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(54) METHOD OF TREATING FLUIDS

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EP 0 238 639 B1

Description

This application is a continuing application of US application Serial No. 605,652 filed April 30, 1984, WO 85/05099 The present invention generally relates to fluid treating and, more particularly, to apparatus and methods which are especially adapted for providing for improved treatment of fluids. Industrial and domestic water supplies often contain undesirable constituents which require treating prior to end use. Although capable of a variety of uses, this invention finds advantageous utility in the treatment of water to remove or inhibit the growth of undesirable constituents contained therein such as, for example, dissolved chlorine and bacteria constituents.

In this regard, industrial and utility processes often require large amounts of water for cooling. Many water cooling operations utilize heat exchange for primary heat regulation, with a resulting rise in the temperature of the cooling water passing through the equipment. This rise in temperature promotes the growth of organisms already in the water which in turn can result in fouling of the equipment such as by clogging of the system or by build-up of a biological slime layer on the heat exchange surfaces which greatly reduce their effectiveness.

Chlorination is the most common means of controlling bacteria in cooling water systems as well as in drinking water systems. While the biocial properties of hypochlorous acid are effective to kill bacteria the hypochlorous acid itself may be deliterious to other equipment or treatment systems being used. In addition excess chlorine in drinking water often imparts an undesirable taste and odor to the water and the effluent water can be harmful to the environment. In this regard, the EPA has established effluent limitations for residual chlorine and it is often necessary to utilize dechlorination procedures to remove excess residual chlorine resulting from over chlorination in order to comply with EPA guidelines.

In the field of fluid treating, and particularly in the field of treating water for commercial, industrial and domestic use, a number of systems have been proposed, some or all of which have certain undesirable characteristics, drawbacks or disadvantages associated therewith.

For example, ion-exchange systems are commonly used to soften water and selectively remove specific impurities from the water. The active medium of the ion-exchanger is an ion-exchange resin which is designed to remove undesirable constituents from the fluid and replace those undesirable constituents with a less undesirable constituent. For instance, a cation exchange resin employed to remove the hardness-producing elements of calcium and magnesium may be designed to simultaneously give up sodium in exchange for the calcium and magnesium contained in the water which has passed through the ion-exchanger. Regardless of the specific ion-exchange resin used, eventually the bed of resin becomes exhausted and the unit must be removed from service and be regenerated to become useful again. In addition to chemical exhaustion iron bacteria can quickly fill an ion-exchange resin tank and plug chemical feed nozzles and other orifices. The resin is also susceptible to chemical degradation such as by excess chlorine present from a bacteria treatment process. Accordingly, the ion-exchanger unit must be carefully maintained and monitored to assure continued acceptable performance.

Another popular type of process for treating water is reverse osmosis wherein pressure in excess of the osmotic pressure of the fluid is used to force untreated water, normally at ambient temperature, through a selective membrane in a direction opposite to that normally observed in osmotic processes. The selective membrane is designed to allow the water to permeate through while rejecting the dissolved undesirable constituents. The success of this process depends in large part upon the development of suitable membranes. Membranes utilized in reverse osmosis typically experience a variety of temperature, chemical and pressure stability problems as well as speed and capacity limitations. Just as bacteria can foul heat exchangers so can it produce a fouling film on reverse osmosis membranes. If the water supply is treated with chlorine as an antibacterial agent the dissolved chlorine, although highly effective in combating bacteria, often has a deleterious effect on reverse osmosis membranes. Additionally, reverse osmotic equipment also must be carefully set up, maintained, and monitored. Accordingly, regardless of the sophistication of the technology used, if the end user fails to maintain the system and perform the necessary sampling required to ensure that the system is functioning to design specifications a breakdown in treatment can occur.

Still another popular water treatment process is the application of activated carbon, which is widely used for taste and odor control as well as removal of organic contaminants from water by adsorbtion since activated carbon is characterized by a high adsorbtivity for gases, vapors, and colloidal solids. However, similiar to the resin in ion-exchangers, the adsorbtive capacity of the carbon is eventually depleted and the carbon either must be regenerated or replaced. Therefore a system incorporating activated carbon also requires careful monitoring to determine the effectiveness of the medium. An additional disadvantage of activated carbon is that it collects microorganisms including harmful bacteria and provides a medium upon

which such harmful bacteria can multiply. As a result the activated carbon which is supposed to be purifying the water can end up contaminating the water with harmful bacteria. In an effort to overcome this disadvantage, manufacturers have attempted to provide a bacteriostatic activated carbon media by impregnating activated carbon with silver. However, such efforts have not been totally satisfactory since it is difficult to achieve effective bacteriostatic concentrations of silver and keep within the EPA established guidelines for dissolved silver content. Silver also has other disadvantages associated with its use such as the cost of the silver itself can be prohibitive to economical water treatment.

More specifically, in the use of metals for water treatment it has been known for centuries that copper metal has an effect on water-borne lower forms of plant and animal life, for this reason it has been used as anti-fouling on ships and underwater structures. DE-A-2316668 discusses the use of copper and other metals in the bacteriostatic treatment of water.

US-A-4416854 discloses that particles of copper or zinc may be used, with particles of lead, in bacteriocidal treatment of water, and GB-A-279085 states that certain metals, including copper, or alloys thereof which have "oligo-dynamic" properties, may be used to "activate" water which thereby requires bacteriocidal properties.

The present invention provides a fluid treating bacteriocidal or bacteriostatic method which employ metal particulate matter which is an alloy of copper and zinc having at least 50% by weight of copper. The metal particulate matter can be of varying mesh size, preferably of from 4 to 400 mesh based on U.S. Standard screen sizes, of any desired shape and is typically arranged in a loose bed confined within a treating tank by means which prevent the escape of the particulate matter but which, at the same time, permit fluid flow therethrough. Alternatively, techniques for adhering the particles into an aggregate porous body with the surface areas freely exposed can be utilized. Suitable techniques for forming such aggregate porous bodies include sintering and processes wherein a binder is utilized which results in all, or substantially all, of the surface area of the particles freely exposed for contacting fluids to be treated therewith. In this regard, an important aspect of the present invention involves a discovery that such a method will provide economical and long lasting removal of such undesirable contaminants and thereby greatly eliminate the weak link in most treatment systems i.e. maintaining and monitoring the system on a relatively frequent basis.

Another feature of the present invention involves a method of using such a bed of metal particulate matter in conjunction with another type of fluid treating apparatus such as activated carbon, reverse osmosis, or ion-exchange processes. In this regard, an important aspect of the present invention involves the removal of undesirable bacteria which may be detrimental to the operation and life of other treatment methods such as activated carbon, reverse osmosis and ion-exchange processes.

Furthermore it may treat bacteria present in a fluid such as water without concentrating such constituents in the treating medium.

In the accompanying drawings:

Fig. 1 is a vertical sectional view of one form of fluid treating apparatus of the invention, showing a loose bed of metal particulate matter;

Fig. 2 is a vertical sectional view of one form of fluid treating apparatus of the invention, showing a bed of activated carbon and a bed of metal particulate matter separate from each other but contained in a common housing;

Fig. 3 is a vertical sectional view of one form of fluid treating apparatus of the invention, showing a bed of activated carbon and a bed of metal particulate matter in series; and

Fig. 4 is a vertical sectional view of one form of fluid treating apparatus of the invention, showing a conventional treatment process such as a bed of activated carbon, and a bed of metal particulate matter contained in a common housing.

Although an important aspect of the present invention is directed to the treatment of water, especially drinking water, it will be appreciated that the apparatus and method of this invention may also find advantageous utility in the treatment of a variety of other source fluids with various different undesirable contaminants. For purposes of illustration only therefore, this invention will, in most part, be described by reference to an embodiment wherein water is the source fluid being treated.

It has now been discovered that fluid treating media containing Zn/Cu alloys such as brass particulate matter acts as an effective bacteriocidal and/or bacteriostatic agent with respect to common bacterial contaminants such as E. coli and Pseudomonas. It has also been discovered that when water containing dissolved iron, such as ferrous iron, which could stain clothing upon contact therewith is passed through a bed of brass that the effluent water is apparently free of dissolved iron and does not stain clothing upon contact therewith. It has further been discovered that when water contaminated with tannins is passed through a bed of brass that the effluent water is clear and apparently tannin free. As a result of such

findings, it is presumed that the present development may have widespread application to other types of inorganic contaminants such as hydrogen sulphide and sulphur dioxide to name but a few as well as organic contaminants.

Moreover it is believed that the useful life of such a method of fluid treatment under normal operating conditions, would far exceed the useful life of other conventional treating systems. Accordingly, such a finding represents a considerable step forward in the art in that it helps to eliminate one of the major drawbacks of conventional systems, i.e. the need to frequently replenish the active source of treatment and the concomitant need to constantly maintain and monitor the system.

In addition such a method has wide spread potential application for a variety of domestic, commercial and industrial uses.

As previously noted, this development is intended to have application to other fluid media besides water treatment including other liquid fluid media as well as gaseous fluid media by itself as well as gaseous fluid media dissolved in liquids.

Referring now to the drawings, FIG. 1 shows the invention to be typically embodied in an apparatus generally designated 10 for treating a fluid such as water, and shows that the apparatus includes an inlet 12, an outlet 14, and a treating tank 16 containing a bed of metal particulate matter 18. The treating tank 16 can be of a variety of shapes and sizes depending upon the desired application. For example, treating tank 16 can take the form of a cannister as depicted in FIG. 1.

As shown in FIG. 1 fluid treating tank 16 comprises impermeable side walls 20, and top and bottom walls 22 and 24. Top wall 22 and bottom wall 24 include inlet 12 and outlet 14 permitting flow of fluid to be treated respectively into and out of the treating tank 16. The fluid treating tank 16 further comprises, foraminous or permeable top and bottom plates 26 and 28 which allow fluid to pass respectively into and out of the fluid treating tank 16 while preventing the escape of the metal particulate matter 18. In accordance with a further aspect of the present invention, the bed of metal particulate matter may be used in combination or conjunction with other fluid treating mediums to provide an enhanced fluid treating system.

FIGS. 2-4 illustrate examples of such enhanced fluid treating systems. In FIG. 2 apparatus 40 includes fluid treating tank 16 which further comprises a middle foraminous or permeable plate 42 dividing the tank 16 into an upper chamber 44 and a lower chamber 46. The upper chamber 44 includes a conventional fluid treating medium such as activated carbon 48 and the lower chamber includes the bed of metal particulate matter 18. In FIG. 4 apparatus 50 includes fluid treating tank 16 which includes a conventional fluid treating medium such as, for example, activated carbon 48 mingled with the metal particulate matter 18. Treating medium 48 could, of course, also be any conventional treating media such as, for another example, a reverse osmosis media in which case fine mesh metal particulate matter 18 could be flocked onto the membrane.

In FIG. 3 apparatus 60 includes two fluid treating tanks 62 and 16 which are connected in series. The fluid treating tank 62 includes an inlet 64 and an outlet 66 which is connected to inlet 12 of fluid treating tank 16. Fluid treating tank 62 includes a conventional treating medium such as a bed of activated carbon 66. The fluid treating tank 62 comprises impermeable side walls 68, and top and bottom walls 70 and 72. Top wall 70 and bottom wall 72 include inlet 64 and outlet 66 permitting flow of fluid to be treated respectively into and out of the treating tank 62. The fluid treating tank 62 further comprises foraminous or permeable top and bottom plates 74 and 76 which allow fluid to pass respectively into and out of treating tank 62 while preventing the escape of the activated carbon 66.

It will be appreciated that the relative positioning of the fluid treating mediums depicted in FIGS. 2 and 3 and described above can be inverted depending upon the desired application. For example, as previously described, if the conventional treating medium is activated carbon it may be desirable to have the bed of metal particulate matter downstream of the activated carbon to treat any harmful bacteria contained in the fluid leaving the bed of activated carbon. On the other hand if the conventional treating medium is a reverse osmosis or ion-exchange medium it may be desirable to have the bed of metal particulate matter upstream of such medium to eliminate constituents such as dissolved chlorine which may be deleterious to such medium.

Zinc and copper alloys are the chosen metals for our process since they are relatively good reducing agents with respect to common inorganic contaminants such as chlorine and since both can be tolerated in solution in moderate concentrations without adverse effects. While other metals such as iron and aluminum are also theoretically good reducing agents such metals have disadvantages, which limit their applicability to universal commercial use. For example, while relatively high concentrations of iron can be tolerated in drinking water without toxic effects, such concentrations tend to feed iron based bacteria and also tend to stain items such as clothes when used domestically. In this regard, it has now been discovered that when

water containing dissolved iron, such as ferrous iron which could stain clothing upon contact therewith, is passed through a bed of brass that the effluent water is apparently free of dissolved iron and does not stain clothing upon contact therewith. Additionally, an iron based bed of metal particulate is inclined to premature clogging. Similarly, aluminum based treatment beds tend to scab, i.e. an oxide film forms on the surface, thus becoming practically ineffective after short use.

In practice it has been found that a zinc and copper alloy, such as brass is also more effective in the removal of dissolved chlorine than is either pure zinc or pure copper or a heterogeneous mixture thereof. In addition to the noted effectiveness of brass, brass is also a preferred metal from the viewpoint of chemical safety. This is especially true in aqueous media since brass does not have the violent reactivity to aqueous fluids as do metals such as pure sodium, potasium, calcium or zinc.

A copper/zinc alloy such as brass is also a preferred metal from the viewpoint of dissolved metal concentrations in the effluent. In this regard, it is noted that by-products of the redox reactions between zinc, copper and alloys thereof with inorganic contaminants such as dissolved chlorine are dissolved zinc, dissolved copper, and mixtures thereof, respectively. When zinc or copper are used alone to treat excessively chlorinated drinking water it is possible to effect dissolved metal concentrations which, while relatively dilute, exceed EPA (Environmental Protection Agency) recommended guidelines. While, as discussed further below, any resulting undesirable metal concentration could be effectively removed by further treatment with conventional treatment processes such as ion-exchange or reverse osmosis processes, it has been found that when a copper/zinc alloy such as brass is utilized as the treatment medium, the resulting dissolved metal concentrations fall well within current EPA guidelines for dissolved zinc and dissolved copper in drinking water.

As noted above a further embodiment of the present invention is a method for purification whereby the water is passed through both a bed of particulate copper/zinc alloy such as brass and a conventional treatment process such as reverse osmosis or ion-exchange or activated carbon. This could be especially advantageous due to the fact that semipermeable membranes such as cellulose acetate often used in reverse osmosis treatment methods are often susceptible to degredation by dissolved chlorine as is divinylbenzene which is often used to cross link ion-exchange resins. Utilization of a bed of brass in conjunction with the reverse osmosis membrane or ion-exchanger could substantially lengthen the life of the membrane or resin. Additionally, each of the reverse osmosis, ion-exchange and activated carbon conventional treatment methods are susceptible to bacterial fouling and/or bacterial build-up. In this regard, it has been found that the use of copper or a copper alloy such as brass in a treating system is effective to combat bacteria such as E. coli commonly found in sewage contaminated water supplies as well as other undesirious organisms such as Pseudomonas.

It will be appreciated that the term "brass" is used herein to indicate a copper-zinc alloy, in general, and that such alloy can contain other constituents and/or be commonly denominated by different nomenclature. For example, alloys commonly termed bronze containing copper and zinc, such as, but not limited to, architectural bronze composed of approximately 57% Cu-40% Zn-3% Pb, manganese bronze A composed of approximately 58.5% Cu-39% Zn-1.4% Fe-1% Sn-.1% Mn and manganese bronze B composed of 65.5% Cu-23.3% Zn-4.5% Al-3.7% Mn-3% Fe as well as other metals such as Muntz metal composed of 60% Cu-40% Zn are generally referred to as brasses herein and are within the scope of the present invention.

Where brass is the chosen metal, it has been found that washing the brass such as with a hydrochloric acid solution and then rinsing the brass will cleanse the surface of the brass of contaminants, such as iron filings or other foreign matter, which might interfere with the activity of the brass. However, it has additionally been noted that the surface of the brass which is exposed to the atmosphere or to a source fluid such as water may develop a greenish rust which may be a carbonate and/or oxide complex. When the surface itself is physically scraped to remove the greenish rust, the removed rust also shows excellent purifiying tendencies.

It has been found that brasses composed of respective percentage, by weight, of copper and zinc, yield different effluent concentrations of dissolved metals. In this regard, and with respect to current effluent limitations, brasses containing approximately a 1:1 ratio of copper to zinc are preferred, brasses containing approximately a 3:2 ratio of copper to zinc are more preferred and brasses containing approximately a 7:3 ratio of copper to zinc are most preferred. It will of course be appreciated that since copper is a better bacteriocidal and bacteriostatic agent than is zinc that increasing the percentage of copper in the brass should produce an enhanced bacteriocidal/bacteriostatic treating media.

It is contemplated that a 50 cm (20 inch) bed of 14 x 30 mesh brass housed in a cylinder having a 6 inch diameter could accomodate the full pressure water flow rate of a domestic home user and effectively treat influent chlorinated water for many years without replacing the bed of brass.

Set forth below are Examples I and II which describe quantitative analysis conducted by an independent laboratory of water innoculated with E. coli and Pseudomonas bacteria, respectively, before and after treatment with each of brass; a mixture of 50% brass and 50% activated carbon; zinc; copper; and, activated carbon.

EXAMPLE I

Initial innoculum Escherichia coli was prepared from an overnight stock culture grown on standard methods agar and suspended in phosphate buffered saline. Single strength tryptic soy broth was added to the innoculum suspension to achieve a final tryptic soy broth concentration of 10%, so to provide adequate available nutrient to allow bacterial growth.

Approximately 100 cubic centimeters of each of the following test material were pladed into respective 400 ml. beakers:

Test Materials

1. Brass shavings (approximate elemental composition: 70% Cu and 30% Zn by weight);
2. 50:50 mixture of brass (as above) and commercial activated carbon particles;
3. Particulate zinc;
4. Particulate copper;
5. Commercial activated carbon.

The innoculum (prepared as stated above) was added to each beaker sufficient to bring the fluid level just below the surface of the test material. A microbial count of the innoculum was made prior to addition of the test material. Each beaker was incubated at room temperature for 16 hours, and a microbial count was then performed on 1 ml. of the available fluid.

The results* were:

Test Material	Initial E. coli Inoculum:CFU/ml Liquid	Final E.coli CFU/ml Liquid
Brass	33,000,000	<10
50% Brass/50% Activated Carbon	33,000,000	35,000
Zinc	33,000,000	810,000
Copper	33,000,000	10
Activated Carbon	23,000	3,000,000

The tests using brass, 50% brass/50% activated carbon, zinc and copper were performed on the same day using the same innoculum. The test using activated carbon was performed by the same independent laboratory at a later date using a different inoculum prepared in the same manner as described above.

EXAMPLE II

Initial innoculum Pseudomonas was prepared from an overnight stock culture grown on standard methods agar and suspended in phosphate buffered saline. Single strength tryptic soy broth was added to the innoculum suspension to achieve a final tryptic soy broth concentration of 10% so to provide adequate available nutrient to allow bacterial growth.

Approximately 100 cubic centimeters of each of the following test material were placed into respective 400 ml. beakers:

Test Materials

1. Brass shavings (approximate elemental composition: 70% Cu and 30% Zn by weight);
2. 50:50 mixture of brass (as above) and commercial activated carbon particles;
3. Particulate zinc;
4. Particulate copper;
5. Commercial activated carbon.

The innoculum (prepared as stated above) was added to each beaker sufficient to bring the fluid level just below the surface of the test material. A microbial count of the innoculum was made prior to addition of the test material. Each beaker was incubated at room temperature for 16 hours, and a microbial count was then

performed on 1 ml. of the available fluid.

The results were:

Test Material	Initial Pseudomonas Inoculum: CFU/ml Liquid	Final Pseudomonas CFU/ml Liquid
Brass	2,300,000	20,000
50% Brass/50% Activated Carbon	2,300,000	1,300,000
Zinc	2,300,000	1,000,000
Copper	2,300,000	15,000
Activated Carbon	2,300,000	2,000,000

The preceding Examples are offered to illustrate the method of the present invention and the effect produced thereby and are not intended to limit the general scope thereof. As shown above brass proved to be exceptionally effective bacteriocidal agents when used alone as treating medias. As best illustrated by Example I, activated carbon provided a breeding ground for bacterial growth and over a 100 fold increase in bacteria was experienced when activated carbon was used alone. However, by mixing brass shavings with the activated carbon, an effective bacteriostatic media was achieved. It will of course be appreciated that brass can be used in conjunction with other fluid treating processes such as ion-exchange and reverse osmosis processes to achieve similar bacteriocidal/bacteriostatic medias. It will further be appreciated that the metal bacteriocide can be discrete from the other treating media or integrated therewith such as by impregnating activated carbon with brass. Example IV illustrates that the present invention is also effective to control the growth of organisms having a greater resistance to antimicrobial agents such as Pseudomonas.

In addition to chemically treating undesirable constituents the method of the present invention also has application to physically filtering undesirable suspended solids. This aspect of the present invention has particular application to removing suspended iron from water which iron is present in the water naturally, as a result of pretreatment such as by chlorination, or as a result of reaction with the bed of metallic particles utilized in the present method. Where the water is pretreated with chlorine to treat dissolved iron, the present method will not only filter the resulting suspended iron but also will treat the remaining chlorine in the water. The canister housing the bed of metal particulate matter can be periodically backwashed to remove any filtered matter which has collected in the bed and to declog the bed. However, unlike in other treatment methods such as reverse osmosis and ion-exchange methods, such backwashing does not result in the dumping of concentrated undesirable constituents.

Another alternative embodiment of the present invention is a method for purification whereby the water is passed through both a bed of metallic particulate matter such as brass and a bed of filter material and/or filter aid such as sand to enhance filtration of undesirable suspended matter.

Claims

1. A method for treating fluid to kill and inhibit undesirable bacteria constituents contained therein, said method comprising killing and inhibiting said constituents by passing fluid containing said constituents through a bed comprising metal particles, the metal particles being of a copper/zinc alloy containing at least 50% weight of copper.

2. The method according to claim 1 wherein the ratio of copper to zinc in said alloy is approximately 1:1 by weight.

3. The method according to claim 1 wherein the ratio of copper to zinc in said alloy is approximately 3:2 by weight.

4. The method according to claim 1 wherein the ratio of copper to zinc in said alloy is approximately 7:3 by weight.

5. The method according to any one of the preceding claims wherein the bed additionally includes activated carbon.

6. The method according to claim 5 wherein the metal particles are intimately intermingled with said

activated carbon.

7. The method according to claim 5 wherein the metal particles are integral with the activated carbon.

8. The use of an alloy of zinc and copper containing at least 50% by weight of copper, as a bacteriocide or bacteriostat in the treatment of a fluid containing bacteria.

Patentansprüche

1. Verfahren zum Behandeln von Fluid zum Abtöten und Hemmen von darin enthaltenen unerwünschten Bakterienbestandteilen, wobei das genannte Verfahren das Abtöten und Hemmen der genannten Bestandteile durch Hindurchschicken von Fluid, welches die genannten Bestandteile enthält, durch ein Metallteilchen aufweisendes Bett umfaßt, wobei die Metallteilchen aus einer Kupfer/Zinklegierung bestehen, die zumindest 50 Gew.-% Kupfer enthält.

2. Verfahren nach Anspruch 1, worin das Gewichtsverhältnis zwischen Kupfer und Zink in der genannten Legierung etwa 1:1 beträgt.

3. Verfahren nach Anspruch 1, worin das Gewichtsverhältnis zwischen Kupfer und Zink in der genannten Legierung etwa 3:2 beträgt.

4. Verfahren nach Anspruch 1, worin das Gewichtsverhältnis zwischen Kupfer und Zink in der genannten Legierung etwa 7:3 beträgt.

5. Verfahren nach einem der vorhergehenden Ansprüche, worin das Bett zusätzlich aktivierten Kohlenstoff/Aktivkohle enthält.

6. Verfahren nach Anspruch 5, worin die Metallteilchen mit dem genannten aktivierten Kohlenstoff innig vermengt sind.

7. Verfahren nach Anspruch 5, worin die Metallteilchen mit dem aktivierten Kohlenstoff integriert vorliegen.

8. Einsatz einer Legierung aus Zink und Kupfer, die zumindest 50 Gew.-% Kupfer enthält, als Bakterizid oder Bakteristat bei der Behandlung eines Bakterien enthaltenden Fluids.

Revendications

1. Procédé de traitement d'un fluide afin de détruire et d'inhiber les composants bactériens indésirables qu'il contient, ce procédé comportant les étapes de tuer et d'inhiber lesdits constituants en faisant passer ledit fluide à travers un lit comportant des particules métalliques, ces particules métalliques consistant en un alliage cuivre/zinc contenant au moins 50% en poids de cuivre.

2. Procédé selon la revendication 1, dans lequel le rapport entre le cuivre et le zinc dans ledit alliage est d'environ 1:1 en poids.

3. Procédé selon la revendication 1, dans lequel le rapport entre le cuivre et le zinc dans ledit alliage est d'environ 3:2 en poids.

4. Procédé selon la revendication 1, dans lequel le rapport entre le cuivre et le zinc dans ledit alliage est d'environ 7:3 en poids.

5. Procédé selon l'une des revendications précédentes, dans lequel le lit contient en plus du charbon actif.

6. Procédé selon la revendication 5, dans lequel les particules métalliques sont intimement mêlées avec le charbon actif.

7. Procédé selon la revendication 5, dans lequel les particules métalliques forment une masse avec le

charbon actif.

8. Utilisation d'un alliage de zinc et de cuivre contenant au moins 50% en poids de cuivre, comme agent bactéricide ou bactériostatique dans le traitement d'un fluide contenant des bactéries.

FIG. 1

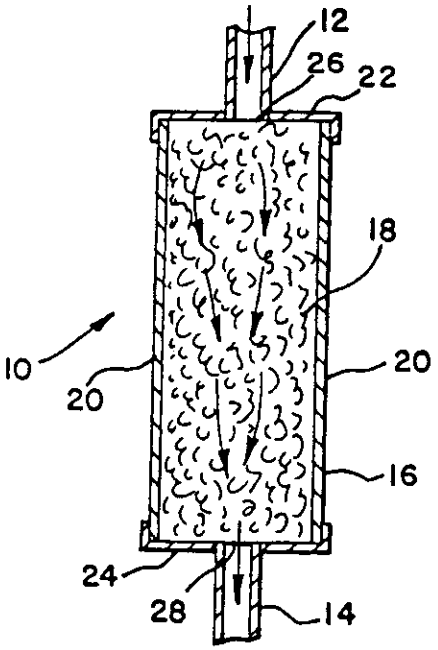


FIG. 3

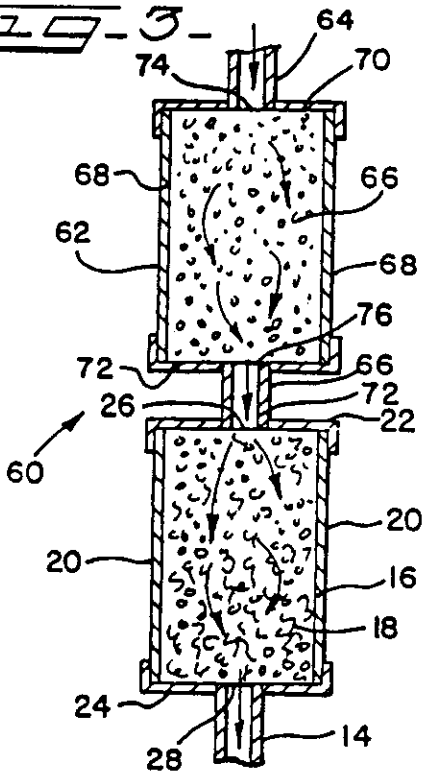


FIG. 2

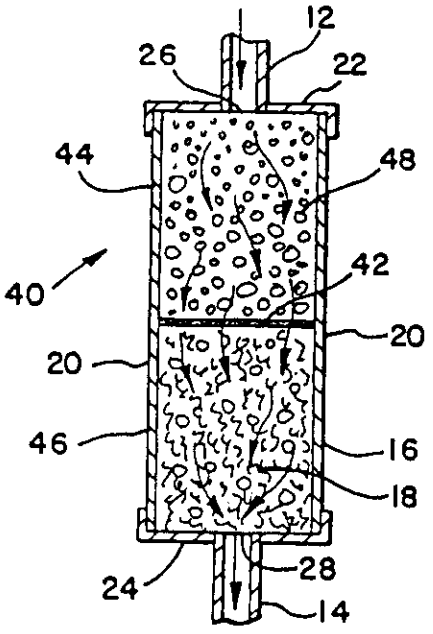
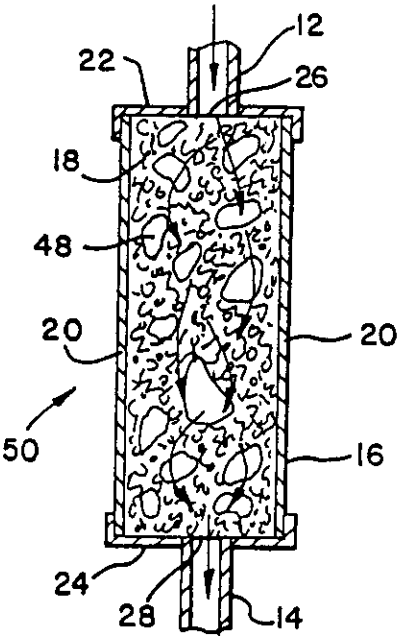


FIG. 4



REGISTER ENTRY FOR EP0238639

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PCT EUROPEAN PHASE
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DAVID CHRISTOPHER HARRISON, MEWBURN ELLIS & CO 2/3 Cursitor Street, London EC4A 1BQ, United Kingdom [ADP No. 50659499001]
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14.09.1992 Notification from EPO of change of Applicant/Proprietor details from
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KDF FLUID TREATMENT, INC., 120 S Washington Street, Constantine, MI 49042, United States of America [ADP No. 60209350001]
see (3)'
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**** END OF REGISTER ENTRY ****

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