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(54) Title: DEVICE FOR HYGENISATION OF FLUIDS AND SEMI-FLUIDS

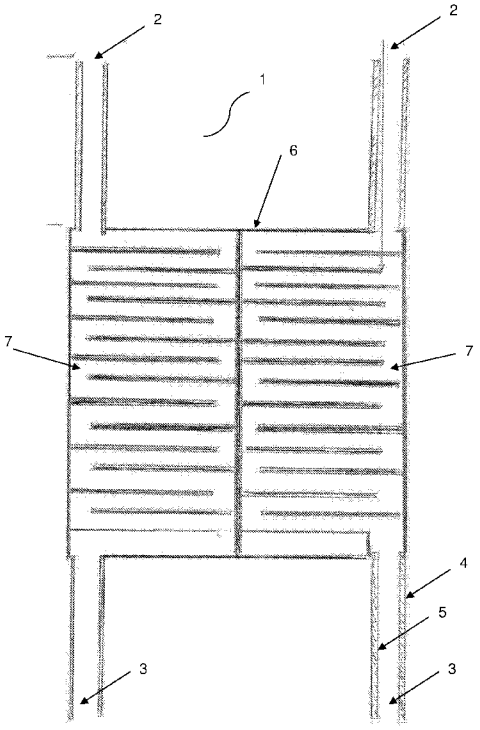


Figure 1

(57) Abstract: The present invention relates to a device for hygenisation of fluids, wherein the hygenisation device (1) comprises a container (6), wherein the material of said container comprise a UV transparent polymer material approved by the FDA (food and drug administration), further comprising an inlet (2) and an outlet (3), said hygenisation device is arranged to contain a flow of fluid to be sanitized.

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DEVICE FOR HYGENISATION OF FLUIDS AND SEMI-FLUIDS

Field of the invention

The present invention relates to a hygenisation device for hygenisation of fluids allowing users to sanitize also non transparent fluids, by providing a user friendly, more efficient and competitive invention.

Technical Background

The use of UV to decrease the amount of microorganisms and micropollutants has long been known. Within various technical fields there have been a long range of attempts to create devices for purification of fluids with the use of UV. One problem is however that a fluid containing micropollutants and/or microorganisms is not necessarily a transparent fluid. Within, for example, the areas of food, feed, nutrition and pharmaceuticals many times the fluid is more or less opaque. The effect of treatments using UV is highly affected by the turbidity of a liquid as an increased turbidity decreases the effect of the UV. Opaque or even semi opaque fluids are difficult to purify. It is hard to achieve a homogeneous result. Furthermore, the legislation which surrounds the food, feed, nutrition and pharmaceutical industry is rigid, with very strict demands on safety. There is therefore, still a need for a device for hygenisation of opaque and semi opaque fluids that is user friendly, practical and also more efficient than the existing alternatives.

Summary of the invention

One aim of the present invention is to provide the end user with a product that the end user find easy to use, is more efficient than the existing alternatives and can reduce the amount of micropollutants also in non transparent and opaque fluids leaving the end user with a satisfactory sanitizing result. The purpose above is achieved by a device for hygenisation of fluids characterized in that the hygenisation device comprises a container, wherein the material of said container comprise a UV transparent polymer material approved by the FDA (Food and Drug Administration), further

comprising an inlet and an outlet, said hygenisation device is arranged to contain a flow of fluid to be sanitized. The present invention may sanitize or conduct hygenisation of a fluid, meaning said hygenisation device according to the present invention enables users to reduce the amount of micropollutants in fluids. Furthermore, the present invention provides a more efficient and user friendly option of hygenisation. There are several advantages with the present invention and among those, a product that provides the user with an option to also sanitize semi opaque and opaque fluids and semi fluids which existing alternatives does not. Further, the present invention implies less energy consumption, increased safety, shorter retention time and presents an environmentally friendly alternative.

One aim of the present invention is to provide the end user with a product that the end user find easy to use, is more efficient than the existing alternatives and can reduce the amount of micropollutants also in non transparent and opaque fluids leaving the end user with a satisfactory sanitizing result. The purpose above is achieved by a device for hygenisation of fluids characterized in that the device for hygenisation comprises an outer container and a removably arranged inner container wherein the material of said outer container and said removably arranged inner container comprise a UV transparent material approved by the FDA (Food and Drug Administration), wherein said outer container further comprises an inlet, an outlet and a connection for applying vacuum, wherein said device for hygenisation is arranged for batch or semi batch flow of a fluid to be sanitized. The present invention may sanitize or conduct hygenisation of a fluid, meaning said device for hygenisation according to the present invention enables users to reduce the amount of micropollutants in fluids. Furthermore, the present invention provides a more efficient and user friendly option of hygenisation. There are several advantages with the present invention and among those, a product that provides the user with an option to also sanitize semi opaque and opaque fluids and semi fluids which existing alternatives does not. Another advantage is allowing for a batch or semi batch process and the present invention also implies less energy consumption, shorter retention time and presents an environmentally friendly alternative.

Short description of the drawings

Fig 1 shows one embodiment of the hygenisation device 1 according to the present invention, comprising an inlet 2, an outlet 3, an outer wall 4 and an inner wall 5, comprising a container 6, and a channel path 7.

Fig 2 shows one embodiment of the hygenisation device 1 according to the present invention in a cross section view, comprising an outer container 11, a removably arranged inner container 12 an inlet 13, an outlet 14, a connection 15 for applying vacuum, a channel 16 formed between the outer container 11 and the removably arranged inner container 12, a packing 17, here illustrated with an O-ring, and a seal 18.

Detailed description

Below, specific embodiments of the present invention are described. In one embodiment the present invention is a device for hygenisation of fluids, wherein the hygenisation device comprises a container, wherein the material of said container comprises a UV transparent polymer material approved by the FDA (Food and Drug Administration), said container further comprises an inlet and an outlet, said hygenisation device is arranged to contain a flow of fluid to be sanitized. In another embodiment of the invention, the material of the container comprise fluorinated ethylene polymer. In another embodiment the fluorinated ethylene polymer is selected from the group of fluorinated ethylene propylene (FEP) and polytetrafluoroethylene (PTFE).

In one embodiment said inlet and said outlet of the container are placed at an angle of 0-180° relative to each other, seen from a cross view, across the center axis of said container, a side view or a top view of said container.

The present invention comprises at least one inlet and at least one outlet of the container, connected to each other via a channel path. Said channel path may comprise various shapes and designs. Seen from a top view or a side view of the container, the channel path is in the shape of zigzag, straight, loop, spiral, helix, back and forth, circular or serpent shape or any other geometrical form. The present invention is not to be seen as limited

by a specific design of the channel path. Seen from a cross view, across the length axis of the channel path, the channel path may comprise a circular, a square, an elliptical or any other geometrical shape. The cross section view of the channel path is not to be seen as limited by a specific geometrical shape. Further, the channel path sets the shape and the design of a flow path inside said channel path. The channel path may preferably be designed to avoid dead zones of the flow within the flow path. Rounded corners and rounded turns are preferable. Preferably no right angles are to be used. When the flow within the channel path is to change direction, a bend or turn with a large radius is beneficial. The channel path is designed for the flow path to be facilitated and dead zones avoided. The channel path may be formed as part of the container, i.e. materially engaged. In one embodiment the container comprises welding. In one embodiment the channel path is fixed arranged, materially engaged with the container.

In another embodiment the channel path is removably arranged within the container. When the channel path is removably arranged this implies flexibility since the part forming the channel path is in this embodiment exchangeable. Further, it is washable and may also be recyclable which in turn implies an environmentally friendly alternative. Part of the channel path may comprise non transparent material. However the channel path must still allow light to pass at some sections of the container, to allow for hygenisation of a fluid. Further, the container and the channel path may comprise the same material, different material or a mixture of materials.

In one embodiment the channel path is created by an outer force. In one embodiment a part, comprising the design of the desired channel path, is removably arranged next to the container. The container is fixed arranged and a force is applied to the removably arranged part, pressing the removably arranged part together with the container. When the fluid is allowed to pass the container, the flow path will follow the channel path of the removably arranged part. In one embodiment equal force is applied to the container and the removably arranged part comprising a channel path design.

In one embodiment the device for hygenisation of fluids comprises more than one inlet and more than one outlet.

The hygenisation device may be operated at various flow rates. The flow rate is dependent upon various factors such as which fluid is to be sanitized and also, what is suitable for the rest of the system that the hygenisation device is connected to. In one embodiment the present invention is adapted to comprise a flow rate of at least 1dm^3/h, preferably at least 10 m^3/h, and more preferably at least 100 m^3/h. The present invention may be operated at different flow rates, dependent upon outer circumstances. The flow rate may vary and the present invention is to be seen as comprising a variety of flow rates and not only the once exemplified with. In one embodiment, the flow rate is 1dm^3/h. In another embodiment the flow rate is 0.1 m^3/h. In another embodiment the flow rate is 10 m^3/h. In another embodiment the flow rate is 100 m^3/h. In one embodiment the flow rate is chosen from 1-100 m^3/h, 1dm^3/h -200 m^3/h, 10 dm^3/h -100 m^3/h or 5 dm^3/h - 20 m^3/h.

In one embodiment the container comprises at least one polymer material. Preferably the polymer material is approved by the FDA (Food and Drug Administration of the US). Examples of polymers, however not exclusively, are fluorinated ethylene polymers, preferably fluorinated ethylene propylene or FEP. In one embodiment the material of the container may comprise FEP. In one embodiment the container is manufactured in a material comprising FEP. Preferably the material of the container comprises a high transparency for UV light, preferably for UVC light. Fluorinated ethylene propylene (FEP) is a copolymer of hexafluoropropylene and tetrafluoroethylene. It differs from the PTFE (polytetrafluoroethylene) resins in that it is melt-processible using conventional injection molding and screw extrusion techniques. FEP is very similar in composition to the fluoropolymers PTFE (polytetrafluoroethylene) and PFA (perfluoroalkoxy polymer resin). FEP and PFA both share PTFE's useful properties of low friction and non-reactivity, but are more easily formable. In one embodiment of the present invention the container is a FEP container. In another embodiment the container comprises FEP. In another embodiment the container is manufactured in a material comprising FEP. In yet another embodiment the container comprises a polymer selected from the group FEP, PTFE or PFA.

The use of a container comprising a polymer material approved by the FDA impliles a high safety and security.

The present invention aims at providing a device able to reduce the amount of microorganisms and/or micropollutants in fluids. In one embodiment the hygenisation device comprises at least one radiation source, preferably said radiation source generates UV light, and more preferably said radiation source generates UVC light. In one embodiment the present invention allows for hygenisation with UV-radiation. In another embodiment the hygenisation device comprises at least one UV light source. The radiation source, generating UV-radiation may be an external source placed nearby or next to the container. In another embodiment the present invention comprises a light source generating light within the germicidal area or within the germicidal range. In another embodiment the present invention comprises a light source generating light within the bactericidal or disinfectant area. One specific embodiment comprises UVC-light. For the purpose of increasing the radiation, a reflection of the light emitted by the radiation source is desired to increase exposure of the UV-light. By arranging a reflective surface around the container, enclosing the container and the UV-light source or alternatively arranging a reflective surface on one side of the container and the UV-light source on the other, this may be accomplished.

The present invention is suitable for hygenisation of a variety of fluids, various forms of liquids and/or semi liquids, adjusted for various fluids such as, but not exclusively, food, feed, health food products, nutritive supplements, pharmaceuticals chemical, residue or biofuels products. The present invention is suitable also for sensitive products, such as products sensitive to, for example heat, such as egg. Egg may be sanitized with the present invention both as a whole, as a mixture or separated in to egg white and yolks. Egg is difficult to sanitize with for example pasteurization due to coagulation. Other sensitive products or ingredients in products may be vitamins, minerals or flavoring. The present invention implies that more vitamins, minerals and flavoring components remain in the product when hygenisated using the present invention.

The hygenisation device is adapted for fluid to flow in a flow path inside the container. Said container may be a polymer container e.g. a bag comprising a channel path between the inlet and the outlet, as may be seen in figure 1. A fluid is a gas or a liquid. Further, fluids can be defined as a substance that continually deforms, or flows, under an applied shear stress. Fluids can be defined as substances which have zero shear modulus or in simpler terms a fluid is a substance which cannot resist any shear force applied to it. In one embodiment the present invention is adapted for sanitation or hygenisation of semi fluids and as an example, the present invention may be adapted for hygenisation of semi fluids such as sauce and puree.

The viscosity of the fluid may differ according to the present invention. The fluid may be low viscous or high viscous. Thus, semi fluids are also to be included as possible fluids to purify according to the present invention. Provided the fluid to be hygenisated is a fluid more difficult to treat (for example by hygenisation), the fluid may then be allowed to pass the container at least one time, e.g. twice or three times or more. In one embodiment the present invention comprises recirculation. Recirculation may be used to return the fluid for further hygenisation.

Further, the present invention implies less energy consumption, as it does not require heating of the fluid for hygenisation. Pasteurization implies a time consuming heating step and also a time consuming cooling step. Therefore, the retention time for the present invention may be shortened in comparison with conventional systems in need of hygenisation using heating and following cooling before optional further processing.

Further yet, the present invention is exchangeable, washable, recyclable and therefore environmentally friendly.

One aspect of the present invention relates to a method for hygenisation of a fluid comprising the steps of:

a. passing a fluid through a hygenisation device according to the present invention; and

b. exposing said fluid in said device to UV light during the passing of the container comprising UV transparent polymer material approved by the FDA (food and drug administration).

The fluid is exposed to UV light during the passing of at least part of the container, preferably all of the container.

Further, the present invention also relates to the use of a device for hygenisation of fluids using UV. Further, the present invention relates to the use of a device, for hygenisation of food, feed, health food products, nutritional supplements or pharmaceuticals. Another aspect of the present invention relates to a system comprising at least two devices according to the present invention for hygenisation of fluids which are connected in series or in parallel.

It should be noted that the device for hygenisation according to the present invention of course may comprise different standard components, such as tubing, couplings, pumps and flow meters etc. Moreover, the composition of the container of the device for hygenisation may comprise various additives in the composition such as softeners, coloring and the like. Further yet, the design of the hygienic device may vary, and the present invention, as formulated in claim 1, should be seen as embodying different forms of the product. One embodiment of such a form is a system comprising at least two devices. Said devices for hygenisation of fluids may be connected in series or in parallel.

According to one embodiment, the hygenisation device for hygenisation of fluids comprise a double wall polymer container structure, wherein said double wall polymer container structure comprise an outer polymer container wall and an inner polymer container wall, said inner polymer container wall arranged inside said outer polymer container wall and both walls are connected to form one double wall polymer container structure. Said double wall polymer container structure may in one embodiment be comprised of a spiral formed or helix shaped tubing the outer part constitutes the outer polymer container wall and the inner part of the shaped tubing constitutes the outer polymer container wall. The double wall polymer container structure further comprises an inlet and an outlet placed at opposite

end portions of said double wall polymer container structure. Said hygenisation device is adapted for fluid to flow between the outer and inner wall of said double wall polymer container structure. Looking at a cross section along the center axis of the container, the double wall polymer container structure comprises a first end portion where the inlet is positioned and a second end portion at which the outlet is positioned. The inlet and the outlet may be located at different places of the double wall polymer container within each end portion. Both a position horizontally in reference to the center axis along the double wall polymer container and a position vertically in reference to the center axis along the double wall polymer container are possible embodiments. In one embodiment the inlet and the outlet are arranged vertically or each at an angle in relation to the center axis along of the double wall polymer container as may be seen in figure 1. The inlet and the outlet are not necessarily placed in parallel with each other. In yet another specific embodiment, said inlet and outlet are placed at an angle of 0-180° relative to each other, seen from a cross view section across the center axis of said double wall polymer container structure, as may be seen in figure 1. In another embodiment the inlet and the outlet are arranged in parallel with the double wall polymer container and therefore in parallel with the direction of a flow direction optionally created inside the double wall polymer container. This direction is also in parallel with the center axis along the double wall polymer container. In one embodiment of the present invention the inlet and the outlet of the double wall polymer container are placed at opposite end portions. This indicates one placement, but not exclusively, other placements are thinkable, near the end portions of the double wall polymer container. The end portions of the double wall polymer container comprises the connection points, where the outer wall of the double wall polymer container and the inner wall of the double wall polymer container are connected and, from a cross view across the center axis, a ring shaped or ring donut shaped area is created. There is one end portion at each end of the double walled polymer container, a first end portion and a second end portion. The double wall polymer container structure comprises at least one inlet and at least one outlet. Said inlet and said outlet are placed at a distance from the middle of the double walled

polymer container length wise, seen from a view along the double walled polymer container and near opposite end portions of the double walled polymer container. The distance from the middle at which the inlet is placed may be the same or different from the distance at which the outlet is placed. The hygenisation device is adapted for fluid to flow between the outer and inner wall of said hygenisation device. A fluid is a substance that continually deforms, or flows, under an applied shear stress. Fluids can be defined as substances which have zero shear modulus or in simpler terms a fluid is a substance which cannot resist any shear force applied to it. In one embodiment the present invention is adapted for sanitation or hygenisation of semi fluids and as an example, the present invention may be adapted for hygenisation of semi fluids such as sauce and puree.

The viscosity of the fluid may differ according to the present invention. The fluid may be low viscous or high viscous. Thus, semi fluids are also to be included as possible fluids to purify according to the present invention.

In one embodiment the distance between the inner wall and the outer wall is adapted for sufficient UV-reactivity e.g. of a water-like fluid, an oil like fluid and/or for a puree like fluid. The present invention may be seen as suitable for various forms of liquids and/or semi liquids, adjusted for various fluids such as, but not exclusively, food, chemical, residue or biofuels products.

As previously mentioned, there is a need for further improvements relating to sanitizing or hygenisation of non transparent, cloudy or turbid fluids and semi fluids. Turbidity is the cloudiness or haziness of a fluid caused by large numbers of individual particles that are generally invisible to the naked eye. The measurement of turbidity may be a test of water quality. Fluids, including semi fluids can contain suspended solid matter consisting of particles of many different sizes. These solid particles cause the liquid to appear turbid or opaque. Fluids that are opaque are neither transparent, meaning allowing all light to pass through, nor translucent, meaning allowing some light to pass through. When light strikes an interface between two substances, in general some light may be reflected, some absorbed, some scattered, and the rest transmitted. An opaque substance transmits no light, and therefore reflects,

scatters, or absorbs all of it. Opacity depends on the frequency of the light being considered. For instance, some kinds of polymer, while transparent in the visual range, are largely opaque to ultraviolet light. Thus, not all polymers are suitable for the application according to the present invention. Fluorinated ethylene propylene (FEP) and polytetrafluoroethylene (PTFE) are two examples of polymers that illustrate better ultraviolet transmission than most other polymers, and are thus examples of preferable polymers for the container of the present invention.

The present invention aims at providing a device able to reduce the amount of microorganisms and/or micropollutants in fluids with UV-radiation. In one embodiment the hygenisation device comprises at least one UV light source. The radiation source, generating UV-radiation may be an external source placed within the polymer container structure. In another embodiment said UV light source is removably arranged in said hygenisation device. In yet another embodiment of the present invention, the radiation source, generating UV-light is incorporated, i.e. not removably arranged, in the double wall polymer container structure. The radiation source and the double wall polymer structure are arranged as one unit. In another more specific embodiment, the present invention comprises a light source generating UVC-light.

For the purpose of increasing the radiation, a reflection of the light emitted by the radiation source is desired to increase exposure of the UV-light. By arranging a reflective surface around the double wall polymer container this may be accomplished. In one embodiment the present invention is coated with a reflective material and in yet another embodiment the hygenisation device is coated with at least one layer of a reflective material. In one specific embodiment of the present invention the double wall polymer container is coated with Aluminum. Coating may be accomplished in various ways and in one embodiment the coating is provided to the invention by sputtering. Sputtering is a process whereby atoms are ejected from a solid target material due to bombardment of the target by energetic particles. It only happens when the kinetic energy of the incoming particles is much higher than conventional thermal energies ($\gg$ 1 eV). This process is commonly

utilized for thinletfilm deposition, etching and analytical techniques. For the present invention, it is used for Sputter deposition which is a physical vapor deposition (PVD) method of thin film deposition by sputtering. This involves ejecting material from a "target" that is a source onto a "substrate". This is a similar process as the process to deposit the metal (e.g. aluminum) layer during the fabrication of CDs and DVDs. In one embodiment of the hygenisation device, the double wall polymer container comprises quartz polymer. In one specific embodiment, said double wall polymer container structure is coated with a layer of a reflective material, preferably on the outer wall, and in yet another specific embodiment, said reflective material is Aluminum.

One aspect of the invention, relates to a method for hygenisation of a fluid comprising the steps of:

a. passing a fluid through a hygenisation device according to the present invention; and

b. exposing said fluid in said device to UV light during the passing of a double wall polymer container construction.

It should be noted that the hygienic device according to the present invention of course may comprise different standard components, such as tubing, couplings, pumps and flow meters etc. Moreover, the design of the hygienic device may vary, and the present invention, as formulated in claim 1, should be seen as embodying different forms of the product. One embodiment of such a form is a system comprising at least two devices. Said devices for hygenisation of fluids are connected in series or in parallel characterized in that each hygenisation device comprises a double wall polymer container structure, wherein said double wall polymer container comprise an outer polymer container wall and an inner polymer container wall, said inner polymer container wall arranged inside said outer polymer container wall and connected to form one double wall polymer container structure, further comprising an inlet and an outlet placed at opposite ends of said double wall polymer container structure, said hygenisation device is adapted for fluid to flow between the outer and inner wall of said double wall polymer container structure.

In one embodiment, the present invention is a device for hygenisation of fluids characterized in that the hygenisation device comprise a container, wherein the material of said container comprise polymer material approved by the FDA (food and drug administration), further comprising an inlet and an outlet, said hygenisation device is arranged to contain a flow of fluid to be hygenisated.

In another embodiment the container comprise fluorinated ethylene polymer.

In another embodiment the fluorinated ethylene polymer is selected from the group comprising Fluorinated ethylene propylene (FEP) and polytetrafluoroethylene (PTFE).

In another embodiment said inlet and an outlet are placed at an angle of 0-180° relative to each other, seen from a cross view across the center axis of said container, a side view or a top view of said container.

In another embodiment the present invention, comprising at least one radiation source, preferably said radiation source generates UV light, more preferably said radiation source generates UVC light.

One aspect of the present invention relates to a method for hygenisation of a fluid comprising the steps of:

a. passing a fluid through a hygenisation device according to the present invention; and

b. exposing said fluid in said device to UV light during the passing of container comprising polymer material approved by the FDA (food and drug administration).

Another aspect of the invention relates to use of a device according to the present invention, for hygenisation of fluids using UV.

Yet another aspect of the present invention relates to a system, wherein at least two devices according to the present invention, for hygenisation of fluids are connected in series or parallel.

In one embodiment the present invention is a device for hygenisation of fluids characterized in that the device for hygenisation comprises an outer container and a removably arranged inner container wherein the material of said outer container and said removably arranged inner container comprise a UV transparent material approved for being in contact with materials to be

consumed by humans or animals, wherein said outer container further comprise an inlet, an outlet and a connection for applying vacuum, wherein said device for hygenisation is arranged for batch or semi batch flow of a fluid to be sanitized. As previously mentioned, there is a need for further improvements relating to sanitizing or hygenisation of non transparent, cloudy or turbid fluids and semi fluids. Turbidity is the cloudiness or haziness of a fluid caused by large numbers of individual particles that are generally invisible to the naked eye. The measurement of turbidity may be a test of water quality. Fluids, including semi fluids can contain suspended solid matter consisting of particles of many different sizes. These solid particles cause the liquid to appear turbid or opaque. Fluids that are opaque are neither transparent, meaning allowing all light to pass through, nor translucent, meaning allowing some light to pass through. When light strikes an interface between two substances, in general some light may be reflected, some absorbed, some scattered, and the rest transmitted. An opaque substance transmits no light, and therefore reflects, scatters, or absorbs all of it. Opacity depends on the frequency of the light being considered. For instance, some kinds of polymer, while transparent in the visual range, are largely opaque to ultraviolet light. Thus, not all polymers are suitable for the application according to the present invention. Fluorinated ethylene propylene (FEP) and polytetrafluoroethylene (PTFE) are two examples of polymers that illustrate better ultraviolet transmission than most other polymers, and are thus examples of preferable polymers for the device according to the present invention. In one embodiment of the invention, the material of the removably arranged inner container and the outer container comprise at least one polymer material, e.g. a fluorinated ethylene polymer or a perfluoroalkoxy polymer resin (PFA). In another embodiment the fluorinated ethylene polymer is selected from the group consisting of fluorinated ethylene propylene (FEP), and polytetrafluoroethylene (PTFE). Preferably the polymer material is approved for being in contact with materials to be consumed by humans or animals. Such polymer materials may be approved by National Food Administrations for example regulated by legislation. Preferably the polymer material is approved by the FDA (Food and Drug Administration of the US). In

one embodiment the material of the containers may comprise FEP. In one embodiment the containers are manufactured in a material comprising FEP. Fluorinated ethylene propylene (FEP) is a copolymer of hexafluoropropylene and tetrafluoroethylene. It differs from the PTFE (polytetrafluoroethylene) resins in that it is melt-processible using conventional injection molding and screw extrusion techniques. FEP is very similar in composition to the fluoropolymers PTFE (polytetrafluoroethylene) and PFA (perfluoroalkoxy polymer resin). FEP and PFA both share PTFE's useful properties of low friction and non-reactivity, but are more easily formable. In one embodiment of the present invention the removably arranged inner and outer container are FEP containers. In another embodiment the containers comprise FEP. In another embodiment the containers are manufactured in a material comprising FEP. In yet another embodiment the containers comprises a polymer selected from the group FEP, PTFE or PFA. These types of materials are FDA approved and approved for being in contact with materials to be consumed by humans or animals. The use of a container comprising a polymer material approved by the FDA impliles a high safety and security. Another material well suited for the present invention is quartz. In one embodiment, the material of the removably arranged inner container and the outer container comprise quartz. In one embodiment the material of the containers is quartz. In another embodiment the containers are manufactured in a material comprising quartz. In yet another embodiment the outer container and/or removably arranged inner container comprises a material selected from the group consisting of fluorinated ethylene polymer, perfluoroalkoxy polymer resin and quartz. Also a mixture of materials is considerable. In one embodiment the removably arranged inner container and the outer container comprise different materials, preferably chosen from fluorinated ethylene polymer, perfluoroalkoxy polymer resin and quartz. In one embodiment the device comprise a material with a high transparency for UV light, preferably for UVC light.

The present invention comprises at least one inlet and at least one outlet of the container, connected to each other via a channel formed between said containers. When placing the removably arranged inner

container within the outer container a flow is allowed to run in the space (the channel) arranged, from said inlet, towards said outlet. Said channel may comprise various shapes and designs. Seen from a cross view, across the length axis of the channel path, the channel path may comprise a circular, a square, an elliptical or any other geometrical shape. The cross section view of the channel is not to be seen as limited by a specific geometrical shape. Further, the channel sets the shape and the design of a flow path inside said channel. The channel may preferably be designed to avoid dead zones of the flow within the flow path. Rounded corners and rounded turns are preferable, i.e. preferably no angles with pointed sections in connection with the flow path meaning that angles with a blunt or rounded point of intersection is desirable.

Between the removably arranged inner container and the outer container, in an attempt to prevent leakage, a packing is positioned. The packing may also be considered to be a gasket or seal. The packing may comprise an O-ring. In one embodiment the removably arranged inner container has said packing attached. In another embodiment the outer container has said packing attached. In even yet another embodiment the hygenisation device comprise at least one packing. The packing may comprise different materials. In one embodiment the packing comprise a polymeric material. In another embodiment the packing is selected from the group consisting of polymeric material, e.g. rubber, silicone, thermoplastic or thermosetting polymer. Since the purpose of the packing is to seal the channel, and in part prevent leakage by gravitational force and in part allow for vacuum to be applied, in one embodiment the hygenisation device comprises two packings. One packing may be placed between the outer container and the removably arranged inner container at, adjacent to or before the outlet, from a flow direction perspective. Another packing may be placed between the outer container and the removably arranged inner container adjacent to the inlet. This allows sealing of the arranged channel. In one embodiment a first packing is arranged near the inlet on a side allowing for fluid to enter the channel, and a second packing is placed on the other side of the inlet allowing for the fluid entering the channel to remain in the channel while vacuum is applied to the channel. In yet another embodiment

the second packing is arranged before the outlet from a possible fluid flow direction perspective. In yet another embodiment a seal is placed near the inlet of the hygenisation device. In one embodiment a seal is placed near the top of the device sealing one end of the channel. The purpose of the two seals, packings or gaskets is to allow for a seal of the channel, preventing leakage. Further, another purpose is to render it possible to apply a decrease in pressure to the channel of the hygenisation device.

The device for hygenisation further comprises an inlet and an outlet placed at opposite end portions of said outer container. Said device for hygenisation is adapted for fluid to flow between the outer container and the removable arranged inner container. Looking at a cross section along the center axis of the tube, the outer container comprises a first end portion where the inlet is positioned and a second end portion at which the outlet is positioned. The inlet and the outlet may be located at different places of the outer container within each end portion. Both a position horizontally in reference to the center axis along the outer container and a position vertically in reference to the center axis along the outer container are possible embodiments for inlet and outlet, respectively. The inlet and the outlet are not necessarily placed in parallel with each other. In yet another specific embodiment, said inlet and outlet are placed at an angle of 0-180° relative to each other, seen from a view along the center axis of the outer container. In another embodiment the inlet and the outlet are arranged in parallel with the center axis along the outer container, and therefore in parallel with the direction of a flow direction optionally created inside the removable arranged channel. This direction is also in parallel with the center axis along the device for hygenisation. In one embodiment of the present invention the inlet and the outlet of the device for hygenisation are placed at opposite end portions of the outer container. This indicates one placement, but not exclusively, as other placements is considerable, near the end portions of the outer container. Said inlet and said outlet are placed at a distance from the middle of the outer container length wise, seen from a view along the outer container and near opposite end portions of the outer container. The distance from the middle at

which the inlet is placed may be the same or different from the distance at which the outlet is placed.

In one embodiment the inlet comprises a valve. In another embodiment said valve is a magnetic valve. In another embodiment the inlet is a solenoid valve. Other valves are thinkable and in one embodiment the inlet comprise a valve adapted for use while applying vacuum to the hygenisation device.

In one embodiment, the hygenisation device comprises an inlet, an outlet and a connection for applying vacuum. In one embodiment the connection for applying vacuum comprises a valve. In another embodiment said valve is a magnetic valve. In another embodiment the connection for applying vacuum comprises a solenoid valve. Other valves are thinkable and in one embodiment the connection for applying vacuum comprises a valve adapted for use while applying vacuum to the hygenisation device.

In one embodiment the hygenisation device comprises a motor. Said motor being adapted for lifting the inner container enclosed by the outer container of the hygenisation device. When the inner container of the hygenisation device is lifted, fluid contained within the device is discharged through the outlet of the hygenisation device. In one embodiment fluid enclosed between the inner container and the outer container is discharged. In another embodiment fluid contained in the channel of the hygenisation device is discharged. In one embodiment the hygenisation device comprises an eccentric shaft.

The inner container may be lifted through other force as well or through other arrangements and the present invention is not to be seen as limited by the means for lifting the inner container.

In an attempt to increase flexibility, a removable cylinder, comprising material that is transparent to radiation, preferably UV radiation may be placed within the device. The cylinder comprises an outer diameter smaller than the inner diameter of the outer container and an inner diameter larger than the outer diameter of the inner container. The cylinder may be of various wall thicknesses, adapted for the fluid to be sanitized. A more opaque fluid implies the need of a larger wall thickness of the removable cylinder. The removable cylinder allows for a flexible and more narrow channel between the

outer container and the inner container. Part of the removable cylinder may comprise non transparent material. However the removable cylinder and channel must still allow light to pass at some sections of the container, to allow for hygenisation of a fluid. Further, the containers and the cylinder may comprise the same material, different material or a mixture of materials. Preferably the cylinder is made of the same selection of materials as the two containers.

In one embodiment the device for hygenisation of fluids comprises more than one inlet and more than one outlet.

The device for hygenisation may be operated at various flow rates. The flow rate is dependent upon various factors such as which fluid is to be sanitized and also, what is suitable for the rest of the system that the device for hygenisation is connected to. In one embodiment the present invention is adapted to comprise a flow rate of at least 1dm^3/h, preferably at least 10 m^3/h, and preferably at least 100 m^3/h. The present invention may be operated at different flow rates, dependent upon outer circumstances. The flow rate may vary and the present invention is to be seen as comprising a variety of flow rates and not only the once exemplified with. In one embodiment, the flow rate is 1dm^3/h. In another embodiment the flow rate is 0.1 m^3/h. In another embodiment the flow rate is 10 m^3/h. In another embodiment the flow rate is 100 m^3/h. In one embodiment the flow rate is chosen from 1-100 m^3/h, 1dm^3/h-200 m^3/h, 10 dm^3/h-100 m^3/h or 5 dm^3/h-20 m^3/h.

The present invention aims at providing a device able to reduce the amount of microorganisms and/or micropollutants in fluids. In one embodiment the device for hygenisation comprises at least one radiation source, preferably said radiation source generates UV light, and preferably said radiation source generates UVC light. In one embodiment the present invention allows for hygenisation with UV-radiation. In another embodiment the device for hygenisation comprises at least one UV light source. The radiation source, generating UV-radiation may be an external source placed nearby or next to the outer container; or inside the inner container, or any combination. In another embodiment the present invention comprises a light source generating light within the germicidal area or within the germicidal

range. In another embodiment the present invention comprises a light source generating light within the bactericidal or disinfectant area. One specific embodiment comprises UVC-light.

The hygenisation device comprises an outer container and a removable arranged inner container and the device for hygenisation is adapted for fluid to flow between the outer and, removably arranged inner container. In one embodiment the distance between the inner wall of the outer container and the outer wall of the removably arranged inner container (i.e. the flow area) is adapted for sufficient UV-reactivity e.g. of a water-like fluid, an oil like fluid and/or for a puree like fluid. A fluid is a substance that continually deforms, or flows, under an applied shear stress. Fluids can be defined as substances which have zero shear modulus or in simpler terms a fluid is a substance which cannot resist any shear force applied to it. In one embodiment the present invention is adapted for sanitation or hygenisation of semi fluids and as an example, the present invention may be adapted for hygenisation of semi fluids such as sauce and puree.

The present invention is suitable for hygenisation of a variety of fluids, various forms of liquids and/or semi liquids, adjusted for various fluids such as, but not exclusively, food, feed, health food products, nutritive supplements, pharmaceuticals chemical, residue or biofuels products. The present invention is suitable also for sensitive products, such as products sensitive to, for example heat, such as egg. Egg may be sanitized with the present invention both as a whole, as a mixture or separated in to egg white and yolks. Egg is difficult to sanitize with for example pasteurization due to risk of coagulation. Other sensitive products or ingredients in products may be vitamins, minerals or flavoring. The present invention implies that more vitamins, minerals and flavoring components remain in the product when hygenisated using the present invention.

A fluid is a gas or a liquid. Further, fluids can be defined as a substance that continually deforms, or flows, under an applied shear stress. Fluids can be defined as substances which have zero shear modulus or in simpler terms a fluid is a substance which cannot resist any shear force applied to it. In one embodiment the present invention is adapted for

sanitation or hygenisation of semi fluids and as an example, the present invention may be adapted for hygenisation of semi fluids such as sauce and puree.

The viscosity of the fluid may differ according to the present invention. The fluid may be low viscous or high viscous. Thus, semi fluids are also to be included as possible fluids to purify according to the present invention. Provided the fluid to be hygenisated is a fluid more difficult to treat (with for example hygenisation), the fluid may then be allowed to pass the container at least one time, e.g. twice or three times or more. In one embodiment the present invention comprises recirculation. Recirculation may be used to return the fluid for further hygenisation.

Further, the present invention implies less energy consumption, as it does not require heating of the fluid for hygenisation. Pasteurization implies a time consuming heating step and also a time consuming cooling step. Therefore, the retention time for the present invention may be shortened in comparison with conventional systems in need of hygenisation using heating and following cooling before optional further processing.

Further yet, the present invention is exchangeable, washable, and may also be recyclable which in turn implies an environmentally friendly alternative.

One aspect of the present invention relates to a method for hygenisation of a fluid comprising the steps of:

a'. introducing a fluid in a device for hygenisation according to the invention;

b'. applying vacuum to the device;

c'. exposing the fluid in the device to radiation, preferably UV light;

d'. removing the vacuum; and

e'. discharging the fluid from the device, preferably by gravitational force.

Another aspect of the present invention relates to a method for hygenisation of a fluid comprising the steps of:

a''. closing an inlet valve of a device for hygenisation according to the invention and applying vacuum to the device for hygenisation through a connection for applying vacuum comprising a valve;

b''. closing the valve of the connection for applying vacuum;

c''. opening the inlet valve and thereby introducing a fluid in to the device for hygenisation;

d''. exposing the fluid in the device to radiation, preferably UV light, preferably UVC light;

e''. lifting an inner container enclosed by the outer container of the device for hygenisation; and

f''. discharging the fluid from the device for hygenisation, preferably by gravitational force.

Further, the present invention also relates to the use of a device for hygenisation of fluids preferably using radiation, preferably using UV, preferably using UVC. Further, the present invention relates to the use of a device, for hygenisation of food, feed, health food products, nutritional supplements or pharmaceuticals. Another aspect of the present invention relates to a system comprising at least two devices according to the present invention for hygenisation of fluids which are connected in series or in parallel.

The present invention aims at providing a device able to reduce the amount of microorganisms and/or micropollutants in fluids with UV-radiation. In one embodiment the device for hygenisation comprises at least one UV light source. The radiation source, generating UV-radiation may be an external source placed within the container structure. The radiation source, generating UV-radiation may be an external source placed adjacent the container structure. In another embodiment said UV light source is removably arranged in said device for hygenisation. In another more specific embodiment, the present invention comprises a light source generating UVC-light.

It should be noted that the device for hygenisation according to the present invention of course may comprise different standard components, such as tubing, couplings, pumps and flow meters etc. The composition of the container of the device for hygenisation may comprise various additives in the composition such as softeners, coloring and the like.

Moreover, the design of the device for hygenisation may vary, and the present invention, as formulated in claim 1, should be seen as embodying

different forms of the product. One embodiment of such a form is a system comprising at least two devices. Said devices for hygenisation of fluids may be connected in series or in parallel.

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Claims

1. A device for hygenisation of fluids c h a r a c t e r i z e d in that the hygenisation device comprises a container (6), wherein the material of said container comprise a UV transparent polymer material, wherein said container further comprises an inlet (2) and an outlet (3), said hygenisation device is arranged to contain a flow of fluid to be sanitized wherein the device comprise at least one radiation source.

2. The device according to claim 1, wherein the container comprises fluorinated ethylene polymer.

3. The device according to claim 2, wherein the fluorinated ethylene polymer is selected from the group of fluorinated ethylene propylene FEP and polytetrafluoroethylene PTFE.

4. The device according to anyone of claims 1-3, wherein said inlet (2) and an outlet (3) are placed at an angle of 0-180° relative to each other, seen from a cross view across the center axis of said container, a side view or a top view of said container.

5. The device according to anyone of claims 1-4, wherein said radiation source generates UV light, preferably said radiation source generates UVC light.

6. The device according to anyone of claims 1-5, adapted to comprise a flow of at least 1dm^3/h, preferably at least 10 m^3/h, and more preferably at least 100 m^3/h.

7. The device according to anyone of claims 1-6, comprising a channel path connecting said inlet and said outlet, wherein said channel path is removably arranged within the container.

8. The device according to claim 7, wherein the channel path is in the shape of zigzag, straight, loop, spiral, helix, back and forth, circular or serpent shaped.

9. A method for hygenisation of a fluid comprising the steps of:
   a. passing a fluid through a hygenisation device according to claims 1-8; and
   b. exposing said fluid in said device to UV light during the passing of the container comprising UV transparent polymer material.

10. Use of a device according to anyone of claims 1-8 for hygenisation of fluids using UV.

11. Use of a device according to anyone of claims 1-8 for hygenisation of food, feed, health food products or pharmaceuticals.

12. A system comprising at least two devices according to any one of claims 1-8 for hygenisation of fluids which are connected in series or parallel.

13. A device for hygenisation of fluids c h a r a c t e r i z e d in that the device for hygenisation comprises an outer container (11) and a removably arranged inner container (12) wherein the material of said outer container (11) and said removably arranged inner container (12) comprise a UV transparent material approved for being in contact with materials to be consumed by humans or animals, wherein said outer container (11) further comprises an inlet (13), an outlet (14) and a connection (15) for applying vacuum, wherein said device for hygenisation is arranged for batch or semi batch flow of a fluid to be sanitized.

14. The device according to claim 13, wherein the outer container (11) and/or removably arranged inner container (12) comprises a material

selected from the group consisting of fluorinated ethylene polymer, perfluoroalkoxy polymer resin and quartz glass.

15. The device according to claim 14, wherein the fluorinated ethylene polymer is selected from the group consisting of fluorinated ethylene propylene and polytetrafluoroethylene.

16. The device according to anyone of claims 13-15, comprising at least one radiation source, preferably said radiation source generates UV light, more preferably said radiation source generates UVC light.

17. The device according to anyone of claims 13-16, adapted to comprise a flow of at least 1dm^3/h, preferably at least 10 m^3/h, and preferably at least 100 m^3/h.

18. The device according to anyone of claims 13-17, comprising a channel (16) formed between the outer container (11) and the removably arranged inner container (12) when placing the removably arranged inner container (12) within the outer container (11) allowing a flow to run in the space arranged, from said inlet (13), towards said outlet (14).

19. The device according to any one of claims 13-18, wherein the removably arranged inner container (12) further comprise at least one packing (17, 18).

20. The device according to claim 19, wherein the packing is selected from the group consisting of polymeric, rubber, silicone, thermoplastic or thermosetting material.

21. A method for hygenisation of a fluid comprising the steps of:

a''. closing an inlet valve of a device for hygenisation according to claim 13-20 and applying vacuum to the device for hygenisation through a connection for applying vacuum further comprising a valve;

b''. closing the valve of the connection for applying vacuum;

c''. opening the inlet valve and thereby introducing a fluid in to the device for hygenisation;

d''. exposing the fluid in the device to radiation, preferably UV light, preferably UVC light;

e''. lifting an inner container enclosed by the outer container of the device for hygenisation; and

f''. discharging the fluid from the device for hygenisation, preferably by gravitational force.

22. Use of a device according to anyone of claims 13-20 for hygenisation of fluids, preferably using radiation, preferably using UV preferably using UVC.

23. Use of a device according to anyone of claims 13-20 for hygenisation of food, feed, health food products or pharmaceuticals.

24. A system comprising at least two devices according to any one of claims 13-20 for hygenisation of fluids which are connected in series or parallel.

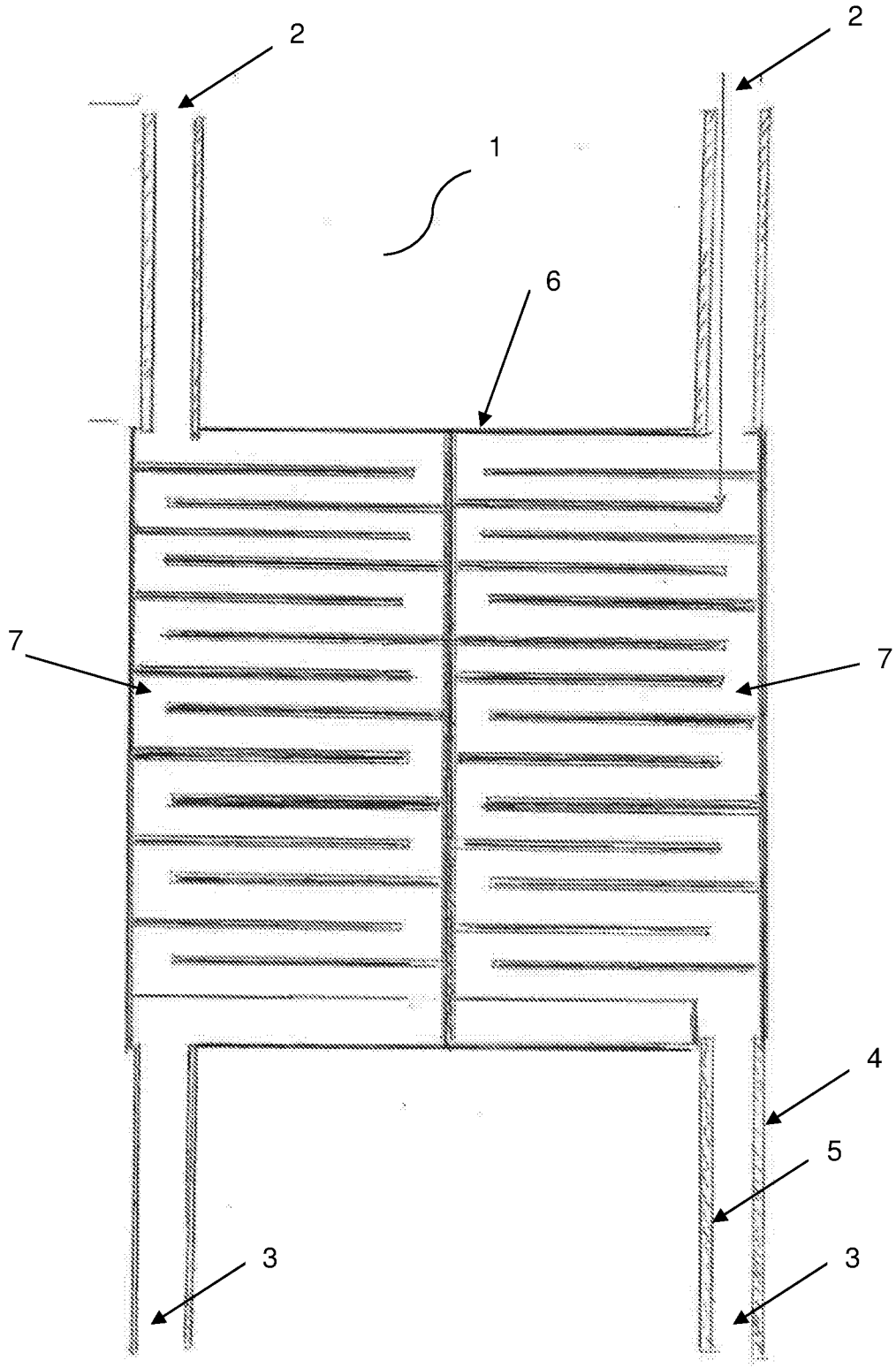


Figure 1

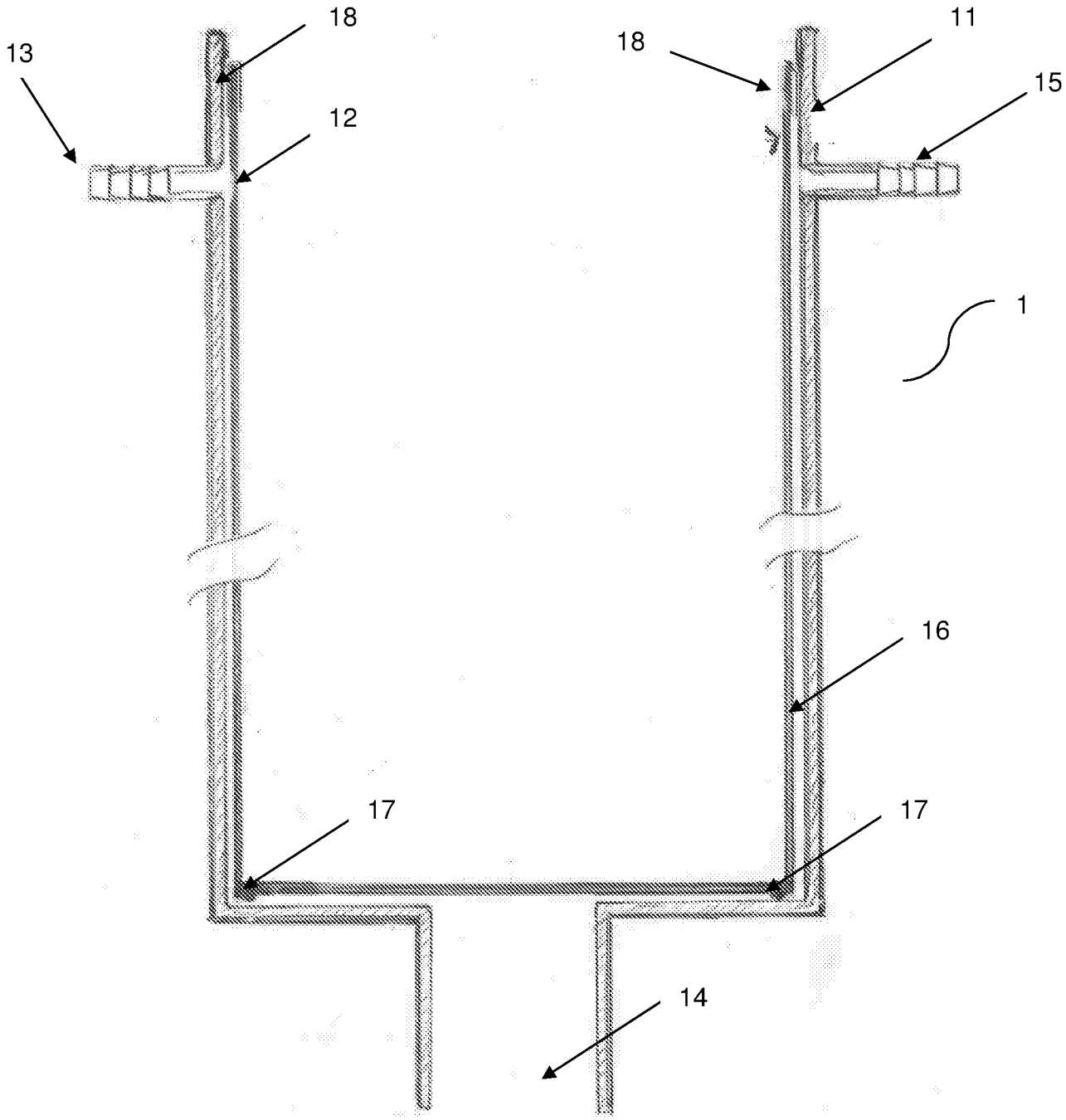


Figure 2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2016/050334

A. CLASSIFICATION OF SUBJECT MATTER

IPC: see extra sheet

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: A23L, A61L, C02F

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

SE, DK, FI, NO classes as above

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

EPO-Internal, PAJ, WPI data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 20130078702 A1 (DHANASEKHARAN MUTHUKUMAR), 28 March 2013 (2013-03-28); abstract; paragraphs [0003], [0054], [0056], [0057], [0062], [0064], [0067]; figures 1A,4-7; claims 1,2,18,24,38,44,61 --	1-12
X	WO 2007035114 A1 (LOGISTIC SOLUTIONS LTD ET AL), 29 March 2007 (2007-03-29); figure 1; claims 1,12,13,23,28,33-35,46 --	1-11
X	EP 2848264 A1 (TREFLE GROUPE), 18 March 2015 (2015-03-18); figure 8; claims 1,4,5 --	1-11

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

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
26-08-2016	26-08-2016

Name and mailing address of the ISA/SE	Authorized officer
Patent- och registreringsverket Box 5055 S-102 42 STOCKHOLM Facsimile No. + 46 8 666 02 86	Emma Dahlstedt Telephone No. + 46 8 782 28 00

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2016/050334

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 20120011874 A1 (CONRADT BERTHOLD ET AL), 19 January 2012 (2012-01-19); abstract; paragraphs [0001], [0013], [0021], [0035], [0060]; figures 1-5; claims --	1-12
X	CRAPULLI, F. et al., "Modeling virus transport and inactivation in a fluoropolymer tube UV photoreactor using Computational Fluid Dynamics", In: Chemical Engineering Journal, 2010, July, vol. 161, no. 1-2, pp. 9-18, ISSN 1385-8947.; abstract; page 10, column 2, paragraph [0002]; figure 3 -- --------	1-11

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2016/050334

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

See supplemental Box No. III.

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.: 1-12

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

International application No.
PCT/SE2016/050334

Continuation of: Box No. III

The following separate inventions were identified:

1: Claims 1-12 are directed to a device, the use of said device, a system comprising at least two devices and a method for hygienisation of a fluid. The device for hygienisation of fluids is characterised in that it comprises a container, wherein the material of said container comprise a UV transparent polymer material, wherein said container comprises an inlet and an outlet. Said hygienisation device is arranged to contain a flow of fluid to be sanitised wherein the device comprise at least one radiation source.

2: Claims 13-24 are directed to a device, the use of said device, a system comprising at least two devices and a method for hygienisation of a fluid. The device for hygienisation of fluids is characterised in that it comprises an outer container and a removable arranged inner container, wherein the material of said container comprise a UV transparent material approved for being in contact with materials to be consumed by humans or animals, wherein said container comprises an inlet and an outlet, and a connection for applying vacuum. Said hygienisation device is arranged for batch or semi batch flow of a fluid to be sanitised.

International application No.
PCT/SE2016/050334

Continuation of: second sheet

International Patent Classification (IPC)

A23L 3/28 (2006.01)
A61L 2/10 (2006.01)
C02F 1/32 (2006.01)

US	20130078702	A1	28/03/2013	AU	2011265099	A1	20/12/2012
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				CA	2801774	A1	15/12/2011
				CN	103068408	A	24/04/2013
				EP	2575901	A1	10/04/2013
				JP	2013534816	A	09/09/2013
				JP	5769802	B2	26/08/2015
				KR	20130041074	A	24/04/2013
				KR	101481394	B1	12/01/2015
				MX	2012014206	A	05/03/2013
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				SG	185747	A1	28/12/2012
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				EP	1937319	A4	15/02/2012
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				ZA	200803032	B	25/02/2009
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				RU	2507159	C2	20/02/2014
				TW	201004874	A	01/02/2010
				US	8614425	B2	24/12/2013
				WO	2010004028	A1	14/01/2010