDO complex therefore constitutes a biocatalytically activatable oxygen carrier, which differs in terms of its oxidation properties qualitatively from hypochlorite, chlorate and hydrogen peroxide and quantitatively from chlorite. Merely oxygen and chloride are formed as the final reaction products, which do not lead to any waste water problems.

A preferred embodiment of the invention therefore uses an aqueous solution of the tetrachloride decaoxide complex dianion $[Cl_4O_{10}]^{2-}$, which has outside excellent properties owing to the biocatalytically selective action mechanism. This aqueous solution containing tetrachloride decaoxide complex dianions is preferably obtained by mixing an aqueous solution of pH $\leq$ 3 containing sulfate ions with a peroxo compound, which is stable in it, and subsequently adding the alkaline aqueous solution of a chlorite to this solution. The aqueous solution containing sulfate ions is preferably mixed with the peroxo compound, which is

stable in it, in such an amount as to provide a peroxo compound concentration of from about 0.001 to 0.01 molar in the solution. According to the invention, it is also possible for the aqueous solution containing sulfate ions to be mixed with the peroxo compound, which is stable in it, and for the alkaline aqueous solution of a chlorite to be subsequently added to this solution in such an amount as to obtain a pH of more than 7.0, in particular between 7.5 and 8.0.

It has been found particularly advantageous for an inorganic peroxo compound in the form of hydrogen peroxide, persulfate, percarbonate, perborate or a peroxide of an alkali or alkaline earth metal, to be used as the peroxo compound. An alkali or alkaline earth metal chlorite is preferably used as the chlorite. Particularly advantageous results are obtained when the aqueous solution containing sulfate ions has a pH $\leq$ 1.

When the aqueous starting solutions which are used have only a minor carbonate hardness, or can be prepared with demineralized water, it is recommendable to operate in an inert gas atmosphere since the formation of explosive air/chlorine dioxide mixtures can occur in the absence of a protective gas layer between the slightly gas-evolving chlorine dioxide and air. With an air to chlorine dioxide component ratio of about 10:1, air/chlorine dioxide mixtures are susceptible to explosive breakdown of the chlorine dioxide into chlorine and oxygen. In the case of the aqueous starting solutions of medium or high carbonate hardness (carbonate hardness > about 7 degrees or > about 1.3 mmol/l), the use of an inert gas is generally unnecessary since a kind of a protective gas layer of carbon dioxide is formed. Mineralized water is

therefore preferably used to prepare the aqueous solution containing sulfate ions, which is to be used in order to form the solution containing tetrachloride decaoxide complex dianions.

The solution containing tetrachloride decaoxide complex dianions preferably contains a water-soluble phosphate, since the amount of peroxo compounds can be reduced when the final solution includes a small amount of a water-soluble phosphate, for example sodium metapolyphosphate.

The concentration with which the aqueous rinsing solution is used depends on various factors, for example the degree of contamination and/or biogenic deposits or bacterial contamination of the water supply system. The aqueous rinsing solution containing chlorine oxide, halogen and/or containing peroxide in the method according to the invention is therefore preferably used in a concentration which corresponds to and an initial chlorite concentration of at least about 0.1 mol/l, preferably at least about 0.15 mol/l. This has led to particularly good results according to the invention.

Other aqueous rinsing solutions containing chlorine oxide, halogen and/or containing peroxide besides the aforementioned inventive variants of the aqueous solution of the tetrachloride decaoxide complex dianion $[Cl_4O_{10}]^{2-}$ may of course be used, although these are less preferred.

The method is preferably configured in such a way that continuous dosing of the disinfectant is provided. Such a dosing technique may, for example, be provided using feed water of a unit for providing washing and shower water, or alternatively in the bypass of a feed water line of swimming bath units or

in feed lines of water for industrial purposes. It is particularly preferable to configure a unit so that both continuous rinsing with the disinfectant and continuous dosing of the disinfectant are possible. Fig. 1 shows an arrangement for a shower unit, with which it is both possible to introduce the necessary amounts of disinfectant for periodic rinses of water supply systems, but also continuous dosing of disinfectants can be carried out.

For the case of periodic rinsing, the shut off taps (3) and (20) are closed. The draining cock (7) is opened and the same amount of water is taken from the system as will subsequently be refilled with a disinfectant solution-working solution. The shut off taps (6) and (17) need to be opened before draining and filling with the disinfectant solution. The circulation pump (16) is subsequently turned on and the required amount of disinfectant is simultaneously dosed (the rinsing is carried out according to a stop-and-go method, the delivery flow device being changed at specific intervals). The entire system is drained after the rinsing process. The system is subsequently filled again with drinking water, circulated again and drained. This insures that any remaining disinfectant solution and residues of biogenic deposits and contamination are rinsed from the system. The line is then filled again with drinking water and can return to operation.

If continuous dosing of the disinfectant is intended to be carried out, the two shut off taps (6) and (20) are closed. The shut off taps (1), (3), (8), (14) and (17) are opened. The required amount of disinfectant solution is dosed as a function of the

water consumption, using the two dosing pumps and contact water meters.

Although this description refers to a shower unit as an example, other applications of the method for sterilizing and cleaner water supply systems and quantitatively proportional dosing of disinfectant are possible.

The invention also relates to a device for sterilization and cleaning of water supply systems and areas, comprising:

(1) a closed circuit between two points of the water supply system, or the water supply area, containing a predetermined amount of at least one disinfecting agent in the form of an aqueous rinsing solution containing chlorine oxide, halogen and/or peroxide, for sterilization and cleaning,

(2) a pump for circulation of the rinsing solution in the closed line system while sterilizing and cleaning the pipes and filters contained in the system,

(3) an outlet for the aqueous rinsing solution, and

(4) means for re-establishing the original water circuit.

In the preferred embodiment, the water supply system is a swimming or bathing pool unit. In this case, the sterilization and cleaning of the swimming and bathing pool system is carried out by a device comprising:

(1) a closed circuit between the outlet of the overflow water tank and the inlet immediately before the clean water enters the swimming or bathing pool, containing a predetermined amount of at least one disinfecting agent in the form of an aqueous rinsing

solution containing chlorine oxide, halogen and/or peroxide, for sterilization and cleaning,

(2) a pump for circulation of the rinsing solution in the closed line system while sterilizing and cleaning the pipes and filters contained in the system,

(3) an outlet for the aqueous rinsing solution, and

(4) means for re-establishing the original water circuit.

The device according to the invention thus comprises a closed circuit between the outlet of the overflow water tank and the inlet immediately before the clean water enters the swimming or bathing pool, and contains a predetermined amount of at least one disinfecting agent in the form of an aqueous rinsing solution containing chlorine oxide, halogen and/or peroxide, for sterilization and cleaning. This is preferably the aforementioned tetrachloride decaoxide complex dianion in aqueous solution.

At least one pump is furthermore provided for circulation of the rinsing solution in the closed circuit while sterilizing and cleaning the pipes and filters present in the system, which pump operates in the so-called "stop and go" mode, that is to say circulation is carried out for a defined time interval as required, in which case the circulation may also take place alternately in one direction and then the other, and is subsequently turned off so that the rinsing solution remains in the water supply system and can act, before resuming the circulation of the rinsing solution.

According to a preferred refinement according to the invention, the device for sterilization and

cleaning of water supply systems and areas, especially in treatment units, pipe systems as well as swimming and bathing pool units, may comprise:

(a) means for isolating a defined section inside the water supply system,

(b) means for introducing a highly concentrated rinsing solution, containing at least one disinfectant agent,

(c) means for flushing the defined section with the rinsing agent, optionally with circulation,

(d) a device for collecting the rinsing solution,

(e) means for checking for the presence of the active agent and/or the concentration of the active agent and/or the sterilizing and cleaning effect,

(f) means for discharging the aqueous rinsing solution, and

(g) means for re-establishing the original water circuit of the swimming and bathing pool water unit.

This allows optimum control and supervision of the cleaning and sterilization effect on the water supply system, as already explained in detail with reference to the respective variant of the method of the invention.

The method and the device of the invention are suitable for sterilizing and cleaning various types of water supply systems in bathing units, especially in swimming and bathing pool circuits, there being in principle no restrictions with respect to the type, size and design of the water supply system. The two variants of the method, or devices of the invention may also be combined, so that even problematic regions of the process path can be sterilized and cleaned.

Overall, it can be said that the invention provides for sterilization and cleaning of swimming pool units which leads to much better results compared with the prior art. For instance, the cleaning effect with respect to biogenic deposits (biofilms) is significantly improved. The very crucial advantages with respect to the effect against contamination by germs, microorganisms, sporogens, viruses and fungi are thus particularly pronounced. The cleaning methods described in the prior art only achieve a weak effect in this case. Surprisingly, it has been found that the method according to the invention not only leads to substantial disinfection with respect to occurrence of microorganisms or the buildup of biofilms structures, but a strong preventive effect is also be achieved. This is possibly attributable to the fact that killing all the germs and simultaneously eliminating virtually all the contamination which could lead to growth of the microorganisms, for example by acting as a nutrition source, prevents proliferation of microorganisms even for a prolonged time after the treatment. Use of the method according to the invention therefore can and should be regarded and carried out as a preventive method for active and preventive health protection.

The aforementioned embodiments according to the invention therefore make it possible to select expediently particular sections of a process path and adapt the cleaning and disinfection method to them. This entails less consumption of water, especially when the pipe cross sections are relatively large. The required amount of rinsing solution can be reduced drastically, while the same high cleaning and sterilizing effect is still achieved. Another advantage of the described variants of the method of the

invention makes it possible to check the cleaning effect after each run, so that expedient control can be achieved and another run can be carried out only if required. This ensures that the concentration of the rinsing solution, the duration of the cleaning process and the amount of water used can be matched optimally to one another. Regions that are particularly difficult to clean can furthermore be addressed, and particular sections of pipeline in a process path, for example the filtrate line and the clean water line, can be expediently cleaned and disinfected. Owing to the much lower amount of water, costs for the rinsing solution can therefore be saved according to the invention, but without the occurrence of significant levels in the waste water.

An embodiment of the device according to the invention will be presented with reference to appended Figure 2. It schematically represents the following:

- overflow water tank (10),
- access to the feed water pipeline (20a),
- sampling line and sampling cock (25a) for feed water before the first treatment stage of flocculation (Fl.),
- filter (30) with
    - adsorption stage (30a)
    - barrier layer (30b) and
    - protective layers (30c),
- sampling line and sampling cock (25b) in the filtrate before the disinfection (chlorination),
- heat exchanger (40),
- device for the basic and operational chlorination (50),
- sampling line and sampling cock (25c) in the clean water after the disinfection (chlorination) immediately before entering the pool,

- access to the clean water pipeline (20b) and
- swimming pool (60).

The filter (30) has the strongest degree of contamination in the lower region, i.e. in the protective layers (30c), which then continues to the device for the basic and operational chlorination (50) and may extend in an attenuated form as far as the swimming pool (60). Nevertheless, strong to medium contamination also occurs in the upper region of the filter, the adsorption stage (30a) and on the tank edges of the overflow water tank (10).

In order to sterilize and clean these particularly strongly contaminated regions of the process path in the water supply system of the swimming pool unit, therefore, a closed line system (not shown) is formed between the outlet of the overflow water tank, i.e. the access (20a), and the inlet immediately before the clean water enters the swimming or bathing pool, the access (20b). A predetermined amount of an aqueous rinsing solution containing chlorine oxide, halogen and/or peroxide, preferably the TCDO complex, is added to this system for sterilization and cleaning and is circulated at defined time intervals by using a pump (not shown). The sampling cocks should be slightly open during the circulation of the rinsing solution, so as likewise to permit cleaning and disinfection by the rinsing solution of the pipes and tubes which lie between the pipelines (lines for feed water, filtrate and clean water) and the sampling cocks.

This is important because, as is known, the water in these pipelines and tubes is predominantly in a stagnation phase over time and during operation of the circulation unit (filtration process). This repeatedly leads to enhanced microbiological

contamination of the pipes and tubes of the sampling cocks and possible misinterpretation in the microbiological testing.

After cleaning and sterilization has been carried out, the aqueous rinsing solution is discharged and the original water circuit of the bathing unit as shown in Figure 1 is restored.

The invention will be explained below with reference to examples:

Example 1:

- Preparation of a solution containing tetrachloride decaoxide complex dianions -

0.5 g of a 30 wt.% strength hydrogen peroxide solution is added to 1 l of water containing sulfate (carbonate hardness: 18 degrees or 3.2 mmol/l) with a pH of 0.5. 0.9 l of a commercially available sodium chlorite solution (about 300 g of sodium chlorite/l) are added to this solution while stirring thoroughly. The solution then passes through a brown color change, which becomes a light lime-green color when the pH of 7 is exceeded after the stabilization reaction has taken place. A pH of about 7.5 is thereby set up in the solution.

Example 2:

- Sterilization and cleaning of the water supply system of a swimming bath with the first method according to the invention, or device variant -

In the present case, a bathing water treatment unit of a swimming pool and a recreational pool in a public baths are sterilized and cleaned. The flow rate is 150 $m^3$ per hour with a pool water volume of about 470 $m^3$. The bathing unit is used by 350 persons/day on average. The user frequency varies between about 250 and 1000 persons/day during the times when it is open.

The method according to the invention was carried out as follows:

A closed circuit was first set up between the outlet of the overflow water tank and the inlet to the swimming pool. This is done by providing extra inputs and outputs and particular points on the feed water pipeline and clean water pipeline of the swimming water treatment unit.

The filter is then rinsed according to the rinsing data required for the unit. After rinsing, the circulation unit is returned to normal operation. After circulation of the swimming and bathing pool water for about 10 minutes, the unit is turned off and a check is made that no water has been lost from the process path.

Just the amount of water which will be made up again by introducing the disinfection solution is then removed from the process path to be cleaned. An aqueous rinsing solution for sterilization and cleaning in the form of a tetrachloride decaoxide complex dianion solution is then added in a concentration which corresponds to an initial chlorite concentration of about 0.1 to 0.2 mol/l.

The disinfection solution is introduced by dosing by means of dosing pumps during the circulation in the parts of the process path of the bathing pool water treatment unit to be cleaned.

The rinsing solution was circulated by means of a special frequency-controlled circulation pump with the so-called "stop-and-go" method for defined intervals, each of about 1 to 3 hours, and the pump was turned off for about 20 to 40 min. in order to provide a specific action time of the rinsing solution.

In the so-called "resting phases", it is advantageous for there to be a rinsing air fan in order

to "blow" rinsing air into the filter for 2 to 5 min. and achieve additional loosening of the filter material, which promotes the oxidative cleaning process by the TCDO solution in the filter material.

After having used the rinsing solution for about 3 hours, a check should be carried out using a TCDO reagent as to whether and active agent from the TCDO solution being used is still present in the rinsing solution. This is intended to ensure that sufficient efficacy of the disinfection solution is provided throughout the cleaning process.

The aqueous rinsing solution is then discharged and disposed of. This is only done in the pipelines. The residual rinsing solution in the filter is extracted by rinsing the filter via the rinsing water line.

The original water circuit of the swimming and bathing pool water treatment system is then restored.

The filter should then be rinsed again after an operating time of 24 to 36 hours.

The amount of rinsing solution was 120 l of working solution (active agent: TCDO anion) which was introduced into a total of 9 $m^3$ water and used as the rinsing solution.

Example 3:

- Sterilization and cleaning of the water supply system with a variant of the method according to the invention -

The procedure in Example 2 was carried out, but the rinsing solution was circulated for defined time intervals, each of about 1 to 3 hours, and the pump was turned off for about 30 to 60 min. in order to provide a specific action time of the rinsing solution.

The sterilizing and cleaning effect of the rinsing solution was found by the disinfectant test according to DIN EN 1276/August 1997 (Chemical Disinfectants and Antiseptics) and studies and tests - by laboratory techniques and on the industrial scale - for the chemical cleaning and disinfection of microbiologically contaminated granular activated carbons from various public swimming pool units with the tetrachloride decaoxide dianion (TCDO complex).

For practical use, qualitative detection of the TCDO anion in the rinsing solution can be and is carried out using the "HydroQuant" TCDO reagent. The "HydroQuant" TCDO reagent essentially consists of an aqueous solution of iron(III) chloride with the empirical formula $FeCl_3$, constitutes an easy-to-handle chemical test agent and makes it possible to detect the TCDO anion in the form of a color change (coloration from bright yellow to brown). If the TCDO anion is still present in the rinsing solution, then a brown coloration is found which occurs irrespective of the pH of the solution in a broad pH interval of from pH 3 to pH 11. The brown coloration also occurs irrespective of the freely active chlorine content. Even freely active chlorine concentrations of up to 100 mg/l have no effect on the measurability of the TCDO anion in the rinsing solution. The sterilizing and cleaning effect of the rinsing solution was accordingly found from the consumption of the TCDO complex.

Example 4:

- Sterilization and cleaning of the water supply system with another variant of the method according to the invention -

A closed circuit was set up as in Example 2, but with accurately defined delimitations, by means of

which a very specific section of the process path is to be sterilized and cleaned.

A tetrachloride decaoxide complex dianion solution in a concentration which corresponds to an initial chlorite concentration of about 1.5 mol/l was then added as a highly concentrated aqueous rinsing solution for sterilization and cleaning. The amount of rinsing solution was from 1/100 to 1/20 of the pipe volume. The rinsing solution was delivered through the isolated section by compressed air.

The sterilizing and cleaning effect was determined as described above in Example 3.

## Patent Claims

1. A method for sterilization and cleaning of water supply systems and areas, with the following steps:

(1) setting up a closed circuit between two points of the water supply system, or the water supply area,

(2) adding a predetermined amount of a disinfecting agent in the form of an aqueous rinsing solution containing chlorine oxide, halogen and/or peroxide, for sterilization and cleaning,

(3) sterilizing and cleaning the pipes, filters and filter materials contained in the system, including filter carbon with or without adsorptive properties, while periodically circulating the rinsing solution in the closed circuit at defined time intervals,

(4) discharging and disposing of the aqueous rinsing solution, and

(5) re-establishing the original water circuit.

2. The method as claimed in claim 1, characterized in that the water supply system is a swimming or bathing pool unit.

3. The method as claimed in claim 2, with the following steps:

(1) setting up a closed circuit between the outlet of the overflow water tank and the inlet immediately before the clean water enters the swimming or bathing pool,

(2) adding a predetermined amount of a disinfecting agent in the form of an aqueous rinsing solution containing chlorine oxide, halogen and/or peroxide, for sterilization and cleaning,

(3) sterilizing and cleaning the pipes, filters and filter materials contained in the system, including

filter carbon with or without adsorptive properties, while periodically circulating the rinsing solution in the closed circuit at defined time intervals,

(4) discharging and disposing of the aqueous rinsing solution, and

(5) re-establishing the original water circuit.

4. The method as claimed in claim 1, characterized in that the water supply system is a hot tub, in particular a hot whirlpool or a whirl tub.

5. The method as claimed in claim 1, characterized in that the water supply system is a drinking water supply system in a household installation, in particular a shower system.

6. The method as claimed in claim 5, characterized by the formation of a closed circuit in step (1) between the hot water boiler and the shower head.

7. The method as claimed in claim 1, characterized in that the water supply system is a process water treatment system in the industrial sector.

8. The method as claimed in one of the preceding claims, characterized in that the circulation according to step (3) is carried out in a privileged direction or alternately in one of the two directions.

9. The method as claimed in at least one of the claims, characterized in that the rinsing solution is circulated from a few minutes to a several hours, in particular about 3 to 12 h, in which case the circulation may be interrupted one or more times.

10. A method for sterilization and cleaning of water supply systems and areas, especially in treatment units, pipe systems and swimming and bathing pool units, with the following steps:

(a) isolating a defined section inside the water supply system,

(b) introducing a highly concentrated rinsing solution, containing at least one disinfectant agent,

(c) flushing the defined section with the rinsing agent, optionally with circulation,

(d) collecting the rinsing solution,

(e) checking for the presence of the active agent and/or the concentration of the active agent and/or the sterilizing and cleaning effect,

(f) optionally repeating steps (c) to (e),

(g) discharging and disposing of the aqueous rinsing solution, and

(h) re-establishing the original water circuit of the swimming and bathing pool unit.

11. The method as claimed in claim 10, characterized in that the rinsing solution is flushed by means of a gas at high pressure in step (c).

12. The method as claimed in claim 10, characterized in that the rinsing solution is sprayed onto the pipe inner walls, filters and/or filter materials in step (c).

13. The method as claimed in one of the preceding claims, characterized in that the sterilization and cleaning according to step (3), or the flushing according to step (c), also affects the sampling line and sampling cocks contained in the system.

14. The method as claimed in one of the preceding claims, characterized in that an aqueous rinsing solution containing chlorine oxide, halogen and/or peroxide is used as the disinfecting agent, in a concentration which corresponds to an initial chlorite concentration of at least about 0.1 mol/l, in particular at least about 0.15 mol/l.

15. The method as claimed in claim 14, characterized in that the tetrachloride decaoxide

complex dianion $[Cl_4O_{10}]^{2-}$ is present in the aqueous solution containing chlorine oxide.

16. The method as claimed in at least one of claims 14 and 15, characterized in that the aqueous solution of the tetrachloride decaoxide complex dianion is obtained by mixing an aqueous solution of pH ≤ 3 containing sulfate ions with a peroxo compound, which is stable in it, and subsequently adding the alkaline aqueous solution of a chlorite to this solution.

17. The method as claimed in claim 16, characterized in that the aqueous solution containing sulfate ions is mixed with the peroxo compound, which is stable in it, in such an amount as to provide a peroxo compound concentration of from about 0.001 to 0.01 molar in the solution.

18. The method as claimed in claim 16 or 17, characterized in that the aqueous solution containing sulfate ions is mixed with the peroxo compound, which is stable in it, and the alkaline aqueous solution of a chlorite is subsequently added to this solution in such an amount as to obtain a pH of more than 7.0, in particular between 7.5 and 8.0.

19. The method as claimed in at least one of claims 16 to 18, characterized in that an inorganic peroxo compound in the form of hydrogen peroxide, persulfate, percarbonate, perborate or a peroxide of an alkali or alkaline earth metal, is used as the peroxo compound.

20. The method as claimed in at least one of claims 16 to 19, characterized in that an alkali or alkaline earth metal chlorite is used as the chlorite.

21. The method as claimed in at least one of claims 16 to 20, characterized in that the aqueous solution containing sulfate ions has a pH ≤ 1.

22. The method as claimed in at least one of claims 16 to 21, characterized in that demineralized water is used to prepare the aqueous solution containing sulfate ions.

23. The method as claimed in at least one of claims 16 to 22, characterized in that the rinsing solution contains a water-soluble phosphate.

24. The method as claimed in at least one of the preceding claims, characterized in that continuous dosing of the disinfectant is provided.

25. A device for sterilization and cleaning of water supply systems and areas, comprising:

(1) a closed circuit between two points of the water supply system, or the water supply area, containing a predetermined amount of at least one disinfecting agent in the form of an aqueous rinsing solution containing chlorine oxide, halogen and/or peroxide, for sterilization and cleaning,

(2) a pump for circulation of the rinsing solution in the closed line system while sterilizing and cleaning the pipes and filters contained in the system,

(3) an outlet for the aqueous rinsing solution, and

(4) means for re-establishing the original water circuit.

26. The device as claimed in claim 25, characterized in that the water supply system is a swimming or bathing pool unit.

27. The device as claimed in claim 26, comprising:

(1) a closed circuit between the outlet of the overflow water tank and the inlet immediately before the clean water enters the swimming or bathing pool, containing a predetermined amount of at least one disinfecting agent in the form of an aqueous rinsing solution containing

chlorine oxide, halogen and/or peroxide, for sterilization and cleaning,

(2) a pump for circulation of the rinsing solution in the closed line system while sterilizing and cleaning the pipes and filters contained in the system,

(3) an outlet for the aqueous rinsing solution, and

(4) means for re-establishing the original water circuit.

28. A device for sterilization and cleaning of water supply systems and areas, especially in treatment units, pipe systems as well as swimming and bathing pool units, comprising:

(a) means for isolating a defined section inside the water supply system,

(b) means for introducing a highly concentrated rinsing solution, containing at least one disinfectant agent,

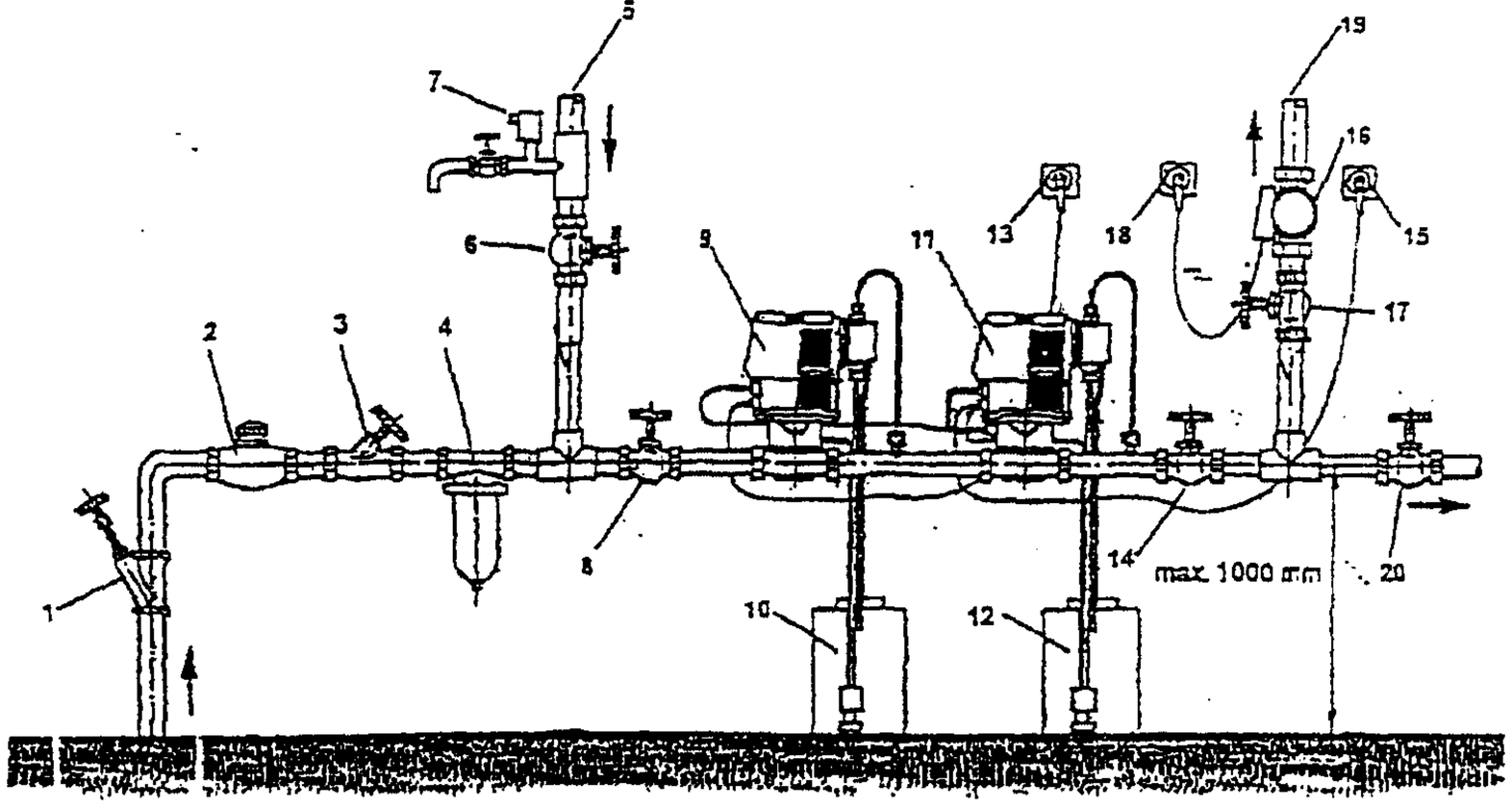
(c) means for flushing the defined section with the rinsing agent, optionally with circulation,

(d) a device for collecting the rinsing solution,

(e) means for checking for the presence of the active agent and/or the concentration of the active agent and/or the sterilizing and cleaning effect,

(f) means for discharging the aqueous rinsing solution, and

(g) means for re-establishing the original water circuit of the swimming and bathing pool water unit.




1 shut off feed line
2 *water meter*
3 shut off tap
4 *dirt filter*
5 return circulation line
6 *shut off tap*
7 draining tap with air vent
8 *shut off tap*
9 dosing pump 1
10 dosing container 1
11 dosing pump 2
12 dosing container 2
13 power point for dosing pump 1
14 *shut off tap*
15 power point for dosing pump 2
16 *circulation pump (cleaning circuit)*
17 shut off tap
18 *power point for circulation pump*
19 feed (cleaning circuit) or supply lines
20 *shut off tap*

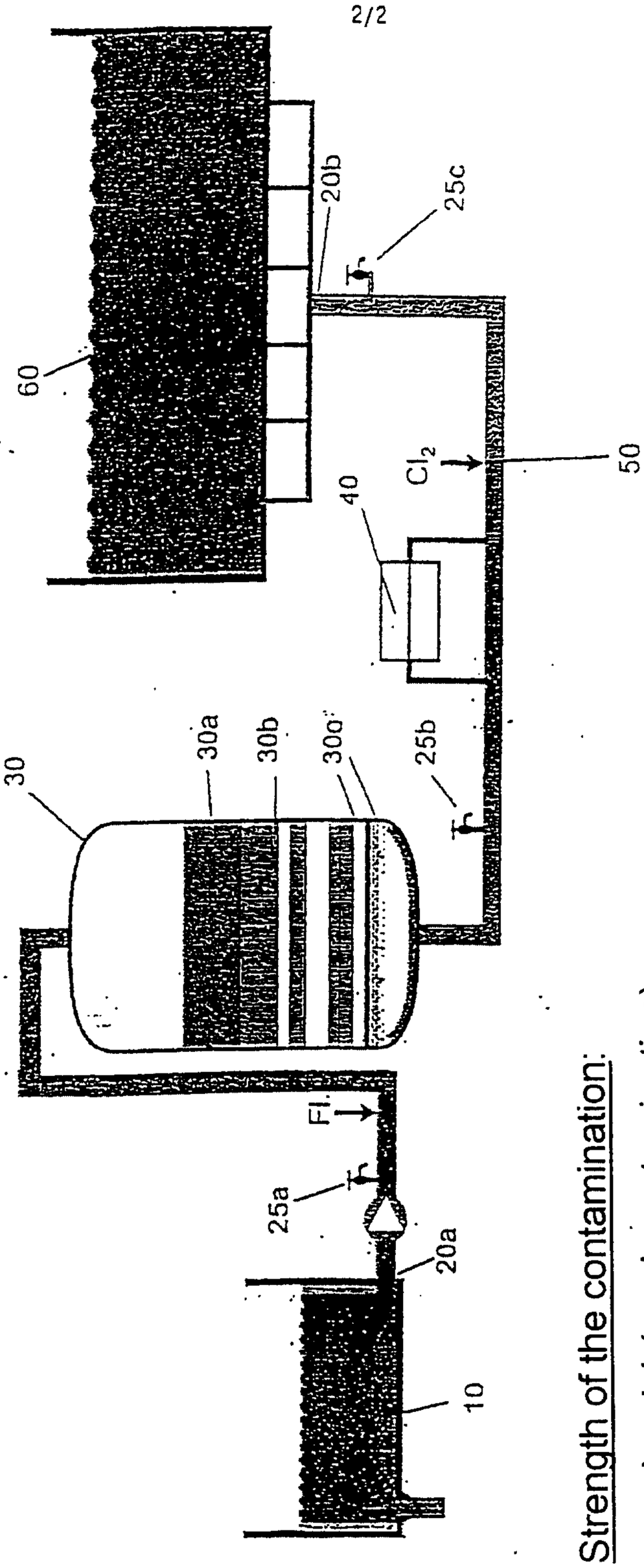
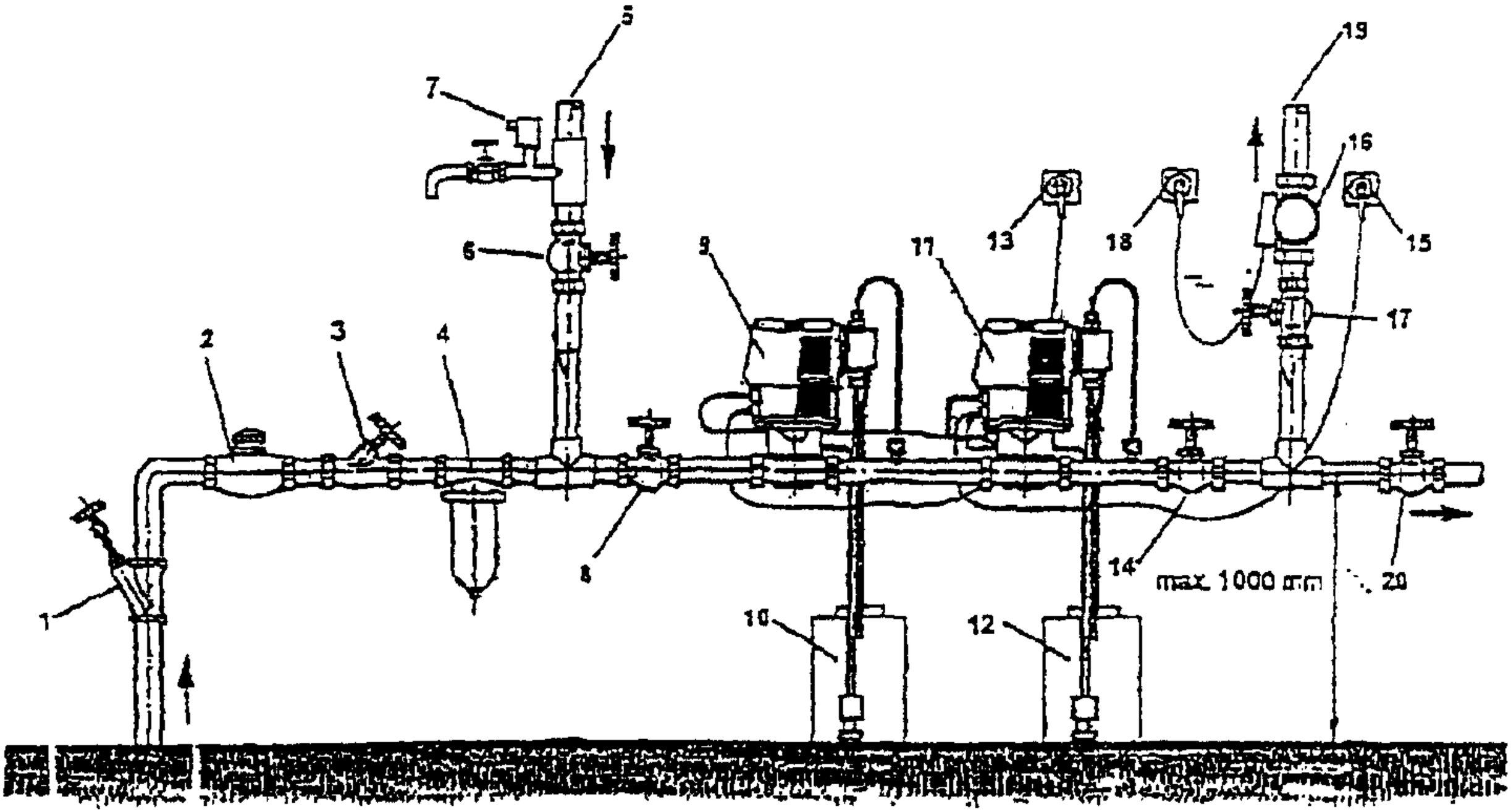



Figure 2

Strength of the contamination:

- level 1 (weak contamination)
- level 2 (medium contamination)
- level 3 (strong contamination)

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4 *dirt filter*
5 return circulation line
6 *shut off tap*
7 draining tap with air vent
8 *shut off tap*
9 dosing pump 1
10 *dosing container 1*
11 dosing pump 2
12 dosing container 2
13 power point for dosing pump 1
14 *shut off tap*
15 power point for dosing pump 2
16 *circulation pump (cleaning circuit)*
17 shut off tap
18 *power point for circulation pump*
19 feed (cleaning circuit) or supply lines
20 *shut off tap*