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(54) Title: WATER DISPERSIBLE PRODUCTS

(57) Abstract: Water dispersible fiber products are provided. In one embodiment, a water dispersible fiber sheet is provided and it is preferably formed from regenerated cellulose fibers, a second fiber that is adapted to provide strength to the water dispersible fiber sheet, and a water soluble binder. In use, the fiber sheet can be formed into a variety of products including, for example, for labels, packaging, medical and health care products. The fiber sheet is particularly advantageous in that it is readily dispersible upon contact with water, yet it will retain its strength when used with other fluids, such as alcohol and oils. The biodegradability of the fiber sheet will also allow the fibers to be consumed naturally by environmental bacteria, thus eliminating the need for special disposal procedures. In another embodiment, the water dispersible fiber sheet can be incorporated into a filter media.

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WATER DISPERSIBLE PRODUCTS

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims priority from U.S. Provisional Patent Application Serial No. 60/515,480, filed on October 29, 2003, entitled "Water Dispersible Products," which is hereby expressly incorporated by reference in its entirety.

FIELD OF THE INVENTION

The present invention relates to water dispersible products.

BACKGROUND OF THE INVENTION

With the increasing concern for the environment, it is desirable to provide products that can be easily disposed of and/or recycled. The products should have sufficient strength while they are dry, and they should be capable of dissolving upon contact with water. While some water dispersible products are available, they are limited to certain uses and/or they require expensive and time-consuming manufacturing techniques. Accordingly, there remains a need for a water dispersible product that can be used for a variety of purposes, that readily dissolves upon contact with water, and that is efficient to produce.

SUMMARY OF THE INVENTION

The present invention provides water dispersible products for use in a variety of applications. In one embodiment, a water dispersible fiber sheet is provided and it is formed from at least two types of fibers: regenerated cellulose fibers, and a second fiber that is adapted to provide strength to the water dispersible fiber sheet. The water dispersible fiber sheet also preferably includes a water soluble binder, i.e., a binder that is adapted to lose strength upon coming into contact with water. An exemplary water soluble binder is carboxymethyl cellulose (CMC). In use, the fiber sheet is adapted to disperse upon contact with water. In an exemplary embodiment, the fiber sheet is used for labels, packaging, medical and health care products, such as wipes and identification markers, or for industrial and personal use. In another embodiment, the water dispersible fiber sheet forms part of a filter media. In an exemplary embodiment, the

filter media includes a first layer formed from a water dispersible fiber sheet, and a second layer formed from a water soluble meltblown non-woven fiber web. The water soluble meltblown non-woven fiber web can be formed from, for example, a polymer containing a polyether amide. The filter media can be used in a variety of air filtration applications, such as vacuum filters, filter bags, face masks, organic liquid filters, and ASHRAE filtration applications. When the filter media is disposed of, it is adapted to disperse upon contact with water.

The present invention also provides a method for preparing a water dispersible fiber sheet by combining regenerated cellulose fibers, a second fiber adapted to provide strength to the water dispersible fiber sheet, and a water soluble binder. The sheet is then formed from the fibers and the binder, preferably using standard paper-making techniques, and the sheet is adapted to disperse upon contact with water. The sheet can also be combined with one or more layers of a meltblown fiber web to form a filter media.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be more fully understood from the following detailed description taken in conjunction with the accompanying drawing, in which:

FIG. 1 is a photograph of one embodiment of a water dispersible fiber sheet in the dry form according to the present invention;

FIG. 2 is a photograph of the water dispersible fiber sheet shown in FIG. 1 after being sprayed with water for about three (3) seconds;

FIG. 3 is a photograph of the water dispersible fiber sheet shown in FIG. 1 after being sprayed with water for about five (5) seconds;

FIG. 4 is a photograph of a pleated filter media; and

FIG. 5 is a photograph of a heat sealed filter bag.

DETAILED DESCRIPTION OF THE INVENTION

The present invention generally provides a water dispersible fiber sheet that, in an exemplary embodiment, is formed from regenerated cellulose fibers, a second fiber that is adapted to provide strength to the water dispersible fiber sheet, and a water soluble binder. In use, the fiber sheet can be formed into a variety of products including, for example, medical and health products such as packaging and labels. In another embodiment, the fiber sheet can be incorporated into a filter media. The fiber sheet is particularly advantageous in that it is readily dispersible upon contact with water, yet it will retain its strength when used with non-aqueous fluids, such as alcohol, oils, and organic solvents. The biodegradability of the fiber sheet will also allow the fibers to be consumed naturally by environmental bacteria, thus eliminating the need for special disposal procedures. In the case of a dispersible sheet which does not need to be biodegradable, synthetic fiber can be used in place of the regenerated cellulose.

[0002] A variety of different types of regenerated cellulose fibers can be used to form the fiber sheet of the present invention. Suitable types of regenerated cellulose fibers include, for example, viscose rayon, cuprammonium rayon, high wet modulus rayon, polynosic rayon, saponified acetate, and cellulose triacetate. In one embodiment, the regenerated cellulose fibers can be present in the fiber sheet in the range of about 20% to 90% by weight. In an exemplary embodiment, however, the regenerated cellulose fibers are present in the fiber sheet in the range of about 30% to 70% by weight. The fibers are preferably relatively short, and in particular they preferably have a length in the range of about 1 mm to 10 mm. This allows the fibers to disperse more readily when placed into contact with water.

The second fiber used to form the fiber sheet can also be present in a variety of forms. In an exemplary embodiment, however, the second fiber is a natural fiber that is biodegradable. The second fiber can, however, also include synthetic fibers. Natural fibers such as softwood fibers and hardwood fibers are preferred, but other suitable fibers include, for example, synthetic fibers such as polyethylene terephthalate fibers, nylon fibers, polyolefin fibers, synthetic wood pulp fibers, polyvinyl alcohol fibers, acrylic fibers, modacrylic fibers, vinyl chloride fibers, vinylidene chloride fibers, acetate fibers, regenerated protein fibers, polylactide fibers, poly(lactide-co-glycolide) fibers, glass fibers, ceramic fibers, metal fibers, mineral fibers, and combinations thereof.

Other suitable fibers include non-wood vegetation fibers such as cotton, seed flax, hemp, abaca, eucalyptus, sisal, bamboo, kenaf, jute, esparto, papyrus, sugar cane base, corn straw, wheat straw, rice straw, ramie, and combinations thereof.

When used to form a fiber sheet, the second fiber is effective to provide tensile strength and/or to control the density of the sheet. In one embodiment, the second fiber can be present in the fiber sheet in the range of about 10% to 75% by weight, and more preferably the second fiber includes natural fibers that are present within the sheet in the range of about 10% to 80% by weight, and synthetic fibers that are present within the sheet in the range of about 0% to 50% by weight. In an exemplary embodiment, however, the second fiber is present in the fiber sheet in the range of about 30 to 60% by weight. The size of the second fiber can also vary, especially for the natural fibers. In an exemplary embodiment, the second fiber has a diameter that is in the range of 0.1 μ to 100 μ, and more preferably that is in the range of about 0.3 μ to 70 μ, and most preferably that is in the range of about 0.3 μ to 40 μ, and they have a length that is in the range of about 0.1 mm to 6 mm. The second fiber can also have a length to diameter ratio that is less than about 1000, and more preferably that is less than about 500, and most preferably that is less than about 200. The short length of the fibers is particularly advantageous in that it allows the fibers to more readily disperse when placed into contact with water.

As previously stated, the fiber sheet also includes a binder that is effective to bind the regenerated cellulose fibers and the second fiber to one another. A variety of binders can be used, but the binder should be water soluble to allow the fiber sheet to readily disperse upon coming into contact with water. Suitable binders include, for example, carboxylmethyl cellulose (CMC), polyvinyl alcohol, protein, polyethylene oxide, polyacrylic acid, starches, gums and combinations thereof. The binder should be present within the fiber sheet in the range of about 0.05% to 10% by weight. In an exemplary embodiment, the binder is water soluble sodium CMC, which has ideal adsorption, adhesion, water binding, film forming, viscosifying, and dispersing properties. An exemplary water soluble CMC binder is manufactured by Hercules Incorporated, in Wilmington, DE, and it is sold under the name Aqualon® CMC, which is an anionic water soluble polymer.

A person skilled in the art will appreciate that the water dispersible fiber sheet can include a variety of other components, in addition to the regenerated cellulose fibers, the second fiber, and the binder. By way of non-limiting example, the fiber sheet can include wetting agents, additives, mineral fillers such as titanium oxide, calcium carbonate, silica and silicates. While the amount of wetting agent present in the composition will vary depending on the type of wetting agent and the composition of the fiber sheet, in an exemplary embodiment the wetting agent is present in the range of about 0.01% to 1.0% by weight. One example of a suitable wetting agent is sulfonated oil.

A variety of techniques can be used to form a water dispersible fiber sheet in accordance with the present invention, but preferably the regenerated cellulose fibers, the second fiber, e.g., hardwood and/or softwood fibers, and the binder are all combined and formed into a fiber sheet using standard paper-making techniques. The binder can be added to the fiber sheet using a beater-addition process, or it can be coated, sprayed, saturated or foamed saturated onto the fiber sheet during formation of the sheet. An exemplary method for making a fiber sheet in accordance with the present invention will be discussed in more detail below.

In use, the fiber sheet can be formed into a variety of products including, for example, labels, packaging, components for medical, personal and industrial use, embroidery backing, paper bags, printing and/or writing paper, decorative paper, pouches, alcohol wipes, polishing wipes, industrial wipes, automotive and aerospace wipes, filters, fragrance sheets for bathing, publication inserts, seeding beds, cotton swabs, test paper, backing paper, toiletries, paper core, paper box, wipes, applicators and strips for health care, cosmetic and personal care, home care wipes, packaging for baby, adult diapers and feminine hygiene, etc.

In an exemplary embodiment of the present invention, the water dispersible fiber sheet has a breaking strength when dry of about 8 lb/in, but the sheet is adapted to disperse upon coming into contact with water such that it has no breaking strength when wet. This is illustrated in FIGS. 1-3. FIG. 1 shows a dry fiber sheet, FIG. 2 shows the sheet after being spraying with water for less than 3 seconds, and FIG. 3 shows the sheet after being spray with water for about 5 seconds. As shown, the fibers in the sheet begin

to disperse after 3 seconds, and the sheet falls apart after 5 seconds. This is particularly advantageous in that it allows the user to simply place the sheet into contact with water.

In another embodiment of the present invention, the water dispersible fiber sheet can be incorporated into a filter media to form a water dispersible filter media. While the filter media can have a variety of configurations, and it can be formed using any number of layers of fiber webs formed from various polymeric materials, in one exemplary embodiment the filter media includes a first layer formed from a water dispersible fiber sheet as previously described, and a second layer formed a water soluble non-woven meltblown polymer fiber web. The first and second layers can be mated to one another using a variety of techniques known in the art, but in an exemplary embodiment the layers are adhered together using a water soluble adhesive, such as a water soluble polymer.

The non-woven meltblown polymer fiber web can be formed from virtually any water soluble polymeric material. In an exemplary embodiment, the non-woven polymer fiber web is formed from a water soluble polyether amide. One method for producing the polyether amide is by reacting at least one polyalkylene glycol diamine with at least one dicarboxylic acid or ester. The polyalkylene glycol diamine preferably has the formula NH2-(CH2)x-(OCH2-CH2)y-O-(CH2)Ox-NH2, where x ranges from 2 to 3 and y ranges from 1 to 2. An exemplary water soluble polyether amide resin for use with various embodiments of the present invention is Hydromelt™, available from H.B. Fuller, Inc.

The resin can be formed into a non-woven meltblown polymer fiber web by extruding the resin into fibers. An exemplary process for forming a meltblown polymer fiber web is described in more detail in U.S. Patent No. 6,780,226, which is incorporated herein by reference in its entirety. In an exemplary embodiment, the fibers are meltblown onto the first layer, i.e., the water dispersible fiber sheet, which functions as a support layer for the meltblown fibers. The resulting fiber web can be comprised of fibers having a relatively broad distribution of fiber diameters, and the fiber diameter can be adjusted during the extrusion process to form a filter media having a desired filtration efficiency as needed based on the intended use. In one exemplary embodiment, the average fiber diameter can be in the range of about 5 μ to 20 μ, and more preferably about 1 μ to 15 μ. The basis weight of the meltblown polymer fiber

web can also vary, especially considering the intended application. In general, higher web basis weights yield better filtration, but there exists a higher resistance, or pressure drop, across the filter barrier when the filter media has a higher basis weight. For most applications, the basis weight can be in the range of about 10 g/m^2 to 520 g/m^2, and more preferably from about 30 g/m^2 to 200 g/m^2. One of ordinary skill in the art can readily determine the optimal web basis weight, considering such factors as the desired filter efficiency and permissible levels of resistance. Furthermore, the number of plies of the polymer fiber web used in any given filter application can also vary. Each ply of the polymer fibrous web can be of a different fiber diameter. One of ordinary skill in the art can readily determine the optimal number of plies to be used.

The following non-limiting examples serve to further illustrate the present invention.

EXAMPLE 1

A cellulose binder spray was made with 1889g of Hercules Aqualon® CMC in 50 gallons of water. The solution was mixed until the CMC was completely dissolved. Trax H-10 wetting agent, produced by Nippon Yushi, was then added to the solution, which was set aside. 8 lbs. of Prince George bleached softwood pulp and 300 gallons of water were combined in a hydropulper and agitated until the pulp was dispersed. 32 lbs. of Minifiber Rayon 0.8 denier x 2 mm was then added to the hydropulper and agitated until the fibers were dispersed. The fiber mixture was then transferred to a tank with a total of 1200 gallons of water and stock. A fiber sheet was then formed on a fourdrinier paper machine, and the sheet was sprayed with the CMC solution, and dried to form a water dispersible fiber sheet.

The resulting fiber sheet had a basis weight of about 32 lb/ 3000 ft^2, a thickness of about 0.012 in., a tensile strength of about 8 lb/in, and a peak elongation of about 1.6%.

EXAMPLE 2

A first layer was formed by combining 30 lbs. of Primacell eucalyptus pulp, 6 lbs. of Prince George bleached softwood pulp, 12 lbs. of Minifiber Rayon 0.8 denier x 2 mm, 18 lbs. of Diawabo Rayon 0.6 denier x 3 mm, and 50 lbs. of Hercules Aqualon®

CMC in 1500 gallons of water. The fiber mixture was then passed through a fourdrinier paper machine and dried to form a water dispersible fiber sheet having a basis weight of 60 g/m^2.

A second layer of a water soluble non-woven meltblown polymer fiber web was then formed by meltblowing H.B. Fuller Hydromelt NP2116 onto the first layer. The basis weight of the second layer was 40 g/m^2. The resulting filter media is referred to below as Sample 1.

The above process was repeated to form a second filter media, referred to below as Sample 2, having a first layer with a basis weight of 60 g/m^2 and a second layer with a basis weight of 80 g/m^2.

Table 1 illustrates the resulting properties of the first layer, Sample 1, and Sample 2.

TABLE 1

SAMPLE	Basis weight (g/m^2)	MD Tensile (lbs/in)	MD elongation (%)	0.3 μ DOP efficiency (%)	Air Resistance (mm H_2O)
First Layer	60	4.16	1.17	98.1	0.8
Sample 1	100	5.31	1.65	92.7	1.1
Sample 2	140	4.64	1.74	84.6	1.5

The filter media can optionally be formed into a pleated filter, as shown in Figure 4, or it can be formed into a filter bag by heat seat, as shown in Figure 5.

EXAMPLE 3

A water dispersible paper was formed by combining 30 lbs. of Primacell eucalyptus pulp, 6 lbs. of Prince George bleached softwood pulp, 12 lbs. of Minifiber Rayon 0.8 denier x 2 mm, 18 lbs. of Diawabo Rayon 0.6 denier x 3 mm, and 50 lbs. of Hercules Aqualon® CMC in 1200 gallons of water. The fiber mixture was then passed through a fourdrinier paper machine and dried to form a water dispersible fiber sheet having a basis weight of 60 g/m^2.

The resulting sheet has a tensile in excess of 4 lbs./in and it can be easily processed using a paper converting process, such as printing, die cutting, sheeting, etc. The resulting sheet can be easily dispersed in water within 20 seconds.

EXAMPLE 4

A water dispersible paper was formed by combining 30 lbs. of Primacell eucalyptus pulp, 6 lbs. of Prince George bleached softwood pulp, 12 lbs. of Minifiber Rayon 0.8 denier x 2 mm, 18 lbs. of Diawabo Rayon 0.6 denier x 3 mm, and 50 lbs. of Hercules Aqualon® CMC in 1200 gallons of water. The fiber mixture was then passed through a fourdrinier paper machine and dried to form a water dispersible fiber sheet having a basis weight of 60 g/m^2. The paper was sprayed with an Eastman AQ copolyester having an intrinsic viscosity of about 0.2. The AQ copolyesters are soluble in water, but they are not soluble in saline or body fluids. The resulting paper can be used for hospital wipes, after which they can be placed in water and eventually dissolved for disposal.

EXAMPLE 5

A water dispersible paper was formed by combining 30 lbs. of Primacell eucalyptus pulp, 6 lbs. of Prince George bleached softwood pulp, 12 lbs. of Minifiber Rayon 0.8 denier x 2 mm, 18 lbs. of Diawabo Rayon 0.6 denier x 3 mm, and 50 lbs. of Hercules Aqualon® CMC in 1200 gallons of water. The fiber mixture was then passed through a fourdrinier paper machine and dried to form a water dispersible fiber sheet having a basis weight of 60 g/m^2. The fiber sheet is then laminated to another layer of paper using an adhesive, such as Hydromelt NP2116. The adhesive can be coated onto the paper at a weight ranging from 0.1 g/m^2 to 20 g/m^2. The resulting paper can be formed into a disposal bag, such as a shopping bag, leaf bag, or commercial bags for powder, pellets, flakes and granular materials such as sugar, chemicals, resin, etc. After use, the bag can be disposed of in the environment where exposure to rain and moisture will dissolve the bag. The bag can also easily be recycled into a usable fiber in the paper making process.

EXAMPLE 6

Several samples of water dispersible papers were formed from 2.41 grams of Primacell eucalyptus pulp, 0.48 grams of Prince George bleached softwood pulp, 2.41 grams of Minifiber Rayon 0.8 denier x 2 mm in 1000 ml of water, along with various amounts of Hercules Aqualon® CMC. The CMC of different degrees of substitution and molecular weight, and levels was either added to the mixture, passed through a handsheet mold, and dried to form a water dispersible fiber sheet, or it was sprayed onto the sheet after the sheet was formed and dried to form a water dispersible fiber sheet. The samples were vacuumed and dried on photodryers, and the resulting samples were tested for tensile strength using a tensile machine which showed results of about 1.5 to 3 lb./in.. The basis weight was 35 lb./3000ft^2. The dispersing time was measured by the time it takes for a 2 inch strip to tear apart from being sprayed by a spray bottle three inches away. The results are listed below in Table 2.

TABLE 2

	Furnish	Spray					
Runs	7MT	7MT_1	7H	9H	Basis weight (lb/3000ft^2)	Tensile (lb/in)	Dispersing time (sec)
1	0.000%	0.000%	0.000%	0.000%	32	1.42	4
2	0.010%	0.050%	0.000%	0.000%	34	2.07	5
3	0.020%	0.000%	0.000%	0.000%	34	1.43	6
4	0.010%	0.000%	0.000%	0.000%	35	1.46	6
5	0.020%	0.050%	0.000%	0.000%	34	2.37	7
6	0.000%	0.100%	0.000%	0.000%	36	2.32	4
7	0.000%	0.050%	0.000%	0.000%	36	2.07	5
8	0.010%	0.100%	0.000%	0.000%	35	2.98	11
9	0.020%	0.100%	0.000%	0.000%	35	2.81	5
10	0.010%	0.000%	0.050%	0.000%	35	2.37	8
11	0.020%	0.000%	0.050%	0.000%	34	2.15	9
12	0.000%	0.000%	0.100%	0.000%	35	2.73	11
13	0.000%	0.000%	0.050%	0.000%	34	1.89	8
14	0.010%	0.000%	0.100%	0.000%	36	2.79	11
15	0.020%	0.000%	0.100%	0.000%	34	2.72	14
16	0.010%	0.000%	0.000%	0.050%	35	1.95	9
17	0.020%	0.000%	0.000%	0.050%	34	1.96	14
18	0.000%	0.000%	0.000%	0.100%	35	2.81	14
19	0.000%	0.000%	0.000%	0.050%	34	1.87	6
20	0.010%	0.000%	0.000%	0.100%	34	2.99	22
21	0.020%	0.000%	0.000%	0.100%	34	2.86	14

EXAMPLE 7

A water dispersible paper was formed by combining 40% eucalyptus pulp, 10% softwood pulp, 50% of Minifiber Rayon 0.8 denier x 2 mm and passing the mixture through a fourdrinier paper machine. The resulting sheet was saturated with CMC with a basis weight of 35 lb./3000 ft^2. The original caliper or thickness of the sheet was 0.0083 inches, and with calendaring a caliper of 0.0021 inches could be achieved. Table 3 shows the calendaring conditions and the resulting caliper. The caliper reduction can be as high as 5 to 1.

TABLE 3

Interval	Top Load Cell	Bottom Load Cell	Thickness
	psi	psi	inches
B	NA	NA	0.0083
8	2,500	NA	0.0052
7	3,000	NA	0.0051
6	3,000	56,000	0.0031
5	3,000	68,000	0.0024
4	3,000	80,000	0.0031
3	3,000	100,000	0.0023
2	3,000	150,000	0.0036
1	3,000	200,000	0.0021

EXAMPLE 8

A water dispersible paper was formed by combining 47.5% eucalyptus pulp, 5% softwood pulp, 47.5% of Minifiber Rayon 0.8 denier x 2 mm. The composition was saturated with CMC with a basis weight of 35 lb./3000ft^2, and then passed through a handsheet mold. Table 4 shows that with an increasing level of CMC-7MT added to the composition before it is formed into a sheet and/or sprayed onto the resulting sheet after it is formed, the tensile strength increases but the dispersion time remains less than 6 seconds.

TABLE 4

7MT Mold	7MT Spray	Tensile (lb/in)	Disperse time (sec)
0.02%	0.50%	6.3	5
0.00%	0.50%	5.8	4
0.02%	0.25%	3.9	5
0.00%	0.25%	2.9	5
0.01%	0.25%	2.9	6
0.01%	0.50%	4.8	4

EXAMPLE 9

A water dispersible paper was formed by various combinations of eucalyptus pulp, softwood pulp and rayon fibers of different deniers for the base composition. The

pulp can also be refined to a lower Canadian Standard Freeness (CSF) such as the Prince George pulp at 600 CSF. The composition was passed through a handsheet mold. A 1.5% CMC solution was made up with various CMC, such as Aqualon® CMC-7MT, Noviant Finnfix® 30G, 300 and 700. The compositions was saturated with CMC to a basis weight of 38 lb./3000 ft^2.

Table 5 shows the type and level of both pulp and CMC solution. The samples were tested using Dispersion Time Test A, which is the time it takes for the sample to fall apart while hand spraying a strip of about 1" x 2" sample with cold water from about 3 inches away, and using Dispersion Time Test B, which is the time it takes for a 1" x 1" sample to fall apart in 300 ml of water using a VWR Dynadual® 942009 magnetic stir plate and a magnetic stir rod at a stir setting of 5.

TABLE 5

	Prince George (g)	Crestbrook (g)	Primacell (g)	Suzano (g)	1.5% CMC Dip	Minifiber Rayon (g)	Diawabo Rayon (g)
A	0.00	1.27	0.00	1.76	30G	1.47	2.41
B	0.00	1.27	0.00	1.76	300	1.47	2.41
C	0.00	1.27	0.00	1.76	700	1.47	2.41
D	0.00	1.27	0.00	1.76	7MT	1.47	2.41
E	0.294 or 15 ml (600CSF)	0.00	2.65	0.00	7MT	1.47	2.41
F	0.294 or 15 ml (600CSF)	0.00	2.65	0.00	300	1.47	2.41
G	1.18	0.00	1.76	0.00	300	1.47	2.41

	Thickness (inches)	Basis weight (#/ream)	Tensile (lb/in)	Elongation (%)	Dispersion Time Test A (sec)	Dispersion Time Test B (sec)	Air Perm (cfm)
A	0.0106	38	16.5	2.3	2	4	56.7
B	0.0095	39	18.3	3.4	3	6	44.9
C	0.0087	39	24.1	4.0	2	7	43.6
D	0.0089	38	18.4	4.4	3	5	49.7
E	0.0084	37	25.3	4.0	2	6	32.7
F	0.0099	42	20.5	3.8	2	4	61.6
G	0.0097	38	18.1	4.3	2	5	63.6

One skilled in the art will appreciate further features and advantages of the invention based on the above-described embodiments. Accordingly, the invention is not to be limited by what has been particularly shown and described, except as indicated by the appended claims. All publications and references cited herein are expressly incorporated herein by reference in their entirety.

What is claimed is:

CLAIMS:

1. A water dispersible fiber sheet, comprising:

a first fiber comprising regenerated cellulose;

a second fiber adapted to provide strength to the water dispersible fiber sheet; and

a water soluble binder.

2. The water dispersible fiber sheet of claim 1, wherein the water dispersible fiber sheet includes about 20% to 90% of the first fiber, about 10% to 80% of the second fiber, and less than about 10% of the water soluble binder.

3. The water dispersible fiber sheet of claim 1, wherein the second fiber includes about 10% to 80% of a natural fiber and about 0% to 50% of a synthetic fiber.

4. The water dispersible fiber sheet of claim 1, wherein the water soluble binder is added to the water dispersible fiber sheet by applying the water soluble binder to the first and second fibers after the first and second fibers are formed into a fiber sheet.

5. The water dispersible fiber sheet of claim 1, wherein the water soluble binder is added to the water dispersible fiber sheet by mixing the water soluble binder with the first and second fibers before the mixture is formed into a water dispersible fiber sheet.

6. The water dispersible fiber sheet of claim 1, wherein the second fiber is selected from the group consisting of natural fibers, synthetic fibers, and combinations thereof.

7. The water dispersible fiber sheet of claim 6, wherein the natural fibers are selected from the group consisting of softwood fibers, hardwood fibers, vegetation fibers, and combinations thereof.

8. The water dispersible fiber sheet of claim 6, wherein the synthetic fibers are selected from the group consisting of polyethylene terephthalate fibers, nylon fibers, polyolefin fibers, synthetic wood pulp fibers, polyvinyl alcohol fibers, acrylic fibers, modacrylic fibers, vinyl chloride fibers, vinylidene chloride fibers, acetate fibers, regenerated protein fibers, polylactide fibers, poly(lactide-co-glycolide) fibers, glass fibers, ceramic fibers, metal fibers, mineral fibers, and combinations thereof.

9. The water dispersible fiber sheet of claim 1, wherein the water soluble binder is selected from the group consisting of water soluble carboxymethyl cellulose, polyethylene oxide, polyvinyl alcohol, protein, polyacrylic acid, starches, gums, and combinations thereof.

10. The water dispersible fiber sheet of claim 1, wherein the fiber sheet will disperse in less than about 20 seconds when agitated in water.

11. The water dispersible fiber sheet of claim 1, wherein the fiber sheet will disperse in less than about 10 seconds.

12. The water dispersible fiber sheet of claim 1, wherein the fiber sheet will disperse in less than about 5 seconds.

13. The water dispersible fiber sheet of claim 1, wherein the fiber sheet has an MD tensile strength that is at least about 2 lb/inch.

14. The water dispersible fiber sheet of claim 1, wherein the first fiber has a length in the range of about 1 mm to 10 mm.

15. The water dispersible fiber sheet of claim 1, wherein the second fiber has a length in the range of about 0.1 mm to 6 mm.

16. The water dispersible fiber sheet of claim 1, wherein the second fiber has a size that is in the range of about 0.1 μ to 100 μ.

17. The water dispersible fiber sheet of claim 1, wherein the second fiber has a length to diameter ratio that is less than about 1000.

18. The water dispersible fiber sheet of claim 1, wherein the second fiber has a length to diameter ratio that is less than about 500.

19. The water dispersible fiber sheet of claim 1, wherein the second fiber has a length to diameter ratio that is less than about 200.

20. The water dispersible fiber sheet of claim 1, wherein the fiber sheet is not soluble in organic liquids.

21. The water dispersible fiber sheet of claim 1, wherein the fiber sheet is not soluble in alcohol.

22. The water dispersible fiber sheet of claim 1, wherein the water dispersible fiber sheet forms a first layer of a filter media, the filter media further comprising a second layer formed from a water soluble non-woven polymer fiber web.

23. The water dispersible fiber sheet of claim 22, wherein the water soluble non-woven polymer fiber web is formed from a water soluble polyether amide.

24. The water dispersible fiber sheet of claim 22, wherein the second layer is meltblown onto the first layer.

25. The water dispersible fiber sheet of claim 22, wherein the first and second layers are adhered to one another with a water soluble polymer.

26. A water dispersible filter media, comprising:

a first layer formed from regenerated cellulose fibers, a second fiber adapted to provide strength to the water dispersible fiber sheet, and a water soluble binder; and

a second layer formed from a water soluble non-woven polymer fiber web.

27. The water dispersible filter media of claim 26, wherein the water soluble binder in the first layer is selected from the group consisting of water soluble carboxymethyl cellulose, polyethylene oxide, polyvinyl alcohol, protein, polyacrylic acid, starches, gums, and combinations thereof.

28. The water dispersible filter media of claim 26, wherein the water soluble non-woven polymer fiber web is formed by extrusion of a water soluble polymer.

29. The water dispersible filter media of claim 26, wherein the water soluble non-woven polymer fiber web is formed from a water soluble polyether amide.

30. The water dispersible filter media of claim 26, wherein the second layer is meltblown onto the first layer.

31. The water dispersible filter media of claim 26, wherein the first and second layers are adhered to one another with a water soluble polymer.

32. The water dispersible filter media of claim 26, where in the first and second layer are heat sealed to form a bag.

33. A method for making a water dispersible product, comprising:

forming a first fiber sheet layer from regenerated cellulose fibers, a second fiber adapted to provide strength to the water dispersible fiber sheet, and a water soluble binder.

34. The method of claim 33, wherein the step of forming a first fiber sheet layer comprises:

forming a fiber mixture containing the regenerated cellulose fibers, the second fiber, and water;

passing the mixture through a paper machine to form a fiber sheet; and

applying a water soluble binder to the sheet.

35. The method of claim 33, wherein the step of forming a first fiber sheet layer comprises forming a fiber mixture containing the regenerated cellulose fibers, the second fiber, the water soluble binder, and water, and passing the mixture through a paper machine to form a fiber sheet.

36. The method of claim 33, further comprising the step of melt blowing a water soluble non-woven polymer fiber onto the first layer to form a second fiber sheet layer.

37. The method of claim 36, wherein the water soluble non-woven polymer fiber is formed from a water soluble polyether amide.

Fig. 1

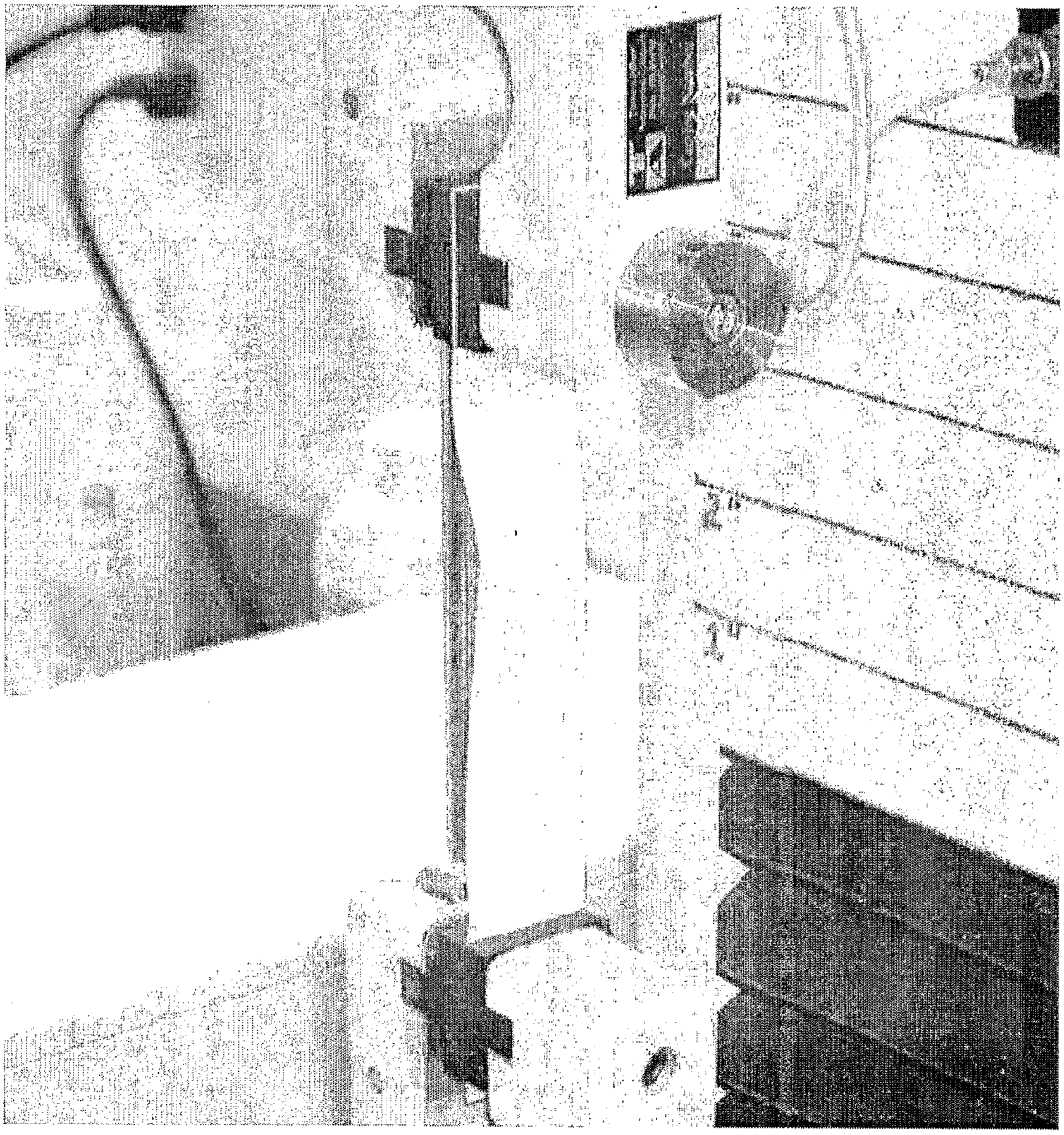

Fig. 2

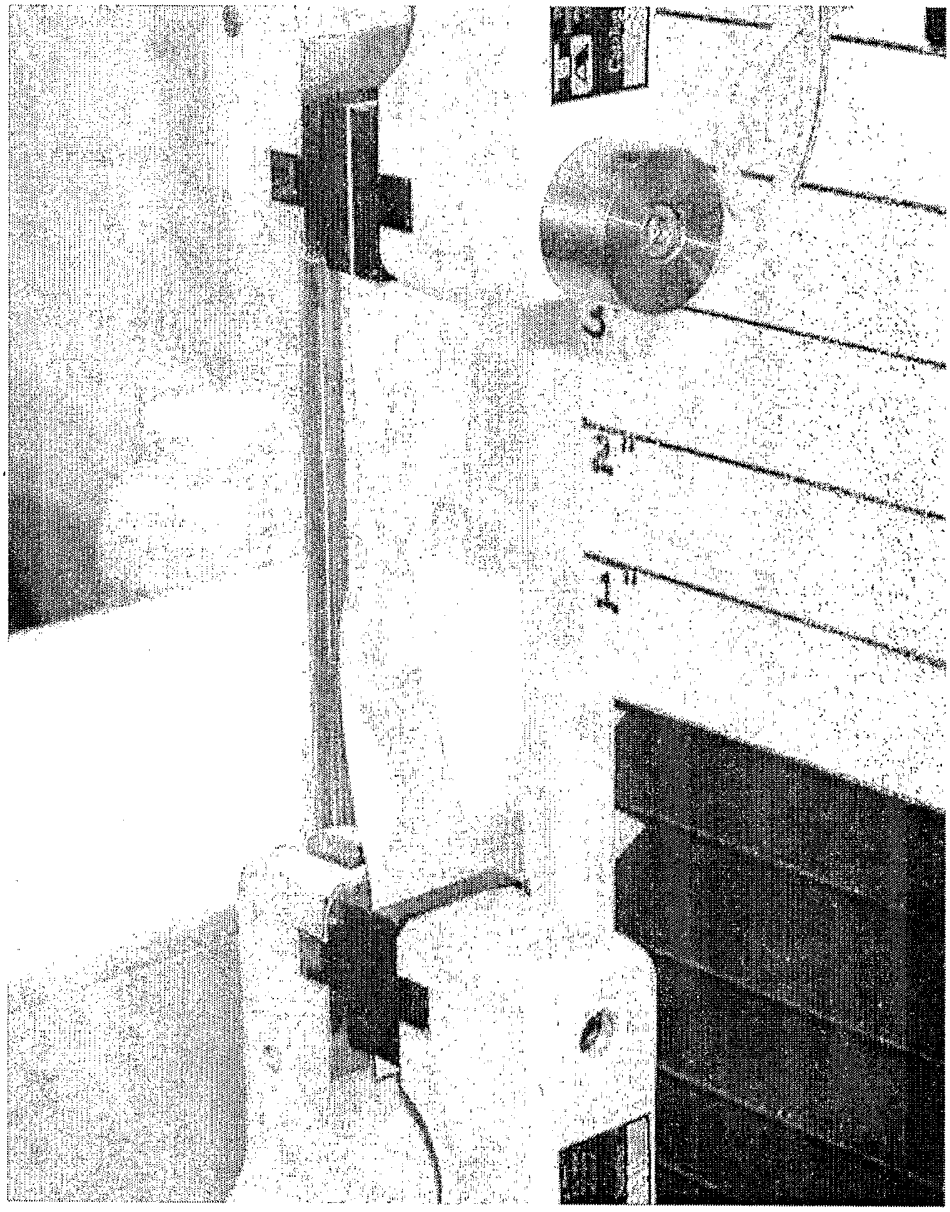

Fig. 3

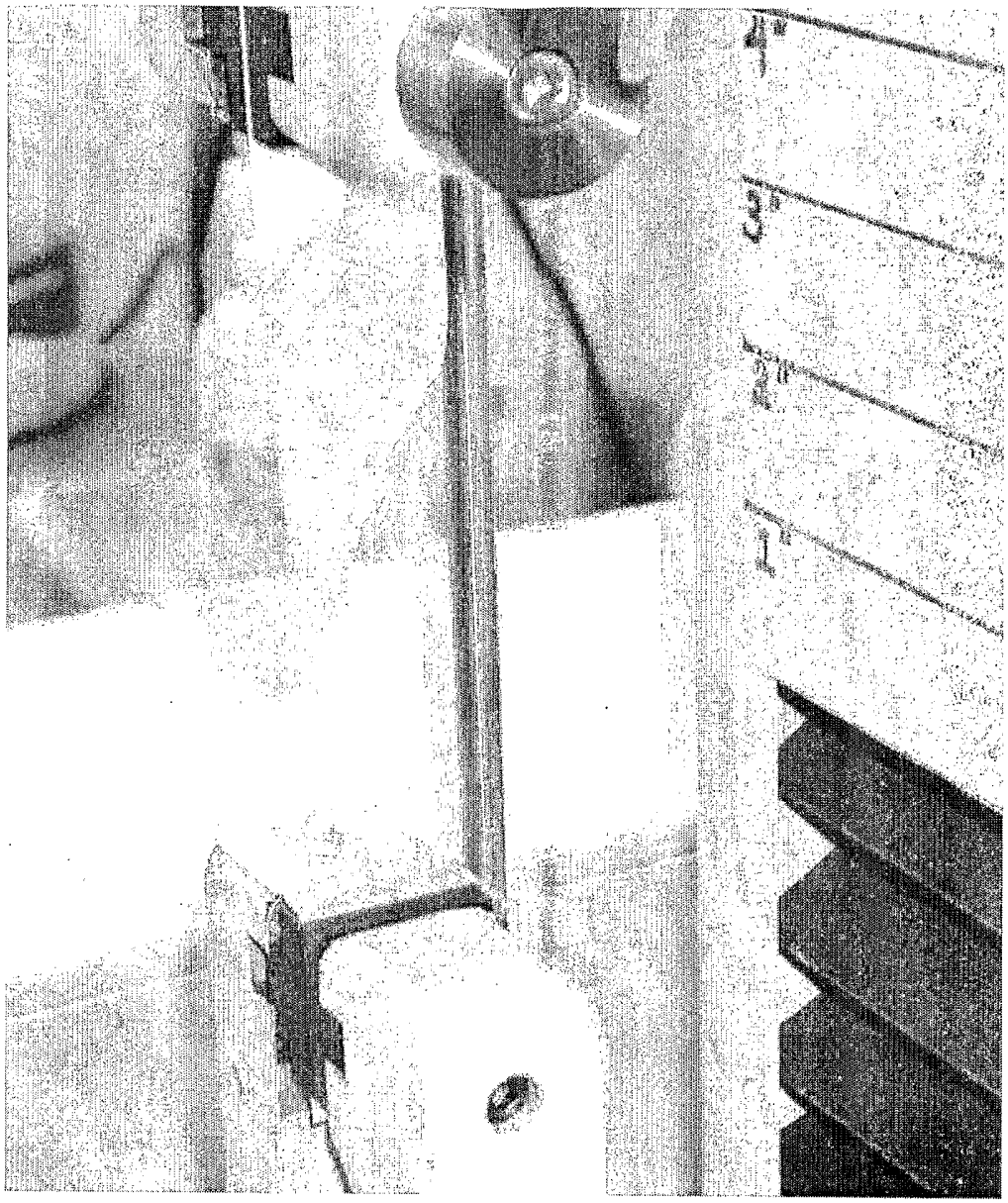

Fig. 4

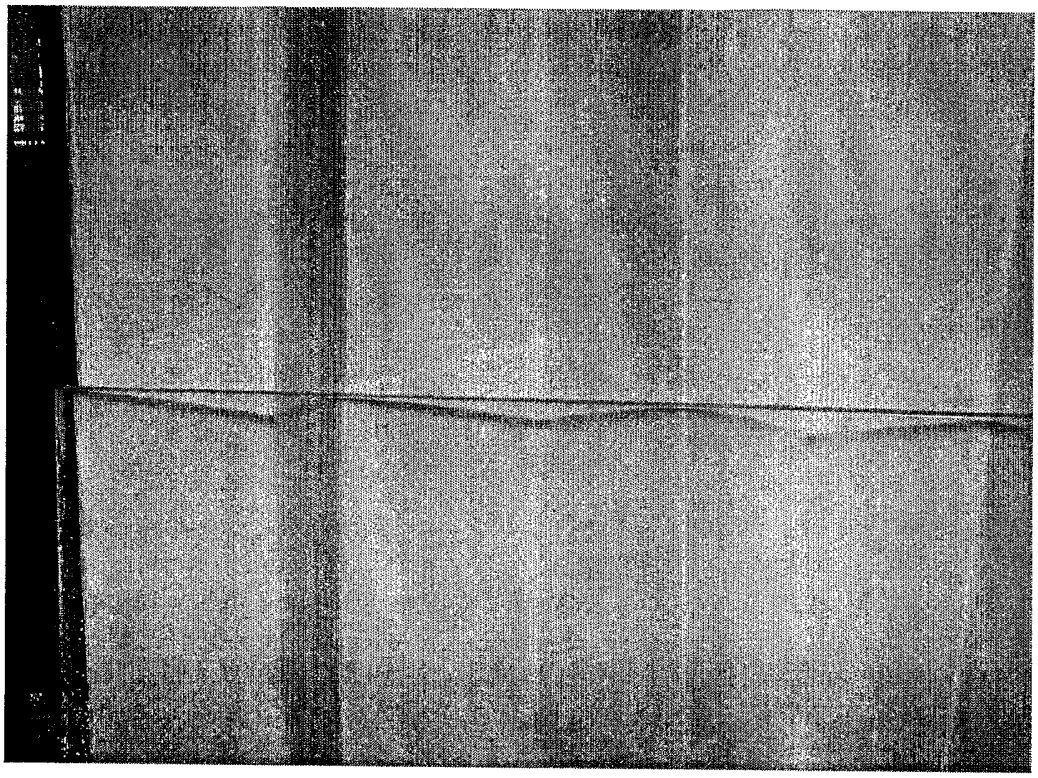

Fig. 5