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Politicchio et al.(10) **Pub. No.: US 2008/0028560 A1**(43) **Pub. Date: Feb. 7, 2008**(54) **DUSTER SYSTEM FOR DAMP AND DRY
DUSTING**(22) Filed: **Aug. 7, 2006**(76) Inventors: **Nicola John Politicchio**, Mason,
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Newport, KY (US)**Publication Classification**(51) **Int. Cl.**
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CINCINNATI, OH 45224**(57) **ABSTRACT**

A duster pad comprising at least one layer comprising hydrophilic non-woven fibers capable of contacting a surface to be cleaned and at least one non-woven layer capable of being attached to a handle wherein the at least one layer comprises at least one free end.

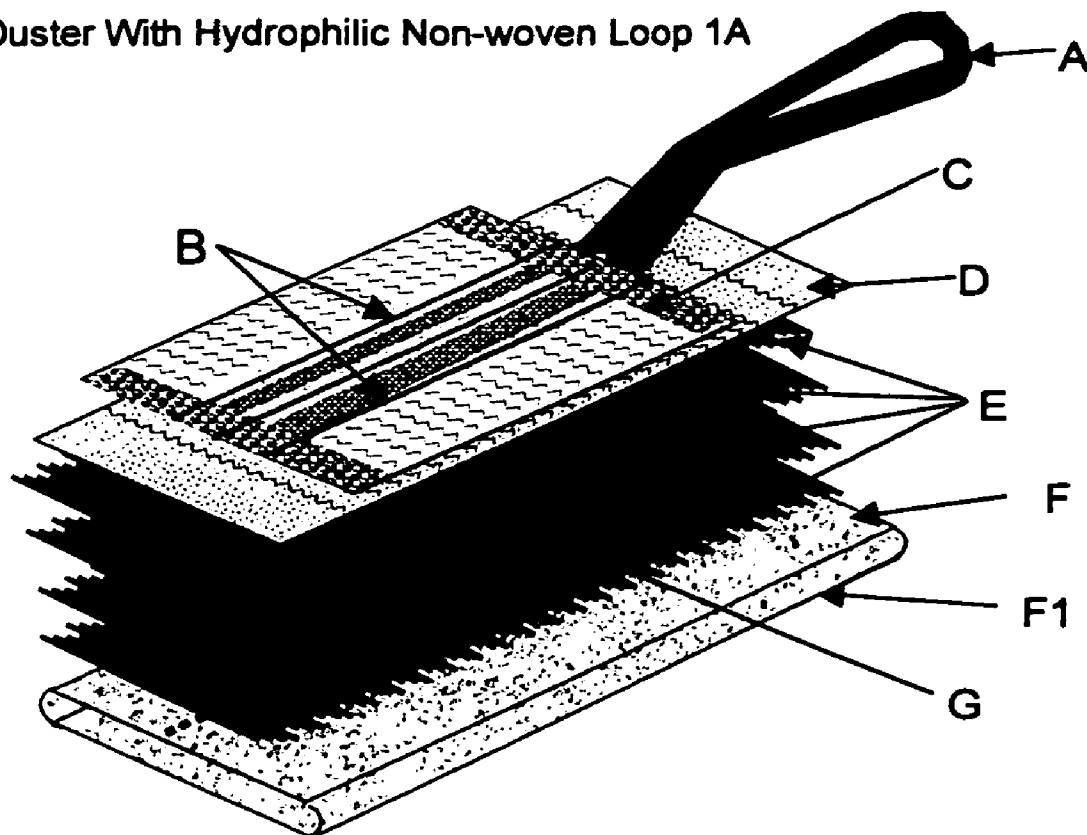
(21) Appl. No.: **11/500,233****Duster With Hydrophilic Non-woven Loop 1A**

Figure 1

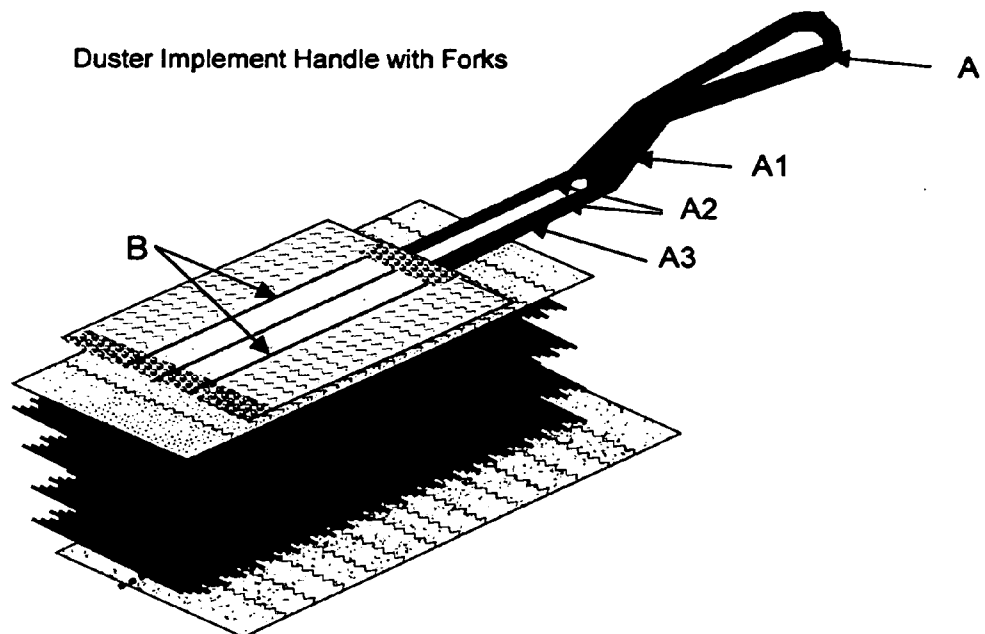


Figure 2

Duster Handle Relative to Cleaning Surface

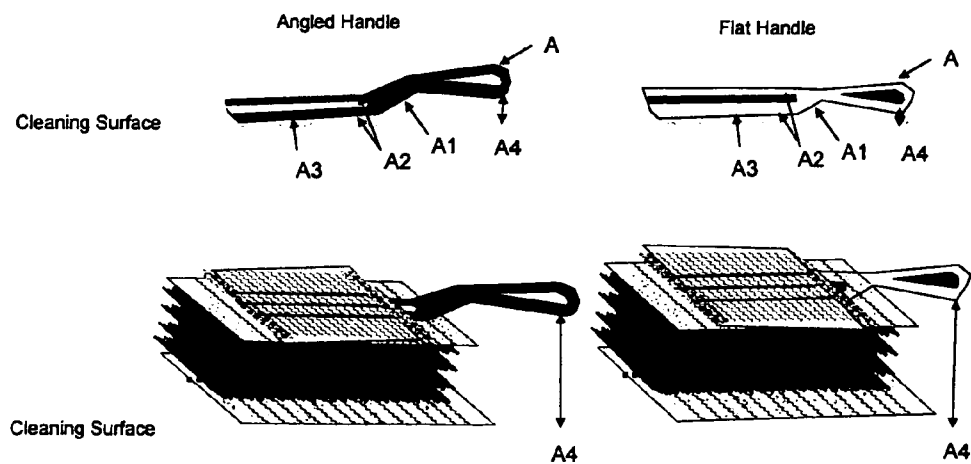


Figure 3

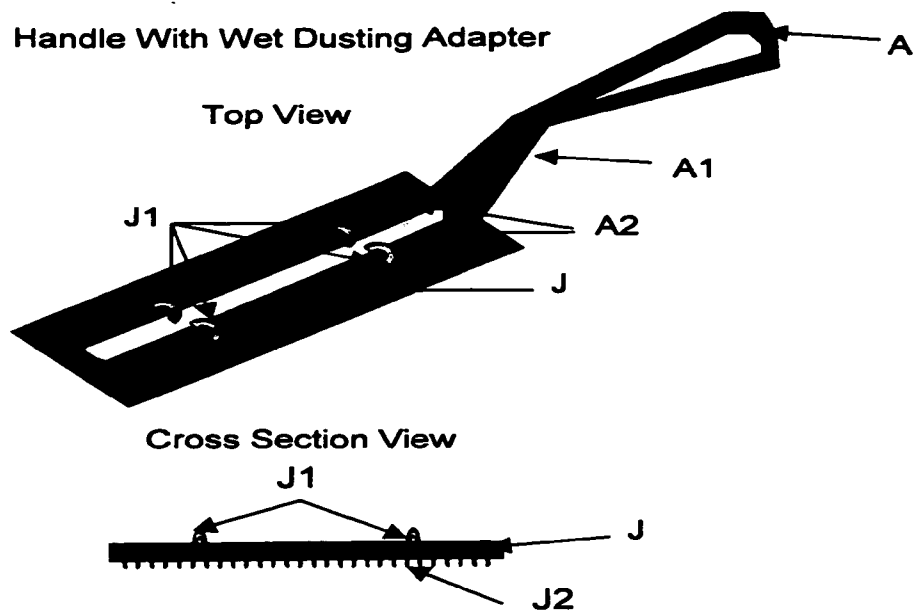


Figure 4

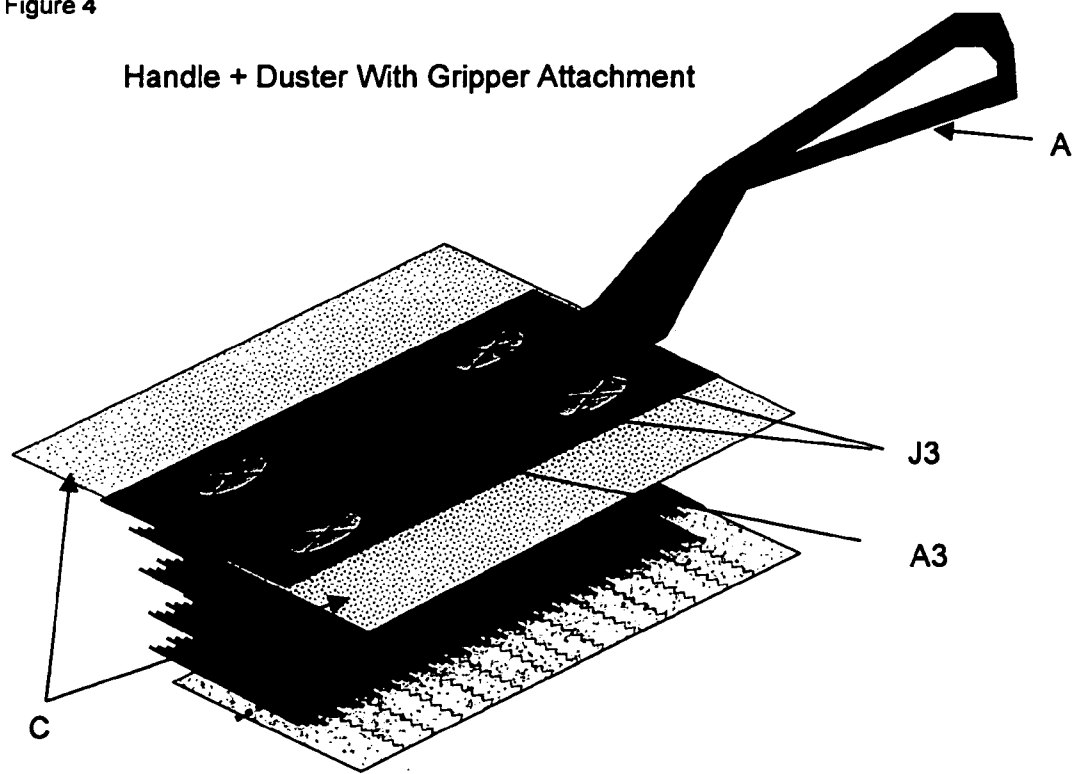


FIGURE 5

Duster With Hydrophilic Non-woven Loop 1A

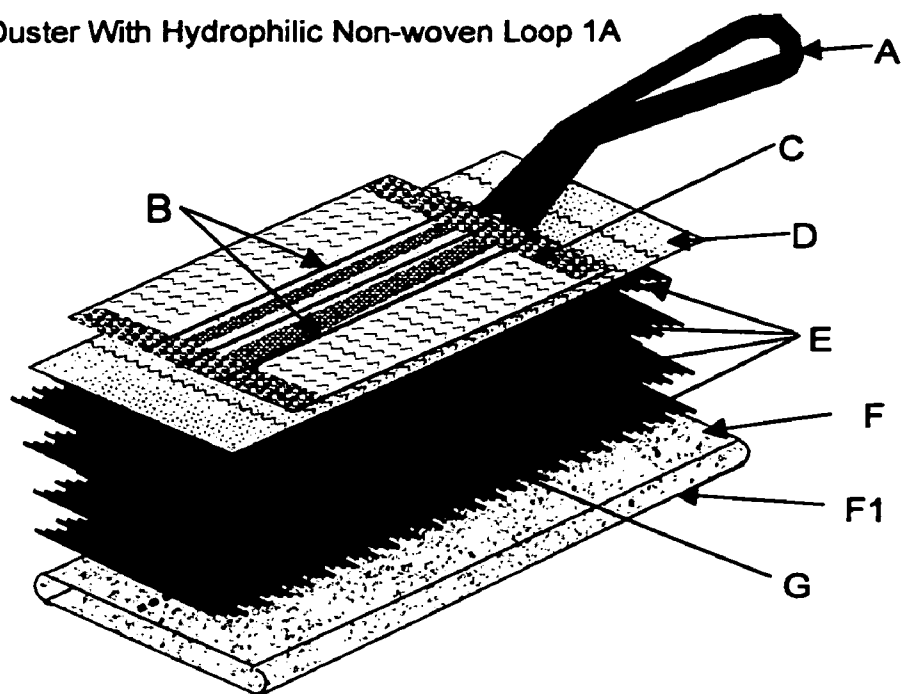


Figure 5A

Duster With Hydrophilic Non-woven Design 1

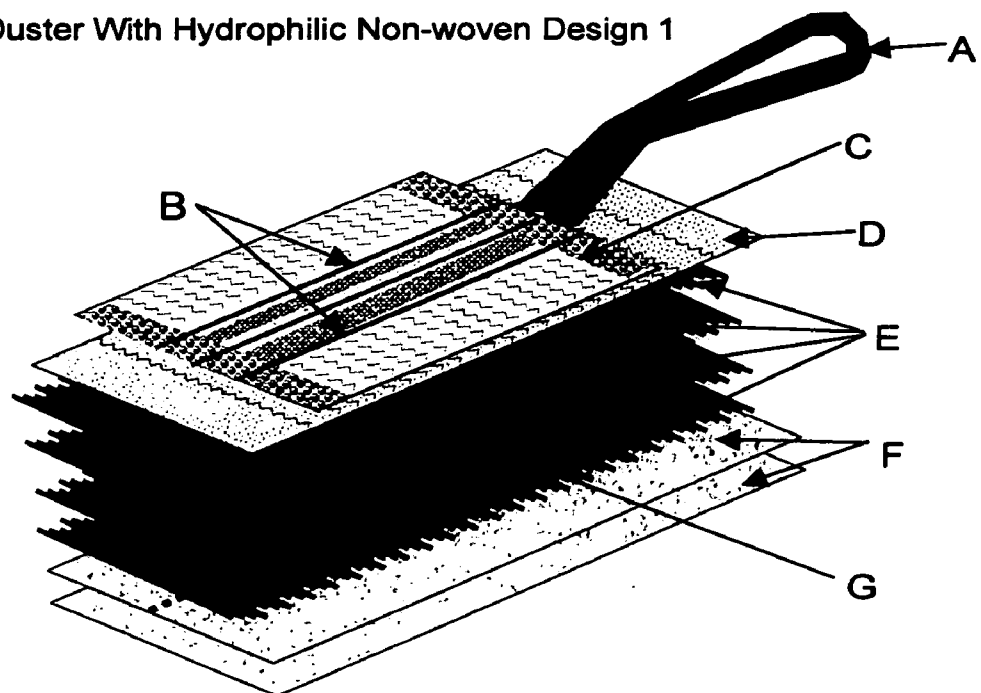


FIGURE 6

Duster With Hydrophilic Non-woven Design 2

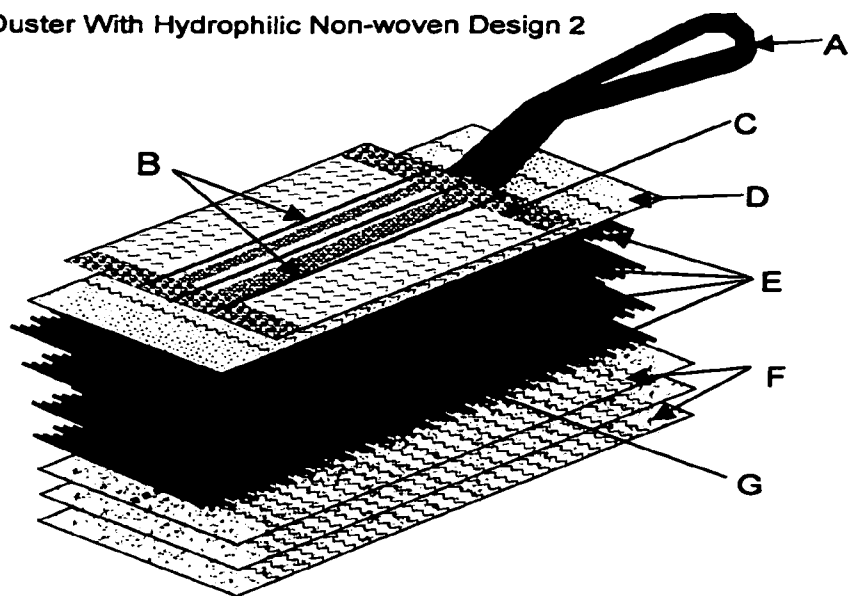


FIGURE 6A

Duster With Hydrophilic Non-wovens with loops 2A

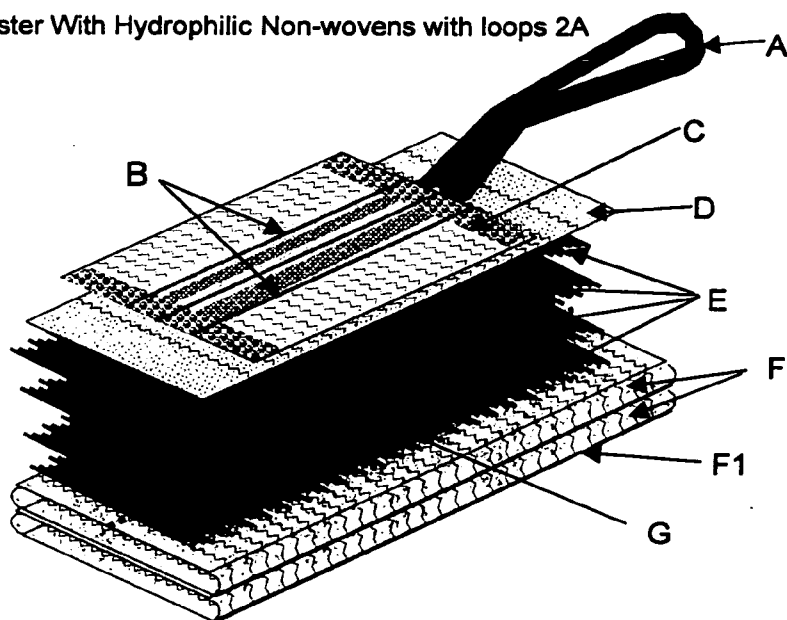


FIGURE 7

Duster With Hydrophilic Non-woven Design 3

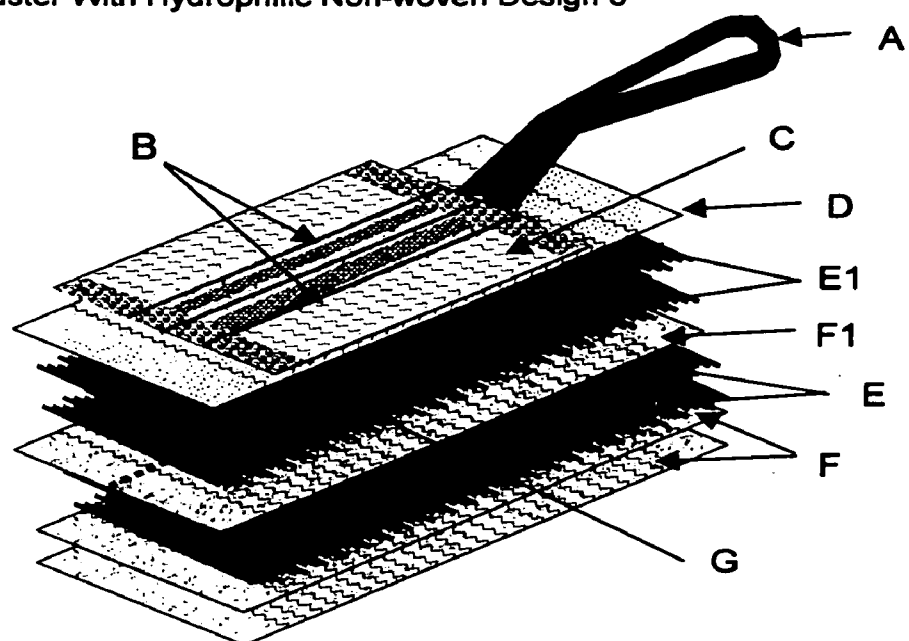


FIGURE 8

**Duster With Hydrophilic Non-wovens +
Absorbent Core Design 4**

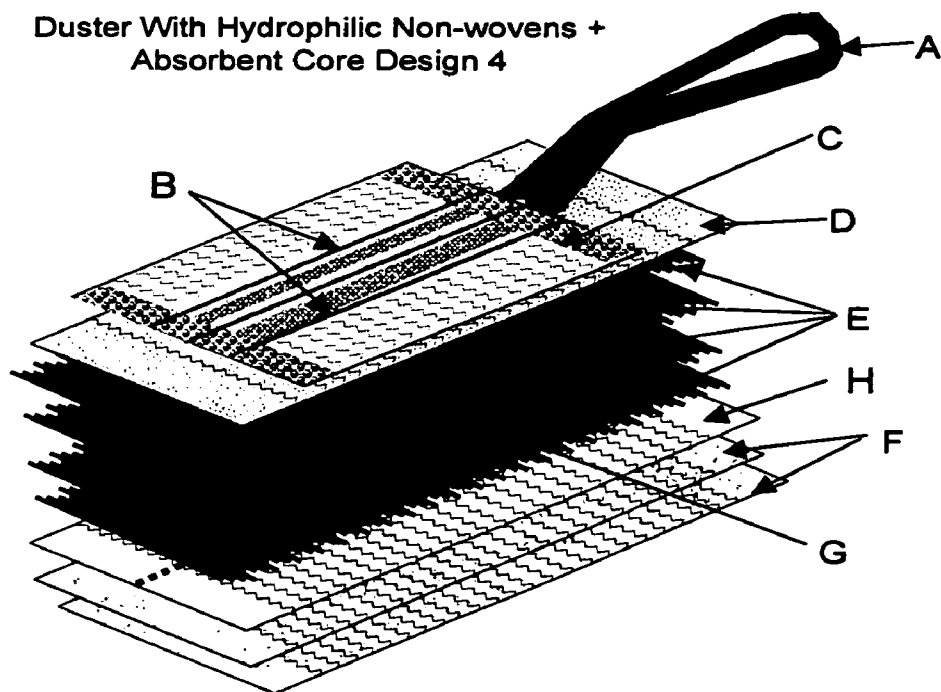


FIGURE 8A

Top View of Cut Pattern of Core or Hydrophilic Non-woven

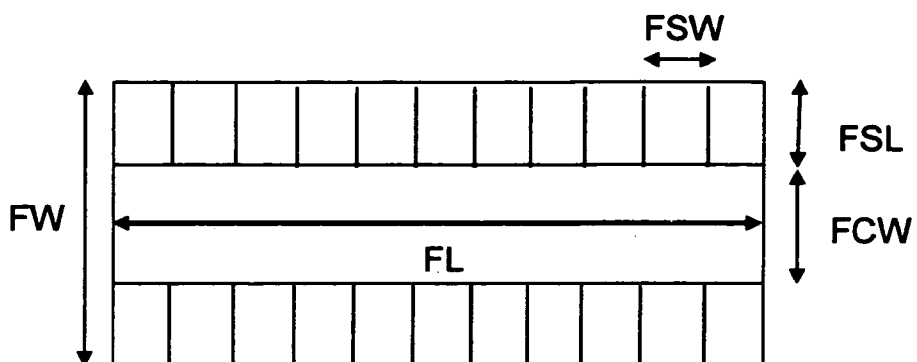


Figure 9

Duster With Hydrophilic Non-wovens + Narrow Absorbent Core Design 5

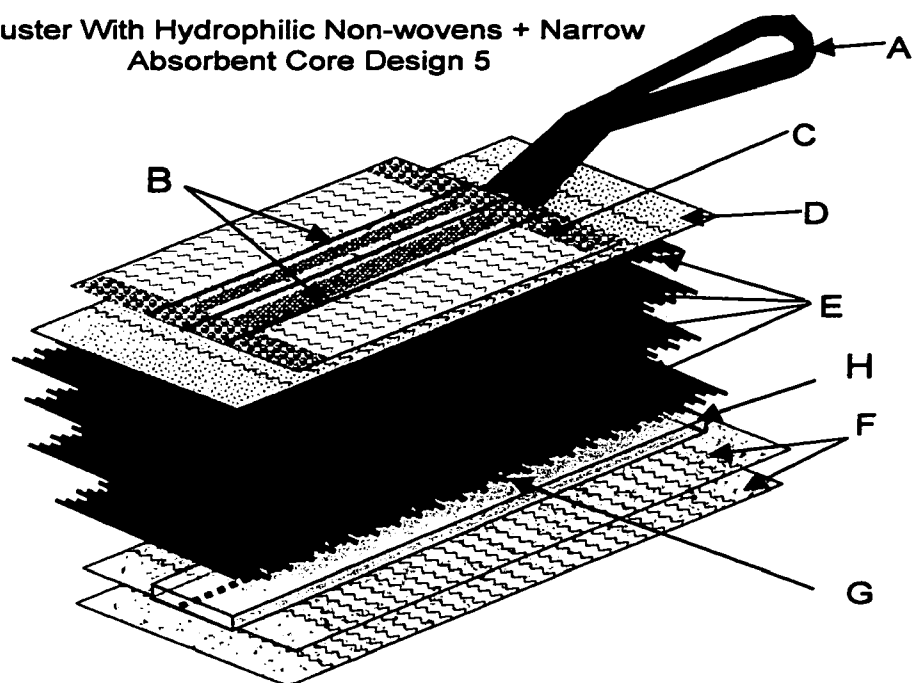


Figure 10

Duster With Hydrophilic Non-wovens Only
Design 6

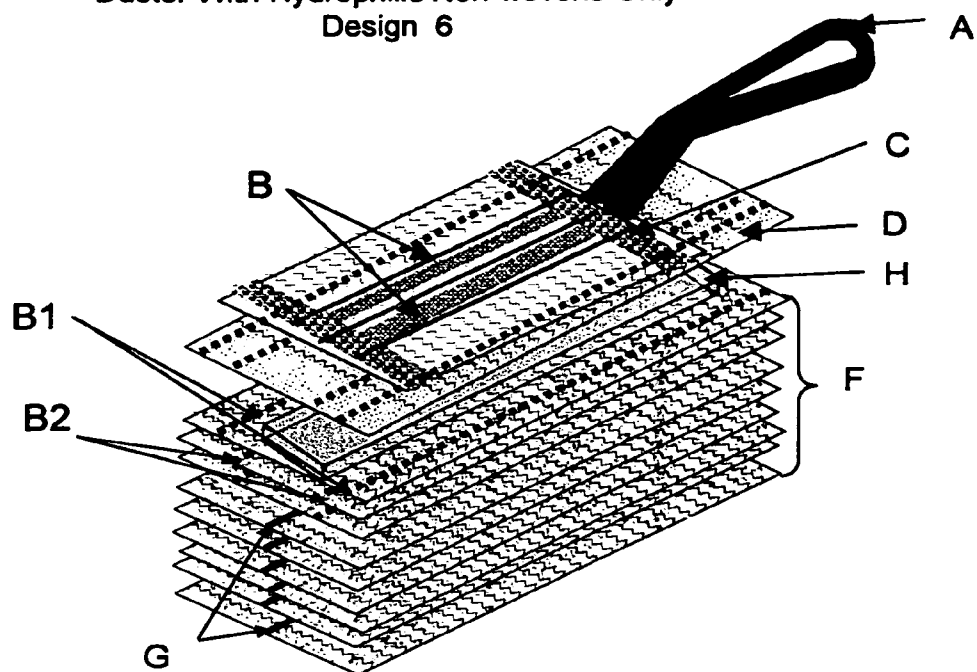


Figure 11

Two sided Dry and Wet Duster Design 7

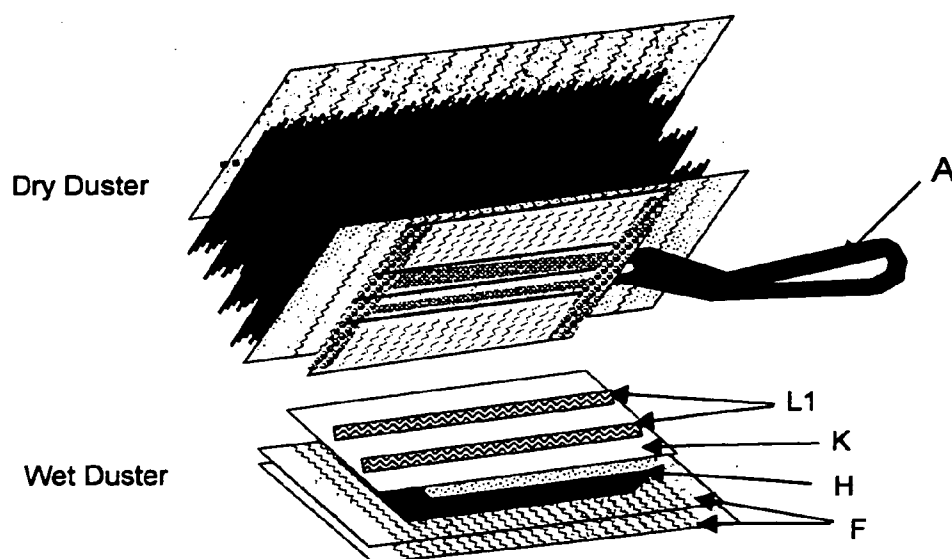


Figure 12

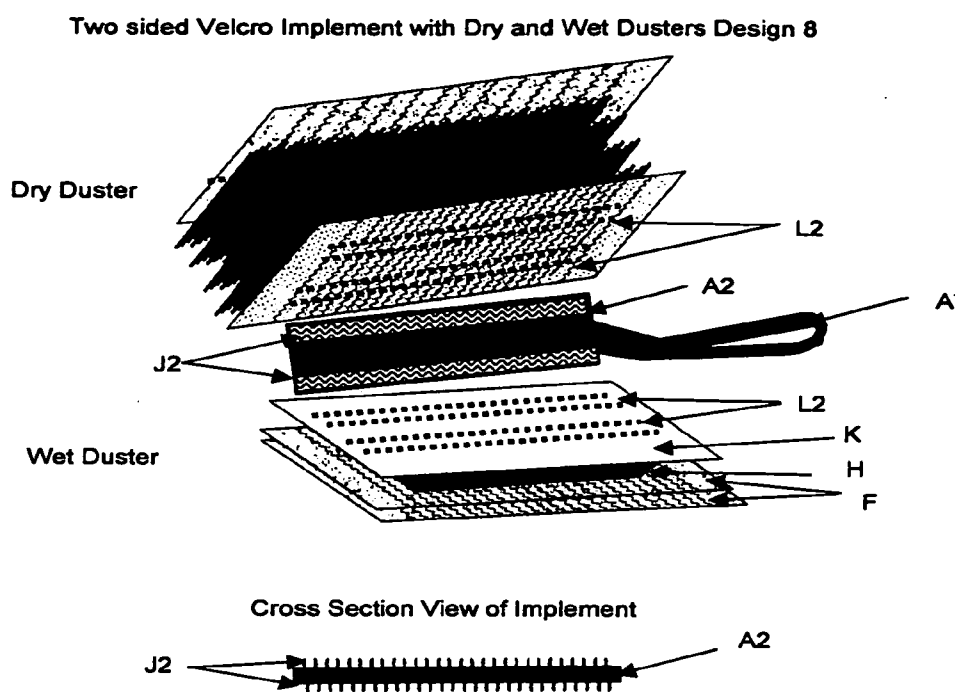
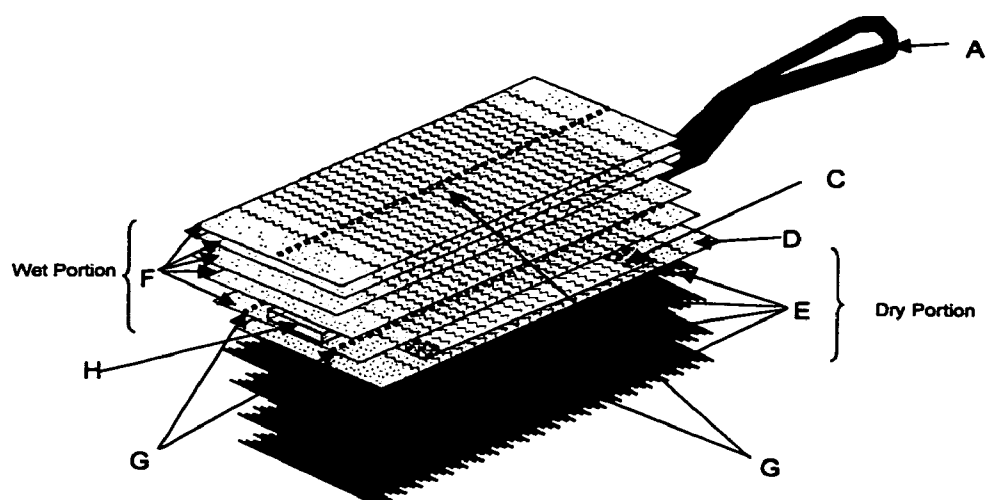


Figure 13

All-in-one Dry and Wet Duster Design 9



All-In-one Side by Side Duster For two sided Use Design 9A

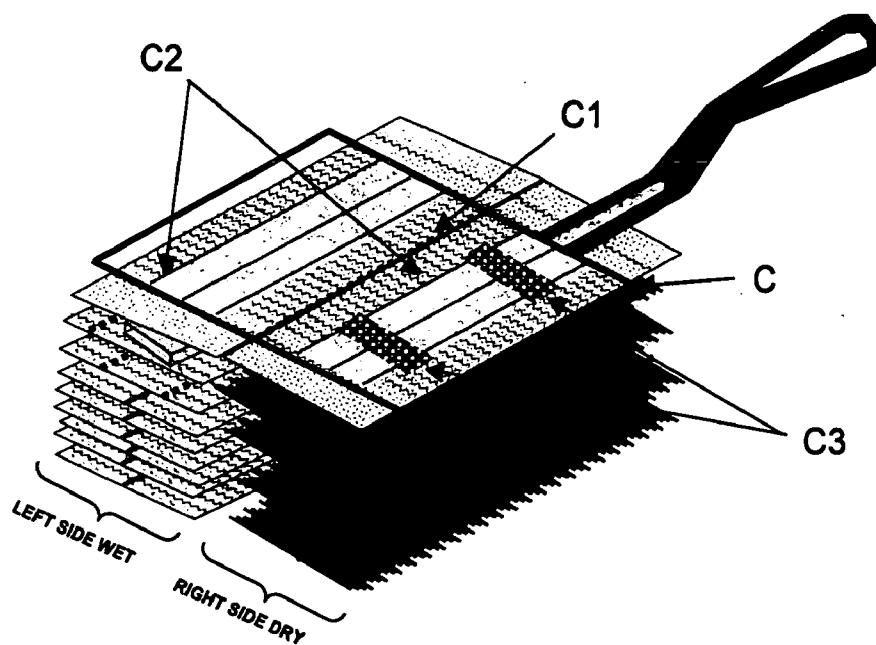


Figure 14

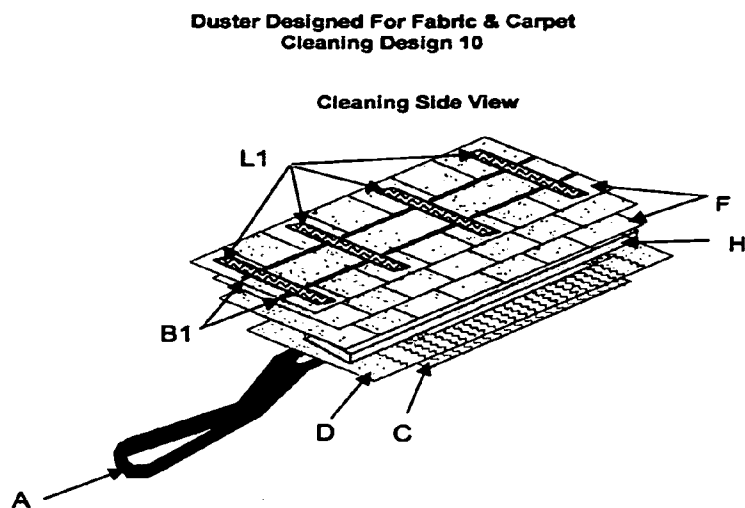
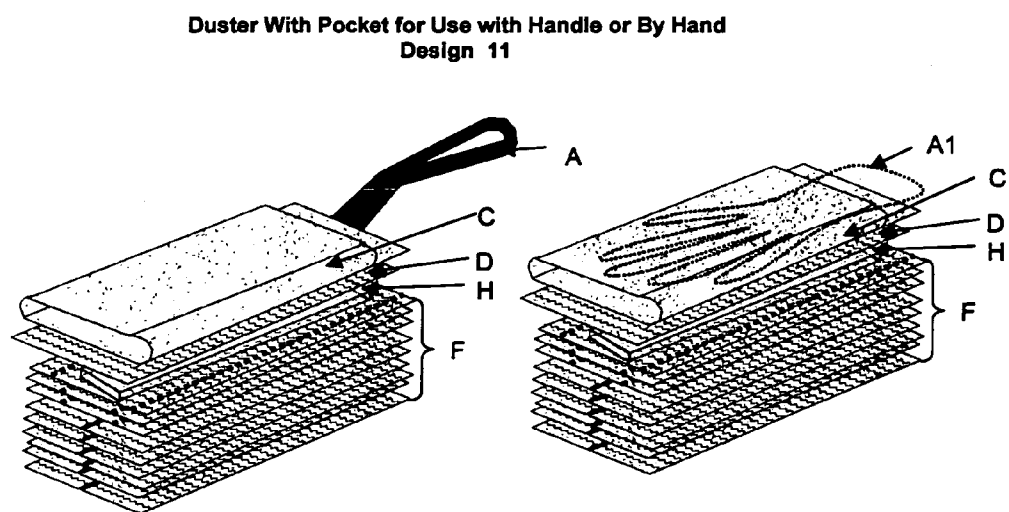


Figure 15



DUSTER SYSTEM FOR DAMP AND DRY DUSTING

BACKGROUND OF THE INVENTION

[0001] Many cleaning articles have been created for dusting. Rags or paper towels used dry or wet with dusting compositions have been used on relatively flat surfaces; however, they are less effective when cleaning cracks and crevices. To overcome the problems associated with rags and paper towels, dust gathering devices have been created using feathers, lamb's wool, and synthetic fibers brushes. These dust gathering devices can be expensive to manufacture, and as such are designed to be re-usable. Soiled traditional dusters are typically cleaned via shaking the dust gathering device. An inherent problem associated with dusting with a dust gathering device is that dust gathering devices do not hold on or trap dust very well. As such, soils trapped by dust gathering devices are prone to redeposit dust, often during use, which can be frustrating to consumers.

[0002] To address the problems experienced with dust gathering devices, disposable dust gathering devices have been developed which have limited re-usability. These disposable dust gathering devices may include brush portions made of synthetic fiber bundles attached to a non-woven. While these disposable dust gathering devices may be useful for dusting, when used in combination with liquid cleaning compositions the disposable dusters are rendered ineffective. Moreover, oils and/or other materials that are coated onto the disposable dust gathering devices can be washed off. While the use of liquids with dust gathering devices may provide some cleaning, the residue and soils that remain are often worse than before utilization of the dust gathering devices.

[0003] The S.C. Johnson company introduced a disposable dust gathering device used in combination with a spray solution. This system is prone to leaving behind a visually noticeable residue. This residue creates an unacceptable hazy appearance on glass and shiny surfaces. On wood surfaces, the shine is often uneven and splotchy due to inability of the duster to evenly spread the solution across the entire surface. A significant deficiency of the Pledge system is that it is constructed of 100% thermoplastic synthetic materials. Instrumental analysis using Infrared and Light microscopy indicate that the materials making up the Pledge duster are bicomponent thermoplastic synthetic fibers of polyethylene and polyester. This includes the attachment layer non-wovens and fibrous tow material making up the cleaning layers. While synthetic non-wovens and synthetic fibrous materials such as tow fibers have characteristics that make them effective for dry dusting, they are not optimized for wet dusting, smudge removal or wet cleaning. Thermoplastic synthetic fibers such as polyethylene and polyester have a low affinity for water or aqueous solutions and poor water absorbency. Furthermore, the water or aqueous solution that is adsorbed between the fibers is only loosely bound and is therefore easily dumped back onto the surface. As a result, dusters composed of synthetic fibers do not evenly or effectively spread liquid when wiped across a surface.

[0004] While attempts to improve the cleaning characteristics of dust gathering devices have been made, there has to date been no dust gathering device that substantially eliminates its problems and inefficiencies.

[0005] It is, therefore, highly desirable to create a duster that maximizes a user's effort while minimizing the spreading of dust particles. It is also highly desirable to create a duster that does not leave residue when used by itself or in combination with a liquid. Further, it is highly desirable to maximize the functionality and versatility of a duster. This invention accomplishes those goals.

SUMMARY OF THE INVENTION

[0006] One aspect of the invention relates to a duster pad comprising at least one layer comprising hydrophilic non-woven fibers capable of contacting a surface to be cleaned and at least one non-woven layer capable of being attached to a handle, wherein the at least one layer comprises at least one free end.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] FIG. 1 illustrates a duster with a fork removably attached to a hydrophilic sheet.

[0008] FIG. 2 illustrates a comparison between a duster having an angled handle and a duster having a flat handle.

[0009] FIG. 3 illustrates a duster further comprising a wet dusting adapter.

[0010] FIG. 4 illustrates a duster comprising gripper attachments.

[0011] FIGS. 5 and 5a illustrate a duster having two non-woven sheets and a loop of non-woven sheet, respectively.

[0012] FIGS. 6 and 6A illustrate a duster having straight non-woven layers and loop non-woven layers, respectively.

[0013] FIG. 7 illustrates a third alternate duster comprising a hydrophilic non-woven

[0014] FIG. 8 illustrates a duster comprising a non-woven and an absorbent core.

[0015] FIG. 8a illustrates a top view of the cut pattern of the core or hydrophilic non-woven.

[0016] FIG. 9 illustrates an alternate duster comprising a non-woven and a narrow absorbent core.

[0017] FIG. 10 illustrates a duster comprising an alternate core and non-woven.

[0018] FIG. 11 illustrates a duster capable of two sided wet and dry cleaning.

[0019] FIG. 12 illustrates a duster having a hook and loop attachment mechanism for wet and dry dusting.

[0020] FIG. 13 illustrates an all-in-one dry and wet duster design.

[0021] FIG. 14 illustrates a duster capable for fabric and carpet cleaning

[0022] FIG. 15 illustrates a duster sheet capable of attachment to a handle or to a user's hand.

DETAILED DESCRIPTION OF THE INVENTION

[0023] While the specification concludes with the claims particularly pointing and distinctly claiming the invention, it is believed that the present invention will be better understood from the following description.

[0024] The devices, apparatuses, methods, components, and/or compositions of the present invention can include, consist essentially of, or consist of, the components of the present invention as well as other ingredients described herein. As used herein, "consisting essentially of" means that the devices, apparatuses, methods, components, and/or

compositions may include additional ingredients, but only if the additional ingredients do not materially alter the basic and novel characteristics of the claimed devices, apparatuses, methods, components, and/or compositions.

[0025] All percentages and ratios used herein are by weight of the total composition and all measurements made are at 25° C., unless otherwise designated. A degree is a planar unit of angular measure equal in magnitude to $1/360$ of a complete revolution. When possible, an angle is measured between the outer edge of the inner facing surface and the vertex, whereby the outer edge is located is distally located from the vertex.

[0026] All measurements used herein are in metric units unless otherwise specified.

[0027] All ratios described herein are on a weight by weight basis unless otherwise specified.

[0028] As used herein "limited re-usability" means that the substrate is used for one job (one job equaling cleaning about 100 square feet of surface), stored and re-used for about 2 to 5 more jobs (cleaning about 200 to about 500 square feet of surface), and then disposed of.

[0029] As used herein "disposable cleaning substrate" means that the substrate is typically used for cleaning and then disposed of. Such disposable cleaning substrates have limited reusability. For purposes of clarification, traditional dusters including feather dusters, cloths, string mops, strips mops and the like, are not disposable cleaning substrates for purposes of this invention.

[0030] As used herein "bundle fibers" and/or "tow" means fibers comprising thermoplastic synthetic polymers including polyester, polypropylene, polyethylene and cellulosic materials including cellulose acetate and mixtures thereof manufactured where in the individual fibers are long continuous strands manufactured in bundles. In the context of a duster where the bundle fibers are cut, the bundle fibers is defined as any fibers which have a distinct start and end point where in the distance between the start and end point is at least about 1 cm in length.

[0031] As used herein "basis weight" means the weight of a non-woven substrate or layer divided by its area. It is herein reported on as grams per square meter (g/m^2).

[0032] As used herein "hydrophilic", "naturally hydrophilic" and "cellulosic" refers to fibers that have a high affinity for water and/or aqueous solutions. Hydrophilic fibers include but are not limited to woody fibers such as cellulose pulp obtained from trees or produced by microbes, and non-woody fibers such as cotton, hemp, jute, abaca, kenaf, sabai grass, flax, esparto grass, straw, bagasse, milkweed floss fibers, and pineapple leaf fibers. Hydrophilic fibers can also include those that are based on naturally hydrophilic fibers but have been chemically treated such as rayon, viscose, lyocell, acetate, triacetate and the like.

[0033] As used herein "hydrophilic non-woven layer(s)" or "hydrophilic non-woven(s)" refers to a layer or layers comprising hydrophilic non-woven fibers.

[0034] As used herein "aqueous solution(s)" "dusting solution(s)" "cleaning solution(s)" means a cleaning solution whether isotropic or non-isotropic, that comprise in one embodiment a majority water, in another embodiment at least about 60%, in yet another embodiment at least about 70%, in yet another embodiment at least about 80% and in still another embodiment at least about 90% water.

[0035] As used herein "hydrophobic", "synthetic", "thermoplastic", and "naturally hydrophobic" refers to fibers are

those that have a low affinity for water and aqueous solutions. Fibers which are naturally hydrophobic include polymers derived from ethylene, propylene, styrene, amides and esters, either as homologous polymers random copolymers or block copolymers.

[0036] As used herein, an 'absorbent core' is defined as a hydrophilic non-woven material with a caliper at least about 0.4 mm thick at 0.1 psi weight that additionally displays an absorbency of deionized water of at least about 7 grams per gram of substrate. The "saturation hang drip" method is used to measure the absorbency of cores and other non-woven materials. A dry non-woven substrate is pre-weighed then dunked into a reservoir filled containing one liter of deionized water. The substrate is allowed to soak for one minute. It is then removed and hung from two ends in a vertical orientation with the length of the non-woven projecting below and allowed to drip freely for 3 minutes. The wet substrate is then weighed and the amount of solution absorbed determined by difference. The gram of water per gram absorbency is calculated by dividing the weight of liquid retained by the weight of the dry substrate. Cores typically have a basis weight at least about 70 g/m^2 , in an alternate embodiment from about 75 g/m^2 to about 500 g/m^2 , in an alternate embodiment from about 75 g/m^2 to about 300 g/m^2 and in an alternate embodiment from about 75 g/m^2 to about 250 g/m^2 . Absorbent cores act as reservoirs for the retention of aqueous fluids and are chosen such that the density of the non-woven is at most about 0.15 g/cm^3 , in an alternate embodiment at most about 0.125 g/cm^3 and in an alternate embodiment at most about 0.10 g/cm^3 so as to maximize fluid capacity and bulk.

[0037] As used herein "kinetic coefficient of friction" means the friction created between a substrate and a surface wiping across a given amount of de-ionized water under a pressure of about 5 g/cm^2 measured while the substrate is in motion.

[0038] As used herein "static coefficient of friction" means the friction created between a substrate and a surface wiping across a given amount of de-ionized water under a pressure of about 5 g/cm^2 measured when the substrate is at rest.

[0039] For purposes of orientation, unless otherwise specified, the z-direction of the duster is the direction perpendicular to the non-woven layer closest to the handle; the x-y plane of the duster is defined as the plane defined by the non-woven layer closest to the handle.

[0040] It has now surprisingly been discovered that the duster of the present invention provides increased cleaning efficiency. The present invention incorporates the advantages of being disposable as well as the benefits of traditional rags, paper towels, and the like for cleaning and dusting a wide assortment of surfaces ranging from hard surfaces such as wood, melamine, and glass, to soft surfaces including fabrics, upholstery, and carpet. This performance is achieved by a duster comprising a handle and a duster pad, said duster pad comprising at least one hydrophilic non-woven layer, optionally at least one absorbent core and optionally at least one fiber bundle layer. In one embodiment, the hydrophilic non-woven layer, optional absorbent core and/or optional fiber bundle layer, and optional cores are centrally joined forming the duster pad. In another embodiment, the hydrophilic sheet is positioned on the outer portion of the duster, directly facing the cleaning surface; the optional fiber bundle layer is positioned between the optional core layer and the hydrophilic non-woven layer. In another embodiment, the

hydrophilic non-woven layers comprise a plurality of strips free to move independently from each other for improved cleaning and dust pick-up, especially in tough to reach areas. In yet another embodiment, the duster comprises hydrophilic non-woven layers partially formed into strips in combination with one or more absorbent cores.

[0041] The present invention is also capable of being used in combination with cleaning solution for wet cleaning and smudge removal. In one embodiment, the cleaning solution is pre-applied to the duster pad, creating a pre-moistened duster. In another embodiment, the cleaning solution is contained within a separate container, such as an aerosol sprayer, non-aerosol sprayer, bottle, and the like for dosing on the duster pad and/or the surface to be cleaned. For multi-surface usage the cleaning solution in one embodiment comprises at most about 1% and in another embodiment than about 0.5% solids by weight.

[0042] Without wishing to be bound by theory, it is believed that the improved cleaning of the present invention is a result of the physical characteristics of the duster and duster pad. The duster pads of the invention comprise at least one layer comprising hydrophilic non-woven fibers, wherein the layers are bonded in a configuration so as to provide at least one free end that moves independently. In one embodiment, free ends are achieved by partially bonding at least one layer comprising hydrophilic non-woven fibers to a second layer. In an alternate embodiment, an increased amount of free ends is created by cutting the layer comprising hydrophilic non-woven fibers into a plurality of strips. The free ends are capable of moving, thus allowing the duster to compress into a flat position and increase the ability of the duster to get into small spaces. By having one layer or in the alternative at least two layers with moving free ends, the surface area of the duster pad is increased providing better cleaning of large areas. The duster of the present invention is also capable of being "fluffed up" to be used to clean three-dimensional surfaces, irregular shaped surfaces, curved surfaces and the like. Moreover, the hydrophilic fibers of the duster pad and the optional absorbent core, unlike other dusting gathering devices, have a high capacity for absorbing and trapping water, enabling wet cleaning.

Handle:

[0043] The duster of the present invention comprises a handle. Without wishing to be bound by theory, it is believed that the handle facilitates reach and maneuverability, provides pressure to the cleaning surface to improve cleaning, and provides separation between the dust and the user's hands. Any handle that inserts into, or is used in conjunction with, the duster pad of the invention is contemplated.

[0044] In one embodiment, a handle of the present invention comprises a gripping portion, an attachment portion, and a wiping portion. The gripping portion is defined as the portion of the handle used for gripping. The attachment portion operatively connects the gripping portion and the wiping portion. The wiping portion is capable of being removably connected to the duster pad. In one embodiment, the gripping portion and wiping portion of the handle is in the same x-y plane. In an alternate embodiment, the gripping portion and wiping portion of the handle are in different x-y planes. In such an embodiment, the x-y planes formed by the length and width of the gripping portion and wiping portion

intersect each other so that the angle formed from at the intersection of the x-y planes is from about 70° to about 160°.

[0045] The handle is connected to duster pad and/or any optional attachments by any means known in the art, including mechanical and chemical means. In one embodiment, hook and loop fasteners such as Velcro® hooks, are used in conjunction with a handle. In another embodiment, at least one is formed into at least one pocket along the duster pad, and the handle is inserted into the pocket.

[0046] The following are non-limiting handles provided to illustrate the duster of the present invention. One of ordinary skill in the art will recognize that alternative designs can be made with the knowledge provided herein.

[0047] A implement handle design which is used with a dry duster is described in patent filing WO 02/34101 A1 filed Oct. 25, 2001 to Tanaka et al. A representative drawing of this duster is shown in FIG. 1. The implement handle comprises a gripping portion A, transition portion A1, attachment portion A2 and wiping portion A3. In this illustration, the wiping portion is bifurcated at the root end to provide two insert plates or forks, which are flat and level, and are to be inserted into the gaps formed in the pocket B of the duster pad.

[0048] The implement described in FIG. 1 has a transition portion A1 at an angle upward away from the surface being cleaning. By contrast, the flat handle shown in FIG. 2 has a gripping portion A, an attachment portion A2 and a wiping portion A3 are all in the same plane. The flat handle design is rendered more ergonomically friendly when the number of non-woven layers is increased. This is shown by A4 which is the distance between the cleaning surface and the gripping portion A when the implement is held in a parallel position relative to the cleaning surface.

[0049] To provide increased rigidity, the handle illustrated in FIG. 3 incorporates an adapter below the wiping portion. The forks of the wiping portion A2 are attached to an adapter piece J. The forks A2 are slipped through eyelets J1 which are formed into the adapter piece J. The adapter of this embodiment re-enforces the forks A2, and widens cleaning base. Increased rigidity from the adapter benefits edge cleaning for framed surfaces such as mirrors, windows, TV screens and the like. It also provides improved scrubbing and surface contact ability for z-directional cleaning of all surfaces. The adapter piece is capable of being attached and detached on the handle via any means known in the art. The detachment ability is beneficial as there are situations where users may wish to have flexible forks either for wet or dry dusting. To allow for attachment under both these situations the adapter J in one embodiment comprises an additional attachment mechanism. Any attachment means known to one of ordinary skill is contemplated. As a non-limiting example, hook and loop fasteners J2, such as Velcro®, are located on the bottom of the adapter. To ensure attachment, the material used to form the outer most portion of the duster pocket comprises of a fibrous material such as a thru-air non-woven, or comprise looped non-wovens typically used in conjunction with Velcro® hooks. In an alternate embodiment loop materials that are specifically designed to engage with hooks are chosen. Non-limiting examples of suitable

loop materials include the XPL series, including XPL-99139 available from 3M Corp., Series 800, 804, and 040 loops from Aplix Corp., Series 1000 and 2000 from Velcro USA Inc.

[0050] In an alternative embodiment, the entire handle is modified by making the wiping portion of the implement wider and stiffer. The hook and loop attachment means shown in FIG. 3 as well as all other mechanical fastening systems known in the art are contemplated for use. In an alternative embodiment, grippers are incorporated on the wiping portion as shown in FIG. 10. In an alternate embodiment, the duster design includes an attachment non-woven C having a wider width than the wiping portion of the handle A. The extra width of the attachment non-woven C allows the non-woven to be wrapped around the wiping portion A3 so that it can be secured into slitted grippers J3 located above the wiping portion A3 of the implement.

Duster Pad:

[0051] The duster of the present invention comprises a duster pad. The duster pad of the present invention comprises at least one layer comprising hydrophilic non-woven fibers. While there is no limitation on the number of layers comprising hydrophilic non-woven fibers that can be added to the duster, performance and commercial considerations provide a range of from 2 to about 20 layers, in another embodiment from 3 to about 15 layers, and in another embodiment from 4 to about 12 layers. The basis weight of each hydrophilic non-woven is from about 5 to about 500 g/m², in another embodiment from about 10 to about 125 g/m², in another embodiment from about 15 to about 75 g/m², and in another embodiment from about 15 to about 50 g/m². In one embodiment, the hydrophilic non-woven is formed into a plurality of strips that are joined together. While non-wovens with high cellulosic content are contemplated, they are more difficult to consolidate into a duster using high speed manufacturing processes using heat sealing, pressure bonding or ultrasonic welding techniques. As such, other bonding methods such as gluing and sewing are used in addition to the high speed manufacturing process above. In another embodiment, to facilitate consolidation of the materials using a high speed manufacturing process, the non-woven can advantageously be constructed of a mixture of hydrophilic fibers and low melt point thermoplastic synthetic fibers such as polyethylene, polypropylene or mixtures thereof. In one embodiment, the low melt point thermoplastic material consists of bicomponent fibers wherein the inner fiber core is a high melt point polypropylene or polyester and the outer sheath is low melt point polyethylene. In one embodiment a thermoplastic synthetic layer is composed of lower melt point materials having a lower melt point lower than about 175° C., in an alternate embodiment at most about 150° C., in an alternate embodiment at most about 130° C. Bicomponent fibers comprising an outer sheath polyethylene layer, especially when combined with the inner polypropylene core, can also advantageously be used to promote stronger bonding at faster manufacturing speeds.

[0052] In one embodiment, the hydrophilic cellulosic and low melt thermoplastic synthetic fibers are mixed homogeneously and formed into fabrics using non-woven making processes such as carded thermal bonding, thru-air bonding

or spun-lacing. One process for cellulosic non-woven making can be constructed using a wet laid approach. A wet laid approach takes cellulose fibers and creates a slurry using water and chemicals. The slurry is placed on a screen mesh which allows the water to drain. As the slurry drains it forms into felts. These felts are further de-watered by running the felt through compression rolls and then dried through a drying machine especially designed for making tissue papers. The wet-laid process leads to non-wovens that are very absorbent and very low in Tinting which is highly advantageous in wet dusting and cleaning applications, especially on surfaces such as glass where lint is very noticeable.

[0053] An alternate means for making for improving bonding using high speed manufacturing processes is to create laminates comprising a first side that is a tissue layer and a second side that is a synthetic (or predominantly synthetic) layer. The laminate can be created by any number of means including gluing, mechanical bonding, needle punching, sewing, ultrasonic welding and the like. In one embodiment the tissue non-woven and the synthetic non-woven is consolidated using a spun-lace process. This involves feeding a preformed tissue non-woven and a preformed thermoplastic synthetic non-woven into a spun-lacing process. The high pressure water jets used in the spun-lacing process can effectively bond the tissue onto the thermoplastic synthetic layer. The high pressure from the water jet can actually force some of the fibers in the tissue layer to penetrate through the fibers in the synthetic layer. This results in a substrate that comprises cellulose fibers on both sides of the non-woven.

[0054] To further improve the strength of the laminate and minimize delamination issues, an additional tissue layer can optionally be applied over the exposed side of the synthetic layer forming a trilayer sandwich-type structure. A commercially available tissue laminate non-woven is commercially available under the trade name Genesis technology is available from Ahlstrom Corporation (Two Elm Street, Windsor Locks, Conn., USA). The material is a bilaminate comprising a cellulosic tissue layer bonded onto a synthetic spun-bond layer composed of polypropylene fibers via the spun-lace process.

[0055] In the context of this invention, materials that comprise both hydrophilic and hydrophobic fibers are characterized as either hydrophilic or hydrophobic based on the 'moisture regain' test. The test is conducted by taking about a 0.5 to 1 gram sample of conditioned material, drying it in an oven at about 110° C. for 12 hours and then reconditioning it at higher humidity (65% Relative Humidity and 21° C.) for 5 days. After reaching equilibrium at 65% RH, the amount of moisture gained is measured as a percent: moisture regain=[(total conditioned sample weight at 65% RH—sample weight after drying)+dried sample weight]*100%. For purposes of this invention, 'hydrophilic' material composites have a moisture regain at 65% at least about 2%, in another embodiment at least about 3%, in another embodiment at least 4% and in another embodiment at least about 5% and in another embodiment at least about 6%. Table 1 below shows a comparison of different fiber types for % moisture regain at equilibrium in 65% RH.

TABLE 1

% Moisture Regain at Equilibrium in 65% RH								
Hydrophilic Fibers					Hydrophobic fibers			
Cellulose	Rayon	Cotton	Acetate	Tri-acetate	Polyester	Acrylic	Polyethylene	Polypropylene
12-15	11-13	7-8	6.0-6.5	4.0-4.5	0.4	1.5-2.0	Below 0.1	Below 0.1

[0056] Without wishing to be bound by theory, it is believed that the affinity of water for hydrophilic fibers (particularly those that are cellulosic in nature) is due to the presence of free hydroxyl or anionic groups on the substrate which serve as sorption sites. Water can be firmly chemisorbed to the fibers by hydrogen bonding and somewhat less firmly sorbed through secondary polar interactions. Dust can also be wetted and then sorbed onto the hydrophilic non-woven by aqueous solutions. Success of the chemisorption process depends on the ability of the cleaning solution and duster to overcome the soil-to-surface hydrogen bonding forces. More hydrophilic dusters maximize the energetics of soil adsorption through ionic and hydrogen bonding mechanisms that are weak or non-existent for hydrophobic dusters. Additionally, hydrogen bonding increases the friction between the duster and surface during the wiping motion, imparting better the mechanical action for pick-up and reducing the need for consumers to exert additional pressure. Finally, high absorbency of the hydrophilic material also guarantees enhanced siphoning of fluid, reducing the level of left-behind residue. By contrast, hydrophobic fibers, especially bundle fibers such as tow, and even cellulose acetate to a lesser extent, suffer from poorer kinetics and thermodynamics for adsorption, absorption and retention of fluids and embedded soils. In the presence of aqueous compositions, the bundles bunch up with each other so as to lower the interaction with water, and this can lead to the formation of lines during the cleaning process. Without the benefit of absorbency, the lines turn into streaks following dry-down of the aqueous composition.

[0057] Other non-woven layers and woven layers may optionally be used within duster pads of the present invention. These layers include any combination of hydrophobic, hydrophilic and neutral layers. One of ordinary skill would readily understand after being instructed by this invention what additional layers may be incorporated.

Optional Synthetic Fiber or Bundle Fiber Layers:

[0058] The duster pad of the present invention optionally comprises bundle fiber layers. The bundle fiber layers of the present invention also include synthetic fibers. In one embodiment, bundle fiber layers are intermixed together with the hydrophilic non-woven layers of the invention in any manner. In an alternate embodiment, the bundle fibers are not situated on the outermost perimeter of the duster pad. Bundle fiber layers provide an opportunity to increase the versatility of the dusters of the invention by providing dry dusting capacity. Bundle fibers may also be incorporated for aesthetic reasons, for example, to improve the look, feel and fullness of the duster. Dry dusters are well known in the art and have been widely commercialized. While the bundle fibers of many commercial dusters are coated with wax and/or oils so as to provide increase retention of adsorbed

soils, in one embodiment the bundle fibers of the present invention are uncoated. While coatings comprising tacky waxes and/or oils such do provide improved retention of adsorbed soils in dry applications, they can be washed away or rendered ineffective when placed in contact with aqueous media. When the bundle fibers comprise a coating, the coatings present on the bundle fibers of the dusters herein are in another embodiment not easily washed away and have tackifying properties that are not modified by dilute aqueous chemistry.

[0059] If fiber bundles or synthetic fibers are present, the weight a ratio of said fibers to hydrophilic non-wovens and/or absorbent ranges from about 10 to about 1, in another embodiment from about 5 to about 1 and in another embodiment from about 3 to about 1. If cleaning is more important than dusting, the weight ratio of fiber bundles to hydrophilic non-wovens and/or absorbent core is from about 2 to 1, in another embodiment from about 1 to about 1, in another embodiment from about 1 to about 3, and in another embodiment from about 1 to about 5.

Optional Absorbent Core:

[0060] The duster pad of the present invention optionally comprises an absorbent core. The absorbent core comprises a hydrophilic non-woven material with a caliper at least about 0.4 mm thick at 0.1 psi weight that additionally has absorbency of deionized water of at least about 7 grams per gram of substrate. As such, the absorbency typically exceeds that of the hydrophilic non-wovens. The absorbent core can be produced by any process known in the art. In one embodiment the absorbent core is produced using the air-laid process. In the air-laid process, cellulose fibers or cellulose/synthetic fiber blends are suspended in the air and then separated by being laid onto a screen. The fibers are then deposited onto rotating perforated cylinders or moving screen belts. The synthetic polymer is typically a bicomponent comprising of a low melt point polyethylene on the sheath portion and higher melt point polypropylene or polyester as the core. This synthetic polymer is homogeneously blended with the cellulose at ratios from about 5% to 25%. The batt of fibers is compressed and then sent through a heating such as an oven to partially melt the bicomponent which helps to fuse the fibers together. To reduce Tinting a chemical binder emulsion is sprayed on the outer surface of both sides of the web. The typical add-on is about 5 to 25% of dry binder to dry fiber weight. The aqueous formulation of the binder is typically 7-20% solids. The formulation typically consists of a latex binder, a surfactant to help penetration into the web and reduce de-lamination and a catalyst to accelerate the cross-linking reaction during curing. As in the case of the optional stiffening layer described below, the hydrophilic core is, in

one embodiment, positioned in close proximity to the duster handle, thereby providing pressure points for cleaning and dusting applications.

Optional Duster Stiffening Materials:

[0061] The absorbent cores described above not only add absorbency but also help stiffen the wiping portion of the handle, providing rigidity for edge cleaning framed surfaces such as windows, mirrors, TV screens, and the like, and pressure points for stain and tough dirt cleaning. The absorbent core(s) can be positioned anywhere with respect to the duster pad. In one embodiment, the absorbent core(s) is positioned close to the wiping portion of the handle, in an alternate embodiment just below the non-wovens that directly contact the handle so as to maximize pressure points along the length of the duster wiping handle portion. Alternatively, dusters of the present invention comprise a stiffening layer that has limited absorbency properties. Non-limiting examples of suitable stiffening materials that are absorbent include cardboard, PVA foams, and waddings; non-limiting examples of suitable non-absorbent stiffening layers include as polyethylene, polypropylene and polyester films and mixtures thereof, rigid foams, rubber, wood, industrial non-wovens such as Type® and the like.

Optional Premoistening of Duster Hydrophilic Non-Woven Layers:

[0062] In one embodiment, one or more of the hydrophilic non-woven layers in the dusters are premoistened with a cleaning solution. In one embodiment, synthetic fibers and ‘tow’ fibers are not premoistened whereas fiber bundles composed of cellulose acetate are premoistened. Premoistened hydrophilic dusters comprise cleaning solution loaded onto said dusters at a load factor of from about 1 to about 10, in another embodiment from about 1.2 to about 8, in another embodiment from about 1.5 to about 7 and in another embodiment from about 2 to about 6 by weight of chemistry per weight of duster.

Optional Scrubbing Zone

[0063] The duster pad of the present invention optionally further comprises a scrubbing zone. The function of the scrubbing zone is to provide more abrasive cleaning to the surface to be cleaned. One of ordinary skill will readily know of many ways, upon review of this invention, to include scrubbing zones onto the duster pad and/or handle. In one non-limiting embodiment, hooks are located onto the duster pad to create a scrubbing zone.

DUSTER PAD EXAMPLES

[0064] The following are non-limiting duster pad examples provided to illustrate the duster of the present invention. Those skilled in the art will recognize that alternative designs can be made with the knowledge provided herein. Importantly, all the designs below incorporate a handle and hydrophilic non-woven(s). For purposes of simplicity, the handle design is kept the same throughout; those skilled in the art will recognize the opportunities to mix and match handle designs and duster composition designs. Many of the design illustrations below comprise both hydrophilic non-woven fibers and optional fiber bundle or synthetic fibers. Those skilled in the art will recognize that in a dry dusting context, the higher the fiber bundle or synthetic fiber

content, the better the dry dusting performance. Conversely, the higher the hydrophilic non-woven content, the better the wet cleaning. As such, dusters of the invention can be optimized depending on the application need. Bundle fibers can also be incorporated into the duster design for the sole purpose of improving the aesthetic attributes or appeal of the dusters.

[0065] For purposes of clarification, the ‘length of the duster’ is defined as the direction parallel to the length of the handle A inserted into the duster and along the plane of attachment layers C & D. The actual length measurement is taken to correspond to the distance measured on the longest layer of the duster. ‘Non-woven length’ is the edge to edge non-woven distance for the specified non-woven along a vector parallel to the handle length.

[0066] The ‘width of the duster’ corresponds to the direction perpendicular to the length of the handle along the plane of the attachment layers C & D. The actual width measurement is taken to correspond to the distance measured on the widest layer of the duster. ‘Non-woven width’ is the edge to edge non-woven distance for the specified non-woven along the vector perpendicular to the handle length.

[0067] The “thickness of the duster” is defined as the dimension in the z-direction. For the purposes of the invention thickness is defined as “flat thickness” whereby the duster is kept in its original state when first removed from the package and “fluffed thickness” is the thickness after the duster is loosened up using wave motions. Many of the designs described below have compressibility to allow to be used in tight spaces and resiliency which allows it to be effective to clean three-dimensional surfaces and maximize dirt trapping capacity of the duster. To measure this ability to vary thickness the duster’s thickness in a flat position is first measured. “Flat thickness” is measured by removing the duster out of its package without disturbing it. Place the flat duster with the cleaning side facing down in a plexiglass box. The box dimensions are about 1 cm greater in both the lengthwise and widthwise dimension of the duster to allow duster to fit without being hung up. The thickness is measured from the surface where the cleaning side of the duster touches to the highest most points on the opposite side of the duster furthest away from the surface. Using a ruler measure thickness at 5 different points along the length of the duster and 3 different points along the width. The average of these represents the flat thickness. To measure “fluffed” thickness, grip the edges of duster in the lengthwise direction with fingers of each hand. On the corner of a table rub the duster cleaning side down vigorously using 10 strokes to loosen it up. Next using an “S” or “wave” motion move the duster up and down while gripping with the fingers to fluff it up. This should be done with 10 vigorous up and down movements. Place the fluffed duster with the cleaning side facing down gently into the plexiglass box being careful not to compress it. Using a ruler measure thickness at 5 different points along the length of the duster and 3 different points along the width similar to flat duster measurements. The average of these represents the fluffed thickness. In one embodiment the ratio of “fluffed thickness” to “flat thickness” is from about 2 to 1 to 200 to 1, in an alternate embodiment from about 3 to 1 to about 100 to 1, and in an alternate embodiment from about 5 to 1 to about 50 to 1.

Duster Pad Example 1

[0068] An example of the invention combining tow fibers with one or more hydrophilic cellulosic based non-wovens

wherein the non-wovens are placed on the outer clean portion of the duster is shown in FIG. 5. Handle A inserts into pocket B formed by bonding the side of a first non-woven layer C with attachment side of a second non-woven D. Below the attachment side non-wovens, one or more synthetic or fiber bundle layers E (continuous strands of tow fibers) are partially bonded to the attachment side non-woven base material D. Below the fiber bundle layers E, one or more hydrophilic non-wovens F are partially bonded, in another embodiment using a single seal G to the fiber bundle layers E. Attaching the hydrophilic non-woven using a single seal along the length of the duster provides has some freedom of movement for the non-woven during the wiping process due to availability of free ends. The ability for the non-woven to move back and forth is particularly important in allowing some of the fiber bundles to be exposed, especially for dry dusting. The single seal G and dual seals B can be continuous or discontinuous. The availability of hydrophilic and bundle fiber layers allows for effective performance wet or dry.

[0069] FIG. 5A is similar to FIG. 5 with the exception that the hydrophilic non-woven is in the form of a loop configuration F1. The loop is formed by taking the ends of two non-woven layers and folding them toward each other and then tacking them down around on each other.

Duster Pad Example 2

[0070] Alternative embodiments are shown in FIG. 6. All the elements remain the same as in FIG. 5 with the exception of the hydrophilic cellulosic based non-wovens F which are cut into a plurality of strips emanating from the axis defined by the length of the handle A. An exemplary bonding process is a single seal G that runs the length of the pad which is the dimension parallel to the handle A. Cutting the hydrophilic non-wovens into a plurality of strips, thus creating even more free ends, improves freedom of movement back and forth during the dusting process and allows even more exposure of the bundle fibers (tow and/or cellulose acetate) for aiding dust pick-up. The plurality of strips also increases non-woven three-dimensional surface area during use, reaching better into tight spaces and enhancing utilization of the non-woven fibers. FIG. 6A is similar to FIG. 6 with the exception that the non-wovens used to form the plurality of strips is in the form of loops F1. This duster design provides effective performance wet or dry.

Duster Pad Example 3

[0071] An alternative embodiment is shown in FIG. 7. All the elements remain the same as the design in FIGS. 6 or 6A with the exception that one set of hydrophilic non-woven layers F are placed on the outer cleaning portion or below fiber bundles E. One or more additional layers of hydrophilic non-wovens F1 are placed between layers of fiber bundles E1 located closer to the handle. Having hydrophilic layers between layers of fiber bundles provides higher absorbency zones between the fiber bundles E and E1. In embodiments where the fiber bundles are comprised of synthetic fibers (especially tow), the higher absorbency zones aide in drawing moisture away from the synthetic fibers so that they do not get saturated. Optionally, the hydrophilic non-woven F1 located between the fiber bundle layers E and E1 and the hydrophilic non-woven F located on the outer cleaning side

of fiber bundles E can also be in the form of loops as shown in FIG. 6A. This duster design provides effective performance wet or dry.

Duster Pad Example 4

[0072] An alternative embodiment is shown in FIG. 8. All the elements remain the same as the designs shown in FIG. 6 or FIG. 7 with the exception that one or more absorbent core layers H are added between the fiber bundle layers E and the hydrophilic non-woven layers F (or F1 if the strips are looped). An absorbent core adds even higher absorbent capacity and thickness than that provided by the hydrophilic cellulosic layers by trapping and retention, which is especially useful for cleaning and dusting applications that use high solution dosing levels. The core also provides increased rigidity to the duster, strengthening the product appearance. Enhanced rigidity also provides additional degrees of freedom with respect to handle design. Thus, while flexible handles help ease of use, they can be also appear or be flimsy. In such cases, an absorbent core can be used to create pressure points along the length of the handle enhancing tough cleaning and scrubbing properties. The combination of the core and hydrophilic non-woven formed into strips provides the opportunity to deliver the tough cleaning of a pre-moistened wipe and the reach into tight spaces of a traditional duster within the same execution. This duster design provides effective performance especially wet, but can also be used dry.

[0073] It is recognized that the fibers from the fiber bundles can penetrate in between gaps created by cutting the core and hydrophilic non-woven into strips. As these bundle fibers penetrate through these spaces, they can interrupt absorption and friction from the hydrophilic non-woven. An even better design is diagrammatically illustrated in FIG. 8A, which shows a top view of the cut pattern of an absorbent core and/or the hydrophilic non-wovens. In this design the cuts made to form the strips in the width dimension are not continuous and the center portion of the core and/or gather strip remains a solid strip across the entire length FL. The dimension of the cut strip length FSL and dimension of the uncut center width FCW are optimized to minimize fiber bundle penetration while still having enough cut strip length to allow strip to move back and forth. The dimension of the uncut center width FCW is in one embodiment about 25 to 75% the width of the duster FW, in an alternate embodiment about 30% to 65% the width of the duster FW and in an alternate embodiment about 50% the width of the duster FW.

Duster Pad Example 5

[0074] An alternative embodiment is shown in FIG. 9. All the elements remain the same as the designs shown in FIG. 8 with the exception that absorbent core layer H is essentially a solid piece in the x-y dimension positioned in the center of the pad that is not cut into a set of moveable plurality of strips. In one embodiment the width-wise dimension of the absorbent core is narrower than the width of fiber bundles E. in one embodiment from about 25% to about 75%, in an alternate embodiment about 25% to 60% and in an alternate embodiment from about 40% to 60% the width of the fiber bundles E. In one embodiment, the fiber bundles E do not contact the cleaning surface. Since these fiber bundles E comprise of thermoplastic synthetic fibers

they do not absorb well and can negatively affect the friction and absorbency of the hydrophilic non-wovens. Positioning one or more solid absorbent cores between the fiber bundles E and the hydrophilic non-woven plurality of strips F (or F1), substantially prevents the fiber bundles from penetrating through the spaces between the pluralities of strips. This mitigates interference caused by the fiber bundles on the cleaning ability of the hydrophilic non-woven strips. In essence, the duster is optimized to have two different cleaning zones. The outer face of the duster represents the portion of the duster optimized for cleaning surfaces such as glass mirrors and windows where high absorbency and ability to smooth-out solution is important for avoiding streaks. The sides of the duster are optimized for removing dust since fiber bundles typically provide a greater surface area and greater number of attachment points for dust to get trapped.

Duster Pad Example 6

[0075] Duster Pad Example 6 comprises a handle, hydrophilic non-wovens cut into strips, and an optional solid core. It does not include the fiber bundle layers of Duster Pat Examples 1 to 5 shown in FIGS. 5 through 9. Removing the bundle fibers from the design optimizes the duster for wet cleaning and dusting applications and discourages dry usage relative to the designs disclosed hereinbefore. This design is particularly well suited for the cleaning of surfaces that require significant levels of aqueous fluid such as glass including mirrors and windows. The design is also effective for picking up dust particularly in a dampened form.

[0076] An alternate embodiment of the design is shown in FIG. 10. Starting with handle A which inserts into pocket B formed by bonding attachment side first non-woven layer C with attachment side second non-woven D. Below the attachment side non-wovens, one or more absorbent cores H are bonded to the attachment side non-woven base material D. Below the absorbent core layers H, multiple layers of hydrophilic nonwovens F (or F1 if the layers are formed into loops) form the outer portion of the duster architecture.

[0077] In another embodiment one or more hydrophilic layers just below the attachment non-wovens C and D are bonded using a wide dual seals such as those shown by B1. The wide dual seals are intended to be positioned outside the edges of the absorbent core H. Below these hydrophilic layers one or more layers are bonded using dual seals B2 which are narrower in spacing compared to the wide dual seals used to encase the core B1. Below these layers one or more additionally hydrophilic layers are attached using a single seal G. To optimize the fullness of this type of duster, the number of attachments point seals and the width of the attachment point seals of the various layers are in another embodiment configured such that the layers closest to the handle have wider attachments points whereas layers further away from the handle have narrower attachment points. Specific executions of this idea depend on the number of layers and the stiffness of the layers. By having the width of the bonding go from wide to narrow, the layers create a more uniform semi-circle shape when the fibers get wet. The bonding configuration used to make the seals can be continuous or discontinuous. The bonding can be achieved

through any means including thermal, mechanical, pressure, ultrasonic bonding, adhesive bonding, sewing and any combinations thereof.

Duster Pad Example 7

[0078] Duster Pad Example 7 shown in FIG. 11 comprises two sides, a first side comprising a handle and bundle fibers, such as tow fibers, in another embodiment tow fibers, and a second side comprising a fastening mechanism to attach hydrophilic non-woven fiber layers to the duster wiping portion of the handle. The first side of the duster is structurally and compositionally similar to the commercially marketed Swiffer® Duster. As such, it provides excellent dry dusting benefits. The second side intended for wet dusting and cleaning applications, comprises several layers of hydrophilic non-wovens F in another embodiment cut into a plurality of strips and an absorbent core H positioned above the strips closest to the attachment side. Above the core a barrier layer K is attached to the duster wiping portion using any fastening mechanism means known in the art. The fastening mechanism can consist of, for example, tacky polymers (e.g. polyisobutylene polymers, N-decylmethacrylate and mixtures), pressure sensitive adhesives (e.g., HB FULLER with trade names HL-1496, HL-1500, HM-1597, HM-1902, HM-1972, HM-2713), oil gels (e.g., National Starch SoftGel 546-47E) or waxes like paraffin, beeswax or microcrystalline waxes. With this two sided duster design consumers can use a spray bottle for wet dusting. In one embodiment the barrier layer is a water impermeable layer such as a polyethylene film. An alternative attachment can comprise of hooks L1 positioned on top of the barrier layer. These attachment hooks are in another embodiment low cost such as those used in attachment of disposable diapers. Commercially available examples of hooks include Aplix 963, 964, 731 and 946 manufactured by Aplix Inc. (123000 Steele Creek Rd., Charlotte, N.C., USA).

[0079] Duster Pad Example 7 clearly separates the hydrophilic non-woven layers from the layers designed for dry dusting. As such, it intuitively conveys suitability as an all-in-one system for dry dusting and wet dusting and cleaning. The clear delineation of the fiber bundles from the hydrophilic non-woven layers allows incorporation of tacky coatings such as wax, oils, pressure sensitive adhesives and tacky polymers onto the bundle fibers for dust trapping, because of reduced concerns related to the effects of aqueous chemistry. For example, instructions for use can encourage to first dry dust using the first side of the duster, and then attach the hydrophilic non-woven layers to the back side of the handle wiping portion for wet dusting and cleaning applications. Duster Pat Example 7 shows an angled duster handle connector portion; it can be optimized by making it flat like the one shown in FIG. 2. This makes the duster more ergonomically friendly, allowing the user to easily turn the flip the handle gripping portion 180° to change from dry dusting to wet dusting without the handle bumping the surface. Alternatively, to easily change from dry to wet, the forks pivot 360 degrees as illustrated in U.S. application Ser. No. 11/436,441 to Bonilla, the entirety of which is incorporated by reference. In yet another embodiment the handle comprises a swivel joint at the transition portion of the handle. The swivel joint allows the gripping portion of the implement to be kept in a constant position, but the attachment portion of the handle to be turned 180° in order to

switch from dry duster to wet duster. In this design the connector portion of the handle can be kept in angled.

Duster Pad Example 8

[0080] An alternative two sided system is shown in FIG. 12. The implement wiping portion A2 has Velcro® hooks J2 for attachment on both sides of the wiping/attachment portion A2. The dry dusting fiber bundles and hydrophilic non-woven layers can be secured to the hooks as previously described.

Duster Pad Example 9

[0081] An alternative two sided system is shown in FIG. 13. This example is an all-in-one Dry and Wet duster. The implement A inserts into a pocket formed with non-wovens C and D located in the center of the duster. On one side of the duster hydrophilic non-wovens F and absorbent core H are position similar to designs described above. On the other side one or more synthetic or fiber bundle layers E (continuous strands of tow fibers) are attached using a single seal G. In an alternative embodiment the non-woven on the wet duster which is closet to the handle are perforated along its length just outside the dual seal bonds. This perforation allows the wet portion of the duster to be peeled off as it becomes exhausted, allowing continued use of the dry duster portion. Perforations can call be incorporated on the attachment non-woven of the dry duster portion should the opposite be required where the dry gets exhausted before the wet. Alternative all-in-one designs are contemplated. A duster in a side by side configuration is illustrated in FIG. 13 as Duster Pad Example 9A. In this Duster Pad Example 9A either the left or right side is designed for wet dusting while the opposite left or right side is designed for dry dusting. Both the left and right side are two separate and distinct cut portions for the majority of the duster with the exception of the attachment non-woven C which is one piece where both the left and right side are attached. With this design the user places the wiping part of a handle on the left or right side of the combination duster. Then the opposite end is folded over creating a two-sided duster. The handle is held by inserting into one or more pockets C2, Velcro or other attachment means. As the duster is folded over, in one embodiment an additional attachment mechanism is provided to keep the two-sided configuration in place C3. The attachment mechanism includes adhesive, Velcro, hook and loop fasteners, mechanical such as grippers and the like. Perforations are added to allow the right side to be separated from the left side C1.

Duster Pad Example 10

[0082] Duster Pad Example 10 shown in FIG. 14 comprises a handle, hydrophilic non-wovens, and an optional solid core. The hydrophilic non-wovens F can in another embodiment be cut into a plurality of strips. In this design the cuts made to form the strips in the width dimension are not continuous and the center portion of the gather strip remains a solid strip across the entire length similar to the design shown in FIG. 8A. Further the non-wovens F are bonded using a two bond lines B1 to limit movement. For cleaning fabrics and carpets, the duster further comprises Velcro® hooks L1 positioned on the outer portion of the outer most hydrophilic non-woven. These hooks can function to scrub and to pick-up and retain hair and lint.

Commercially available examples of hooks include Aplix 963, 964, 731 and 946 manufactured by Aplix Inc. (123000 Steele Creek Rd., Charlotte, N.C., USA).

Duster Pad Example 11

[0083] Duster Pad Example 11 shown in FIG. 15 comprises a handle, hydrophilic non-wovens, and an optional solid core similar to duster pad example 6 shown in FIG. 10. The modification in the design is the attachment portion. This duster is designed such that it can be attached to a handle or used by hand. Using the duster by hand can provide the user flexibility for jobs that require extra pressure or buffing. In duster pad example 11 the non-woven C is about 2 times or more the width of the duster. This non-woven can be folded over onto itself and bonded at the end to form a large pocket or bag-like opening. The user simply slips their hand into the large pocket to use the duster by hand. Below this large pocket the duster maintains dual seals to allow for implement forks to be attached. In this design alternative means for attachment are used such as those shown in FIGS. 3 and 4. It is also understood that the large pocket for inserting the users hand can be pre-formed on the duster or are formed by the user by folding over non-wovens and attaching them together using adhesive, Velcro and the like. In alternative embodiments of the present invention there are series of two or more smaller pockets where rather than inserting the entire hand into one large pocket the user inserts one or more fingers into two or more smaller pockets. In further alternative embodiments rather than insert a hand into a pocket, non-wovens are used to construct extensions from the duster. These extensions provide a means for gripping the duster with the users hand and wiping it on a surface.

Friction Testing:

[0084] Without intending to be bound by any theory, it is believed that the higher affinity for water of naturally derived hydrophilic fibers is due to the presence of hydroxyl groups that serve as sorption sites. Additionally, as these sorption sites absorb water, they also provide 'grip' or friction on the surface.

[0085] Friction depends partly on the smoothness of the contacting surfaces, a greater force being needed to move two surfaces past one another if they are rough rather than if they are smooth. However, friction decreases with smoothness only to a certain degree; friction actually increases between two extremely smooth surfaces because of increased attractive electrostatic forces between their atoms. Friction does not depend on the amount of surface area in contact between the moving bodies or (within certain limits) on the relative speed of the bodies. It does, however, depend on the magnitude of the forces holding the bodies together. When a body is moving over a horizontal surface, it presses down against the surface with a force equal to its weight, i.e., to the pull of gravity upon it; an increase in the weight of the body causes an increase in the amount of resistance offered to the relative motion of the surfaces in contact.

[0086] When a wet hydrophilic, e.g., cellulosic substrate, is pressed against a surface and forced to move, the friction is higher than when it is dry due to extensive hydrogen bonding (between hydroxyl groups of cellulose substrate and water). Hydrogen bonding creates a strong electrostatic

attraction between two independent polar molecules, i.e., molecules in which the charges are unevenly distributed, usually containing oxygen or nitrogen, or fluorine. These elements have strong electron-attracting power, and the hydrogen atom serves as a bridge between them. The hydrogen bond is much weaker than the ionic or covalent bonds. The friction of wet substrate on a surface is directly proportional to the extent of hydrogen bonding. Since materials composed of naturally derived hydrophilic polymers have a large number of hydroxyl groups available for hydrogen bonding, it provides more grip or friction in comparison to the synthetic substrates, which do not have free hydroxyl groups for hydrogen bonding.

[0087] One skilled in the art will understand that materials, in particular non-woven materials, composed of naturally derived hydrophilic fibers rather than synthetic fibers, have a greater total absorbency, greater liquid retention when subjected to pressure because the aqueous liquid is held more tightly within the fibers as well as higher wet surface friction. These observations are also true for fibrous materials composed of a homogeneous blend of naturally hydrophilic and synthetic fibers with a higher level of naturally hydrophilic fibers than synthetic fibers.

[0088] One skilled in the art will also understand that fibers which are synthetic based and thus naturally hydrophobic such as polyester, polypropylene, polyethylene, and acrylic, can be treated with chemicals to make them behave in a more hydrophilic way. For example surfactants can be applied on the outer surface of fibers after the fibers have been formed into a non-woven or the surfactant can be added to the synthetic polymer during the extrusion process. While these steps can create a more hydrophilic composition by reducing the surface tension of the synthetic hydrophobic fiber, these fibers still lack the functional sorption sites that naturally hydrophilic fibers such as rayon, cotton, acetate and the like contain. So while these treated synthetic hydrophobic fibers have the ability to absorb greater amounts of liquid relative to the untreated synthetic hydrophobic fibers, they still lack the ability to tightly bind to water or create high wet surface friction through hydrogen bonding. Conversely, one skilled in the art will understand that fibers which are naturally hydrophilic can be treated to render the fibers hydrophobic. The outer surface of a non-woven composed of rayon fibers can be coated with waxes, oils and the like. This treatment causes naturally hydrophilic fibers to have less affinity for water and less wet surface friction.

"Coefficient of Friction" Test Method

[0089] In order to evaluate friction in a wet environment, dusters of varying compositions are tested using a "Coefficient of Friction" test. This test method uses a Friction/Peel Tester Model 225-1 (from Thwing-Albert Instrument Company, Philadelphia, Pa., USA 19154). This instrument can be used to measure both the static and kinetic coefficients of friction of a material. The coefficient of friction of a duster can be viewed as the number U which is equal to the resistive force of friction F_r divided by the normal or perpendicular force pushing the objects together F_n .

[0090] One skilled in the art will understand that when an object (or solid), which is in contact with a substantially flat smooth surface, is subjected to a force, this solid remains immobile until the resistive force caused by the static

friction is overcome. The kinetic friction (or drag force) is the force holding back regular motion once the static friction has been overcome.

[0091] The static friction but more particularly the kinetic friction impacts the ability of a duster to be wiped on a surface, particularly when the surface is wet.

Preparation of the Sample Material to be Tested:

[0092] Duster samples to be tested are positioned to determine the length and width of the duster. With the duster positioned in the lengthwise dimension remove 2 cm from the outer edges of the duster cutting parallel to the width dimension (dimension perpendicular to the length in which handle attaches). Then cut a sample 7 cm wide, with the cut being made in the direction parallel to the width of the duster. The dimension of the duster sample for testing is 7 cm long by the actual width dimension of the dust. This dimension varies for different dusters but is typically somewhere between 10 and 20 cm. A 200 g sled composed of metal is covered with a 2 mm thick dense foam on its top and bottom surfaces and then further covered with a plastic laminate material for water proofing. The sled dimensions are 6.5 cm wide \times 6.5 cm long by 1.5 cm thick. The bottom of the sled has Velcro hooks for attaching the duster sample. The 6.5 cm by 6.5 cm sled is carefully positioned over the center of the duster sample. The pressure per unit area created by the sled is about 5 g/cm². This pressure simulates a typical amount of pressure applied by a duster used in wet cleaning.

Preparation of the Test Surface:

[0093] The test surface is a smooth, tile made of tempered glass such as that used for windows. The glass tile is 7.5 cm wide 30.5 cm long and 0.5 cm thick.

Test Procedure:

[0094] 1. Press the "Sled" button repeatedly until the sled weight displayed is 200 g (corresponding to the weight of sled used in the test)

[0095] 2. Press the "Test Time" button repeatedly until 20 seconds is displayed for time.

[0096] 3. Set the speed of the sled by pressing the "Test Speed" button at 1 cm/sec (in order to check press speed, press test, press return)

[0097] 4. Using the "Return" switch, position the Load Cell to the starting point for test.

[0098] 5. Clean the glass tile using a solution comprising of 20% IPA and deionized water. Wipe slide thoroughly with paper towel. Follow this up with a cleaning using de-ionized water and paper towel drying completely. Place the first sample on top of the glass tile such that the normal actual width of the duster is positioned parallel to the length of the glass tile. The back of the sled should be position about 3.0 cm in front of the back edge of tile test surface. The sled and duster sample is lined up in the center of the path of the tile where the clamp on the sled lines up with the hook on the load cell. Then, press the "Zero" switch in order to zero the load cell.

[0099] 6. Using the clamp attach the sled with the sample to the load cell. Press down gently on sample once to allow it to contact the surface.

[0100] 7. Initiate test by depressing the "Test" switch. The load cell starts moving from the left to the right dragging

the sled and the test sample. The distance traveled by sled as measured from the back edge of the sled in the starting position to front edge of the sled in the ending position is about 25 cm.

[0101] 8. When the test is complete, the load cell stops and the device displays the measure of the Static Coefficient of Friction (ST) as well as the Kinetic Coefficient of Friction (KI). Record the measure of the Kinetic Coefficient of Friction for the dry sample.

[0102] 9. Hit the "Return" switch such that the sled with the sample return to the starting position. Carefully unhook the sled plus the sample from the load cell. Re-clean glass tile surface with 20% IPA solution and buff dry with paper towel.

[0103] 10. Carefully remove the test duster sample and weight it. The re-attach onto the sled preparing it for wet friction testing. Using pump spray bottle or pipette 0.8 mls of de-ionized water directly on the glass tile. The solution should be applied at the center of the area of the tile where the sled with the sample substrate are located at the start of the experiment directly (approximately 1 cm from the edge of the tile when measured from the left to the right and 4 cm from the back edge of the tile when measured forward). The cleaning solution should be applied on a circle or oval shape with an area of about 5-7 cm in width (the width being defined as the longitudinal dimension perpendicular to the direction of the sled) by 5-7 cm in length (the length being defined as the dimension parallel to the direction of the sled in motion). Position the sled with the test sample directly over the cleaning solution. Press down gently on sample once to allow it to absorb some of the solution and make contact with the surface. Then press the "Test" switch in order to initiate the test.

[0104] 11. Again when the test is completed, the load cell stops and the device displays the measure of the Static friction and the Kinetic Coefficient of friction. Record the measure of the Static and Kinetic Coefficient of Friction for a "wet" sample.

[0105] 12. Again hit the Return switch to send the sled back to the start position. Remove the test sample from

the tile surface, and weigh it to determine amount of solution absorbed. Absorbency is determined by taking the amount of solution absorbed by the duster sample and dividing by the amount of solution applied to the surface and multiplying by 100.

[0106] 13. Clean the test tile using a solution comprising 20% of Isopropyl Alcohol (hereinafter IPA), thoroughly wipe off any excess residue that may be left on the tile from the duster using paper towel. Repeat this procedure 3 times. Using de-ionized water do one final wipe of the top surface of the tile and buff this surface until it is dry.

[0107] 14. Reposition the tile in the testing device. Take the sled and wipe it dry in order to remove any wetness from the previous test. Attach a second sample of duster.

[0108] 15. Repeat steps 4 through 14 and record the results as data for the second repetition for the sample 1 duster.

[0109] 18. Repeat steps 4 through 14 three more times for a total of 5 repetitions. Calculate and record the average of each results (i.e. "dry" and "wet" COF).

[0110] 19. Take 5 samples of another duster type and repeat the entire procedure for each type of material.

[0111] Various types of duster constructions (including the same design using different non-woven materials) are tested according to the previously discussed procedure. Since the degree of hydrophobicity or hydrophilicity of the different materials tested varies, it is possible to assess the impact or "behavior" of these materials on the ability of a cleaning pad to "glide" on a hard surface in both dry and wet environment. The different samples tested also vary from a surface characteristic standpoint. Some of these materials have a very smooth outer surface and make a lot of contact with the test surface while others comprise of fibrous bundles which have more irregular surface contact. It is believed that a substrate material having a smooth outer surface results in higher friction due to the greater surface of the material being in contact with the hard surface.

[0112] The following chart in Table 2 describes the dusters tested. Dusters include comparative examples of market dusters and examples pertaining to this invention.

TABLE 2

	Product	Market	Fiber Bundles	Non-Wovens Attachment	Non-woven Cleaning Side	Absorbent Core
Comparative 1	Pledge Duster Plus	US	100% synthetic	100% synthetic	None	None
Comparative 2	Swiffer Duster	US/Europe	100% synthetic	100% synthetic	1 layer 100% synthetic cut strips	None
Comparative 3	Pledge	Europe	100% synthetic	100% synthetic	None	None
Comparative 4	Evercare	US	100% synthetic	100% synthetic	None	None
Example 1	Hydrophilic Duster	No	None	100% synthetic	8 layers Ahlstrom 28 gsm Cellulose laminated with 17 gsm Polypropylene	200 gsm air-laid
Example 2	Hydrophilic Duster	No	100% synthetic	100% synthetic	2 layers Ahlstrom 28 gsm Cellulose laminated with 17 gsm Polypropylene	135 gsm air-laid solid
Example 3	Hydrophilic Duster	No	100% synthetic	100% synthetic	2 layers Ahlstrom 28 gsm Cellulose laminated with 17 gsm Polypropylene	90 gsm air-laid wide cut strips
Example 4	Hydrophilic Duster	No	None	100% synthetic	8 layers 55 gsm - homogeneous 80% Polyester:20% Rayon	200 gsm air-laid solid

TABLE 2-continued

	Product	Market	Fiber Bundles	Non-Wovens Attachment	Non-woven Cleaning Side	Absorbent Core
Example 5	Hydrophilic Duster	No	None	100% synthetic	8 layers 55 gsm - homogeneous 60% Polypropylene:40% Rayon	200 gsm air-laid solid
Example 6	Hydrophilic Duster	No	None	100% synthetic	8 layers 50 gsm - homogeneous 50% Polyester:50% Rayon	200 gsm air-laid solid
Example 7	Hydrophilic Duster	No	None	100% synthetic	8 layers 30 gsm - homogeneous 35% Polyester:65% Rayon	200 gsm air-laid solid
Example 8	Hydrophilic Duster	No	None	100% synthetic	8 layers 55 gsm - homogeneous latex bonded cellulose	200 gsm air-laid solid
Example 9	Hydrophobic Duster	No	None	100% synthetic	8 layers 55 gsm - homogeneous 100% Polypropylene	200 gsm air-laid solid

Results from COF testing dry and wet are shown in the chart shown in Table 3:

[0113]

4 is constructed using non-woven strips comprising of 80% polyester (PET) and 20% rayon. While the low percentage of rayon hydrophilic fibers aide in increasing friction, the

	Product	Dry Coefficient of Friction		Wet Coefficient of Friction		Absorbent Efficiency
		Static	Kinetic	Static	Kinetic	
Comparative 1	Pledge Duster Plus Swiffer	0.357	0.381	0.374	0.404	65%
Comparative 2	Duster	0.649	0.65	0.571	0.609	65%
Comparative 3	Pledge UK	0.273	0.293	0.425	0.451	66%
Comparative 4	Evercare	0.593	0.585	0.578	0.594	69%
Example 1	Hydrophilic Duster	0.698	0.658	1.358	1.334	78%
Example 2	Hydrophilic Duster	0.806	0.771	1.432	0.83	82%
Example 3	Hydrophilic Duster	0.784	0.695	1.458	1.032	79%
Example 4	Hydrophilic Duster	0.756	0.825	0.808	0.874	45%
Example 5	Hydrophilic Duster	0.709	0.731	0.965	1.021	70%
Example 6	Hydrophilic Duster	0.791	0.875	1.086	1.156	76%
Example 7	Hydrophilic Duster	0.560	0.601	1.269	1.310	77%
Example 8	Hydrophilic Duster	0.812	0.822	1.336	1.426	78%
Example 9	Hydrophobic Duster	0.937	0.945	0.631	0.638	26%

[0114] Data in Table 3 shows that current marketed dusters comparative 1, 2, 3, and 4 all have wet coefficient of friction measurements below 0.65 for both static and importantly for kinetic (friction of sample being wiped across a surface). Also the absorbent efficiency of these dusters is also below about 70%. By comparison Examples 1 through 8 which all comprise non-wovens containing some amounts of hydrophilic fibers all have wet coefficient of friction measurements above 0.65 for both static and importantly for kinetic. Most of the examples also have absorbent efficiencies of 70% or greater with the exception of Example 4. Example

absorbency of the material is limited due to the high percentage of synthetic polyester fibers. Example 9 is constructed of 100% polypropylene as the outer strip layers. It too shows a static and kinetic coefficient of friction below 0.65 further supporting the benefit of having some level of hydrophilic fibers. In one embodiment the hydrophilic non-woven layer comprises at least about 20% hydrophilic fibers, in another embodiment at least about 25% hydrophilic fibers, in another embodiment at least about 30% hydrophilic fibers, in yet another embodiment at least about 35% hydrophilic fibers and in yet another embodiment at

least about 50% hydrophilic fibers. One embodiment comprises a kinetic coefficient of friction of at least about 0.65, in another embodiment at least about 0.75, and in another embodiment at least about 0.9. In an alternate embodiment the kinetic coefficient of friction is at least about 0.65, in another embodiment at least about 0.75, and in another embodiment at least about 0.9 and the absorbency is at least about 35%, in another embodiment at least about 45% and in another embodiment at least about 65%.

Aqueous Cleaning Solution and Dispensing:

[0115] Cleaning and shine compositions can be delivered via a continuous flow delivery such as an aerosol or a vacuum sprayer or via a discontinuous flow such as that delivered via a trigger, pump sprayer and the like.

[0116] A measurement of output from a continuous delivery system is determined by 1) Priming the sprayer, 2) Pre-weigh the bottle 3) Depress delivery mechanism for 10 seconds, 4) Re-weigh bottle, and 5) Determine difference of pre and post. The number is then divided by 10 to determine the amount of delivery per second.

[0117] A measurement of output from a discontinuous delivery system is determined by 1) Priming the sprayer, 2) Pre-weigh the bottle 3) Depress delivery mechanism 10 times, 4) Re-weigh bottle, and 5) Determine difference of pre and post. The number is then divided by 10 to determine the amount of delivery per spray accentuation.

[0118] As described above the S. C. Johnson company has recently introduced to the market a disposable duster used in combination with a spray solution. The sprayer attached to the spray bottle is a low dosing sprayer that sprays about 0.15 g per each spray accentuation. The cleaning solution is advertised as being suitable as a multi-surface solution. The package describes that the product can be used on wide range of surface types from wood, to electronics, to glass including mirrors. The cleaning solution was analyzed using several analytical techniques. The first technique was to determine the % solids in the cleaning solution. This analysis was conducted by taking 5 different samples from different bottles and combining into one batch. A 15 g aliquot of this batch was taken, weighed and placed into a pre-weighed Petri dish. This was then placed in a constant temperature room of 140° C. for 1 week. The sample was then removed and allowed to equilibrate in the same temperature and humidity prior to the drying step for 4 hours. The % solids by weight are then determined by difference based on the starting wet weight of the solution. The Pledge Duster Plus multi-surface cleaning solution shows a % solids of about 2.0%. As a point of comparison another S. C. Johnson product was analyzed using the same technique. This product is sold as a "multi-surface" product intended to clean and dust. The key difference is this product is dispensed using a higher dosing trigger sprayer which doses about 0.9 g per spray accentuation. This product also is advertised to be used with paper towels or an absorbent cloth. The Pledge multi-surface surface product sold as a 16 ounce trigger spray shows % solids of about 0.35%. When you compare 1 spray of the Pledge Duster Plus solution (0.15 g containing 2% solids) to 1 spray of the Pledge multi-surface trigger solution (0.9 g containing 0.35% solids), the amount of solids dispensed onto a surface is about the same 0.003 g of solids per spray for each product. However, further analysis of the actual chemical composition of the two products shows the chemistries are quite

different. The Pledge duster Plus solution contains Petroleum distillates as a solvent, with ethoxylated non-ionic surfactant, silicone (about 0.4%) and about 98% water. The Pledge multi-surface trigger solution contains isopropyl alcohol and glycol ether as solvents with ethoxylated non-ionic surfactant, no silicone and about 97% water.

[0119] A simple comparison of the two different chemistries was conducted. One spray of each product was applied to a glass mirror surface and wiped to dryness with a paper towel folded to quarter its size. The end result between the two products was compared for film/streaking and smudging. Evaluation of smudging is done by taking clean paper towel and buffing a portion of the cleaned area. Despite the amount of solids applied to the surface being about the same between the two solutions, the solution used as part of the Pledge Duster Plus system clearly shows worse performance for both film/streaking and smudging compared to the solution used in the Pledge multi-surface trigger spray. So while the amount of solids applied to and absorbed off a surface can impact the end result film/streak and smudging, the type of chemistry used can have just as much if not a bigger impact.

Cleaning Compositions:

[0120] Cleaning compositions for use in multi-surface dusting and cleaning on a wide range of surfaces from wood to electronics to glass comprise low levels of non-volatile cleaning agents as measured using a % solids analysis as described above. The amount of % solids is at most about 1.0%, in another embodiment at most about 0.75%, in another embodiment at most about 0.5% and in another embodiment at most about 0.3%. The amount of % solids is determined by the type of duster used in combination with the cleaning solution. Specifically, if the duster comprises of higher percentage of synthetic fibers and as such is less absorbent and less liquid retaining, the % solids in another embodiment are at most about 0.5% and in another embodiment at most about 0.3%. While the % solids in the cleaning solution is important, the amount of solution dispensed onto a surface is also important. Using a sprayer is a convenient way to apply solution to a surface in a controlled means. For a solution used with a duster, the amount of solution dispensed is important not only from a cleaning but a dusting standpoint. For cleaning the solution is typically dispensed directly to the surface. For dusting the solution is often sprayed directly onto the duster. As such selecting the dosing output of the sprayer highly depends on the composition of the materials used in the construction of the duster. In the case of the Pledge duster Plus system, since the duster is composed of 100% synthetic fibers, the sprayer chosen for use with this duster is a low dosing 0.15 g per actuation sprayer so that the duster does not become overly saturated too quickly. However, as described above, even with this low dose sprayer, the % solids and the types of chemicals used in the Pledge Duster Plus composition are such that film/streaking and smudging problems still occur. The silicone contained in the Pledge Duster Plus cleaning solution is one of the key ingredients causing filming/streaking and smudging problems. In one embodiment, a multi-surface cleaning solution is essentially free of silicone, in another embodiment comprising at most about 0.025% silicone content, more in another embodiment at most about 0.015% silicone content. Incorporation of low levels of solids combined with limiting the amount of silicone in compositions

used for multi-purpose use provides additional degrees of freedom for increasing the spraying dosage. The dosing mechanism is herein can be any known in the art. The dosing mechanism is in another embodiment accomplished by a sprayer. Non-limiting examples of spraying mechanisms for use herein include pump sprayers, trigger sprayers and aerosols. Higher dosage per spray actuation is beneficial especially for the cleaning and dusting of large area surface as it reduces trigger finger fatigue. It also helps provide a cleaning benefit, in addition to dusting, which can be important for effective smudge and light stain removal. The spraying dose is from about 0.15 g to 1.0 g per sprayer actuation, in another embodiment from about 0.15 g to 0.9 g, and in yet another embodiment from about 0.25 g to about 0.75 g per sprayer actuation. In an alternate embodiment, the spray pattern associated with a the sprayer used herein is near circular pattern with the liquid being as evenly dispersed as possible so as to provide even coverage of solution to the surface to be treated. In one embodiment, the sprayer mechanism forms a near circular pattern with a diameter of from about 3 inches to about 14 inches, in another embodiment from about 4 inches to about 12 inches upon actuation from a distance of 8 inches above the surface to be treated.

Aqueous Composition System

[0121] The aqueous compositions herein comprise at least 50% water by weight of the composition, in another embodiment from about 60% to 99.95% by weight of the composition. In addition to water, the aqueous composition system can also include highly water soluble solvents. By "highly water soluble", it is meant a solvent at 25° C. that has a solubility in distilled water of at least 30% (i.e., 30 grams of solvent in 100 g water/solvent solution). Examples of highly water-soluble solvents include methanol, ethanol and isopropanol, and mixtures thereof. These solvents can be used to provide disinfectancy properties to compositions that are otherwise low in active. Additionally, they can be particularly useful in compositions wherein the total level of perfume is very low. In effect, highly volatile solvents can provide "lift", and enhance the character of the perfume. Highly volatile solvents, if present are typically present in from about 0.25% to about 10%, more in another embodiment from about 0.5% to about 5%, most in another embodiment from about 0.5% to about 4%, by weight of the composition. Examples of such solvents include methanol, ethanol, isopropanol, and mixtures thereof.

Surfactants

[0122] The compositions of the invention optionally comprise one or more surfactants. Surfactants consist of a hydrophobic 'tail' groups comprising from about 8 to about 18 carbon atoms in the longest uninterrupted carbon chain and hydrophilic head groups that define the class of surfactant as non-ionic, zwitterionic/amphoteric, anionic or cationic. In one embodiment, multi-surface cleaning solutions comprise low levels of low residue causing surfactants. These surfactants are in another embodiment used at levels from about 0.001% to about 0.75% by weight of surfactant to cleaning solution, more in another embodiment from about 0.01% to about 0.50% and more in another embodiment from about 0.05% to about 0.30%. Suitable surfactants are described in McCutcheon's Vol. 1: Emulsifiers and

Detergents, North American Ed., McCutcheon Division, MC Publishing Co., 2002, incorporated herein by reference.

[0123] In one embodiment, non-ionic surfactants are used in the compositions of the present invention. If present, non-ionic surfactants comprise from about 0.001% to about 0.5% by weight of the composition. In another embodiment, the aqueous compositions comprise from about 0.005% to about 0.40%, more in another embodiment from about 0.0075% to about 0.30%, still more in another embodiment from about 0.01% to about 0.25%, and most in another embodiment from about 0.025% to about 0.25% non-ionic surfactants.

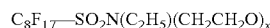
[0124] In one embodiment, at least one of the non-ionic surfactants used in the present invention is an alkylpolysaccharide. Such surfactants are disclosed in U.S. Pat. Nos. 4,565,647, 5,776,872, 5,883,062, and 5,906,973. Among alkylpolysaccharides, examples include those comprising five or six carbon sugar rings, in an alternate embodiment are those comprising six carbon sugar rings, and in an alternate embodiment are those wherein the six carbon sugar ring is derived from glucose, i.e., alkyl polyglucosides. The alkyl moieties of the polyglucoside can be derived from fats, oils or chemically produced alcohols; the sugar moieties are derived from hydrolyzed polysaccharides. Alkyl polyglucosides are formed from the condensation product of fatty alcohol and sugars like glucose with the number of sugar units defining the relative hydrophilicity. The sugar units can additionally be alkoxyated either before or after reaction with the fatty alcohols. Such alkyl polyglucosides are described in detail in WO 86/05199. Technically, alkyl polyglucosides are generally not molecularly uniform products, but represent mixtures of alkyl groups and mixtures of monosaccharides and different oligosaccharides. The average number of glucoside units is in another embodiment from about 1.0 to about 2.0, more in another embodiment from about 1.2 to about 1.8, most in another embodiment from about 1.3 to about 1.7. Alkyl polyglucosides (also sometimes referred to as "APG's") are exemplary non-ionics for the purposes of the invention since they are low residue surfactants. The alkyl substituent in the APG chain-length is in another embodiment a saturated or unsaturated alkyl moiety containing from about 8 to about 16 carbon atoms. C₈-C₁₆ alkyl polyglucosides are commercially available (e.g., Simusol® surfactants from Seppic Corporation, 75 Quai d'Orsay, 75321 Paris, Cedex 7, France, and Glucopon 220®, Glucopon 225®, Glucopon 425®, Plantaren 2000®, Plantaren 2000N®, and Plantaren 2000 N UP®, available from Cognis Corporation, Postfach 13 01 64, D 40551, Dusseldorf, Germany).

[0125] Alkyl ethoxylates represent another class of non-ionic surfactants suitable for the present invention. The alkyl ethoxylates of the present invention are either linear or branched, and contain from about 8 carbon atoms to about 16 carbon atoms in the hydrophobic tail, and from about 3 ethylene oxide units to about 20 ethylene oxide units in the hydrophilic head group. Examples of alkyl ethoxylates include Neodol 91-6®, Neodol 91-8® supplied by the Shell Corporation (P.O. Box 2463, 1 Shell Plaza, Houston, Tex.), and Alfonic 810-60® supplied by Condea Corporation, (900 Threadneedle P.O. Box 19029, Houston, Tex.). Other surfactants are the alkyl ethoxylates comprising from about 9 to

about 12 carbon atoms in the hydrophobic tail, and from about 4 to about 9 ethylene oxide units in the hydrophilic head group. These surfactants offer excellent cleaning benefits and work synergistically with the copolymers of the invention. The alkyl ethoxylate can be linear or branched. Alternate examples of branched alkyl ethoxylate are the ethylene oxide condensates of 2-propyl-1-heptanol and 2-butyl-1-octanol. 2-propyl-1-heptyl EO7 is available from the BASF corporation under the Lutensol tradename.

[0126] Amine oxides are another class of non-ionic surfactant suitable for the present invention. Amine oxides, particularly those comprising from about 10 carbon atoms to about 16 carbon atoms in the hydrophobic tail, are beneficial because of their strong cleaning profile and ability to dissolve high levels of perfume at low concentrations. To help mitigate possible sudsing issues, C10-C16 branched amine oxides can be used in the compositions of the invention. Alternative non-ionic detergent surfactants for use herein are alkoxyated alcohols generally comprising from about 8 to about 16 carbon atoms in the hydrophobic alkyl chain of the alcohol. Typical alkoxylation groups are propoxy groups or ethoxy groups in combination with propoxy groups, yielding alkyl ethoxy propoxylates. Such compounds are commercially available under the tradename Antarox® available from Rhodia (40 Rue de la Haie-Coq F-93306, Aubervilliers Cedex, France) and under the tradename Nonidet® available from Shell Chemical.

[0127] Also suitable for use in the present invention are the fluorinated nonionic surfactants. One particularly suitable fluorinated nonionic surfactant is Fluorad F170 (3M Corporation, 3M Center, St. Paul, Minn., USA). Fluorad F170 has the formula:



[0128] Also suitable for use in the present invention are silicon-based surfactants. One example of these types of surfactants is Silwet L7604 available from Dow Chemical (1691 N. Swede Road, Midland, Mich., USA).

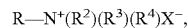
[0129] The condensation products of ethylene oxide with a hydrophobic base formed by the condensation of propylene oxide with propylene glycol are also suitable for use herein. The hydrophobic portion of these compounds, in another embodiment, have a molecular weight of from about 1500 to about 1800 and exhibit water insolubility. The addition of polyoxyethylene (i.e., ethoxylate) moieties to this hydrophobic portion tends to increase the water solubility of the molecule as a whole, and the liquid character of the product is retained up to the point where the polyoxyethylene content is about 50% of the total weight of the condensation product, which corresponds to condensation with up to about 40 moles of ethylene oxide. Examples of compounds of this type include certain of the commercially available Pluronic® surfactants, marketed by BASF. Chemically, such surfactants have the structure $(EO)_x(PO)_y(EO)_z$ or $(PO)_x(EO)_y(PO)_z$ wherein x, y, and z are from about 1 to about 100, in another embodiment about 3 to about 50. Pluronic® surfactants known to be good wetting surfactants. A description of the Pluronic® surfactants, and properties thereof, including wetting properties, can be found in the brochure entitled BASF Performance Chemicals Plutonic® & Tetronic® Surfactants, available from BASF.

[0130] Other suitable non-ionic surfactants include the polyethylene oxide condensates of alkyl phenols, e.g., the condensation products of alkyl phenols having an alkyl

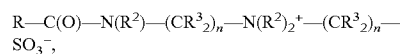
group containing from about 6 to about 12 carbon atoms in either a straight chain or branched chain configuration, with ethylene oxide, the said ethylene oxide being present in amounts equal to about 10 to about 25 moles of ethylene oxide per mole of alkyl phenol. The alkyl substituent in such compounds can be derived from oligomerized propylene, di-isobutylene, or from other sources of iso-octane n-octane, iso-nonane or n-nonane. Other non-ionic surfactants that can be used include those derived from natural sources such as sugars and include C_8-C_{16} N-alkyl glucose amide surfactants.

[0131] Zwitterionic surfactants represent a second class of surfactants within the context of the present invention. If present, zwitterionic surfactants comprise from about 0.001% to about 0.50% by weight of the composition. Zwitterionic surfactants contain both cationic and anionic groups on the same molecule over a wide pH range. The typical cationic group is a quaternary ammonium group, although other positively charged groups like sulfonium and phosphonium groups can also be used. The typical anionic groups are carboxylates and sulfonates, in another embodiment sulfonates, although other groups like sulfates, phosphates and the like, can be used. Some common examples of these detergents are described in the patent literature: U.S. Pat. Nos. 2,082,275, 2,702,279 and 2,255,082.

[0132] A Generic Formula for Some Zwitterionic Surfactants is:

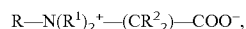


wherein R is a hydrophobic group; R^2 and R^3 are each a C1-4 alkyl hydroxy alkyl or other substituted alkyl group which can be joined to form ring structures with the N; R^4 is a moiety joining the cationic nitrogen to the hydrophilic anionic group, and is typically an alkylene, hydroxy alkylene, or polyalkoxyalkylene containing from one to four carbon atoms; and X is the hydrophilic group, most in another embodiment a sulfonate group. Exemplary hydrophobic groups R are alkyl groups containing from about 6 to about 20 carbon atoms, in another embodiment at most about 18 carbon atoms. The hydrophobic moieties can optionally contain sites of unsaturation and/or substituents and/or linking groups such as aryl groups, amido groups, ester groups, etc. A specific example of a "simple" zwitterionic surfactant is 3-(N-dodecyl-N,N-dimethyl)-2-hydroxypropane-1-sulfonate (Lauryl hydroxy sultaine) available from the McIntyre Company (24601 Governors Highway, University Park, Ill. 60466, USA) under the tradename Mackam LHS®.



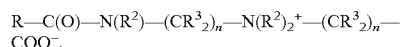
wherein each R is a hydrocarbon, e.g., an alkyl group containing from about 6 to about 20, in another embodiment up to about 18, more in another embodiment up to about 16 carbon atoms, each (R^2) is either a hydrogen (when attached to the amido nitrogen), short chain alkyl or substituted alkyl containing from about 1 to about 4 carbon atoms, in another embodiment groups selected from the group consisting of methyl, ethyl, propyl, hydroxy substituted ethyl and propyl and mixtures thereof, more in another embodiment methyl, each (R^3) is selected from the group consisting of hydrogen and hydroxyl groups, and each n is a number from about 1

to about 4, more in another embodiment about 2 or about 3, most in another embodiment about 3, with no more than about 1 hydroxy group in any (CR^3_2) moiety. The R group can be linear or branched, saturated or unsaturated. The R^2 groups can also be connected to form ring structures. A surfactant of this type is a C12-14 acylamidopropylene (hydroxypropylene) sulfobetaine that is available from McIntyre under the tradename Mackam 50-SB®.

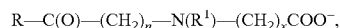


wherein R is a hydrocarbon, e.g., an alkyl group containing from about 6 to about 20, in another embodiment up to about 18, more in another embodiment up to about 16 carbon atoms, each (R^1) is a short chain alkyl or substituted alkyl containing from about 1 to about 4 carbon atoms, in another embodiment groups selected from the group consisting of methyl, ethyl, propyl, hydroxy substituted ethyl and propyl and mixtures thereof, more in another embodiment methyl, (R^2) is selected from the group consisting of hydrogen and hydroxyl groups, and n is a number from about 1 to about 4, in another embodiment about 1. An exemplary low residue surfactant of this type is Empigen BB®, a coco dimethyl betaine produced by Albright & Wilson.

[0133] In Another Embodiment, these Betaine Surfactants have the Generic Formula:



wherein each R is a hydrocarbon, e.g., an alkyl group containing from about 6 to about 20, in another embodiment up to about 18, more in another embodiment up to about 16 carbon atoms, each (R^2) is either a hydrogen (when attached to the amido nitrogen), short chain alkyl or substituted alkyl containing from about 1 to about 4 carbon atoms, in another embodiment groups selected from the group consisting of methyl, ethyl, propyl, hydroxy substituted ethyl and propyl and mixtures thereof, more in another embodiment methyl, each (R^3) is selected from the group consisting of hydrogen and hydroxyl groups, and each n is a number from about 1 to about 4, more in another embodiment about 2 or about 3, most in another embodiment about 3, with no more than about 1 hydroxy group in any (CR^3_2) moiety. The R group can be linear or branched, saturated or unsaturated. The R^2 groups can also be connected to form ring structures. A surfactant of this type is Mackam 35HP®, a coco amido propyl betaine produced by McIntyre.



wherein $R-C(O)-$ is a about C5 to about C15, pre hydrophobic fatty acyl moiety, each n is from about 1 to about 3, each R^1 is in another embodiment hydrogen or a C1-C2 alkyl or hydroxyalkyl group, and x is about 1 or about 2. Such surfactants are available, in the salt form, from Goldschmidt chemical under the tradename Rewoteric AM®. Examples of other suitable low residue surfactants include cocoyl amido ethyleneamine-N-(methyl) acetates, cocoyl amido ethyleneamine-N-(hydroxyethyl) acetates, cocoyl amido propyleneamine-N-(hydroxyethyl) acetates, and analogs and mixtures thereof. Other suitable, amphoteric surfactants are represented by surfactants such as dodecylbetaine, N-alkyltaurines such as the one prepared by reacting dodecylamine with sodium isethionate according to the teaching of U.S. Pat. No. 2,658,072, N-higher alkylaspartic acids such as those produced according to the teaching

of U.S. Pat. No. 2,438,091, and the products sold under the trade name "Miranol®", and described in U.S. Pat. No. 2,528,378.

[0134] Anionic surfactants are also suitable for use within the compositions of the present invention. Anionic surfactants herein typically comprise a hydrophobic chain comprising from about 8 to about 18 carbon atoms, in another embodiment from about 8 to about 16 carbon atoms, and typically include a sulfate, sulfonate or carboxylate hydrophilic head group. If present, the level of anionic surfactant is in another embodiment from about 0.005% to about 0.10%, more in another embodiment from about 0.0075% to about 0.05%, most in another embodiment from about 0.01% to about 0.03%. Anionic surfactants are often useful to help provide good surface end result appearance through a 'toning' effect. By toning effect, it is meant an improvement in the visual appearance of the end result due to less visual surface haziness. While not wishing to be limited by theory, it is believed that the toning effect is obtained by breaking up surfactant system aggregation system that occurs as the aqueous elements in the composition evaporate. One toning effect surfactants are most useful when alcohol ethoxylates are used as primary surfactants in the compositions of the present invention. Toning effect surfactants include octyl sulfonate commercially available from Stepan under the tradename Bio-Terge PAS-8® (22 West Frontage Road, Northfield, Ill. 60093, USA). Another outstanding "toning" surfactant of benefit to the present invention is Luviskol CS-1, which can be purchased from BASF (67056 Ludwigshafen, Germany). If present, the Luviskol CS-1 is in another embodiment used in from about 1:20 to about 1:1 weight ratio with respect to the primary surfactant (s).

[0135] Other non-limiting examples of anionic surfactants which suitable for the compositions of the present invention include C_8-C_{18} paraffin sulfonates (Hostapur SAS® from Hoechst, Aktiengesellschaft, D-6230 Frankfurt, Germany), C_8-C_{14} linear or branched alkyl benzene sulfonates, C_9-C_{15} alkyl ethoxy carboxylates detergent surfactant (Neodox® surfactants available from Shell Chemical Corporation, P.O. Box 2463, 1 Shell Plaza, Houston, Tex.), C_{10-14} alkyl sulfates and ethoxysulfates (e.g., Stepanol AM® from Stepan). Other important anionics that can be used in compositions of the present invention include sodium or potassium alkyl benzene sulfonates, in which the alkyl group contains from about 9 to about 15 carbon atoms, especially those of the types described in U.S. Pat. Nos. 2,220,099 and 2,477,383.

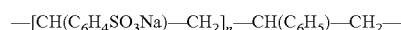
Hydrophilic Polymers:

[0136] In one embodiment, the aqueous composition comprises one or more hydrophilic polymers. Hydrophilic polymers function well with the hydrophilic duster and aqueous compositions of the invention. Exemplary polymers have strong wetting wet properties and soil agglomerating properties. Additionally, polymer substantivity is beneficial as it prolongs the wetting and cleaning benefits. Another important feature of hydrophilic polymers is lack of residue upon drying. Compositions comprising these polymers dry more evenly on surfaces and help end result appearance contributing little or no streaks, films or haze. If present, the hydrophilic polymers are in another embodiment present at levels ranging from about 0.0001% to about 0.25%, more in another embodiment from about 0.005% to about 0.15% and most in another embodiment from about 0.01% to about

0.10% by weight of the aqueous composition. Hydrophilic polymers include homo-polymers and co-polymers with a water solubility of at least about 1%, more in another embodiment at least about 5%, more in another embodiment at least about 10% and more in another embodiment still, at least about 15% and most in another embodiment at least 20%. Non-limiting classes of suitable hydrophilic polymers include polycarboxylates, polyvinylpyrrolidones, polyglycols, polysaccharides, polyvinyl alcohols, polysulfonates, polyamine oxides, poly-amphoterics/zwitterionics and mixtures thereof. These materials are described in U.S. Pat. No. 6,340,663 and U.S. Pat. No. 6,716,805 incorporated herein by reference.

[0137] Polycarboxylates are polymers and co-polymers having a molecular weight of at least 1000 g/mole. They are made starting from ethylenically unsaturated monomers comprising pendant carboxylate functional groups that are then polymerized using techniques known in the art. In one embodiment, the polycarboxylates comprise acrylate or methacrylate monomers covalently bonded to other monomers such as acrylate, methacrylate, alkyl acrylate, acrylamide, alkyl acrylamide, N-vinyl pyrrolidone, ethylene, propylene, butylene, butadiene, styrene, maleic anhydride and the like. Polystyrene-acrylic co-polymers are particularly useful polycarboxylates for the present invention. These are sold by National Starch under the tradename Alcosperse and are further detailed in US#20050096239 A1 filed Oct. 5, 2004, Barnabas et al. Polyvinyl pyrrolidones include polyvinyl pyrrolidone, quaternized pyrrolidone derivatives (such as Gafquat 755N from International Specialty Products), and co-polymers containing pyrrolidone, such as polyvinylpyrrolidone/dimethylaminoethylmethacrylate (available from ISP) and polyvinyl pyrrolidone/acrylate (available from BASF). Polyglycols include the homo- and heteropolymers comprising ethylene glycol, including random and block copolymers comprising other functional moieties including propylene glycol. Exemplary molecular weights of the polyethylene glycol polymers are from 1,000 g/mole to about 5,000,000 g/mole, more in another embodiment from about 2,000 g/mole to about 1,000,000 g/mole. Polysaccharide polymers are those that are based on sugar chemistry; these include ethyl cellulose, hydroxyethyl cellulose, carboxy methyl cellulose, hydroxypropyl cellulose, xanthan gum, guar gum, cationically modified guar gum, locust bean gum and the like. Polyvinyl alcohol polymers are those derived from poly vinyl acetate that are then hydrolyzed. The degree of hydrolysis is in another embodiment at least 80%, more in another embodiment at least 90%.

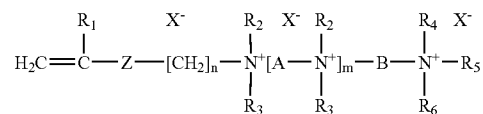
[0138] Polymers that contain sulfonate groups are useful. Sulfonate functional groups, much like the carboxylate groups increase the hydrophilicity of the polymers and provide good wetting properties. Examples of desirable poly-sulfonate polymers include polyvinylsulfonate, and more in another embodiment polystyrene sulfonate, such as those sold by Monomer-Polymer Dajac (1675 Bustleton Pike, Feasterville, Pa. 19053). A typical formula is as follows.



wherein n indicates the degree of polymerization for the styrene monomer. Typical molecular weights are from about 10,000 to about 7,000,000, in another embodiment from about 50,000 to about 1,000,000.

[0139] Other hydrophilic polymers of interest incorporate amine oxide moieties. It is believed that the partial positive charge of the amine oxide group helps the polymer better adhere to the surface, thus promoting longer lasting wetting properties. The amine oxide moiety can also hydrogen-bond with hard surfaces, such as melamine, wood, glass, fiberglass, and other dusting surfaces commonly encountered in consumer homes. To the extent that polymer anchoring promotes better wetting higher molecular weight materials are contemplated. Increased molecular weight improves efficiency and effectiveness of the amine oxide-based polymer. In one embodiment polymers of this invention have one or more monomeric units containing at least one N-oxide group. At least about 10%, in another embodiment at least about 50%, more in another embodiment at least about 90% of said monomers forming said polymers contain an amine oxide group. The average molecular weight of the amine oxide polymers used herein is from about 2,000 to about 500,000, in another embodiment from about 5,000 to about 250,000, and more in another embodiment from about 7,500 to about 200,000.

[0140] In one embodiment, polymers used in conjunction with the dusters of the invention are amphoteric or zwitterionic. By selectively choosing the functional groups, the polymers can be made substantive to surfaces (from cationic moieties of the polymer), yet also provide hydrophilic modification of surfaces and improved wetting (from the anionic moieties in the polymer). Polymers of particular interest in this context are those described in applications WO 2004/083354, WO 01/05920 and WO 01/05921, incorporated herein by reference. In one embodiment, the polymers are derived from monomers of the formula:



in which

[0141] R_1 is a hydrogen atom, a methyl or ethyl group;

[0142] R_2 , R_3 , R_4 , R_5 and R_6 , which are identical or different, are linear or branched C_1 - C_6 , alkyl, hydroxy-alkyl or aminoalkyl groups;

[0143] m is an integer from 0 to 10;

[0144] n is an integer from 1 to 6;

[0145] Z represents a $-\text{C}(\text{O})\text{O}-$ or $-\text{C}(\text{O})\text{NH}-$ group or an oxygen atom;

[0146] A represents a $(\text{CH}_2)_p$ group, p being an integer from 1 to 6;

[0147] B represents a linear or branched C_2 - C_{12} , polymethylene chain optionally interrupted by one or more heteroatoms or heterogroups, and optionally substituted by one or more hydroxyl or amino groups;

[0148] X, which are identical or different, represent counter-ions.

in the range 40 to 1500 are also contemplated because of their ready availability and their relatively low cost.

[0153] Suitable silicone compounds for use herein are commercially available from various companies including GE, Rhodia and Dow Corning. Examples of silicone compounds for use herein are DC 1410, Silicone DB® 100 and Silicone Emulsion 2-3597® all commercially available from Dow Corning.

Perfume and Other Adjuvants

[0154] Perfume is an optional component. As used herein, perfume includes constituents of a perfume which are added primarily for their olfactory contribution, often complemented by use of a volatile organic solvent such as ethanol. Perfume components can be natural products such as essential oils, terpenes, sesquiterpenes, absolutes, resinoids, resins, concretes, etc., and/or synthetic perfume components such as hydrocarbons, alcohols, aldehydes, ketones, ethers, acids, acetals, ketals, nitriles, etc., including saturated and unsaturated compounds, aliphatic, carboxylic and heterocyclic compounds. Perfumes useful herein are described in detail in U.S. Pat. No. 5,108,660, incorporated herein by reference.

[0155] The aqueous compositions herein can also comprise other additives and adjuncts. Buffers can be included to provide pH stability while not leading to filming/streaking issues. Buffers are in another embodiment present at a level of from about 0.001% to about 0.10% by weight of the aqueous composition. Alkaline buffers are in another embodiment selected from the group consisting of ammonium, 1,3-bis(aminomethyl) cyclohexane, 2-amino-2-methyl-1-propanol, 2-dimethyl-2-methyl-1-propanol, sodium carbonate, sodium bicarbonate and mixtures thereof. Neutral pH buffers are in another embodiment selected from amino acids and imidazole. Acidic buffers are in another embodiment selected from the group consisting of acetic acid, hydroxyacetic acid, citric acid, tartaric acid, succinic acid, glutaric acid and mixtures thereof. The compositions can also incorporate preservatives and antimicrobial agents. Cationic preservatives and antimicrobials are in another embodiment selected from the group consisting of di-octyl dimethyl ammonium chloride, didecyl dimethyl ammonium chloride, C12-C16 alkyl benzyl ammonium chloride and derivatives thereof, chlorhexidine digluconate, chlorhexidine diacetate, poly hexamethylene biguanide hydrochloride and mixtures thereof. Non-ionic preservatives and antimicrobials are in another embodiment selected from the group consisting of 2-bromo-2-nitropropane-1,3-diol, 1,2-benzisothiazolin-3-one, n-butyl-1,2-benzisothiazolin-3-one, 5-chloro-4-methyl-2-isothiazolin-3-one, 4-methyl-2-isothiazolin-3-one, glutaraldehyde, phenoxyethanol and mixtures thereof. Suds suppressors can be used to limit the sudsing profiles of the compositions, especially for compositions impregnated in premoistened wipes. The compositions herein can also comprise other adjuvants including but not limited to, colorants, opacifiers, dyes, enzymes, chelants, builders and the like.

Technical Performance Comparison:

[0156] To demonstrate the benefits of an optimized cleaning and dusting solution used in combination with an optimized wet duster design a series of technical performance tests were conducted. The performance tests were

conducted on a glass surfaces as this represents a stress case for film/streaking and smudging. The test uses a 20 inch by 30 inch framed mirror (test surface ID 425458-U purchased from Target Corporation, Minneapolis, Minn. 55403). A range of cleaning solutions is tested using a range of different sprayer types ranging in dosing from 0.15 g to 0.9 g per spray. These cleaning solutions are tested using several different types of dusters including a duster comprising of 100% synthetic fibers and a duster comprising of over 50% hydrophilic fibers.

[0157] Each duster is attached to an appropriate handle. Testing is conducted in a constant humidity and temperature environment of 50 RH and 72° F.

[0158] Each test is conducted by first priming the test duster with 4 sprays of a test solution using a test sprayer. Priming is done by spraying the 4 sprays directly to the duster to pre-saturate the duster. For example if a sprayer that doses 0.15 g per spray is used, the duster is primed with 4x0.15 g of solution or 0.6 g. After priming the duster, the test mirror surface is sprayed with 4 additional sprays using the same solution and sprayer. Each spray is spread out across the mirror surface to get even coverage. The sprayed mirror is then wiped using the pre-primed duster in a side to side motion using 8 strokes and allowed to dry. The surface is then allowed to sit for about 15 minutes. The mirror is graded for film/streaking using a 0 to 4 scale where 0 is no film/streaks, 1 is slightly noticeable film/streaks, 2 is moderately noticeable film/streaks, 3 is noticeable film/streaks and 4 is very noticeable film/streaks. Grading is done by turning off room lights and using fluorescent lights to highlight the film/streaks. After grading for film/streaks, a portion of the cleaned mirror is buffed using a folded paper towel by applying firm pressure using 10 up and down strokes of about 6 to 8 inches in length and 4 to 6 inches in width. The buffed area is then graded for smudging by compared the buffed area to the unbuffed area using the same lighting approach. The scale for smudging is also 0 to 4 where 0 is no smudging, 1 is slightly noticeable smudging, 2 is moderately noticeable smudging, 3 is noticeable smudging and 4 is very noticeable smudging. At least 4 replicates are run for each condition and the average grade for film/streak and smudging is recorded. An overall performance index is determined for each condition by averaging the film/streak and smudging grades together into one weighted grade.

Cleaning and Dusting Composition

EXAMPLE 1

- [0159]** Non-ionic surfactant 1—0.15%
- [0160]** Non-ionic co-surfactant 2—0.01%
- [0161]** Propylene glycol butyl ether solvent—1.4%
- [0162]** Ethanol solvent—2.5%
- [0163]** Hydrophilic polymer—0.025%
- [0164]** Dow Corning AF suds suppressor—0.003%
- [0165]** Preservative—0.01%
- [0166]** Perfume—0.1%
- [0167]** % solids—0.2

Wet Duster Using Hydrophilic Non-Wovens

EXAMPLE 1

- [0168]** Attachment layers used to form pocket for holding handle—1 layer 30 gsm synthetic bicomponent thru-air+1 layer 20 gsm synthetic bicomponent spun-bond

[0169] Absorbent core—200 gsm air-laid core 55 mm wide by 150 mm long

[0170] Hydrophilic Non-wovens—10 layers of Ahlstrom material 45 gsm comprising 28 gsm cellulose tissue and 17 gsm spun-bond polypropylene laminate cut into strips 6 mm wide forming 26 strips per layer, 6 layers bonded using single seal and 4 layers bonded using dual seal.

[0171] Tow Fibers—None Present

Comparative Solution 1

[0172] Pledge Multi-surface clean and dust solution sold in 16 ounce trigger spray bottle

Comparative Solution 2

[0173] Windex glass cleaner solution sold in 32 ounce bottle

Comparative Solution 3

[0174] Pledge Duster Plus clean and dust solution sold as part of a kit in 0.8 ounce bottle

Comparative Duster 1

[0175] Pledge Duster Plus duster composed of 3 layers of 20 gsm synthetic bicomponent spun-bond bond layers to form attachment+ about 10 g of 50:50 polyethylene:polyester bicomponent tow fibers used in the form of fiber bundles. No other non-wovens are present on cleaning side.

core located in close proximity to the duster handle wiping portion; the Starter Kit also comprises a separate container housing aqueous cleaning solution, said container being optionally releasably attachable to the duster handle; the solution container in another embodiment includes a means for dosing an the aqueous cleaning solution. The attachment portion of the duster handle in another embodiment forms an angle of 70° to 160° with respect to the base of the wiping portion of the handle; the fiber bundles are in another embodiment polyester 'tow' fibers and the hydrophilic non-woven layers comprise about 25% or more cellulose fibers and are cut into a plurality of strips. The duster core is in another embodiment uncut. Exemplary arrangements of the hydrophilic non-woven layers, bundle fibers and core with respect to each other are described in Duster Pat Examples 1-5. In another embodiment, the Starter Kit dusters lack bundle fibers; the duster architecture is then similar to that described in Duster Pat Example 6. The starter kits described above are in another embodiment marketed and sold along with system refills. In one embodiment, a solution refill container comprising solution is provided such that the refill container in another embodiment houses a larger volume of aqueous cleaning solution than that provided in the starter kit. The refill container in another embodiment is not equipped with a spraying mechanism. Instead, consumers are instructed, using pictures and/or words, to dispense some of the contents of the refill container into the spray bottle container provided in the Starter Kit. Optionally, a refill for

Overall Performance Index – Average Film/streak + Smudging - 0 to 4 Scale Table 4

Solution	Duster	0.15 g sprayer	0.3 g sprayer	0.45 g sprayer	0.75 g sprayer	0.9 g sprayer	Average All Conditions
Example Solution 1	Example 1 Hydrophilic Duster	0.1	0.1	0.3	0.4	0.5	0.3
Example Solution 1	Comparative 1 Pledge Duster	0.8	1.0	0.9	1.1	1.3	1.0
Comparative Solution 1	Example 1 Hydrophilic Duster	0.6	0.1	0.3	0.7	0.4	0.4
Comparative Solution 1	Comparative 1 Pledge Duster	1.7	1.9	1.4	2.0	2.2	1.8
Comparative Solution 2	Example 1 Hydrophilic Duster	0.3	1.0	0.8	1.1	1.2	0.9
Comparative Solution 2	Comparative 1 Pledge Duster	1.7	2.4	2.1	2.3	2.5	2.2
Comparative Solution 3	Example 1 Hydrophilic Duster	3.8	2.7	—	—	—	3.2
Duster Plus							
Comparative Solution 3	Comparative 1 Pledge Duster	3.5	3.6	—	—	—	3.5
Pledge Duster Plus							

Single Duster Starter Kits and Refills

[0176] In one embodiment, the invention relates to a starter kit comprising a handle suited to for the duster and given amount of dusters (1-10) wherein each duster comprises hydrophilic non-woven layers, bundle fibers and a

dusters is also provided wherein the number of dusters in the refill system is in another embodiment larger than that provided in the Starter Kit. The refill package for the dusters optionally includes one or more handles. In further embodiments the dusters described in the invention are to be sold as

stand alone items without any solution and the solution is sold as stand alone without any dusters.

[0177] Wet dusters and associated aqueous chemistry sprays are provided with instructions for use. For best results, fiber bundle layers, if present, are first used for dry dusting. The accumulated dust on the bundle fibers is then in another embodiment emptied, optionally by shaking the duster, into a disposal area prior to wet dusting and cleaning. This minimizes potential contamination of the hydrophilic non-woven layers. For wet dusting, the duster is sprayed one to five times with aqueous chemistry solution sufficient to dampen it. The number of sprays depends on the actuation spray volume and the amount of surface to be dusted; continued dampening of the duster is done as needed. For wet cleaning, spray the surface directly. For glass surfaces, the user is instructed to start with a clean duster. Then after spraying wipe the surface to dryness; optionally additional wiping once the surface is dry helps minimize lint left on the glass surface. Once glass surfaces are cleaned the same used duster can continue to be used for dusting. Optionally, further instructions and advertising are provided explaining that the aqueous spray solution can be used with other duster systems and that the duster can be used in combination with alternative cleaning and dusting solutions. In one embodiment where the duster is sold as a stand-alone, instructions are provided to instruct the consumer to use the duster with plain water. In one example the instructions instruct the user to place the wet duster under a tap of running water, wring out to damp state, and shake gently to fluff it back up. Optionally, the instructions explain usage with plain water for damp dusting and usage with glass and multi-surface spray for cleaning.

Two Duster Starter Kits and Refills

[0178] Optionally, one or more kits are sold and marketed for separate dry and wet dusters. This provides optimum dry and wet dusting as the benefits of performance boosting tacky and hydrophobic coatings on fiber bundles using combined wet/dry dusters is limited because by the detrimental effects aqueous solutions have on the coatings present on the dry dusters. Use of a separate dry duster maximizes the flexibility for increasing the fiber bundle content of the duster and associated coating. Thus, in one embodiment, two separate dusters, one specially designed for dry dusting and the second one specially designed for wet dusting, are sold on the market. An exemplary dry duster is already marketed under the Swiffer brand. In one embodiment, the wet duster is composed of a plurality of hydrophilic non-woven strips in combination with an absorbent core and exclude tow fibers. An example of this design is shown in FIG. 6. The dry and wet dusters can be combined in a single Starter Kit, bundled together or sold in separate Starter Kits and advertised together for optimum dusting performance. In another embodiment the starter kit of the wet duster can have an additional removable adapter such as the one shown in FIG. 3. Instructions for use explain that the wet side should be used with the cleaning solution while the dry side should be kept dry for optimum performance. Instructions also explain that one of either the dry or the wet

dusters are discarded, while the other are re-used if it still appears to have mileage or capacity left to dust or clean.

All-in-One Duster Starter Kit and Refills:

[0179] An alternative embodiment for providing optimum dry and wet dusting is an all-one duster such as the one shown as Duster Pat Example 9 in FIG. 13. Starter kits and refills are similar to those described above in section for "Single Duster Starter Kits and refills". The important difference is the instructions for use explains that as the wet side gets overly saturated the entire duster should be replaced as the dry side needs to stay dry for optimum performance. If perforations are added whereby the dry and/or the wet portions are strippable from each other, the instructions are modified more in line with those used for the "Two Duster Starter Kits and Refills system".

Pre-Moistened Duster Starter Kit and Refills:

[0180] Optionally kits and refills can be sold where the dusters are pre-moistened. In this embodiment the moistened dusters can be contained within a resealable pouch, canister or tub. In an alternate embodiment, starter kits are sold where the packaged pre-moistened dusters are placed into a carton along with a handle. In another embodiment, dry dusters are added to the starter kit to provide dry and wet dusting. Optionally, a handle can simply be bundled with the pre-moistened dusters.

[0181] The dimensions and values disclosed herein are not to be understood as being strictly limited to the exact numerical values recited. Instead, unless otherwise specified, each such dimension is intended to mean both the recited value and a functionally equivalent range surrounding that value. For example, a dimension disclosed as "40 mm" is intended to mean "about 40 mm".

[0182] It should be understood that every maximum numerical limitation given throughout this specification includes every lower numerical limitation, as if such lower numerical limitations were expressly written herein. Every minimum numerical limitation given throughout this specification includes every higher numerical limitation, as if such higher numerical limitations were expressly written herein. Every numerical range given throughout this specification includes every narrower numerical range that falls within such broader numerical range, as if such narrower numerical ranges were all expressly written herein.

[0183] All parts, ratios, and percentages herein, in the Specification, Examples, and Claims, are by weight and all numerical limits are used with the normal degree of accuracy afforded by the art, unless otherwise specified.

[0184] Except as otherwise noted, the articles "a," "an," and "the" mean "one or more."

[0185] All documents cited in the Detailed Description of the Invention are, in relevant part, incorporated herein by reference; the citation of any document is not to be construed as an admission that it is prior art with respect to the present invention. To the extent that any meaning or definition of a term in this written document conflicts with any meaning or definition of the term in a document incorporated by reference, the meaning or definition assigned to the term in this written document shall govern.

[0186] While particular embodiments of the present invention have been illustrated and described, it would be obvious to those skilled in the art that various other changes

and modifications can be made without departing from the spirit and scope of the invention. It is therefore intended to cover in the appended claims all such changes and modifications that are within the scope of this invention.

What is claimed is:

1. A duster pad comprising:
 - a) at least one layer comprising hydrophilic non-woven fibers capable of contacting a surface to be cleaned;
 - b) at least one non-woven layer capable of being attached to a handle wherein the at least one layer comprises at least one free end.
2. The disposable substrate in claim 1 wherein the duster pad has a wet kinetic coefficient of friction on glass using de-ionized water is at least about 0.75.
3. The disposable substrate in claim 1, wherein the at least one layer comprises at least about 20% hydrophilic fibers.
4. The duster pad of claim 1 further comprising at least one fiber bundle layer.
5. The duster pad of claim 1 further comprising at least one absorbent core.
6. The duster pad of claim 4 further comprising at least one absorbent core.
7. The duster pad of claim 1 wherein the at least one layer comprising hydrophilic non-woven fibers comprises a plurality of strips.
8. The duster pad of claim 1 further comprising a second non-woven layer.
9. The duster pad of claim 1 wherein the at least one layer comprising hydrophilic non-woven fibers is bonded using a single seal, said single seal being continuous or discontinuous along the length of the substrate.
10. The duster pad of claim 9 wherein the at least one layer comprising hydrophilic non-woven fibers is further bonded using one or more sets of staggered continuous or discontinuous double seals.
11. The duster pad of claim 1 wherein the at least one layer comprising hydrophilic non-woven fibers comprises a laminate.
12. The duster pad of claim 1 wherein the at least one layer comprising hydrophilic non-woven fibers comprises a bi-laminate.
13. The duster pad of claim 1 comprising a ratio of fluffed thickness to flat thickness from about 3 to 1 to about 100 to 1.
14. The duster pad of claim 14 comprising a ratio of fluffed thickness to flat thickness from about 2 to 1 to about 50 to 1.
15. The duster pad of claim 11 further comprising one or more stiffening layers.
16. The duster pad of claim 7, wherein the plurality of strips form at least one loop.
17. The duster pad of claim 1, further comprising at least one scrubbing zone.
18. The duster pad of claim 1 comprising from 2 to 20 hydrophilic non-woven layers.
19. The duster pad of claim 1 comprising from 3 to 15 hydrophilic non-woven layers.
20. The duster pad of claim 1 wherein the basis weight of at least one layer comprising hydrophilic non-woven fibers is from about 10 g/m² to about 125 g/m².
21. The duster pad of claim 1 wherein the at least one layer comprising hydrophilic non-woven fibers has an absorbency of from about 2 g/m² to about 10 g/m².

22. The duster pad of claim 1 wherein the at least one layer comprising hydrophilic non-woven fibers has an absorbency of from about 2 g/m² to about 7 g/m².

23. The duster pad of claim 5 wherein the basis weight of the at least one absorbent core is from about 75 g/m² to about 300 g/m².

24. The duster pad of claim 5 wherein the at least one absorbent core has an absorbency of from about 7 grams per gram non-woven to about 20 gram per gram non-woven.

25. The duster pad of claim 1, further comprising a handle.

26. A kit comprising the duster pad of claim 1 and a cleaning solution.

27. The kit of claim 26 wherein the cleaning solution has a solids content of at most about 1% by weight of the cleaning solution.

28. The kit of claim 27 wherein the cleaning solution has a solids content of at most about 0.5% by weight of the cleaning solution.

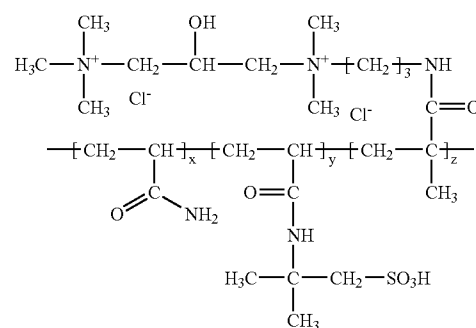
29. The kit of claim 26, wherein the cleaning solution further comprises a non-ionic surfactant.

30. The kit of claim 29 wherein the non-ionic surfactant comprises alkyl polyglycosides, polyamphoterics and polyzwitterionics and mixtures thereof.

31. The kit of claim 26, wherein the cleaning solution further comprises a hydrophilic polymer.

32. The kit of claim 31 wherein the hydrophilic polymer comprises acrylate and methacrylate polymers and copolymers, polystyrene sulfonate polymers, polyamphoterics, polyzwitterionics, and mixtures thereof.

33. The kit of claim 32 wherein the hydrophilic polymer comprises:



wherein x has a mean value of 0 to 50 mol %, y has a mean value of 10 to 95 mol %, and z has a mean value of 3 to 80 mol %.

34. The kit of claim 26 wherein the cleaning solution is dispensed at most about 0.9 g per second.

35. The kit of claim 26 wherein the cleaning solution is dispensed from about 0.15 to about 1.0 mls per actuation.

36. The kit of claim 26 wherein the duster pad is pre-moistened.

37. The kit of claim 36 wherein the duster pad has a load factor of from about 1.5 to about 7.

38. The kit of claim 37 wherein the duster pad has a load factor of from about 2.0 to about 6.0.

39. The kit of claim 26, further comprising a handle.

- 40.** A duster comprising
- a) a handle;
 - b) an adapter operatively attached to the handle;
 - c) the duster pad of claim 1, operatively attached to the adapter.
- 41.** A duster comprising
- a) a handle;
 - b) optionally an adapter operatively attached to the handle;
- wherein at least one of the handle and the optional adapter further comprises at least one gripper capable of attaching the duster pad of claim 1.
- 42.** A duster pad comprising:
- a) at least one layer of fiber bundles;
 - b) at least one layer of absorbent core;
- wherein said duster pad is capable of being attached to a handle.
- 43.** The duster pad of claim 42, further comprising at least one layer comprising hydrophilic non-woven fibers capable of contacting a surface to be cleaned.
- 44.** A duster comprising:
- a) optionally a handle, said handle optionally comprising a swivel joint;
- b) a first duster pad comprising a first cleaning surface, said first duster pad comprising at least one layer comprising hydrophilic non-woven fibers;
 - c) a second duster pad comprising a second cleaning surface, said second duster functionally attached to the first duster pad and/or the handle;
- wherein said first cleaning surface and said second cleaning surface are capable of being engaged without change to the handle, the first duster pad, or the second duster pad.
- 45.** A duster pad for two sided use comprising:
- a) at least one layer comprising hydrophilic non-woven fibers located on a first side of the cleaning substrate;
 - b) at least one layer of fiber bundles located on a second side opposite the first side;
 - c) optionally, at least one non-woven layer between the at least one layer comprising hydrophilic non-woven fibers and the at least one layer of fiber bundles;
 - d) optionally, a handle, said handle optionally comprising a swivel joint.

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