

(19) **DANMARK**



Patent- og
Varemærkestyrelsen

(12)

Oversættelse af europæisk patentskrift

(10) **DK/EP 2545005 T3**

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- (51) Int.Cl.: **C 02 F 1/52 (2006.01)** **C 02 F 1/68 (2006.01)** **C 02 F 1/76 (2006.01)**
C 02 F 9/00 (2006.01)
- (45) Oversættelsen bekendtgjort den: **2017-01-23**
- (80) Dato for Den Europæiske Patentmyndigheds bekendtgørelse om meddelelse af patentet: **2016-10-05**
- (86) Europæisk ansøgning nr.: **11712981.7**
- (86) Europæisk indleveringsdag: **2011-03-10**
- (87) Den europæiske ansøgnings publiceringsdag: **2013-01-16**
- (86) International ansøgning nr.: **FR2011050482**
- (87) Internationalt publikationsnr.: **WO2011110787**
- (30) Prioritet: **2010-03-10 FR 1051721**
- (84) Designerede stater: **AL AT BE BG CH CY CZ DE DK EE ES FI GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR**
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- (54) Benævnelse: **Komprimeret tolagsprodukt i fast form til vandrensning**
- (56) Fremdragne publikationer:
WO-A2-2008/040884

Description

[0001] The present invention concerns a compacted solid product for purifying water in the form of at least two layers.

5 [0002] The water treatment with a view to purifying it and/or making it potable is the object of many researches and is a primordial subject for the humanity.

[0003] In parallel with the development of wastewater treatment plants and large-scale installations for the water treatment of the large agglomerations, in particular in the industrialized countries, it is also sought to develop simple means of
10 efficient and fast treatment of a predetermined volume of water with the aim, for example, of making potable water coming from a natural water hole, such as a well or a pond, in places of the world that cannot benefit, for reasons of difficult access or for economic reasons, from industrial water treatment installations. These waters can, for example, come from rivers or be drawn from the ground.

15 [0004] The purification of any water, in particular with a view to making it potable, implies several treatments and in particular a clarification step, intended to separate the organic matters capable of being in suspension in the water, and a disinfection step, intended to kill the bacteria present in the water. The clarification is generally achieved by flocculation and/or coagulation, then sedimentation and
20 filtration of the organic substances. The disinfection is generally achieved by releasing bactericidal active chlorine. The water purification is accordingly generally achieved in two successive steps, a first clarification step followed by a second disinfection step.

[0005] Moreover, for practical reasons of handling and storage, and taking
25 account of the desired use, it is also sought to have a water purification means in the form of a solid composition, such as, for example, a pellet or tablet, preferably pre-dosed, which can be simply thrown in the predetermined volume of water to be purified, without the need to implement means more complex than a simple one-time agitation.

30 [0006] Solid compositions for clarifying and disinfecting water are already known.

[0007] The documents WO2006/016073 and WO2008/040884 describe compositions in the form of tablets for purifying a predetermined volume of water, comprising inter alia a flocculating agent and a disinfectant releasing active chlorine.

35 [0008] However, it has been observed that water is all the more difficult to efficiently clarify as it is initially a little turbid. But a very good prior clarification is essential to obtain an effective disinfection. Indeed, as seen above, the disinfection is generally achieved by releasing active biocidal chlorine intended to kill the bacteria

possibly present in the water once the latter is clarified. If the prior clarification step is not almost total at the moment when the action of the active biocidal chlorine begins, said active biocidal chlorine can be brought to chlorinate organic matter remaining in suspension due to the failure of the prior clarification step. Such a phenomenon may be doubly damaging to a good purification of the water to be treated: not only the chlorination of the organic matter remaining in suspension in the water generates chlorinated by-products harmful to the human health but such a chlorination, by the undesired consumption of active chlorine to the organic matters in suspension diverts a non-negligible quantity of active chlorine initially available for a biocidal action, and the disinfection step is thus not optimal.

[0009] In order to compensate the negative effect of such a phenomenon on the disinfection step, a solution is to increase the rate of initial active biocidal chlorine. However, for both ecological and economic reasons, it is not desirable to increase the consumption of biocidal active chlorine.

[00010] Thus, it would be interesting to have a water purification means which consumes a little disinfectant while being as effective as the already known purification means, even in the case where the water to be treated is initially a little turbid.

[00011] Thus, there is a need for a simple composition to be handled, stored and used, which would allow clarifying a predetermined volume of any water in a particularly effective way, even in the case where the initial water to be treated is not highly turbid, with the aim of being able to disinfect this water by bactericidal action, in particular to make it potable, without the need to consume large quantities of disinfectant.

[00012] The present invention aims to remedy this problem by proposing a single solid composition having good cohesion, in particular in the form of a pellet or a tablet, capable of effectively clarifying any water, even if it is a little turbid, then disinfecting it without overconsumption of disinfectant.

[00013] In particular, the Applicant discovered that by introducing a specific densifying agent and a particular polyol in a water purification product, it was possible to obtain a solid product having a good cohesion making the handling of this product easy, this solid product being capable of carrying out the clarification step of any water, and in particular of an initially little muddy or little turbid water, in a particularly efficient way and therefore optimizing the subsequent disinfection of this water.

[00014] A first object of the invention is a compacted solid water purification product comprising:

- at least one first layer comprising at least one flocculating system, and

- at least one second layer comprising at least one disinfectant releasing active chlorine in contact with water,
characterized in that:

said flocculating system comprises at least one polyol with a molecular weight
5 lower than or equal to 10000 g/mol and at least one densifying agent comprising a composition of water-insoluble matter particles and chemically inactive vis-a-vis the active chlorine and having a grain size such that 80% of the mass of the densifying agent consists of particles of average size ranging from 5 µm to 80 µm.

[00015] According to the present application, « chemically inactive vis-a-vis
10 the active chlorine » means that the particles of the densifying agent are inert vis-a-vis the active chlorine and are not capable of chemically reacting with the active chlorine.

[00016] The product according to the invention has a good cohesion and allows effectively clarifying and disinfecting any water, regardless of the source and
15 the state thereof, and in particular regardless of the initial turbidity state thereof. Thus, the water of a pond or well, even if initially a little turbid, can be purified and made suitable for consumption with the product according to the invention.

[00017] The turbidity of water generally refers to the content of this water in matters that disturb it. The turbidity is measured by nephelometry and expressed in
20 NTU (nephelometric turbidity unit). The turbidity of a water can vary from a value close to zero (for very clear water and therefore very little turbid) to values greater than 600 NTU for natural waters, for example coming from rivers or ponds. In general, we will speak about low turbidity for a turbidity lower than or equal to 40 NTU and high turbidity for a turbidity greater than or equal to 100 NTU. The
25 maximum limit of the turbidity of the water intended to the human consumption recommended by the WHO (World Health Organization) is 5 NTU.

[00018] The product according to the invention allows making a water potable, for example water coming from a river or a pond, having an initial turbidity greater than the maximum limit of 5 NTU recommended by the WHO: in particular, the
30 product according to the invention allows making such a water potable, regardless of the initial value of the turbidity of the water, in particular even if this initial turbidity is for example lower than 40 NTU.

[00019] Thanks to the specific arrangement and to the respective particular compositions of the two layers thereof, the product according to the invention is easy
35 to handle and allows releasing firstly, the flocculating system, which precipitates the mineral and organic substances in suspension, then, secondly, while the flocs formed by the precipitation of the organic substances and of the flocculating system have

been settled, the disinfecting agent for a biocidal action targeted on the pathogenic germs present in the water.

[0020] In particular, thanks to the particular composition of the first layer, flocs resulting from the precipitation of the mineral and organic substances in suspension have the possibility to be formed, even if the initial turbidity state of the water to be treated is low, that is to say, for example, is lower than 40 NTU. These flocs then rapidly decant and this is before the disinfecting agent has released a substantial quantity of active chlorine in view of the disinfecting step.

[0021] In particular, the specific composition of the first layer of the product according to the invention, and in particular of the flocculating system, allows obtaining large-sized flocs with high density, even if the water to be treated initially included a little organic matter in suspension, so that after decantation, the flocs agglomerate and form a bed at the bottom of the vessel which is not easily redispersed upon drawing off the clarified water.

[0022] Thus, the active chlorine is released in perfectly clarified water and its bactericidal action is not hampered by the undesirable presence of organic matters which are highly chlorine-consuming.

[0023] The product according to the invention is ecological and economical: it does not consume more disinfectant than necessary. Due to its solid form, it is simple and practical to use, store and handle.

[0024] Thanks to the product according to the invention, a filtration of the water is not necessary.

[0025] The product according to the invention is a compacted solid product comprising at least two layers.

[0026] The first layer of the product according to the invention comprises at least one flocculating system.

[0027] According to the present application, « flocculating system » means a system whose compound(s) will react with the mineral and organic substances in suspension present in the water to be purified by causing the precipitation thereof in the form of flocs, that is to say solids of apparent density equal to or greater than 1.010 g/cm^3 , which will, after decantation, deposit and be sedimented at the bottom of the volume of water to be purified. The flocculating system thus allows clarifying the water to be treated.

[0028] The flocculating system of the product according to the invention comprises at least one polyol with a molecular weight lower than or equal to 10000 g/mol and at least one densifying agent comprising a composition of water-insoluble matter particles chemically inactive vis-a-vis the active chlorine and having a grain

size such that 80% of the mass of the densifying agent consists of particles of average size ranging from 5 μm to 80 μm .

[0029] The Applicant has found that the combination in the flocculating system of a polyol with a molecular weight lower than or equal to 10000 g/mol and of a densifying agent having such a grain size promotes the formation of important flocks which can reach sizes of about 2 to 4 mm from initially a little voluminous organic matters in suspension, for example, a size of about 1 mm. The presence of a densifying agent having such a grain size allows increasing the speed of sedimentation of these flocs in the water, accordingly allowing the rapid and effective decantation thereof and the optimal clarification of the water to be treated.

[0030] In one embodiment, the average statistical distribution of the grain size of the particles of the densifying agent satisfies the following mass percentages of residue on sieve:

D10 $\rightarrow$ 80 μm ,

D50 $\rightarrow$ 30 μm , and

D90 $\rightarrow$ 5 μm ,

in other words, 10% of the mass of the densifying agent consists of particles having sizes greater than 80 μm , 50% of the mass of the densifying agent consists of particles having sizes greater than 30 μm and 90% of the mass of the densifying agent consists of particles having sizes greater than 5 μm .

[0031] The particles of the densifying agent can be selected among any water-insoluble particles and chemically inert vis-à-vis the active chlorine. For example, the densifying agent is selected from the hydrated natural aluminosilicates, such as the kaolin, or calcined, the alkaline aluminosilicates, such as the sodium or potassium feldspar, clays, calcium metasilicates, such as wollastonite, silicas, such as the sand, quartz, grinded or not, grinded natural calcium carbonates, hydrated magnesium silicates, such as talc, and mixtures thereof.

[0032] Preferably, the densifying agent is micronized silica sand. Micronized silica sand which is particularly suitable for the product according to the invention is the grinded quartz sold by the company Sibelco France under the trade name « MILLISIL[®] E10 » and whose grain size satisfies the following conditions: the following mass percentages of residue on sieve:

D10 $\rightarrow$ 80 μm ,

D50 $\rightarrow$ 30 μm , and

D90 $\rightarrow$ 5 μm ,

[0033] The flocculating system of the product according to the invention also comprises a polyol with a molecular weight lower than or equal to 10 000 g/mol, preferably lower than or equal to 5 000 g/mol, more preferably lower than or equal to

3 500 g/mol. Within the meaning of the present application, « polyol » means an organic chemical compound comprising at least two hydroxyl groups (-OH). The polyol present in the flocculating system of the product according to the invention is preferably not ionized, particularly in an aqueous medium. The polyol present in the
5 flocculating system of the product according to the invention is preferably a polyol, for example in the form of powder, comprising at least five carbon atoms, preferably at least six carbon atoms and at least two hydroxyl groups (-OH). In one embodiment of the invention, the polyol is selected from sorbitol, mannitol, maltodextrin, xylitol and mixtures thereof. The xylitol is a polyol of formula $C_5H_{12}O_5$ and having a molecular
10 weight of about 152 g/mol. In one embodiment of the invention, the polyol is selected from sorbitol, mannitol, maltodextrin and mixtures thereof. For example, the polyol is the maltodextrin. The maltodextrin is a polysaccharide of formula $C_{6n}H_{(10n+2)}O_{(5n+1)}$ with n ranging from 2 to 20, and therefore having a molecular weight ranging from about 342 to about 3, 258 g/mol. Alternatively, the polyol is mannitol. Alternatively,
15 the polyol is sorbitol. Mannitol and Sorbitol are polyols of formula $C_6H_{14}O_6$ and having a molecular weight of about 182 g/mol. In one embodiment, the polyol present in the flocculating system of the product according to the invention has a molecular weight lower than or equal to 200 g/mol.

[0034] Preferably, the densifying agent is present in the first layer at a content
20 ranging from 15 to 30% by weight, preferably from 20 to 25% by weight, based on the total weight of the first layer.

[0035] Preferably, the polyol is present in the first layer at a content ranging from 15 to 35% by weight, preferably from 20 to 30% by weight, based on the weight of the densifying agent.

25 [0036] Preferably, the flocculating system further comprises at least one trivalent metal salt. The flocculating system can also comprise a sodium alginate.

[0037] Indeed, the combination of a trivalent metal salt, which is a coagulant, and a sodium alginate, which is a flocculant, with the densifying agent and the polyol with a molecular weight lower than or equal to 10 000 g/mol described hereinabove,
30 allows a good flocculation and a better aggregation of the flocs formed by precipitation.

[0038] Particularly, such a combination causes, even in an initially a little turbid water, for example having an initial turbidity lower than or equal to 40 NTU, a consequent growth of the formed flocs and therefore an accelerated decantation of
35 these flocs. Such a combination thus allows accelerating the speed of decantation of the flocs and producing a quasi-non-turbid supernatant water, regardless of the initial turbidity thereof.

[0039] Preferably, the polyvalent inorganic salt is a trivalent metal salt selected from ferric sulfate, aluminum sulfate, aluminum polyhydroxychlorine and mixtures thereof. More preferably, the trivalent metal salt is the hydrated ferric sulphate. These compounds are well known and commercially available.

5 [0040] Preferably, the hydrated ferric sulphate is present in the volume of water to be treated at a content ranging from 8 to 15 ppm expressed as Fe.

[0041] A sodium alginate which is particularly suitable for the present invention is the product sold under the trade name « PROTANAL[®] LF200 alginate » by the company FMC BioPolymer.

10 [0042] Preferably, the sodium alginate is present in said first layer at a content ranging from 0.1 to 10% by weight, more preferably ranging from 3 to 6% by weight, based on the weight of said first layer. Preferably, the sodium alginate content in the water to be treated ranges from 5 to 10 ppm.

[0043] The first layer may also comprise at least one water-soluble cationic
15 polymer.

[0044] Preferably, the water-soluble cationic polymer is a water-soluble cationic polymer of diallyldimethylammonium chloride, preferably of very high molecular weight, for example of molecular weight greater than or equal to 500 000 D. A compound which is particularly suitable for the present invention is the
20 diallyldimethylammonium chloride polymer sold in the form of powder under the trade name « FLOBEADS[®] DW 45 PWG » by the company SNF.

[0045] Preferably, the cationic polymer is present in the volume of water to be treated at a content ranging from 1 to 3 ppm.

[0046] Preferably, the first layer further comprises a disintegrating system.
25 According the present invention, « disintegrating system» means a system whose compound(s) will immediately react in contact with water to lead to the rapid disintegration, preferably in less than one minute, more preferably in less than 30 seconds, of the first layer.

[0047] Preferably, the disintegrating system comprises at least one
30 disintegrating agent selected from cellulose and its derivatives, the effervescent combinations of a water-soluble organic polyacid and a weak base, and mixtures thereof.

[0048] In one embodiment of the invention, the disintegrating agent is a cellulose, for example amorphous or crystalline. An example of amorphous cellulose
35 suitable for the present invention is the product sold under the trade name « ARBOCEL[®] A300 » by the company J.Rettenmaier & Söhne. An example of microcrystalline cellulose suitable for the present invention is the product sold under the trade name « VIVAPUR[®] 200 » by the company J.Rettenmaier & Söhne.

[0049] In another embodiment of the invention, the disintegrating agent is formed from the effervescent combination of a weak base, and the trivalent metal salt described hereinabove. Preferably, the weak base is the sodium bicarbonate.

5 [0050] Preferably, the disintegrating agent is present in the first layer at a content lower than or equal to 50% by weight, preferably at a content ranging from 20% to 40% by weight, based on the weight of the first layer.

[0051] The combination of a flocculating system and a disintegrating system as defined hereinabove in the first layer of the product according to the invention allows rapidly diffusing the coagulants and flocculants in the water to be treated, due
10 to the immediate disintegration, preferably in less than one minute, and more preferably in less than thirty seconds, of this first layer in contact with the water. Thus, the clarification of the water can occur without delay. The sedimentation of the precipitated matters is performed in a few minutes and leads to obtain a water having a very low turbidity.

15 [0052] The first layer of the product according to the invention can also comprise a high molecular weight anionic polymer. In one embodiment of the invention, said high molecular weight anionic polymer has a molecular weight greater than or equal to 5 000 000 D, and preferably greater than or equal to 10 000 000 D.

20 [0053] Preferably, said high molecular weight anionic polymer is present in said first layer at a content ranging from 0.01 to 0.4% by weight based on the weight of said first layer.

[0054] Preferably, said high molecular weight anionic polymer is a water-soluble sodium acrylate copolymer. Water-soluble sodium acrylate copolymers which are particularly suitable for the present invention are the products sold under the
25 trade name « FLOPAM® AN 934 » by the company SNF.

[0055] Preferably, the content of sodium acrylate copolymers in the water to be treated ranges from 0.1 to 0.5 ppm.

30 [0056] In one embodiment of the invention, the first layer comprises a desiccant, such as, for example, magnesium trisilicate. Such a desiccant facilitates the pelletizing of the product according to the invention during its manufacture, in the presence of a high relative humidity of the atmosphere surrounding the pelletizer. Preferably, the magnesium trisilicate is present in the first layer at a content lower than or equal to 3% by weight, more preferably lower than or equal to 1% by weight, based on the weight of the first layer.

35 [0057] The second layer of the product according to the invention comprises at least one disinfectant releasing active chlorine in contact with water.

[0058] Preferably, the second layer further comprises at least one excipient of the disinfectant, said excipient releasing the disinfectant in the water at a controlled

rate such that the excipient-disinfectant combination releases from 0.1 to 6 mg/l of active chlorine per hour.

[0059] Thus, thanks to the product according to the invention, the release of active chlorine is controlled, regardless of the speed of intrinsic dissolution of the disinfectant in the water. Thus, any disinfectant can be used thereby resulting in simplicity of manufacture of the product.

[0060] The disinfectant releasing the active chlorine can be any derivative of known chlorine in order to release active chlorine, regardless of the speed of intrinsic dissolution of this derivative in the water. Preferably, the disinfectant is selected from the sodium salt of N-chloro-4-methylbenzene sulfonamide in the anhydrous or dihydrate form, the sodium salt of 1, 3-dichloro-s-triazine-2, 4, 6-trione in anhydrous or dihydrate form, and mixtures thereof. More preferably, the disinfectant is the sodium salt of 1, 3-dichloro-s-triazine-2, 4, 6-trione in the dihydrate form. Such a compound is well known and is commercially available from the company OXYCHEM.

[0061] within the meaning of the present application, « excipient » means one or more compounds distinct from the disinfectant and serving as a vehicle for this disinfectant, which are more chemically inert vis-a-vis the disinfectant, that is to say which do not react with it, both when the product of the invention is in stored form and when used in the water to be purified.

[0062] Preferably, the excipient of the second layer of the product according to the invention releases the disinfectant in the water at a controlled rate such that the excipient-disinfectant combination releases from 0.1 to 6 mg/l of active chlorine per hour, preferably at a rate ranging from 0.2 to 4 mg /l of active chlorine per hour. Thus, the diffusion of the disinfectant in the water to be treated is progressive and controlled and does not interfere with the clarification step.

[0063] In one embodiment, the excipient is selected from the water-swelling partially hydrophilic compounds. Thus, preferably, the excipient is selected from modified starches, pre-gelatinized starches, potato flour, and mixtures thereof. An example of a pre-gelatinized starch which is particularly suitable for the present invention is the product sold under the trade name « LYCATAB® PGS » by the company Roquette.

[0064] The progressive release of the disinfectant in the water to be treated is achieved by the diffusion of the water within the soaked excipient associated with a progressive disintegration of the excipient releasing the biocidal active chlorine in the water.

[0065] Thus, thanks to the presence of the excipient which controls the release of the disinfectant in the second layer, and due to the fact that this second layer is

distinct from the first layer, the disinfectant is not driven with the coagulating and flocculating agents of the first layer which very rapidly diffuse in the water, in particular thanks to the disintegrating system. The disinfectant is therefore not prematurely consumed by the substances in suspension before said substances in suspension are precipitated and sedimented at the bottom of the volume of water to be treated.

[0066] The second layer of the product according to the invention preferably keeps its integrity during the first phase of the treatment, that is to say during the clarification, which generally lasts less than one minute, or even less than thirty seconds. The second layer can then perform its disinfecting function by progressive and continuous release, in a few minutes or a few hours according to the temperature of the water, of the disinfectant which will be able to act on the pathogenic microorganisms capable of being present in the water to be treated, without interfering with the flocs formed during the first phase, concentrated at the bottom of the volume to be treated.

[0067] Preferably, the second layer comprises an effervescent system. Indeed, an effervescent system facilitates and controls the diffusion of the water, resulting in releasing active chlorine.

[0068] Preferably, the effervescent system comprises a mixture of a weak base, such as sodium bicarbonate, and of a water-soluble organic polyacid, preferably selected from citric acid, malic acid, tartaric acid, malonic acid, fumaric acid, maleic acid, adipic acid, succinic acid and mixtures thereof.

[0069] Preferably, the effervescent system is present in the second layer at a content lower than or equal to 40% by weight, preferably at a content ranging from 10% to 30% by weight, based on the weight of the second layer.

[0070] In one preferred embodiment of the invention, the density of the second layer immersed in the water is strictly lower than 1 g/cm^3 , and preferably ranges from 0.85 to 0.95 g/cm^3 . Thus, at the end of the first phase, when the first layer is totally disintegrated, the second layer rises and floats. It is therefore totally remote from the flocs formed during the first phase and the progressive and continuous release of the disinfectant can be achieved in the best conditions and without excessive and unnecessary consumption of disinfecting agent.

[0071] The product according to the invention can comprise additional compounds such as colorants, perfumes, etc...

[0072] Preferably, all the compounds constituting the product according to the invention are of food grade compounds, that is to say can be ingested by Humans without harm to their health.

[0073] The product according to the invention can have any possible geometric shape. In one embodiment of the invention, the product is in the form of a pellet or a tablet and the two layers are adjacent.

5 [0074] In another embodiment of the invention, in the form of a pill or a pebble, the first layer coating the second layer which forms a core.

[0075] Another object of the invention is a method for preparing a compacted solid product for purifying water comprising at least one first layer and at least one second layer, characterized in that it comprises the following steps:

- 10 - a°) preparing a first pulverulent mixture comprising at least one flocculating system comprising at least one densifying agent as described hereinabove and at least one polyol with a molecular weight lower than or equal to 10000 g/mol,
- b°) preparing a second pulverulent mixture comprising at least one disinfectant releasing active chlorine in contact with water,
- 15 - c°) precompacting the mixture obtained in b°) in a pelletizer,
- d°) adding the mixture obtained in a°) to the pelletizer and compacting the whole in order to obtain a bilayer product.

[0076] The product according to the invention is preferably prepared by direct compression using a pelletizer.

20 [0077] Preferably, the first pulverulent mixture further comprises at least one desiccant, for example magnesium trisilicate. Such a desiccant facilitates the compacting of step d°) of the method for manufacturing the product according to the invention, in the presence of a high relative humidity of the atmosphere surrounding the pelletizer.

25 [0078] In another embodiment, the product according to the invention can comprise, besides the first and second layers, one or more additional layers, such as, for example, an intermediate layer separating the first layer and the second layer or even an external layer.

30 [0079] The degree of compaction of the first layer and that of the second layer are adjusted according to the respective dissolution rates desired for each of these layers within the water to be treated.

35 [0080] The present invention also relates to a method for purifying a volume of water comprising at least the step of introducing in said volume of water a product as described hereinabove. Once the product is introduced in the volume of water, said volume of water can be stirred, for example manually, for five minutes. It is then possible to stop the stirring and the volume of water settled for a few minutes, for example from 1 to 100 minutes. It is therefore possible to eliminate the flocs which have settled and a volume of purified water is therefore obtained.

[0081] Thus, in general, the turbidity of water at 20°C during treatment with the product according to the invention rapidly decreases and can be lower than 5 NTU in less than 15 minutes: such a treatment can lead to obtaining a water having a final turbidity lower than 2 NTU after 45 minutes.

5 [0082] The present invention will now be illustrated using the following examples.

EXAMPLES

10 [0083] The meaning of the terms used in the following examples is given hereinafter:

- Heptahydrate ferric sulphate: in the form of powder, sold by the company Dr. Lohmann.

- FLOBEADS[®] DW 45 PWG: water-soluble cationic polymer of
15 diallyldimethylammonium chloride in the form of powder, with a molecular weight close to 500 000 D, sold by the company SNF.

- DCCNa, 2H₂O: sodium salt of 1, 3-dichloro-s-triazine-2, 4, 6-trione in the form of dihydrate, also called sodium dichloroisocyanurate in the form of dihydrate, in the form of powder.

- 20 - LYCATAB[®] PGS: gelatinized starch, in the form of powder, sold by the company Roquette.

- VIVAPUR[®] 200: microcrystalline cellulose in the form of powder sold by the company J.Rettenmaier & Söhne.

- FLOPAM[®] AN 934 PWG: anionic sodium acrylate copolymer with a
25 molecular weight close to 15 000 000 D, sold by the company SNF.

- MANUGEL[®] GMB: sodium alginate, with a viscosity ranging from 200 to 400 mPa.s at 1% in aqueous solution, in the form of powder, sold by the company ISP.

- MILLISIL[®] E10: grinded quartz sold by the company Sibelco France and
30 whose particles satisfy the following grain size:

the following mass percentages of residue on sieve (Please confirm or correct or specify):

35 D10 :> 80 µm,
D50 :> 30 µm, and
D90 :> 5 µm,

- MACROSORB® MS33 F: magnesium trisilicate in the form of powder, sold by the company INEOS Silicas.

- NEOSORB: sorbitol (molecular weight 182 g/mol) in the form of powder, sold by the company Roquette.

5 - Mannitol: with molecular weight of 182 g/mol, in the form of powder, sold by the company Roquette.

- LYCATAB® DSH: maltodextrin (molecular weight ranging from about 342 to about 3258 g/mol) in the form of powder, sold by the company Roquette.

10 EXAMPLE 1 (according to the invention):

[0084] There are 200 liters of river water with a turbidity of 20 NTU, in a container.

15 [0085] The pH of the water to be treated is close to 7.5 and its temperature is 15°C.

[0086] With a view to treating this volume of 200 liters of slightly turbid water, a bilayer pellet of 44.1 g is prepared, the first layer ensuring the clarification being called the layer A and weighing 33.6 g, the second layer ensuring the disinfection of the water to be treated being called the layer B and weighing 10.5 g. The diameter of the pellet is 45 mm. The pellet is prepared by direct compression. The composition of the layers is given hereinafter:

Composition of layer A	q in layer A
Heptahydrate ferric sulphate	9
FLOBEADS® DW 45 PWG	0.4
VIVAPUR® 200	7.0
Sodium bicarbonate	6.0
FLOPAM® AN 934	0.1
MILLISIL® E10	8
LYCATAB® DSH	1.5
Sodium alginate	1.3
MACROSORB® MS33 F	0.3

25 [0087] In this layer A, the densifying agent (MILLISIL® E10) represents 23.8% by weight of the layer weight, and the polyol with a molecular weight lower than or equal to 10 000 g/mol (LYCATAB® DSH) represents 18.7% of the weight of the densifying agent.

Composition of layer B	g. in layer B
LYCATAB® PGS	6.0
Adipic acid	1.4
Sodium bicarbonate	2.1
DCCNa, 2H ₂ O	1.0

[0088] The obtained pellet, in particular its layer A, is very cohesive. It does not present any risk of crumbling and its handling is not a problem.

[0089] When introduced in the water, under manual stirring for three minutes, the pellet falls to the bottom of the vessel and the layer A of the pellet is disintegrated by effervescence in about thirty seconds.

[0090] The flocs are very rapidly formed, in a few minutes. The stirring is stopped and the matters in suspension are left to settle. The decantation of the flocs is effective in twenty minutes. Very few flocs remain on the surface.

[0091] The portion of the remaining pellet (layer B) rises to the surface, floats and remains on the surface. By progressively disintegrating, it releases the active chlorine in 90 minutes at 15°C.

[0092] The final active chlorine rate measured in the settled and brewed water is 0.7 mg/l measured ninety minutes after the stop of the stirring. The final turbidity is 1.5 NTU. The rate of dosed Fe is 0.2 mg/l.

[0093] Thus, despite the initial relatively low turbidity of the water to be treated, the clarification step was carried out efficiently and the purification of the water could be optimally carried out, shown by the results of Fe dosed in the treated water.

EXAMPLE 2 (Comparative)

[0094] There are 200 liters of water identical to that implemented in Example 1, and having the same turbidity, namely 20 NTU, in a tank.

[0095] The pH of the water to be treated is close to 7.5 and its temperature is 15°C.

[0096] With a view to treating this volume of 200 liters of slightly turbid water, a bilayer pellet comprising the same layer B as the pellet of Example 1, but whose layer A is free of polyol with a molecular weight lower than or equal to 10000 g/mol and of densifying agent, is prepared. Thus, the layer A ensuring the clarification of the pellet of the present example has the following composition:

Composition of layer A	g in layer A
Heptahydrate ferric sulphate	9

FLOBEADS® DW 45 PWG	0.4
VIVAPUR® 200	7.0
Sodium bicarbonate	6.0
FLOPAM® AN 934	0.1
Sodium alginate	1.3
MACROSORB® MS33 F	0.3

[0097] The layer B of the pellet of the present example has the same composition and the same weight as that of Example 1. The diameter of the pellet is 45 mm. The pellet is prepared by direct compression as in Example 1.

5 [0098] When introduced in the water, under manual stirring for three minutes, the pellet falls to the bottom of the vessel and the layer A of the pellet is disintegrated by effervescence in about thirty seconds.

[0099] Flocs are rapidly formed in a few minutes.

[0100] The stirring is stopped and the matters in suspension are left to settle.
10 The decantation of a portion of the flocs is effective in about 20 minutes: However, there remain fine particles of floc on the surface and in the volume of water, very slowly sedimenting. The portion of the remaining pellet (layer B) rises to the surface, floats and remains on the surface. By progressively disintegrating, it accordingly releases the active chlorine in 90 minutes at 15°C.

15 [0101] The active chlorine rate measured in the water, after transferring without roiling the settled solids deposited at the bottom of the vessel and then brewing the recovered water, is 0.5 mg/l ninety minutes after the stop of the stirring.

[0102] Thus, a portion of the active chlorine has been consumed by the flocs remaining on the surface after the clarification step.

20 [0103] The final turbidity of the settled water is 7 NTU, which is greater than the recommendation of the WHO (lower than or equal to 5 NTU) and much greater than the turbidity of 1.5 NTU obtained with the pellet according to the invention of Example 1. The rate of dosed Fe is 0.3 mg/l. Flocs remain on the surface.

25 EXAMPLE 3 (Comparative)

[0104] There are 200 liters of river water with a turbidity of 20 NTU, identical to that implemented in Example 1, in a tank.

[0105] The pH of the water to be treated is close to 7.5 and its temperature is
30 15°C.

[0106] With a view to treating this volume of 200 liters of lowly turbid water, a bilayer pellet of 44.1 g is prepared comprising the same layer B as the pellet of

Example 1, but whose layer A is free of polyol with a molecular weight lower than or equal to 10 000 g/mol. Thus, the layer A ensuring the clarification of the pellet of the present example has the following composition:

Composition of layer A	q in layer A
Heptahydrate ferric sulphate	9
FLOBEADS® DW 45 PWG	0.4
VIVAPUR® 200	7.0
Sodium bicarbonate	6.0
FLOPAM® AN 934	0.1
MILLISIL® E10	8
Sodium alginate	1.3
MACROSORB® MS33 F	0.3

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[0107] The layer B of the pellet of the present example has the same composition and the same weight as that of Example 1. The diameter of the pellet is 45 mm. The pellet is prepared by direct compression as in Example 1. The obtained layer A of the pellet is particularly friable: The obtained pellet is difficult to transport and to handle.

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EXAMPLE 4 (according to the invention):

[0108] There are 200 liters of water coming from the same water as in Example 1, in a container.

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[0109] A bilayer pellet similar to that of the pellet of Example 1, but whose composition of the layer A is modified by replacement of maltodextrin with sorbitol, is prepared. Thus, the composition of the layer A of the pellet of the present example is as follows:

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Composition of layer A	q in layer A
Heptahydrate ferric sulphate	9
FLOBEADS® DW 45 PWG	0.4
VIVAPUR® 200	7.0
Sodium bicarbonate	6.0
FLOPAM® AN 934	0.1
MILLISIL® E10	8
Sorbitol	1.7
Sodium alginate	1.3

MACROSORB [®] MS33 F	0.3
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[0110] In this layer A, the densifying agent (MILLISIL[®] E10) represents 23.7% by weight of the layer weight, and the polyol with a molecular weight lower than or equal to 10 000 g/mol (sorbitol) represents 21.2% of the weight of the densifying agent.

[0111] The layer B of the pellet of the present example has the same composition and the same weight as that of Example 1. The diameter of the pellet is 45 mm. The pellet is prepared by direct compression as in Example 1.

[0112] The pellet, in particular the layer A has a good cohesion and has no tendency to crumble.

[0113] The same protocol as in Example 1 is repeated. The flocs are formed in two minutes.

[0114] The decantation of the flocs is effective in 15 minutes and the final active chlorine rate measured in the settled and brewed water is 0.8 mg/l measured after 30 minutes. No floc remains on the surface. The final turbidity is 1.2 NTU. The rate of dosed residual Fe is 0.15 mg/l.

EXAMPLE 5 (according to the invention):

[0115] This example illustrates the invention in a case where the turbidity of the water to be treated is relatively high. Thus, there are 200 liters of water with a turbidity of 550 NTU, in a container. The temperature of the water is about +12°C.

[0116] The composition of the bilayer pellet and the procedure followed for the treatment of the water are the same as those described in Example 1.

[0117] The pellet is introduced into the container of water to be treated.

[0118] The decantation of the flocs is effective in 25 minutes and the final active chlorine rate measured in the settled and brewed water is 0.6 mg/l measured after 100 minutes. The final turbidity is 1.5 NTU. The rate of dosed residual Fe is 0.15 mg/l.

EXAMPLE 6 (according to the invention)

[0119] There are 200 liters of water coming from the same water as in Example 1 and having the same turbidity, namely 20 NTU, in a container.

[0120] A bilayer pellet similar to the pellet of Example 1 whose composition of the layer A is modified by replacement of maltodextrin with mannitol, is prepared.

Thus, the composition of the layer A of the pellet of the present example is as follows:

Composition of layer A	q in layer A
Heptahydrate ferric sulphate	9
FLOBEADS® DW 45 PWG	0.4
VIVAPUR® 200	7.0
Sodium bicarbonate	6.0
FLOPAM® AN 934	0.1
MILLISIL® E10	8
Mannitol	1.7
Sodium alginate	1.3
MACROSORB® MS33 F	0.3

5 [0121] In this layer A, the densifying agent (MILLISIL® E10) represents 23.7% by weight of the layer weight, and the polyol with a molecular weight lower than or equal to 10 000 g/mol (mannitol) represents 21.2% of the weight of the densifying agent.

10 [0122] The layer B of the pellet of the present example has the same composition and the same weight as that of Example 1. The diameter of the pellet is 45 mm. The pellet is prepared by direct compression as in Example 1.

[0123] As in Example 1, the pellet, in particular the layer A, has a very good cohesion and has no tendency to crumble.

15 [0124] The same protocol as in Example 1 is repeated. The flocs are formed in two minutes.

[0125] The decantation of the flocs is effective in 15 minutes and the final active chlorine rate measured in the settled and brewed water is 0.7 mg/l measured after 30 minutes. No floc remains on the surface. The final turbidity is 1.4 NTU. The rate of dosed residual Fe is 0.20 mg/l.

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EXAMPLE 7 (according to the invention)

[0126] There are 200 liters of water coming from the same water as in Example 1, in a container.

25 [0127] A bilayer pellet similar to the pellet of Example 1, whose composition of the layer A is modified in that the respective concentrations of the densifying agent and maltodextrin are increased, is prepared. Thus, the composition of the layer A of the pellet of the present example is as follows:

Composition of layer A	q in layer A
Heptahydrate ferric sulphate	9
FLOBEADS® DW 45 PWG	0.4
VIVAPUR® 200	7.0
Sodium bicarbonate	6.0
FLOPAM® AN 934	0.1
MILLISIL® E10	10
LYCATAB® DSH	2.5
Sodium alginate	1.3
MACROSORB® MS33 F	0.3

[0128] In this layer A, the densifying agent (MILLISIL® E10) represents 27.3% by weight of the layer weight, and the polyol with a molecular weight lower than or equal to 10 000 g/mol (LYCATAB® DSH) represents 25% of the weight of the densifying agent.

[0129] The layer B of the pellet of the present example has the same composition and the same weight as that of Example 1. The diameter of the pellet is 45 mm. The pellet is prepared by direct compression as in Example 1.

[0130] As in Example 1, the pellet, in particular the layer A, has a good cohesion and has no tendency to crumble.

[0131] The same protocol as in Example 1 is repeated. The flocs are formed in two minutes.

[0132] The decantation of the flocs is effective in 15 minutes and the final active chlorine rate measured in the settled and brewed water is 0.7 mg/l measured after 30 minutes. No floc remains on the surface. The final turbidity is 1.1 NTU. The rate of dosed residual Fe is 0.20 mg/l.

EXAMPLE 8 (according to the invention)

[0133] There are 200 liters of water coming from the same water as in Example 1, in a container.

[0134] A bilayer pellet similar to the pellet of Example 7 whose composition of the layer A is modified by replacement of maltodextrin with sorbitol is prepared. Thus, the composition of the layer A of the pellet of the present example is as follows:

Composition of layer A	q in layer A
Heptahydrate ferric sulphate	9

FLOBEADS® DW 45 PWG	0.4
VIVAPUR® 200	7.0
Sodium bicarbonate	6.0
FLOPAM® AN 934	0.1
MILLISIL® E10	10
Sorbitol	2.9
Sodium alginate	1.3
MACROSORB® MS33 F	0.3

[0135] In this layer A, the densifying agent (MILLISIL® E10) represents 27% by weight of the layer weight, and the polyol with a molecular weight lower than or equal to 10 000 g/mol (sorbitol) represents 29% of the weight of the densifying agent.

5 [0136] The layer B of the pellet of the present example has the same composition and the same weight as that of Example 1. The diameter of the pellet is 45 mm. The pellet is prepared by direct compression as in Example 1. The pellet, in particular the layer A, has a good cohesion and has no tendency to crumble.

10 [0137] The same protocol as in Example 1 is repeated. The flocs are formed in two minutes.

[0138] The decantation of the flocs is effective in 15 minutes and the final active chlorine rate measured in the settled and brewed water is 0.6 mg/l measured after 30 minutes. No floc remains on the surface. The final turbidity is 1.2 NTU. The rate of dosed residual Fe is 0.20 mg/l.

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PATENTKRAV

1. Komprimeret produkt i fast form til vandrensning omfattende:

- mindst et første lag omfattende mindst et flokkuleringssystem, og

5 - mindst et andet lag omfattende mindst et desinfektionsmiddel til frigivelse af aktivt klor ved kontakt med vandet,

kendetegnet ved, at

nævnte flokkuleringssystem omfatter mindst en polyol med molekylvægt mindre end eller lig med 10.000 g/mol og mindst en komprimeringsagent omfattende en
10 sammensætning af partikler, der er uopløselige i vand og kemisk inaktive over for aktivt klor, og som udviser en partikelstørrelse, således at 80% af komprimeringsagentens masse består af partikler af gennemsnitsstørrelsen fra 5 µm til 80 µm.

15 2. Produkt ifølge krav 1, **kendetegnet ved, at** komprimeringsagenten vælges blandt hydratiserede, som kaolin, eller kalcinerede naturlige aluminiumsilikater, alkaliske aluminiumsilikater, som natronfeldspat eller kalinatronfeldspat, ler, kalciummetasilikater, som wollastonit, silikater, som sand, kvarts, malet eller ej, maledede naturlige calciumcarbonater, hydraterede magnesiumsilikater, som talkum,
20 og deres blandinger.

3. Produkt ifølge et hvilket som helst af de foregående krav, **kendetegnet ved, at** polyolen har en molekylvægt mindre end eller lig med 5.000 g/mol, fortrinsvis mindre end eller lig med 3.500 g/mol.

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4. Produkt ifølge et hvilket som helst af de foregående krav, **kendetegnet ved, at** polyolen er en polyol omfattende mindst fem kulstofatomer, fortrinsvis mindst seks kulstofatomer, og mindst to hydroxylgrupper (-OH).

30 5. Produkt ifølge det foregående krav, **kendetegnet ved, at** polyolen vælges blandt sorbitol, mannitol, maltodekstrin, xylitol og deres blandinger.

6. Produkt ifølge krav 4, **kendetegnet ved, at** polyolen vælges blandt sorbitol, mannitol, maltodekstrin og deres blandinger.

7. Produkt ifølge et hvilket som helst af de foregående krav, **kendetegnet ved, at** komprimeringsagenten er til stede i det første lag i et indhold fra 15-30 vægtprocent, fortrinsvis fra 20-25 vægtprocent, i forhold til det første lags totalvægt.

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8. Produkt ifølge et hvilket som helst af de foregående krav, **kendetegnet ved, at** polyolen er til stede i det første lag i et indhold fra 15-35 vægtprocent, fortrinsvis fra 20-30 vægtprocent, i forhold til komprimeringsagentens vægt.

10 9. Produkt ifølge et hvilket som helst af de foregående krav, **kendetegnet ved, at** flokkuleringssystemet derudover omfatter mindst en trivalent metalsalt.

10. Produkt ifølge et hvilket som helst af de foregående krav, **kendetegnet ved, at** flokkuleringssystemet derudover omfatter et natriumalginat.

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11. Produkt ifølge et hvilket som helst af de foregående krav, **kendetegnet ved, at** nævnte første lag derudover omfatter et opløsningssystem omfattende mindst et opløsningsstof udvalgt blandt cellulose og dens derivater, brusende forbindelser af en vandopløselig organisk flerbasiske syre og en svag base og deres blandinger.

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12. Produkt ifølge et hvilket som helst af de foregående krav, **kendetegnet ved, at** det andet lag derudover omfatter mindst et hjælpestof til desinfektionsmidlet, hvilket hjælpestof frigiver desinfektionsmidlet i vandet i en kontrolleret rate, således at forbindelse hjælpestof-desinfektionsmiddel frigiver 0,1-6 mg/l aktivt klor pr. time, fortrinsvis fra 0,2 til 4 mg/l aktivt klor pr. time.

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13. Produkt ifølge et hvilket som helst af de foregående krav, **kendetegnet ved, at** desinfektionsmidlet vælges blandt natriumsalt af N-klor-4-metylbenzensulfonamid i vandfri eller dihydrat-form, natriumsalt af 1,3-dichlor-x-triazin-2,4,6 trion i vandfri eller dihydrat-form, og deres blandinger, fortrinsvis er desinfektionsmidlet natriumsalt af 1,3-dichlor-s-triazin-2,4,6 trion i dihydratform.

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14. Produkt ifølge et hvilket som helst af de foregående krav, **kendetegnet ved, at** densiteten af det andet lag nedsænket i vand er nøjagtigt under 1 g/cm³, og fortrinsvis mellem 0,85-0,95 g/cm³.
- 5 15. Fremgangsmåde til rensning af en vandmængde med en begyndelsesuklarhed under 40 NTU omfattende mindst det trin at tilføre et produkt ifølge et hvilket som helst af kravene 1-14 i nævnte vandmængde.