

Description**Field of the Invention**

5 The present invention relates to the removal of impurities from a fluid by passing the fluid through a filter bed comprised of porous biogenetic silica alone or containing additives.

Background of the Invention

10 Filtration is a well known method to separate impurities from liquids or gases. It is generally used to remove solids, but may also be used to separate compounds of various sized as in the use of molecular sieves. Systems are available that combine preferential absorption along with the physical separation of particles occurring in filtration. For example, it is well known that activated carbon may be used to extract a broad range of chemicals from liquids. Thus, when it is added to a filter media, particles of various sizes
 15 that are too large to pass through the filter media are separated and also certain materials that are absorbed by the carbon as a component of the total media are removed.

These materials are what might be called active particles in that they improve the separation through absorption or some other method. In many filtration processes, it is desirable to have these particles built into the filter medium. When used alone, most of these form density packed beds making it impossible to use them in performing continuous filtration of liquid streams. Therefore, it is desirable to have this type of material in small quantities in a dispersed state for most effective use.

Aggregates used as the principal filtering substance must have certain physical properties. These are:

1. Good porosity.
2. Pore sizes sufficient to allow the desired material to pass through yet prevent the undesirable material
 25 from passing through.
3. They should not readily compact.
4. They should not form a sticky mass like clays when wet.
5. They should be dimensionally stable at the temperature and pressure range where the filtration occurs.

30 It would be highly desirable to have an aggregate with all of the above properties. It would be further advantageous to also have a material with a small percentage of active particulates uniformly dispersed throughout the filter medium, such as activated carbon or water-swellaable polymers providing additional filtering properties that are highly useful in many filtration processes.

US 3,451,944 discloses a process for the production of rice hull ash by the controlled burning of rice
 35 hulls in an attempt to retain the natural siliceous structure in the product. The product has a carbon content within the range of from 2 to 50% and its ability as a filtration medium is improved by treatment with steam or sodium hydroxide solution to partially dissolve the siliceous skeleton which increases its carbon content.

US 4,604,205 discloses a filter medium and a filter for the removal of particulate material and water from non-aqueous liquids such as hydrocarbon fuels. The filter medium includes a porous fibrous material
 40 such as glass fibre and a water-insoluble water-absorbing starch-polyacrylonitrile copolymer.

Summary

45 The present invention is directed to a filter medium and method of filtering by which the above properties are obtained and, if desired, active particulates are uniformly dispersed throughout the filter medium. Advantageously, the filter medium can be produced by the pyrolysis or burning of rice hulls containing large amounts of silica, that is, having a minimum of 15 percent silica by weight in the dry matter and preferably 20 percent or more which leaves an ash that is high in silica (biogenetic silica) and, if desired, a small amount of carbon uniformly dispersed throughout the silica structure. If desired, the carbon
 50 can be activated providing the active particulate uniformly dispersed throughout which is highly useful in many filtration processes.

Accordingly, it is an object of the present invention to provide a filter for filtering fluid comprising a closed container having an inlet and an outlet, and biogenetic silica disposed in the closed container, wherein the inlet and the outlet are arranged to direct flow of the fluid through the biogenetic silica, wherein
 55 the biogenetic silica is rice hull ash devoid of fiber having a porous silicon skeleton in amorphous state and a porosity of approximately 75 to 80 percent by volume.

A further object of the present invention is the provision of a porous filter cartridge having inner and outer body layers of relatively coarse and fine mesh, biogenetic silica contained by the filter cartridge,

impurities in a fluid flowing through the cartridge being filtered from the fluid by the biogenetic silica, wherein the biogenetic silica is rice hull ash devoid of fiber having a porous silicon skeleton in amorphous state and a porosity of approximately 75 to 80 percent by volume.

The filter or filter cartridge of the present invention may contain up to about 2 percent by weight of a water-swellable polymer dispersed throughout the biogenetic silica. The biogenetic silica may be coated with activated carbon and may be one of pelleted and prilled.

A further object of the present invention is the provision of a method for filtering impurities from a fluid comprising flowing the fluid through the filter or filter cartridge of the present invention. The present invention may thus be used to filter water from a fluid or liquids from a gas by passage through the filter or filter cartridge of the present invention.

Brief Description of the Drawings

Figure 1 is a perspective view of a filter system.

Figure 1A is a perspective view of a filter cartridge or medium according to the invention used in the filter system of Figure 1.

Figure 2 is an elevational view, in cross section, illustrating another form of filter according to the invention.

Figure 3 is a further modification illustrating a packed filter according to the invention.

Description of Present and Preferred Embodiments

As previously mentioned, the present invention is directed to a means for and a method of filtering with a filter medium having good porosity, a pore size sufficient to allow the desired material to pass through yet prevent the undesirable material from passing through, does not readily compact, does not form a sticky mass, such as clays when wet, and is dimensionally stable at the temperature and pressure range that the filtration occurs. This is accomplished by utilizing biogenetic silica devoid of fiber having a porosity of approximately 75 to 80 percent by volume, either alone or with active particulates dispersed throughout.

To form an effective, highly porous silica structure, rice hulls are burned which contain a minimum of 15 percent silica by weight in its dry matter and preferably 20 percent or more. Rice hulls are chosen among a limited number of plants that contain these high quantities of silica. Essentially, these are the stalks and hulls of rice, equisetum (horsetail weeds), certain bamboos and palm leaves, particularly polymra, pollen, and the like, all of which when burned leave a porous ash that is highly desirable as a filtration medium.

The biogenetic silica of this invention is rice hull ash. Rice hulls are high in silica content, containing about 18 to 22 percent by weight, with the ash having a porous skeletal silica structure having approximately 75 to 80 percent open or void spaces by volume. In addition, it has been a continuing problem for the rice industry to dispose of rice hulls; and, while a number and variety of uses for rice hulls or rice hull ash have been proposed and used, large volumes of rice hulls are burned; and their ash is disposed by the rice industry as a waste material at great expense.

Biogenetic silica in amorphous state and in substantially porous form can be obtained either by burning or decomposition of the hulls.

Commercially available rice hull ash is prepared by burning rice hulls in a furnace. In the process, raw rice hulls are continually added to the top of the furnace and the ash is continuously removed from the bottom. Temperatures in the furnace range from 800° to about 1400° C, and the time factor for the ash in the furnace is about three minutes. Upon leaving the furnace, the ash is rapidly cooled to provide ease in handling. When treated by this method, silica remains in a relatively pure amorphous state rather than the crystalline forms known as tridymite or cristobalite. This transition from the amorphous to the crystalline state generally takes place when the silica is held at very high temperatures, for example 2000° C, or longer periods of time. The significance of having the silica in an amorphous state is that the silica ash maintains a porous skeletal structure rather than migrating to form crystals, and the amorphous form of silica does not cause silicosis thus reducing cautionary handling procedures. The burning of the rice hulls is time-temperature related, and burning of these hulls under other conditions can be done so long as the ash is in an amorphous state with a porous skeletal structure.

The amount of open or void spaces in the biogenetic silica ash depends on the amount of fines in the ash. The inclusion of fines is not deleterious; however, the more porous the ash the better.

Biogenetic silica devoid of fiber is fire-retardant, inert, and is dimensionally stable at low and high temperatures, thus rendering it useful at elevated temperatures without structural change.

On a commercial burning of rice hulls as an energy source, the resultant ash had the following chemical

analysis (by weight):

Silicon	92 percent
Magnesium	2.0 percent
Moisture	3.0 percent
Carbon	2.5 percent

The remaining 1/2 percent consists of minor amounts of magnesium, barium, potassium, iron, aluminum, calcium, copper, nickel, and sodium.

The carbon content was in a dispersed state throughout the material. To activate the carbon, the ash was treated with super heated steam under standard conditions. This treatment removes particles that clog the pores of the carbon thus enormously increasing the ability of the carbon to absorb gases.

If desired, of course, the rice hull ash can be burned until all of the carbon is removed. However, in many filtration processes, the presence of the carbon is highly advantageous.

Referring now to the drawings and particularly to Figures 1 and 1A, a typical filtering system is illustrated which includes a filter cartridge container 10, an inlet line 12 for flowing liquid to be filtered into the container 10, and an outlet line 14 for flowing filtered liquid out of the container 10. A conventional pressure gauge 16 is provided which measures the pressure within the container 10.

Disposed within the container 10 is a cylindrical cartridge 18, comprised of a cylinder formed of coarse mesh 20, a fine mesh outer layer 22 upon a biogenetic silica cake is disposed. While not shown, means are provided in the container 10 so that the filter cartridge 18 can be placed in the container, and the container closed except for the inlet and outlet lines 12 and 14, respectively, so that the filter cartridge 18 can be inserted into the container or body 10 for operation and can be removed, cleaned, and replaced or simply replaced.

In operation of the embodiment of Figures 1 and 1A, dirty water enters the inlet 12, flows through the cartridge 18, the biogenetic silica 22 filtering out the impurities, and the clean water is discharged out the outlet line 14 for such use as may be desired.

The following Example 1 illustrates the filter system of Figures 1 and 1A in which diatomaceous earth of a conventional system has been replaced with porous biogenetic silica for the purpose of removing trash particles in a swimming pool filter system.

Example 1

A standard swimming pool system utilizing the filter cartridge 18 having an inner core 20 of coarse fibers and an outer core 22 of fine mesh fibers which in prior systems retain an outer coating 24 of aggregates such as diatomaceous earth (DAE) was used. Biogenetic silica (rice hull ash) without additives was used in place of the DAE to form about a 12.7 mm (1/2 inch) coating 24 on the outer layer 22.

Dirty water from the pool was then pumped through the input line 12 through the filter cartridge 18 at a rate of about 30.28 dm³ (8 US gallons) per minute per filter. Pressure reading on the gauge 16 was 4.45 kg (10 pounds). The water passing through the filter system was analyzed for solid particles. All solids were removed down to about 1-2 microns in size. The irregular characteristics of the biogenetic silica and the high porosity allowed free passage of the water.

When the pressure built to 275.6 kPa (40 psig), the filter elements were back flushed and the spent biogenetic silica replaced with fresh biogenetic silica. Since the biogenetic silica does not readily stick together, there was no problem with removal of the spent biogenetic silica cake 24. The process was repeated as required by the amount of trash to be removed.

Referring now to Figure 2, there is illustrated another embodiment of the invention which comprises a container 10a having a cylindrical filter 18a, which is a typical laboratory filter, and a container 26 provided with a suction line 28 to a conventional water aspirator, not shown.

As previously mentioned, the filter 18a is a typical laboratory filter and has a filter paper 30 disposed at its bottom upon which is placed biogenetic silica ash to which is added about 1 percent of a water-swellaable polymer.

The following Example 2 illustrates the use of the filter system of Figure 2 for the removal of minor amounts of moisture in solids from trichloroethylene.

Example 2

Trichloroethylene is a fire resisting solvent used extensively in the industrial process. In this Example, the trichloroethylene contains about 1/2 percent by weight moisture and 1-1/2 percent by weight of chemical solids. The sample was light amber in color and cloudy from the moisture.

5 The trichloroethylene was poured on top of the filter 18a and sucked through it by water aspiration in the suction line 28. The resulting filtered liquid flowed by gravity into the container 26 and was clear, indicating complete removal of the moisture, and was free of solids.

Referring now to Figure 3, a simple packed tube filter containing biogenetic silica is illustrated which includes the filter cartridge container body 10b, the inlet 12b, and the outlet 14b from the container body 10a and a tube packed cartridge 18b having the tube shaped mesh 18b with the closed ends 19 disposed
10 in the body 10b and provided with the seals 21 at each end. The tube 18b is packed with the porous biogenetic silica either alone or with a suitable additive, as desired.

A description of the operation of the packed tube filter of Figure 3 is set forth in connection with the following Example 3 in which moisture and solid particles were removed from a stream of mostly methane gas produced in a commercial gas well.

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Example 3

In this Example, the in line filter 18b comprised an open tube 18b packed with porous biogenetic silica 24b containing approximately 1 percent by weight of a water soluble swellable polymer, such as in Example
20 2. The metal filter disc 19 provided at each end of the tube 18b retained the biogenetic silica having the water-swellable polymer dispersed throughout. This filter was used on a slip stream to keep moisture and trash out of gauges used to measure pressure and flow in a gas well. Gases passing through the filter were then checked for moisture and trash and none was detected.

Any water-soluble polymer and any cross-linked polymer whose linear analog is water soluble can be
25 used. Amounts up to 2 percent and more than 1 percent by weight are satisfactory. The presently preferred water-soluble polymer is a starch acrylonitrile graft copolymer. For a description of such polymers, reference is made to US-A-4,238,374.

Example 4

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In this Example, absorption and hence removal of methane and ethane gas from an air stream is illustrated.

A synthetic gas was formulated to contain approximately 1 percent methane and 1 percent ethane in air. Porous biogenetic silica containing 3.1 percent carbon by weight was obtained by burning rice hulls in
35 an air deficient atmosphere by setting the rice hulls on fire in a metal container and allowing them to burn for two days. When the rice hulls were reduced to a black ash, the container was sealed off forming a hot box, and the ash was allowed to smolder with only minor amounts of air present for one week. The resulting ash was highly porous biogenetic silica ash in amorphous state containing 3.1 percent carbon by weight. The ash was then placed in a tube and subjected to 27.2 kg (60 pounds) of steam for six hours which
40 activated the carbon. The steam was replaced with nitrogen gas and the ash allowed to cool down.

The in-line filter 18b in Figure 3 was packed with this biogenetic silica containing active carbon particles produced by the above-described process. The in-line filter contained 0.114 kg (1/4 pound) of the biogenetic silica having activated carbon as mentioned.

The synthetic gas mixture was then passed through the filter tube 10b at the rate of 16.98 m³/S (10
45 cubic feet per minute) at 23.3°C (74°F) and 68.9 kPa (10 psig). The methane and ethane levels were checked for two hours at 15 minute intervals by gas chromatography with the results as set forth in the following Table 1.

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Table 1

Time	Percent Methane	Percent Ethane
15 minutes	< 0.1	< 0.1
30 minutes	< 0.1	< 0.1
45 minutes	< 0.1	< 0.1
60 minutes	< 0.1	< 0.1
75 minutes	< 0.1	< 0.1
90 minutes	< 0.15	< 0.15
105 minutes	< 0.15	< 0.15
120 minutes	< 0.2	< 0.2

In the foregoing examples, rice hull ash was used as the biogenetic silica.

As previously set forth and as exemplified by the drawings and examples given above, biogenetic silica devoid of fibers provides a porous skeletal support system in which liquids and gases may be pumped or flowed through it in such a manner to filter out particles of solids or liquids. The biogenetic silica has a porosity of approximately 75 to 80 percent. The irregular structure and noncompacting characteristics make biogenetic silica highly suitable for this purpose. The biogenetic silica particles do not break down when wet and remain dimensionally stable through a wide range of temperatures and pressures. The biogenetic silica particles may be formed into a porous cake on top of filter cloth and easily removed by back flushing when fully loaded with removed solids or liquids. By activating the carbon content in the silica ash, the filter medium can be used similar to charcoal baths to clarify organic liquids or to remove hydrocarbon gases from other gases. Similarly, the use of water swellable polymers permits the removal of liquids from gases and other liquids.

The loss due to friction from flow of liquids or gases through the biogenetic silica filter medium is minimal. Its unique pore size and total porosity allows it to remove particles down to about 1 micron in diameter compared to sand filters which only remove particles down to about 40 microns in diameter.

Biogenetic silica ash particles ranging in size from 6 to 40 mesh (471 μm to 3.55 mm) provide good results. Also, the biogenetic silica ash particles can be pelletized with suitable binders, such as fatty acid type and polymer type binders, or prilled with conventional prilling agents suitable for the conditions of use, such as ureaformaldehyde, other resins, and the like.

Accordingly, the present invention is well suited and adapted to attain the objects and ends and has the advantages and features mentioned as well as others inherent therein.

Claims

1. A filter for filtering fluid comprising a closed container (10, 10b) having an inlet (12, 12b) and an outlet (14, 14b), and biogenetic silica disposed in the closed container (10, 10b) wherein the inlet (12, 12b) and the outlet (14, 14b) are arranged to direct flow of the fluid through the biogenetic silica, characterized in that the biogenetic silica is rice hull ash devoid of fiber having a porous silicon skeleton in amorphous state and a porosity of approximately 75 to 80 percent by volume.
2. A filter as claimed in claim 1, wherein up to about 2 percent by weight of a water-swellable polymer is dispersed throughout the biogenetic silica.
3. A filter as claimed in claim 1 or claim 2, wherein activated carbon coats the biogenetic silica.
4. A filter as claimed in any one of claims 1 to 3, wherein the biogenetic silica is one of pelletized and prilled.
5. A porous filter cartridge (18) having inner and outer body layers of relatively coarse mesh (20) and fine mesh (22), biogenetic silica contained by the filter cartridge (18), impurities in a fluid flowing through the cartridge being filtered from the fluid by the biogenetic silica, characterized in that the biogenetic silica is rice hull ash devoid of fiber having a porous silicon skeleton in amorphous state and a porosity of approximately 75 to 80 percent by volume.
6. A porous filter cartridge as claimed in claim 5, wherein up to about 2 percent by weight of a water-



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15 minutes	< 0.1	< 0.1
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60 minutes	< 0.1	< 0.1
75 minutes	< 0.1	< 0.1
90 minutes	< 0.15	< 0.15
105 minutes	< 0.15	< 0.15
120 minutes	< 0.2	< 0.2

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As previously set forth and as exemplified by the drawings and examples given above, biogenetic silica devoid of fibers provides a porous skeletal support system in which liquids and gases may be pumped or flowed through it in such a manner to filter out particles of solids or liquids. The biogenetic silica has a porosity of approximately 75 to 80 percent. The irregular structure and noncompacting characteristics make biogenetic silica highly suitable for this purpose. The biogenetic silica particles do not break down when wet and remain dimensionally stable through a wide range of temperatures and pressures. The biogenetic silica particles may be formed into a porous cake on top of filter cloth and easily removed by back flushing when fully loaded with removed solids or liquids. By activating the carbon content in the silica ash, the filter medium can be used similar to charcoal baths to clarify organic liquids or to remove hydrocarbon gases from other gases. Similarly, the use of water swellable polymers permits the removal of liquids from gases and other liquids.

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Claims

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2. A filter as claimed in claim 1, wherein up to about 2 percent by weight of a water-swellaable polymer is dispersed throughout the biogenetic silica.
3. A filter as claimed in claim 1 or claim 2, wherein activated carbon coats the biogenetic silica.
4. A filter as claimed in any one of claims 1 to 3, wherein the biogenetic silica is one of pelletized and prilled.
5. A porous filter cartridge (18) having inner and outer body layers of relatively coarse mesh (20) and fine mesh (22), biogenetic silica contained by the filter cartridge (18), impurities in a fluid flowing through the cartridge being filtered from the fluid by the biogenetic silica, characterized in that the biogenetic silica is rice hull ash devoid of fiber having a porous silicon skeleton in amorphous state and a porosity of approximately 75 to 80 percent by volume.
6. A porous filter cartridge as claimed in claim 5, wherein up to about 2 percent by weight of a water-



swellable polymer is dispersed throughout the biogenetic silica.

7. A porous filter cartridge as claimed in claim 5 or claim 6, wherein activated carbon coats the biogenetic silica.
8. A porous filter cartridge as claimed in any one of claims 5 to 7, wherein the biogenetic silica is one of pelleted and prilled.
9. A method of filtering impurities from fluid comprising, flowing the fluid through the filter of any of claims 1 to 4.
10. A method of filtering water from fluid comprising, flowing the fluid through the filter of claim 2.
11. A method of filtering liquids from gas comprising, flowing the gas through the filter of claim 3.
12. A method of filtering impurities from fluid comprising, flowing the fluid through the porous filter cartridge of any one of claims 5 to 8.
13. A method of filtering water from fluid comprising, flowing the fluid through the porous filter cartridge of claim 6.
14. A method of filtering liquids from gas comprising, flowing the gas through the filter medium of claim 7.

Patentansprüche

1. Filter zum Filtrieren von Flüssigkeit, umfassend einen geschlossenen Behälter (10,10b) mit einem Einlaß (12,12b) und einem Auslaß (14,14b), und ein biogenetisches Siliciumdioxid, das in dem geschlossenen Behälter (10, 10b) angeordnet ist, wobei der Einlaß (12,12b) und der Auslaß (14,14b) so angeordnet sind, daß Flüssigkeit direkt durch das biogenetische Siliciumdioxid strömt, **dadurch gekennzeichnet**, daß das biogenetische Siliciumdioxid Reisschalenasche ist, die frei von Fasern ist, mit einem porösen Siliciumskelett in amorphem Zustand und einer Porosität von etwa 75 bis 80 Volumenprozent.
2. Filter nach Anspruch 1, worin bis zu 2 Gew.% eines mit Wasser quellbaren Polymers in dem gesamten biogenetischen Siliciumdioxid dispergiert sind.
3. Filter nach Anspruch 1 oder Anspruch 2, worin das biogenetische Siliciumdioxid mit Aktivkohle beschichtet ist.
4. Filter nach einem der Ansprüche 1 bis 3, worin das biogenetische Siliciumdioxid ein pelletisiert oder granuliert ist.
5. Poröse Filterpatrone (18) mit inneren und äußeren, relativ grobmaschigen (20) und feinmaschigen (22), Körperschichten, mit biogenetischem Siliciumdioxid, das in der Filterpatrone (18) enthalten ist, wobei Verunreinigungen in einer Flüssigkeit, die durch die Patrone fließt, durch das biogenetische Siliciumdioxid aus der Flüssigkeit filtriert werden, **dadurch gekennzeichnet**, daß das biogenetische Siliciumdioxid Reisschalenasche ist, die frei von Fasern ist, mit einem porösen Siliciumskelett in amorphem Zustand und einer Porosität von etwa 75 bis 80 Volumenprozent.
6. Poröse Filterpatrone nach Anspruch 5, worin bis zu 2 Gew.% eines in Wasser quellbaren Polymers in dem gesamten biogenetischen Siliciumdioxid dispergiert sind.
7. Poröse Filterpatrone nach Anspruch 5 oder Anspruch 6, worin das biogenetische Siliciumdioxid mit Aktivkohle beschichtet ist.
8. Poröse Filterpatrone nach einem der Ansprüche 5 bis 7, worin das biogenetische Siliciumdioxid pelletisiert oder granuliert ist.



9. Verfahren zum Abfiltrieren von Verunreinigungen aus einer Flüssigkeit, umfassend, daß man die Flüssigkeit durch den Filter nach einem der Ansprüche 1 bis 4 strömen läßt.
10. Verfahren zum Abfiltrieren von Wasser aus einer Flüssigkeit umfassend, daß man die Flüssigkeit durch den Filter von Anspruch 2 strömen läßt.
11. Verfahren zum Abfiltrieren von Flüssigkeiten aus Gas umfassend, daß man Gas durch den Filter nach Anspruch 3 strömen läßt.
12. Verfahren zum Abfiltrieren von Verunreinigungen aus einer Flüssigkeit, umfassend, daß man die Flüssigkeit durch die poröse Filterpatrone nach einem der Ansprüche 5 bis 8 strömen läßt.
13. Verfahren zum Abfiltrieren von Wasser aus einer Flüssigkeit, umfassend, daß man die Flüssigkeit durch die poröse Filterpatrone von Anspruch 6 strömen läßt.
14. Verfahren zum Abfiltrieren von Flüssigkeiten aus Gas, umfassend, daß man das Gas durch das Filtermedium von Anspruch 7 strömen läßt.

Revendications

1. Filtre pour filtrer du fluide, comprenant un récipient clos (10, 10b), ayant une entrée (12, 12b) et une sortie (14, 14b), et de la silice d'origine biologique disposée dans le récipient clos, l'entrée (12, 12b) et la sortie (14, 14b) étant agencées de façon à diriger l'écoulement du fluide à travers la silice d'origine biologique, filtre caractérisé en ce que la silice d'origine biologique est de la cendre de balle de riz, dépourvue de fibres, ayant un squelette de silice poreuse, à l'état amorphe, et ayant une porosité d'environ 75 à 80 % en volume.
2. Filtre tel que revendiqué à la revendication 1, dans lequel jusqu'à environ 2 % en poids d'un polymère, gonflable en présence d'eau, est dispersé dans toute la silice d'origine biologique.
3. Filtre tel que revendiqué à la revendication 1 ou à la revendication 2, dans lequel du charbon actif recouvre la silice d'origine biologique.
4. Filtre tel que revendiqué dans l'une quelconque des revendications 1 à 3, dans lequel la silice d'origine biologique est une silice pastillée ou comprimée.
5. Cartouche (18) de filtre poreux, ayant des couches d'un corps intérieur et extérieur formées d'une toile (20) relativement grossière et d'une toile fine (22), de la silice d'origine biologique étant contenue dans la cartouche (18) de filtre, les impuretés présentes dans un fluide traversant la cartouche étant séparées du fluide par filtration par la silice d'origine biologique, cartouche caractérisée en ce que la silice d'origine biologique est de la cendre de balle de riz dépourvue de fibres, ayant un squelette de silice poreuse à l'état amorphe et présentant une porosité d'environ 75 à 80 % en volume.
6. Cartouche de filtre poreux telle que revendiquée à la revendication 5, dans laquelle une proportion pouvant aller jusqu'à environ 2 % en poids d'un polymère, gonflable en présence d'eau, est dispersée dans toute la silice d'origine biologique.
7. Cartouche de filtre poreux telle que revendiquée à la revendication 5 ou à la revendication 6, dans laquelle du charbon actif revêt la silice d'origine biologique.
8. Cartouche de filtre poreux telle que revendiquée dans l'une quelconque des revendications 5 à 7, dans laquelle la silice d'origine biologique est une silice pastillée ou comprimée.
9. Procédé de filtration d'impuretés pour les séparer d'un fluide, comprenant l'écoulement du fluide à travers le filtre selon l'une quelconque des revendications 1 à 4.
10. Procédé de filtration d'eau pour la séparer d'un fluide, comprenant l'écoulement du fluide à travers le filtre selon la revendication 2.



11. Procédé de filtration de liquides pour les séparer de gaz, comprenant l'écoulement du gaz à travers le filtre selon la revendication 3.

12. Procédé pour filtrer les impuretés et les séparer d'un fluide, comprenant l'écoulement du fluide à travers la cartouche de filtre poreux selon l'une quelconque des revendications 5 à 8.

13. Procédé pour filtrer de l'eau pour la séparer d'un fluide, comprenant l'écoulement du fluide à travers la cartouche de filtre poreux selon la revendication 6.

14. Procédé pour filtrer des liquides et les séparer de gaz, comprenant l'écoulement du gaz à travers le milieu filtrant selon la revendication 7.