(19) NL Octrooicentrum

(11) **1039051**

(12)C **OCTROOI**

(21) Aanvraagnummer: **1039051**

(22) Aanvraag ingediend: **19.09.2011**

(51) Int.Cl.:
C02F 1/00 (2006.01) ***C02F 1/36*** (2006.01)

(43) Aanvraag gepubliceerd:
-

(47) Octrooi verleend:
21.03.2013

(45) Octrooischrift uitgegeven:
27.03.2013

(73) Octrooihouder(s):
Stichting Wetsus Centre of Excellence for Sustainable Water Technology te Leeuwarden.

(72) Uitvinder(s):
Hendrik Jannis Cappon te Kapelle.
Karel Jacob Keesman te Bennekom.
Mateo Jozef Jacques Mayer te Amersfoort.

(74) Gemachtigde:
Ir. A.A.G. Land c.s. te DEN HAAG.

(54) **Filter and filtration method for purifying and/or sampling a liquid.**

(57) The present invention relates to a device and method for purifying and / or sampling a liquid comprising at least one first cilindrical er rectangular fluid channel with a fluid inlet and a fluid outlet, at least a second and preferably also a third fluid side channel both connected to the first cilindrical or rectangular fluid channel, at least one and preferably two acoustic wave generating means that are connected to the second and third fluid side channels respectively and that are capable to produce wave interference in at least the first cilindrical or rectangular fluid channel, control means for controlling the wave generating means capable to achieve a structure with the generated waves such that at least two node lines or node regions are formed in the first cilindrical or rectangular fluid channel whereby a significant angle of at least 5 degrees exists between at least two node lines and the axial direction of the first cilindrical or rectangular fluid channel. With the device and method according to the present invention, t is possible to remove particles from a fluid in a channel and /or to concentrate particles in a fluid channel using acoustic wave generating means, without the need of placing internals or other rigid constructions in the fluid channel. As a result, both a particle concentrate and a purified fluid are obtained. Analysis of the particle concentrate or purified fluid instead of the original sample, will improve the performance and sensitivity of a sensor system in series with the concentration and purification method considerably.

NL C 1039051

Filter and filtration method for purifiying and / or sampling a liquid

The present invention relates to a device and method for purifying and / or sampling a liquid comprising at least one first cilindrical or rectangular fluid channel with a fluid inlet and a fluid outlet, at least a second and preferably also a third fluid side channel both connected to the first cilindrical or rectangular fluid channel, at least one and preferably two acoustic wave generating means that are connected to the second and third fluid side channels respectively and that are capable to produce wave interference in at least the first cilindrical or rectangular fluid channel, control means for controlling the wave generating means capable to achieve a structure with the generated waves such that at least two node lines or node regions are formed in the first cilindrical or rectangular fluid channel whereby a significant angle of at least 5 degrees exists between at least two node lines and the axial direction of the first cilindrical or rectangular fluid channel. With the device and method according to the present invention, it is possible to remove particles from a fluid in a channel and / or to concentrate particles in a fluid channel using acoustic wave generating means, without the need of placing internals or other rigid constructions in the fluid channel. As a result, both a particle concentrate and a purified fluid are obtained. Analysis of the particle concentrate or purified fluid instead of the original sample, will improve the performance and sensitivity of a sensor system in series with the concentration and purification method considerably.

Introduction

In the chemical process industry and the water purification industry, online sensoring methods to detect and analyze particles such as inorganic salts, aggregated humic acids and micro-organisms are vital to ensure product quality or safety of water produced. One of the major challenges in the development of low cost – low maintenance online particle sensors with a low detection limit is the realization of a simple, accurate and reliable device for the concentration of particles. Prior art devices such as 0.2 micron pore size bacterium filters and microfiltration filters require offline sample preparation and / or regular maintenance to achieve both the required sample concentration and reliability of the sampling procedure. Additionally, a sample concentration step with prior art devices results in a change of the particle shape, morphology or even in the number of particles due to particle aggregation, particle dissociation or, in case of bacteria or other living organisms, in the killing and or disappearance of particles.

The technology according to the present invention provides a method and device for a low cost – low maintenance sample concentration device that can be used to concentrate fluids containing particles or particle aggregates without changing the properties of these particles.

Description of the technology according to the present invention

According to a first aspect, the present invention relates to at least one first cilindrical or rectangular fluid channel with a fluid inlet and a fluid outlet. This first cilindrical or rectangular fluid channel is preferably equipped with at least an inlet and an outlet to enable a continuous fluid flow through the channel.

According to a second aspect, the present invention relates to at least a second and preferable also a third fluid side channel, both connected to the first cilindrical or rectangular fluid channel. Preferably, at least one fluid side channel is connected to acoustic wave generating means. More preferably two fluid side channels are connected to acoustic wave generating means. Most preferably more than two fluid side channels are connected to acoustic wave generating means.

According to a third aspect, the present invention relates to control means for controlling the acoustic wave generating means of at least a second cilindrical fluid side channel. Preferably more than one cilindrical fluid side channels are equipped with controlling means for controlling the acoustic wave generating means. Most preferably, the controlling means for controlling the acoustic wave generating means are controlled by the use of at least a microprocessor and software.

According to a fourth aspect, the present invention relates to at least one sensor for sensing properties of the fluid present in the first cilindrical or rectangular fluid channel. Preferably the sensing principle of at least one sensor for sensing the fluid properties in the first cilindrical or rectangular channel is based upon at least one of the following sensing techniques: acoustic measurements, light scattering measurements, light reflection measurements, conductivity measurements, pH measurements, temperature measurements. In case temperature measurements are applied, these measurements preferably comprise temperature measurements using infrared technology and / or PTCs and / or NTCs and / or Pt100 sensing elements preferably placed in the fluid of the first cilindrical or rectangular fluid channel and / or connected to the inner wall and / or outer wall of the first cilindrical or rectangular fluid channel.

The signal(s) produced by the sensor(s) for sensing the fluid properties are preferably fed to a microprocessor, preferably to a microcontroller, preferably by the use of an analog to digital converter.

According to a fifth aspect, the present invention relates to software for controlling the acoustic wave generating means. Preferably the software contains a feed back loop from the sensor to the acoustic wave generating means.

According to a sixth aspect, the present invention relates to software for controlling the acoustic wave generating means in such a manner that wave interference occurs so that node lines are produced in the first cilindrical or rectangular fluid channel. In these node

lines particles will collect, resulting in a fluid filter and / or a particle concentration device. Preferably, a significant angle of at least 5 degrees exists between at least two node lines and the axial direction of the first cilindrical or rectangular fluid channel repectively.

According to a seventh aspect, the present invention relates to an automated filter system comprising one or more of aspects 1 to 6 and software to filter particles from a fluid that is present in and / or pumped through the first cilindrical or rectangular channel in such a way that these particles collect in the node lines generated in the first cilindrical or rectangular channel. Additionally and preferably, the particles collected in the node lines are released by switching off the acoustic sound wave generating means so that they can be analyzed and / or fed into a sensor. Additionally and even more preferably, the sensor and the first cilindrical or rectangular fluid channel are designed such that the sensor can detect the particles when they are immobilized in the node lines. In this particular case, the sensor signal changes as a function of time as long as particles are filtered from the fluid. The course of the changes in the signal (amplitude) as a function of time contains valuable information on for example the number, the shape and other physical properties of the particles such as dielectric permittivity or specific density. By the use of software, the filter can be flushed online by switching off the acoustic sound generating means as soon as the desired data have been collected and / or a steady state in the filtration process has been achieved.

Figure 1 gives a schematic overview of the technology according to the present invention. It is noted that figure 1 is one of the many possible embodiments of the technology according to the present invention and the present invention is by no means limited to figure 1.

The arrows 1 and 2 in figure 1 show the flow direction of the fluid. C1 relates to the first cilindrical or rectangular fluid channel. It is noted that the cilindrical or rectangular shape of the first fluid channel is a preferred embodiment. It is stressed that a large number of other geometrical shapes of the first fluid channel are technically feasible and part of the technology according to the present invention. Fluid channels C2 and C3 relate to the second and third fluid side channel respectively. A1 and A2 relate to the first and second acoustic sound generating means respectively. The angle β relates to the angle between the first cilindrical or rectangular fluid side channel and the second fluid side channel. According to the present invention, this angle is at least 5 degrees. It is noted that the angles between the different fluid side channels and the first cilindrical or rectangular fluid channel may be different. It is also noted that the location at which each fluid side channel is connected to the first cilindrical or rectangular fluid channel is a design parameter. Further, it is noted that other shapes of the fluid side channels than cilindrical or rectangular are possible.

Now the basics aspects of the technology according to the present invention have been

explained, a number of preferred embodiments will be discussed.

A first preferred embodiment of the present invention comprises application of the technology according to the present invention as a filtration system for drinking water. In this embodiment, drinking water is filtered using a system according to one or more previously specified aspects 1 to 7. The filtered water is subsequently fed into a sensor for analyzing the water. In this way, fouling and or clogging of the water sensor is prevented. Regularly, the filtration system according to the present invention is automatically cleaned. One of the many examples of sensoring systems that are feasible for application in combination with the technology according to the present invention are sensors comprising filters such as RO membranes and nanofiltration membranes e.g., for measuring the osmotic pressure of a fluid and gas and / or liquid chromatography sensors.

A second preferred embodiment of the present invention comprises application of the technology according to the present invention as a preconcentration system for drinking water. In this particular case, the technology according to the present invention is applied again as a filter i.e., similarly as described in the first preferred embodiment. However, in this particular case, the particles that are filtered from the drinking water are further analyzed. One of the many examples of sensoring systems that are feasible for application in combination with the technology according to the present invention are sensors for detecting and / or analyzing bacteria, particles and particle size distributions.

A third preferred embodiment comprises application of the technology according to the present invention in combination with a so-called coax sensor. In this particular case the sensor is applied as a preconcentration system and sensor at the same time. An example of a coax sensor is an open ended quarter wave length coaxial stub. Such a sensor can be applied as line flow through sensor with fluid inlet and fluid outlet. Depending of the dielectric properties of the fluid pumped through the coaxial stub, the resonant frequency and quality factor of the filter will change. By equipping the coaxial stub with fluid side channels and acoustic wave generating means according to the present invention, a coax sensor with integrated particle concentration system is obtained. In fact, the coaxial stub is in this case applied as first cilindrical or rectangular fluid channel according to the present invention. It is noted that the particle concentrator can be switched off easily by switching off the acoustic sound generating means. In this way, the concentrator is flushed. Preferably, the diameter of the side channels, connected to the first cilindrical or rectangular fluid channel according to the present invention, is sufficiently small to avoid undesired interaction of the side channel with the electromagnetic waves fed to the coaxial stub.

A fourth preferred embodiment of the present invention comprises application of the technology according to the present invention as preconcentrator and filter at the same time: after filtering a fluid to be analyzed, both the concentrated particle suspension and the

filtered fluid are fed into one or more sensors in order to determine the fluid properties and the properties of the particles separately.

A fifth preferred embodiment of the present invention comprises application of the technology according to the present invention with a first cilindrical or rectangular channel that is equipped with internals i.e., geometrical structures, in order to optimize the filtration effectiveness of the node lines inside of the first cilindrical or rectangular channel.

A sixth preferred embodiment of the present invention comprises application of the technology according to the present invention for analyzing other types of fluids than drinking water e.g., waste water, process water from chemical industry, fruit juices, milk, mineral oil products.

The frequency of the acoustic waves applied in the technology according to the present invention is in the range of 100 Hz to 1 GHz. Preferably ultrasound is applied. More preferably ultrasound in the frequency range between 20 kHz and 100 MHz is applied.

Finally, it is noted that the technology according to the present invention brings along following advantages as compared to prior art particle filtration and / or concentration methods:

1. Absence or at least strong reduction of fouling of the filter or particle concentration device
2. Absence of pressure drop during the filtration / particle concentration process
3. Concentration / filtration without destruction of fragile particles and / or fragile aggregates of particles mainly because of the absence of a filter cake
4. Simpler cleaning procedure of the particle concentrator / filter through switching off the acoustic wave generating means
5. Well defined immobilization of the particles at well defined node lines or node regions bringing along possibilities for inline analysis of particles
6. Possibilities to concentrate particles inside of a sensor e.g., a coax sensor thereby opening possibilities to combine particle concentration and analysis.
7. Absence of internals in the filter / concentrator or at least possibilities for a very low volume fraction of internals in the filter concentrator

Additionally, it is noted that the technology according to the present invention will result in a lattice of volume elements containing high particle concentrations (node lines and / or node regions) and volume elements containing low particle concentrations. This contrary to "small cilindrical plates (thin discs)" perpendicular to the axial direction of the first channel, containing a high concentration of particles.

This lattice of volume elements containing a high concentration of particles results in a better filter performance as compared to the situation that thin discs are present as nodes in the first cilindrical channel for at least 2 reasons:

1. Not all particles have to pass the node region. Therefor, there will be less steric hindrance of the particles, resulting in a higher concentration factor in the node regions.
2. In the lattice of node regions, not all nodes will have the same properties, opening possibilities to capture particles of different size within one and the same device.

Also, it is noted that an increase of the number of fluid side channels equipped with acoustic sound generating means is equivalent to applying a lower number of fluid side channels equipped with acoustic sound generating means at a higher acoustic wave frequency. Hence, a design parameter is obtained to realize a good filter performance at any desired frequency of the acoustic waves. This may be important since some particles (e.g., bacteria) or particle aggregates are destroyed at their resonant frequency. From this reasoning, it is concluded that, if desired, the technology according to the present invention can be designed such that the particles are destroyed. Also, it can be ensured that no particles are destroyed in the first cilindrical or rectangular fluid channel.

Finally it is noted that the lattice of node regions results in a much better distribution of the particles over the fluid volume in the first cilindrical or rectangular fluid channel. This may be an important advantage above prior art technology in case the first cilindrical or rectangular fluid channel is used as a sensor at the same time. A non limiting example of such advantage is the application of a first cilindrical or rectangular fluid channel as a particle concentrator and coax sensor at the same time. In this particular case, homegeneously distributed particles over the fluid within the first cilindrical fluid channel will result in an effective dielectric permittivity of the particle suspension that hardly changes as a function of the length coordinate of the first cilindrical or rectangular fluid channel. As a result, the properties and / or volume fraction of particles within the coax sensor can be determined from the resonant frequency of the coaxial stub.

Based upon these advantages above prior art, a person skilled in the art of particle concentration / filtration will recognize that the technology according to the present invention is very feasible for realizing reliable and fully automated particle concentration / filtration solutions in a wide variety of applications.

The present invention is not limited to the above described example embodiments thereof; the rights sought are defined by the following claims, within the scope of which many modifications can be envisaged.

Clauses

1. Device for purifying and / or sampling a liquid through particle filtration and / or particle concentration comprising
   - at least one first fluid channel with a fluid inlet and a fluid outlet
   - at least a second fluid side channel connected to the first cilindrical or rectangular fluid channel whereby the angle between the first fluid channel and at least one fluid side channel is more than 5 degrees.
   - acoustic wave generating means connected to at least the second fluid side channel, the acoustic wave generating means being capable to produce wave interference in at least the first fluid channel
   - control means for controlling the wave generating means capable to achieve a structure with the generated waves such that at least two node lines or node regions are formed in the first fluid channel as a result of wave interference whereby a significant angle of at least 5 degrees exists between at least two node lines or node regions and the axial direction of the first cilindrical or rectangular fluid channel, resulting in particle being trapped in and / or near the node lines or node regions.
2. Device according to clause 1 further comprising at least a microprocessor and software to control the acoustic wave generating means thereby steering the particle concentration and / or filtration process.
3. Device according to clauses 1 or 2 further comprising at least one sensor for sensing the fluid properties of the first cilindrical or rectangular fluid channel and a control loop to tune the acoustic sound generating means in order to achieve a desired particle filtration and / or concentration performance.
4. Fully automated filter or particle concentrator according to one of the previous clauses 1-3.
5. Sensor comprising a device according to clauses 1-4 whereby the particles immobilized in the node lines within the first cilindrical or rectangular fluid channel are analyzed in situ.
6. Sensor according to clause 5 whereby the first cilindrical or rectangular fluid channel performs as a coaxial stub i.e., a resonator for electromagnetic waves, at the same time.
7. Sensor for analysis of drinking water according to one of the previous clauses 1-6.
8. Sensor for analysis of waste water according to one of the previous clauses 1-6.
9. Sensor for detection and / or analysis of bacteria according to one of the previous clauses 1-8.
10. Method for purifying and / or sampling a liquid through particle filtration and / or

particle concentration characterized by a device described by one of the previous clauses 1-9.

Conclusies

1. Inrichting voor de zuivering en / of bemonstering van een vloeistof door middel van deeltjesfiltratie en / of deeltjesconcentratie gekenmerkt door
   - tenminste een eerste vloeistofkanaal met een instroomopening voor vloeistof en een uitstroomopening voor vloeistof
   - tenminste een tweede vloeistof zijkanaal dat werkzaam verbonden is met het eerste cilindrisch vloeistofkanaal en waarvan de axiale as een hoek van tenminste 5 graden maakt met de axiale as van het eerste vloeistofkanaal.
   - tenminste een inrichting voor het opwekken van acoustische golven die werkzaam verbonden is met het tweede vloeistof zijkanaal en die interferentie van de acoustische golven opwekt in tenminste het eerste cilindrisch vloeistofkanaal
   - middelen om de inrichtingen voor het opwekken van acoustische golven te regelen opdat tenminste twee knooplijnen of knoopgebieden worden gevormd in het eerste cilindrische vloeistofkanaal ten gevolge van interferentie met het kenmerk dat een significante hoek van tenminste 5 graden bestaat tussen tenminste twee knooplijnen of knoopgebieden en de axiale as van het eerste cilindrische vloeistofkanaal opdat deeltjes in en / of nabij de knooplijnen worden ingevangen.
2. Inrichting volgens conclusie 1 vermeerderd met tenminste een microprocessor en software om de inrichtingen voor het opwekken van acoustische golven te regelen en daarmee het filtratie- en / of concentratieproces van de deeltjes te sturen.
3. Inrichting volgens een van de voorgaande conclusies 1 of 2 vermeerderd met tenminste een sensor om de eigenschappen van de vloeistof in het eerste cilindrische vloeistofkanaal te meten en een control loop om de inrichtingen voor het opwekken van acoustische golven zodanig in te stellen dat het filtratieproces en / of het deeltjesconcentratieproces op de gewenste wijze verloopt.
4. Volledig geautomatiseerd filter of volledig geautomatiseerde deeltjesconcentrator volgens een van de voorgaande conclusies 1 t/m 3.
5. Sensor tenminste omvattend een inrichting volgens een van de voorgaande conclusies 1 t/m 4 waarbij de deeltjes die zijn geimmobiliseerd in de knooplijnen of knoopgebieden van het eerste cilindrisch vloeistofkanaal in situ worden geanalyseerd.
6. Sensor volgens conclusie 5 waarbij het eerste cilindrisch vloeistof kanaal tevens een coaxsensor i.e., een resonator voor elektromagnetische golven, is.
7. Sensor voor analyse van drinkwater volgens een van de voorgaande conclusies 1 t/m 6.

Conclusies

1. Inrichting voor de zuivering en / of bemonstering van een vloeistof door middel van deeltjesfiltratie en / of deeltjesconcentratie gekenmerkt door
   - tenminste een eerste vloeistofkanaal met een instroomopening voor vloeistof en een uitstroomopening voor vloeistof
   - tenminste een tweede vloeistof zijkanaal dat werkzaam verbonden is met het eerste cilindrisch vloeistofkanaal en waarvan de axiale as een hoek van tenminste 5 graden maakt met de axiale as van het eerste vloeistofkanaal.
   - tenminste een inrichting voor het opwekken van acoustische golven die werkzaam verbonden is met het tweede vloeistof zijkanaal en die interferentie van de acoustische golven opwekt in tenminste het eerste cilindrisch vloeistofkanaal
   - middelen om de inrichtingen voor het opwekken van acoustische golven te regelen opdat tenminste twee knooplijnen of knoopgebieden worden gevormd in het eerste cilindrische vloeistofkanaal ten gevolge van interferentie met het kenmerk dat een significante hoek van tenminste 5 graden bestaat tussen tenminste twee knooplijnen of knoopgebieden en de axiale as van het eerste cilindrische vloeistofkanaal opdat deeltjes in en / of nabij de knooplijnen worden ingevangen.
2. Inrichting volgens conclusie 1 vermeerderd met tenminste een microprocessor en software om de inrichtingen voor het opwekken van acoustische golven te regelen en daarmee het filtratie- en / of concentratieproces van de deeltjes te sturen.
3. Inrichting volgens een van de voorgaande conclusies 1 of 2 vermeerderd met tenminste een sensor om de eigenschappen van de vloeistof in het eerste cilindrische vloeistofkanaal te meten en een control loop om de inrichtingen voor het opwekken van acoustische golven zodanig in te stellen dat het filtratieproces en / of het deeltjesconcentratieproces op de gewenste wijze verloopt.
4. Volledig geautomatiseerd filter of volledig geautomatiseerde deeltjesconcentrator volgens een van de voorgaande conclusies 1 t/m 3.
5. Sensor tenminste omvattend een inrichting volgens een van de voorgaande conclusies 1 t/m 4 waarbij de deeltjes die zijn geimmobiliseerd in de knooplijnen of knoopgebieden van het eerste cilindrisch vloeistofkanaal in situ worden geanalyseerd.
6. Sensor volgens conclusie 5 waarbij het eerste cilindrisch vloeistof kanaal tevens een coaxsensor i.e., een resonator voor elektromagnetische golven, is.
7. Sensor voor analyse van drinkwater volgens een van de voorgaande conclusies 1 t/m 6.

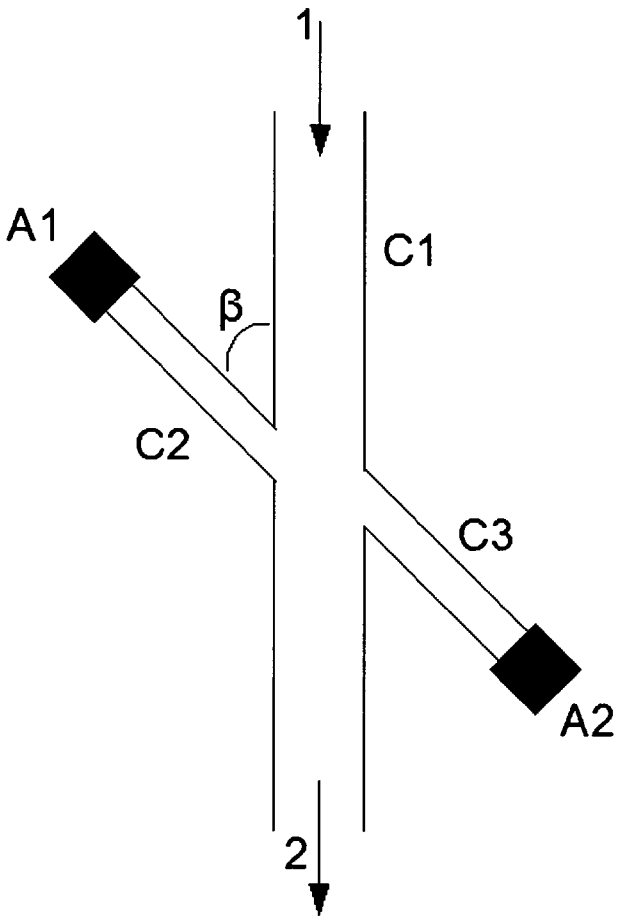

Figure 1.

SAMENWERKINGSVERDRAG (PCT)

RAPPORT BETREFFENDE NIEUWHEIDSONDERZOEK VAN INTERNATIONAAL TYPE

IDENTIFICATIE VAN DE NATIONALE AANVRAGE	KENMERK VAN DE AANVRAGER OF VAN DE GEMACHTIGDE
Nederlands aanvraag nr. **1039051**	Indieningsdatum **19-09-2011**
	Ingeroepen voorrangsdatum

Aanvrager (Naam)

Wetsus, centre of excellence for sustainable water technology

Datum van het verzoek voor een onderzoek van internationaal type	Door de Instantie voor Internationaal Onderzoek aan het verzoek voor een onderzoek van internationaal type toegekend nr.
24-12-2011	**SN 57379**

I. CLASSIFICATIE VAN HET ONDERWERP (bij toepassing van verschillende classificaties, alle classificatiesymbolen opgeven)

Volgens de internationale classificatie (IPC)

C02F1/00 **C02F1/36**

II. ONDERZOCHTE GEBIEDEN VAN DE TECHNIEK

Onderzochte minimumdocumentatie

Classificatiesysteem	Classificatiesymbolen
IPC8	**C02F**

Onderzochte andere documentatie dan de minimum documentatie, voor zover dergelijke documenten in de onderzochte gebieden zijn opgenomen

III.	☐	**GEEN ONDERZOEK MOGELIJK VOOR BEPAALDE CONCLUSIES**	(opmerkingen op aanvullingsblad)
IV.	☐	**GEBREK AAN EENHEID VAN UITVINDING**	(opmerkingen op aanvullingsblad)

ONDERZOEKSRAPPORT BETREFFENDE HET RESULTAAT VAN HET ONDERZOEK NAAR DE STAND VAN DE TECHNIEK VAN HET INTERNATIONALE TYPE

Nummer van het verzoek om een onderzoek naar de stand van de techniek
NL 1039051

A. CLASSIFICATIE VAN HET ONDERWERP
INV. C02F1/00 C02F1/36
ADD.

Volgens de Internationale Classificatie van octrooien (IPC) of zowel volgens de nationale classificatie als volgens de IPC.

B. ONDERZOCHTE GEBIEDEN VAN DE TECHNIEK

Onderzochte miminum documentatie (classificatie gevolgd door classificatiesymbolen)
C02F

Onderzochte andere documentatie dan de mimimum documentatie, voor dergelijke documenten, voor zover dergelijke documenten in de onderzochte gebieden zijn opgenomen

Tijdens het onderzoek geraadpleegde elektronische gegevensbestanden (naam van de gegevensbestanden en, waar uitvoerbaar, gebruikte trefwoorden)
EPO-Internal, COMPENDEX, WPI Data

C. VAN BELANG GEACHTE DOCUMENTEN

Categorie °	Geciteerde documenten, eventueel met aanduiding van speciaal van belang zijnde passages	Van belang voor conclusie nr.
X	US 3 672 823 A (BOUCHER RAYMOND MARCEL GUT) 27 juni 1972 (1972-06-27) * kolom 1, regel 10 - regel 25 * * kolom 7, regel 73 - kolom 8, regel 20 * * figuur 1 * -----	1-10
X	FR 2 442 218 A1 (HYCO & AULAS ETS) 20 juni 1980 (1980-06-20) * bladzijde 1, regel 1 - regel 3 * * bladzijde 2, regel 28 - bladzijde 3, regel 7 * * bladzijde 3, regel 25 - bladzijde 4, regel 39 * * figuur 1 * -----	1-10
X	EP 0 488 097 A1 (EURATOM [LU]) 3 juni 1992 (1992-06-03) * figuren 1,2 * -----	1-10

☐ Verdere documenten worden vermeld in het vervolg van vak C.

☒ Leden van dezelfde octrooifamilie zijn vermeld in een bijlage

° Speciale categorieën van aangehaalde documenten

"A" niet tot de categorie X of Y behorende literatuur die de stand van de techniek beschrijft

"D" in de octrooiaanvrage vermeld

"E" eerdere octrooi(aanvrage), gepubliceerd op of na de indieningsdatum, waarin dezelfde uitvinding wordt beschreven

"L" om andere redenen vermelde literatuur

"O" niet-schriftelijke stand van de techniek

"P" tussen de voorrangsdatum en de indieningsdatum gepubliceerde literatuur

"T" na de indieningsdatum of de voorrangsdatum gepubliceerde literatuur die niet bezwarend is voor de octrooiaanvrage, maar wordt vermeld ter verheldering van de theorie of het principe dat ten grondslag ligt aan de uitvinding

"X" de conclusie wordt als niet nieuw of niet inventief beschouwd ten opzichte van deze literatuur

"Y" de conclusie wordt als niet inventief beschouwd ten opzichte van de combinatie van deze literatuur met andere geciteerde literatuur van dezelfde categorie, waarbij de combinatie voor de vakman voor de hand liggend wordt geacht

"&" lid van dezelfde octrooifamilie of overeenkomstige octrooipublicatie

Datum waarop het onderzoek naar de stand van de techniek van internationaal type werd voltooid	Verzenddatum van het rapport van het onderzoek naar de stand van de techniek van internationaal type
26 april 2012	

Naam en adres van de instantie	De bevoegde ambtenaar
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Janssens, Christophe

Formulier PCT/ISA/201 (tweede blad) (Januari 2004)

ONDERZOEKSRAPPORT BETREFFENDE HET RESULTAAT VAN HET ONDERZOEK NAAR DE STAND VAN DE TECHNIEK VAN HET INTERNATIONALE TYPE

Informatie over leden van dezelfde octrooifamilie

Nummer van het verzoek om een onderzoek naar de stand van de techniek
NL 1039051

In het rapport genoemd octrooigeschrift	Datum van publicatie	Overeenkomend(e) geschrift(en)	Datum van publicatie
US 3672823	A 27-06-1972	CA 930924 A1	31-07-1973
		US 3672823 A	27-06-1972
FR 2442218	A1 20-06-1980	GEEN	
EP 0488097	A1 03-06-1992	CA 2097070 A1	28-05-1992
		DE 59102932 D1	20-10-1994
		EP 0488097 A1	03-06-1992
		IE 913839 A1	03-06-1992
		JP H06509406 A	20-10-1994
		LU 87850 A1	25-08-1992
		PT 99614 A	31-01-1994
		WO 9209354 A1	11-06-1992

Agentschap NL
Ministerie van Economische Zaken,
Landbouw en Innovatie

WRITTEN OPINION

File No.	Filing date *(day/month/year)*	Priority date *(day/month/year)*	Application No.
SN57379	19.09.2011		NL1039051

International Patent Classification (IPC)
INV. C02F1/00 C02F1/36

Applicant
Wetsus, centre of excellence for sustainable water technology

This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the application
- ☒ Box No. VIII Certain observations on the application

	Examiner
	Janssens, Christophe

Application number

WRITTEN OPINION

NL1039051

Box No. I Basis of this opinion

1. This opinion has been established on the basis of the latest set of claims filed before the start of the search.

2. With regard to any **nucleotide and/or amino acid sequence** disclosed in the application and necessary to the claimed invention, this opinion has been established on the basis of:

   a. type of material:

   ☐ a sequence listing

   ☐ table(s) related to the sequence listing

   b. format of material:

   ☐ on paper

   ☐ in electronic form

   c. time of filing/furnishing:

   ☐ contained in the application as filed.

   ☐ filed together with the application in electronic form.

   ☐ furnished subsequently for the purposes of search.

3. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

4. Additional comments:

Box No. V Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty	Yes:	Claims	2, 3
	No:	Claims	1, 4-10
Inventive step	Yes:	Claims	
	No:	Claims	1-10
Industrial applicability	Yes:	Claims	1-10
	No:	Claims	

2. Citations and explanations

see separate sheet

WRITTEN OPINION

Box No. VIII Certain observations on the application

see separate sheet

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1 Reference is made to the following documents:

D1 US 3 672 823 A (BOUCHER RAYMOND MARCEL GUT) 27 juni 1972 (1972-06-27)

D2 FR 2 442 218 A1 (HYCO & AULAS ETS) 20 juni 1980 (1980-06-20)

D3 EP 0 488 097 A1 (EURATOM [LU]) 3 juni 1992 (1992-06-03)

2 The present application does not meet the criteria of patentability, because the subject-matter of claim 1 is not new.

2.1 The document D1 discloses (the references below applying to this document):

A device (see in particular fig. 1) suitable for purifying a liquid through particle filtration comprising:

a) a first fluid channel (30) with a fluid inlet (32) and a fluid outlet (not shown in the picture);

b) a second fluid channel (35) connected to the first channel (30) whereby the angle between the first (30) and the second channel (35) is more than 5 degrees (see figure);

c) acoustic wave generating means (29) connected to the second channel (35) and capable of producing wave interference in the first fluid channel; and

d) control means (indeed: col.7, l.72- col.8, l.20, mentions explicitly that the light intensity and the acoustic energy level and frequency should be kept within a certain range. This can only be achieved if there is a certain control mechanism present, if not operating permanent, than at least operating at the starting (or re-starting) of the treatment)

Although the document does not mention particle filtration and or particle concentration it contains all the features of the device defined by claim 1 of the present application it should therefore also be suitable for this purpose.

2.2 A similar device is disclosed by the document D2 (see D2, fig. 1, and p.2, l. 28- p.4, l.39) and the document D3 (see figure 1, 2).

2.3 The subject-matter of the claims 1 and 5 is therefore not new in view of D1, in view of D2 and in view of D3.

3 Dependent claims 2-9 do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of novelty and/ or inventive step. The documents D1 and D2 do not disclose a microprocessor and software as controller, because they have been published at a moment that computers were not commonly used. It is common practice in the field of water treatment to replace manual and mechanical control mechanisms by computer regulated mechanisms. A person skilled in the art would not need to apply its inventive skill to come to the solution offered by the claims 2 and 3. The claims 4-9 do not meet the requirements of clarity (see item VIII below).

-

Re Item VIII

Certain observations on the application

4 The present application does not meet the requirements of clarity.

4.1 In independent claim 1, a claim specifying a device, the control means is defined by means of it function (controlling the wave generating means to achieve a structure ..., resulting in a particle being trapped in and/or near the node lines or node regions). It is not unambiguously clear from the claim or the description how the control means of this device physically differ from control means commonly used in the field. This renders the subject-matter of claim 1 unclear.

4.2 Independent claim 10 intends to define a method but does not not contain any method step. It defines a method by a device, but does not say what the device does. The intended limitation is therefore not clear from this claim.

4.3 Claim 3 mentions mentions the sensing of "the" fluid properties. The list of fluid properties is long and there no sensor capable of sensing all these properties at once. Assumed is that one of the properties is sensed.

4.4 The claim 4 does not add any features to the device but gives only the device an other name. This puzzles a reader and renders the subject-matter of claim 4 unclear.

4.5 The claims 5-9 do not specify the device further, as they do not add any apparatus features. The appear to define different uses of the device. However, if the intention is to define uses of a device, the claims should be formulated in a different way. The claims 5-9 are therefore not clear.