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(54) **USE OF A DRYER SHEET TO REDUCE AIRBORNE FIBRES RELEASE FROM A DRYER**

VERWENDUNG EINES TROCKNERBLATTS ZUR VERMINDERUNG DER LUFTFREISETZUNG VON FASERN AUS EINEM TROCKNER

UTILISATION D'UNE FEUILLE DE SÉCHAGE POUR RÉDUIRE LA LIBÉRATION DE FIBRES AÉROPORTÉ D'UN SÈCHE-LINGE

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(73) Proprietor: **The Procter & Gamble Company**
Cincinnati, OH 45202 (US)

(72) Inventors:
- **LANT, Neil Joseph**
  Newcastle upon Tyne, NE12 9TS (GB)
- **DEFAYE, Margaux Marie Anna**
  87100 Limoges (FR)
- **Smith, Andrew John**
  Newcastle-upon-Tyne, NE12 9TS (GB)

(74) Representative: **P&G Patent Belgium UK**
Temselaan 100
1853 Strombeek-Bever (BE)

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- **GAYLARDE CHRISTINE ET AL: "Plastic microfibre pollution: how important is clothes' laundering?", HELIYON, vol. 7, no. 5, 1 May 2021 (2021-05-01), GB, pages e07105, XP055915536, ISSN: 2405-8440, DOI: 10.1016/ j.heliyon.2021.e07105**

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Description

FIELD OF THE INVENTION

[0001] The present invention is in the field of fabric treatments. In particular the invention relates to the use of a dryer sheet to reduce airborne fibers release during the treatment of fabrics.

BACKGROUND OF THE INVENTION

[0002] Vented tumble dryers release moist warm air from the fabric drying process to the external environment, usually through pipework linking the appliance to a vent in an exterior wall. Although such dryers have an integrated lint filter intended to remove fibers from this air stream, recent reports suggest that this process is incomplete, leading to microfibers being released in the ducted warm air and subsequently polluting the external environment.

[0003] GAYLARDE CHRISTINE ET AL: "Plastic microfibre pollution: how important is clothes' laundering?", HELIYON, vol. 7, no. 5, 1 May 2021 disclose potential methods for controlling microfibre production and release. These methods for the reduction of microfibre release from laundry activities fall into 3 groups: changes to washing machines or washing procedures, changes in the textiles themselves and improvement of wastewater treatment processes.

[0004] Patent literature US 5470492 A provides examples of dryer-activated fabric softening articles comprising polyester substrates for use in an automatic clothes dryer.

[0005] The objective of the present invention is to reduce the release of airborne microfibers during the treatment of fabrics in a vented tumble dryer.

SUMMARY OF THE INVENTION

[0006] The present invention provides the use of a dryer sheet to reduce airborne fibers release during the treatment, preferably drying, of fabrics in a vented tumble dryer. Preferably the dryer sheet comprises a non-woven substrate and more preferably the non-woven substrate comprises polyester. Preferably the dyer sheet comprises a fabric treatment composition, more preferably a softening composition. The use of a dryer sheet comprising a softening composition, preferably a softening composition comprising a quaternary ammonium softening compound, provides improved reduction of the release of fibers during fabric treatment in a vented tumble dryer.

DETAILED DESCRIPTION OF THE INVENTION

[0007] The present invention encompasses the use of a dryer sheet to reduce airborne fibers release during the treatment, preferably drying, of fabrics in a vented tumble dryer.

[0008] The yarns in fabrics are made up of filaments that are twisted together. During washing, with the effects of water, friction and abrasion those filaments shed. Filaments also shed during treatment in a tumble dryer. Different types of fabric shed more than others. A tightly woven fabric with tightly twisted yarn (one that feels flat and smooth) sheds less than a loosely woven fabric with loosely twisted yarn (one that feels fluffy or fuzzy).

[0009] Tumble dryer sheets are used in some markets to deliver softness, anti-static and freshness benefits to fabrics during treatment, preferably drying, in a tumble dryer.

[0010] During the course of the work leading to the present invention, it was found that the presence of a dryer sheet, preferably comprising a fabric softening composition, in a vented dryer reduced the amount of fibers released from the vent of the vented tumble dryer. The sheets were found to collect fibers during the drying process.

[0011] The fabric to be treated in the dryer can be wet or humid or it can be dry. It can be treated wet after being washed. Alternatively, the fabric can be treated dry in order to refresh it.

[0012] All percentages, ratios and proportions used herein are by weight percent of the composition, unless otherwise specified. All average values are calculated "by weight" of the composition, unless otherwise expressly indicated. All ratios are calculated as a weight/weight level, unless otherwise specified.

[0013] All measurements are performed at 25°C unless otherwise specified.

[0014] Unless otherwise noted, all component or composition levels are in reference to the active portion of that component or composition, and are exclusive of impurities, for example, residual solvents or by-products, which may be present in commercially available sources of such components or compositions.

[0015] As used herein, the term " airborne fiber" means a fiber that can be transported by air.

[0016] As used herein, the term "fabric" is intended to include any object, article or item made from or containing at least in part some woven or non-woven fabric portion that may be treated in an automatic dryer cycle.

[0017] As used herein, the term "dryer sheet" means a sheet for use in the dryer, the sheet is dry and it is not part of the fabrics to be treated. The "dryer sheet" is used to provide benefits to the treated fabrics. The "dyer sheet" is sometimes

herein referred as the "dryer sheet of the invention".

[0018] The dryer for use in the invention is a vented tumble dryer. In a tumble-type dryer the fabrics and the dryer sheet are provided within a rotating drum that causes the fabrics to tumble during the operation of the dryer. Tumble-type dryers are commonly found in residences and in commercial and industrial laundry operations. As mentioned herein before, the fabric can be wet, damp or dry. The drying cycle is initiated in the dryer. Usually, the fabric is subject to a temperature in the range of from about 40°C to about 100°C. The duration of the drying process is determined as function of the wetness of the fabric.

[0019] The dryer sheet disclosed herein are conveniently employed to treat fabrics in the dryer, preferably during a drying process in a dryer. The dryer sheet can be used to treat fabrics that have not been washed or after the fabrics have been washed with a laundry detergent.

Dryer sheet

[0020] The dryer sheet of the invention comprises a substrate and optionally a fabric treatment composition, preferably a fabric softener composition.

[0021] Dryer sheets can be prepared by soaking an absorbent flexible substrate with a liquid mixture of a fabric treatment composition, pressing the resultant soaked sheet to remove any excess liquid and then drying the sheet. Dryer sheets known in the art are preferably prepared by coating an absorbent flexible substrate with a molten mixture of the fabric treating composition and then solidifying the mixture. The fabric treatment composition transfers to the fabric during a drying operation to impart the fabric conditioning properties to the fabric. At an activation temperature that is achieved during a drying cycle in a dryer, at least a portion of the fabric treatment composition transfers from the substrate to the fabric to impart fabric conditioning properties. The activation temperature refers to the temperature at which the fabric treatment composition transfers to the fabrics.

[0022] The dryer sheet can be provided from components that are considered biodegradable or compostable. The terms biodegradable or compostable, are meant to refer to the ability of the dryer sheet to undergo degradation via biodegradation or hydrolysis under conditions favorable to biodegradation or hydrolysis (e.g., composting environment at 95% relative humidity and 180° F.) so that at least 95% of the components are considered degraded within a time period of about 90 days. The dryer sheet can be manufactured from only materials that are considered biodegradable or compostable, or the dryer sheet can be manufactured from a combination of materials that are considered biodegradable or compostable and materials that do not satisfy the biodegradable or compostable test. In addition, the dryer sheet can be provided so that it is characterized as biodegradable under ASTM D 6868-03. Although ASTM D 6868-03 refers to the definition of biodegradability for plastics used as coatings on paper, this definition can be used for determining the biodegradability of paper products.

[0023] The dryer sheet preferably comprises a fibrous substrate, it can be a woven or nonwoven substrate. The substrate can be a single layer substrate or dual-layer substrate. A dual-layer substrate comprises a fibrous first layer, the first layer having a first layer interior surface and a first layer exterior surface opposing the first layer interior surface, wherein the first layer exterior surface has a first layer exterior surface area; a nonwoven fibrous second layer joined to the first layer, the second layer having a second layer interior surface and a second layer exterior surface opposing the second layer interior surface, wherein the second layer exterior surface has a second layer exterior surface area, wherein the second layer interior surface is oriented towards the first layer interior surface. The dryer sheet preferably comprises a fabric treatment composition. In a dual layer-substrate part of the fabric treatment composition is preferably on the first layer interior surface and partially penetrating into the first layer; wherein the first layer exterior surface is free from the fabric treatment composition over more than about 60% of the first layer exterior surface; wherein the second layer exterior surface is free from the fabric treatment composition over more than about 60% of the second layer exterior surface. Preferably the fabric treatment composition is present at a weight ratio relative to the first layer and the second layer combined from about 10:1 to about 1000:1.

Nonwoven Fibrous Materials

[0024] Nonwoven fibrous materials provide for adequate function as a carrier for the cleaning microorganism and fabric treatment composition. The nonwoven fibrous material can be a polyester nonwoven fibrous material. For example, the nonwoven fibrous material can be polyester terephthalate. The nonwoven fibrous material can be a spun bonded polyester terephthalate. Optionally, the nonwoven fibrous material can be continuous filament spun bonded polyester terephthalate. Other nonwoven fibrous materials, such as rayon, can also be practical.

[0025] The nonwoven fibrous material can have a basis weight from about 10 g/m^2 to about 50 g/m^2. Such fibrous materials have sufficient constitution to carry the desired quantity of a treatment composition.

[0026] To provide for the desired release of the treatment composition, the nonwoven fibrous material can have a permeability of from about 50 Darcys to about 150 Darcys, optionally about 90 Darcys to about 140 Darcys. The fibers

constituting the nonwoven fibrous material can have a denier from about 2 to about 6. The nonwoven fibrous material can have a caliper from about 0.1 mm to about 0.5 mm, or optionally from about 0.1 mm to about 0.4 mm. The greater the caliper, the more space within the nonwoven fibrous material to hold a fabric treatment composition.

[0027] The nonwoven substrate can comprise natural fiber and regenerated cellulose fiber. The substrate can include a sufficient amount of regenerated cellulose fiber to provide the nonwoven substrate with desired cloth or hand feel characteristics, and to provide the nonwoven substrate with desired porosity.

[0028] Natural fiber refers to fiber formed from plants or animals. Natural fibers are not fibers that are formed as a result of extrusion or spinning. The natural fibers can be obtained from a source of fiber using techniques such as chemical pulping, chemical mechanical pulping, semi chemical pulping, or mechanical pulping. Natural fibers from plants are often referred to as cellulosic fibers.

[0029] Exemplary natural fibers that can be used to form the nonwoven substrate include wood fibers and non-wood natural fibers such as vegetable fibers, cotton, various straws (e.g., wheat, rye, and others), various canes (e.g., bagasse and kenaf), silk, animal fiber (e.g., wool), grasses (e.g., bamboo, etc.), hemp, corn stalks, abaca, etc.

[0030] Wood fiber can be obtained from wood pulp. The wood pulp can include hardwood fibers, softwood fibers, or a blend of hardwood fibers and softwood fibers. The pulp can be provided as cellulose fiber from chemical pulped wood, and can include a blend from coniferous and deciduous trees. By way of example, wood fibers can be from northern hardwood, northern softwood, southern hardwood, or southern softwood. Hardwood fibers tend to be more brittle but are generally more cost effective for use because the yield of pulp from hardwood is higher than the yield of pulp from softwood. The pulp can contain about 0 to about 100% or about 0 to about 70% hardwood fibers based on the weight of the fibers. Softwood fibers have desired paper making characteristics but are generally more expensive than hardwood fibers. The pulp can contain about 0 to about 100% softwood fibers based on the weight of the fibers. The pulp can contain a blend of hardwood and softwood fibers.

[0031] The natural fibers can be extracted with various pulping techniques. For example, mechanical or high yield pulping can be used for stone ground wood, pressurized ground wood, refiner mechanical pulp, and thermomechanical pulp. Chemical pulping can be used incorporating kraft, sulfite, and soda processing. Semi-chemical and chemi-mechanical pulping can also be used which includes combinations of mechanical and chemical processes to produce chemi-thermomechanical pulp.

[0032] The natural fibers can also be bleached or unbleached. One of skill in the art will appreciate that the bleaching can be accomplished through many methods including the use of chlorine, hypochlorite, chlorine dioxide, oxygen, peroxide, ozone, or a caustic extraction.

[0033] The pulp can include a recycle source for reclaimed fiber. Exemplary recycle sources include post-consumer waste (PCW) fiber, office waste, and corrugated carton waste. Post-consumer waste fiber refers to fiber recovered from paper that is recycled after consumer use. Office waste refers to fiber obtained from office waste, and corrugated carton waste refers to fiber obtained from corrugated cartons. Additional sources of reclaimed fiber include newsprint and magazines. Reclaimed fiber can include both natural and synthetic fiber. Incorporation of reclaimed fiber in the nonwoven substrate can aid in efficient use of resources and increase satisfaction of the end user of the dryer sheet.

[0034] Refining is the treatment of pulp fibers to develop their papermaking properties. Refining increases the strength of fiber to fiber bonds by increasing the surface area of the fibers and making the fibers more pliable to conform around each other, which increases the bonding surface area and leads to a denser sheet, with fewer voids. Most strength properties of paper increase with pulp refining, since they rely on fiber to fiber bonding. The tear strength, which depends highly on the strength of the individual fibers, has a tendency to decrease with refining. Refining of pulp increases the fibers flexibility and leads to a denser substrate. This means bulk, opacity, and porosity decrease (densometer values increase) with refining. Fibrillation is a result of refining paper fibers. Fibrillation is the production of rough surfaces on fibers by mechanical and/or chemical action; refiners break the outer layer of fibers, e.g., the primary cell wall, causing the fibrils from the secondary cell wall to protrude from the fiber surfaces.

[0035] The fibers can be refined so that the resulting nonwoven substrate provides the desired Canadian Standard Freeness value. In general, less refined fiber can provide a nonwoven substrate having more holes and voids and thereby permitting greater penetration into the nonwoven substrate. It may be desirable to provide a desired level of refining to control the presence of holes or voids so that the nonwoven substrate can contain a desired amount or loading of the fabric conditioning agent.

[0036] The nonwoven substrate can comprise natural fiber and regenerated cellulose fiber. The substrate can include a sufficient amount of regenerated cellulose fiber to provide the nonwoven substrate with desired cloth or hand feel characteristics, and to provide the nonwoven substrate with desired porosity.

[0037] Regenerated cellulose fiber can be considered a type of fiber prepared from cellulose and wherein the fiber is formed as a result of extrusion or spinning. An exemplary regenerated cellulose fiber can be referred to as rayon or as viscose. It is understood that viscose is generally another term for rayon.

[0038] The nonwoven substrate can contain a sufficient amount of the regenerated cellulose fiber so that the dryer sheet exhibits desirable cloth and hand feel characteristics. In general, the cloth or hand feel characteristics of the dryer sheet

can be provided so that they are similar to the cloth or hand feel characteristics of commercial dryer sheet products such as those available under the names Bounce® and Downy® from The Procter & Gamble Company. The natural fiber can provide a nonwoven substrate for use as a dryer sheet that is relatively inexpensive but has a tendency to provide the dryer sheet with stiffness. Regenerated cellulose fiber can be included in the nonwoven substrate in an amount sufficient to improve the cloth and hand feel characteristics of the nonwoven substrate.

[0039] The nonwoven substrate can contain a sufficient amount of the regenerated cellulose fiber so that the resulting nonwoven substrate has a desired level of porosity or air permeability. In general, providing the nonwoven substrate with a desired level of air permeability allows the nonwoven substrate to handle or contain a desired amount or loading of fabric conditioning agent. The air permeability of the nonwoven substrate can be controlled to allow for sufficient loading of the fabric conditioning agent onto the nonwoven substrate. It can be desirable for the nonwoven substrate to have an air permeability of at least 1.83 m^3 per minute per m^2 (6 CFM (cubic feet per minute per ft2)) according to Tappi T 251CM-85.

[0040] The nonwoven substrate can be prepared from fibers containing natural fiber, regenerated cellulose fiber, or a mixture of natural fiber and regenerated cellulose fiber. The nonwoven substrate can contain 0 wt. % to 100 wt. % natural fiber and can contain 0 wt. % to 100 wt. % regenerated cellulose fiber, based on the weight of the fiber of the nonwoven substrate. In order to provide the nonwoven substrate with desired cloth and hand feel properties or to provide the nonwoven substrate with desired air permeability, the nonwoven substrate can be prepared from a mixture of natural fiber and regenerated cellulose fiber. The nonwoven substrate can be prepared from a mixture containing about 10 wt. % to about 95 wt. % natural fiber, about 20 wt. % to about 92 wt. % natural fiber, about 40 wt. % to about 90 wt. % natural fiber, or about 50 wt. % to about 85 wt. % natural fiber. The nonwoven substrate can be prepared from a mixture containing about 0.5 wt. % to about 75 wt. % regenerated cellulose fiber, about 2 wt. % to about 60 wt. % regenerated cellulose fiber, about 10 wt. % to about 55 wt. % regenerated cellulose fiber, or about 20 wt. % to about 50 wt. % regenerated cellulose fiber. The weight percent of fiber is based upon the fiber content of the nonwoven substrate.

[0041] It can be desirable to provide the regenerated cellulose fiber having a length that is as long as possible to form a nonwoven substrate on a paper making machine in order to obtain the maximum benefit of the presence of the regenerated cellulose fiber. In general, it is expected that by using a longer regenerated cellulose fiber, it may be possible to use less of the regenerated cellulose fiber prepared with a nonwoven substrate that uses shorter fiber. In general, an exemplary regenerated cellulose fiber length that can be used on a paper making machine is about 3 mm to about 6 mm (about ⅛ inch to about ¼ inch). It may be desirable to provide the regenerated cellulose fiber having a length of up to about 5.08 cm (about 2 inches).

[0042] The regenerated cellulose fiber can have a denier selected to provide desired cloth or hand feel characteristics. In general, a small denier can be used to enhance the cloth or hand feel characteristics. Fibers having a larger denier tend to be more coarse. Accordingly, the regenerated cellulose fiber can have a denier of about 0.5 to about 20, a denier of about 0.5 to about 10, a denier of about 0.5 to about 5, or a denier of about 1.0 to about 2.

[0043] The nonwoven fibrous material can be a continuous filament of polyester homopolymer and binder filaments formed of a polyester copolymer. The nonwoven fibrous material can be a polyolefin nonwoven. The nonwoven fibrous material can be spunbonded nonwoven. The nonwoven fibrous material can be an area bonded or point bonded nonwoven. The nonwoven fibrous material can be a spun bonded polyethylene terephthalate having trilobal fibers having a denier from about 5 to about 6. The nonwoven fibrous material can be a spun bonded a bicomponent fiber having a polyethylene terephthalate core and copolyethylene terephthalate with isophthatlate and or mixture thereof.

[0044] The nonwoven fibrous material can comprise bicomponent fibers. The bicomponent fibers can be core-sheath constructions or lobed constructions. The nonwoven fibrous material can comprise bicomponent fibers that are polyethylene/polyethylene terephthalate core-sheath constructions, with either constituent forming the core or sheath. The bicomponent fibers can be polyethylene/polypropylene, with either constituent forming the core or sheath.

[0045] The nonwoven fibrous material can be the nonwoven fibrous material used presently or in the past or like that used presently or in the past in BOUNCE dryer sheets, available from The Procter & Gamble Company, Cincinnati, OH, United States of America, SNUGGLE dryer sheets, available from Henkel Corporation, Stamford, Connecticut, United States of America, and or SUAVITEL dryer sheets, available from Colgate-Palmolive Company, New York, New Yok, United States of America.

[0046] The nonwoven fibrous material can be cellulose.

Process of Manufacture

[0047] The dryer sheet can be practically formed using a continuous web converting process. A nonwoven fibrous web can be provided. The nonwoven fibrous web can have a top surface and an opposing bottom surface and a pair of web transverse edges. A fabric treatment composition, preferably a fabric softener composition, can be applied to the top surface. The nonwoven fibrous web can be folded toward the top surface about a fold line that divides the first layer and the second layer to bring the web transverse edges into alignment with one another so that the second layer is above the first layer. The nonwoven fibrous web can be cut to form the dryer sheet. The nonwoven fibrous web can practically be cut

before it is folded or after it is folded but may be simpler to convert if the nonwoven fibrous web is cut after being folded.

[0048] The fabric treatment composition, can be applied to the top surface by slot coating, spray coating, kiss rolling, printing, rotogravure, and other processes for applying the cleaning microorganisms as a liquid. One practical approach for applying the fabric treatment composition to a nonwoven fibrous material, as the nonwoven fibrous layers are employed herein, is to slot coat the nonwoven fibrous material and use a scraper set at or just above the surface to which the composition is applied to scrape off the composition at some level at or above the surface of the nonwoven fibrous material so that excess composition is removed.

[0049] The fabric treatment composition may partially penetrate into the nonwoven fibrous web. The fabric treatment composition may be applied to one of what becomes the first layer interior surface and or the second layer interior surface. The step of folding can be conveniently accomplished with a folding rail. Other folding process may be employed if the nonwoven fibrous web is cut in the cross direction CD prior to folding or individual pieces of nonwoven fibrous web are provided and then each dryer sheet is folded individually.

[0050] Once the nonwoven fibrous web, or an individual piece of nonwoven fibrous web, is folded over on itself, the web transverse edges can be bonded to one another. The step of bonding can be performed before or after the step of cutting in the cross direction CD. The bonding can provide coherency to the dryer sheet as described previously.

[0051] Once the first layer and second layer, or the pieces or parts of nonwoven fibrous web that ultimately become the first layer and second layer, are positioned as desired, the layers can be embossed to provide embossments to the layers and to squeeze the fabric treatment composition, if present, within the layers so that the fabric treatment composition fully penetrates the layers. Embossing can be accomplished by an embossing roll such as a cylindrical roll having raised embossing features of the desired pattern that is in operative relationship with an anvil roll.

[0052] Another approach for forming the dryer sheet is to provide the first layer and the second layer. The first layer and the second layer can be provided integral with one another as a single nonwoven fibrous web moving in the machine direction MD. The fabric treatment composition can be applied to the first layer interior surface and or the second layer interior surface, if the first layer and second layer are provided as individual lanes, or the nonwoven fibrous web can be cut in the machine direction MD after the fabric treatment composition is applied to form lanes of the material that ultimately becomes the first layer and second layer.

[0053] One of the first layer and the second layer can be flipped. Flipping can position the surface of the layers to which the treatment composition is applied to be oriented towards one another when the first layer is stacked onto the second layer. Flipping can be performed before or after the nonwoven fibrous web is cut in the cross direction CD.

[0054] Once one of the layers is flipped, the first layer and the second layer can be stacked so that the first layer interior surface is oriented towards the second layer interior surface. The first layer can be bonded to the second layer, which provides the benefit of helping to maintain the form of the dryer sheet before, during, and after use.

Fabric Treatment Composition

[0055] The dryer sheet preferable comprises a fabric treatment composition, the fabric treatment composition can provide care, fragrance, antiwrinkle, color protection, antistatic, softening benefits and any other benefits that add to the longevity and good feeling of fabrics. The fabric treatment composition can be a fabric softening composition such as any of the fabric softening compositions used presently or in the past or like that used presently or in the past in BOUNCE dryer sheets, available from The Procter & Gamble Company, Cincinnati, OH, United States of America, SNUGGLE dryer sheets, available from Henkel Corporation, Stamford, Connecticut, United States of America, and or SUAVITEL dryer sheets, available from Colgate-Palmolive Company, New York, New Yok, United States of America

[0056] The fabric treatment composition is preferably a fabric softening composition. The fabric softening composition preferably comprises from about 10% to about 90% by weight of the composition of a softening agent, preferably a quaternary ammonium softening compound. The quaternary ammonium softening compound may be ester and or amide linked.

[0057] The fabric softening composition may comprise a cationic nitrogen-containing compound such as a quaternary ammonium compound having one or two straight-chain organic groups of at least 8 carbon atoms; optionally one or two such groups of from 12 to 22 carbon atoms and, optionally be ester and or amide linked. Specific non-limiting examples of fabric softening actives include the following: Di Tallow, Di Methyl Ammonium Methyl Sulfate, N,N-di(oleyi-oxy-ethyl)-N,N-dimethyl ammonium chloride, N,N-di(canolyl-oxy-ethyl)-N,N-dimethyl ammonium chloride, N,N-di(oleyl-oxy-ethyl)-N-methyl, N-(2-hydroxyethyl) ammonium methyl sulfate, N,N-di(canolyl-oxy-ethyl)-N-methyl, N-(2-hydroxyethyl) ammonium methyl sulfate-, N,N-di(oleylamidoethyl)-N-methyl, N-(2-hydroxyethyl) ammonium methyl sulfate, N,N-di(2-oleyloxy oxo-ethyl)-N,N-dimethyl ammonium chloride, N,N-di(2-canolyloxy oxo-ethyl)-N,N-dimethyl ammonium chloride-, N,N-di(2-oleyloxyethylcarbonyloxyethyl)-N,N-dimethyl ammonium chloride, N,N-di(2-canolyloxyethylcarbonyloxyethyl)-N,N-dimethyl ammonium chloride, N-(2-oleyloxy ethyl)-N-(2-oleyloxy oxo-ethyl)-N,N-dimethyl ammonium chloride; N-(2-canolyloxy ethyl)-N-(2-canolyloxy oxo-ethyl)-N,N-dimethyl ammonium chloride, N,N,N-tri(oleyl-oxyethyl)-N-methyl ammonium chloride, N,N,N-tri(canolyi-oxy-ethyl)-N-methyl ammonium chloride-, N-(2-oleyloxy oxoethyl)-N-(oleyl)-N,N-

dimethyl ammonium chloride, N-(2-canolyloxy oxoethyl)-N-(canolyl)-N,N-dimethyl ammonium chloride, 1,2-dioleyloxy N,N,N-trimethylammoniopropane chloride, and 5,2-dicanolyloxy N,N,N-trimethylammoniopropane chloride, and combinations thereof. In one embodiment, the fabric conditioning active is N,N-di(tallowyl-oxy-ethyl)-N-methyl, N-(2-hydroxyethyl) ammonium methyl sulfate.

[0058] The fabric softening composition may comprise ingredients such as a nonionic material. Suitable nonionic materials may include polyoxyalkylene glycols, higher fatty alcohol esters of polyoxyalkylene glycols, higher fatty alcohol esters of polyoxyalkylene glycols, ethoxylates of long chained alcohols of from 8 to 30 carbon atoms such as the ethoxylates of coconut, palm, tallow alcohols or hydrogenated alcohols with 4 to 40 moles of ethylene oxide, and alkanolamides. The fabric softening composition may further comprise, with or without a non-ionic material, fatty acids, ethoxylated fatty acids, and combinations thereof. Suitable fatty acids include those wherein the long chain is unsubstituted or substituted alkyl or alkenyl group of from about 8 to 30 carbon atoms. Examples of specific fatty acids are lauric, palmitic, stearic, oleic, and/or combinations thereof.

[0059] The fabric softening composition may comprise one or more organic compounds having at least one relatively long hydrocarbon group serving to provide lubricity and or antistatic effects. Among such groups are alkyl groups containing 8 or more carbon atoms or even 12 to 22 carbon atoms. Suitable fabric softening compositions may comprise cationic, anionic, nonionic, or zwitterionic compounds. Cationic nitrogen containing compounds such as quaternary ammonium compounds having one or two straight chain organic groups of at least eight carbon atoms are practical.

[0060] The fabric softening composition can contain less than about 5% by weight of fatty acid. The fabric softening composition can be selected from the group consisting of polyglyceryl distearate, parrafin wax, branched parrafin wax, polyglyceryl ethers, and combinations thereof. Suitable fabric softening compositions include cationic, anionic, nonionic, or zwitterionic compounds. The fabric softening composition can be a quaternary imidazolinium salt. Optionally, the fabric softening composition can be a polyoxyalkylene glycol, including higher fatty alcohol esters of polyoxyalkylene glycol and higher fatty alcohol ethers of polyoxyalkylene glycol. The fabric softening composition can be a fatty acid ester of sorbitan and ethoxylates of such esters.

Other fabric treatment ingredients

[0061] The fabric treatment composition can comprise a variety of ingredients. The fabric treatment composition may comprise unencapsulated perfume, encapsulated perfume, and combinations thereof. The encapsulated perfume, if provided, can be selected from the group consisting of friable encapsulates, moisture activated encapsulates, heat activated encapsulates and combinations thereof.

[0062] The fabric softening composition can comprise ingredients selected from the group consisting of softening agents, soil release agents, anti-static agents, crisping agents, water/stain repellents, stain release agents, refreshing agents, disinfecting agents, wrinkle resistant agents, wrinkle release agents, odor resistance agents, malodor control agents, abrasion resistance and protection agents, solvents, insect/pet repellents, wetting agents, chlorine scavenging agents, optical brighteners, UV protection agents, skin/fabric conditioning agents, skin/fabric nurturing agents, skin/fabric hydrating agents, color protection agents, dye fixatives, dye transfer inhibiting agents, silicones, preservatives and antimicrobials, fungicides, fabric shrinkage-reducing agents, brighteners, hueing dyes, bleaches, chelants, antifoams, antiscum agents, whitening agents, catalysts, cyclodextrin, zeolite, petrolatum, glycerin, triglycerides, vitamins, other skin care actives such as aloe vera, chamomile, shea butter and the like, mineral oils, and combinations thereof.

Perfume

[0063] In addition to the fabric treatment composition, the dryer sheet can further comprise 0.1% to about 20% by weight perfume. The perfume can be unencapsulated perfume, encapsulated perfume, perfume provided by a perfume delivery technology, or a perfume provided in some other manner. Perfumes are generally described in U.S. Patent No. 7,186,680 at column 10, line 56, to column 25, line 22. The dryer sheet can comprise unencapsulated perfume and are essentially free of perfume carriers, such as a perfume microcapsules. The dryer sheet can comprise perfume carrier materials (and perfume contained therein). Examples of perfume carrier materials are described in U.S. Patent No. 7,186,680, column 25, line 23, to column 31, line 7. Specific examples of perfume carrier materials may include cyclodextrin and zeolites.

[0064] The dryer sheet can comprise about 0.1% to about 20%, alternatively about 1% to about 15%, alternatively 2% to about 10%, alternatively combinations thereof and any whole percentages within any of the aforementioned ranges, of perfume by weight of the dryer sheet. The dryer sheet can comprise from about 0.1% by weight to about 6% by weight of the dryer sheet of perfume. The perfume can be unencapsulated perfume and or encapsulated perfume.

[0065] The dryer sheet can be free or substantially free of a perfume carrier. The dryer sheet may comprise about 0.1% to about 20%, alternatively about 1% to about 15%, alternatively 2% to about 10%, alternatively combinations thereof and any whole percentages within any dryer sheet.

[0066] The dryer sheet can comprise unencapsulated perfume and perfume microcapsules. The dryer sheet may

comprise about 0.1% to about 20%, alternatively about 1% to about 15%, alternatively from about 2% to about 10%, alternatively combinations thereof and any whole percentages or ranges of whole percentages within any of the aforementioned ranges, of the unencapsulated perfume by weight of the dryer sheet. Such levels of unencapsulated perfume can be appropriate for any of the dryer sheet disclosed herein that have unencapsulated perfume.

[0067] The dryer sheet can comprise unencapsulated perfume and a perfume microcapsule but be free or essentially free of other perfume carriers. The dryer sheet can comprise unencapsulated perfume and perfume microcapsules and be free of other perfume carriers.

[0068] The dryer sheet can comprise encapsulated perfume. Encapsulated perfume can be provided as plurality of perfume microcapsules. A perfume microcapsule is perfume oil enclosed within a shell. The shell can have an average shell thickness less than the maximum dimension of the perfume core. The perfume microcapsules can be friable perfume microcapsules. The perfume microcapsules can be moisture activated perfume microcapsules.

[0069] The perfume microcapsules can comprise a melamine/formaldehyde shell. Perfume microcapsules may be obtained from Appleton, Quest International, or International Flavor & Fragrances, or other suitable source. The perfume microcapsule shell can be coated with polymer to enhance the ability of the perfume microcapsule to adhere to fabric. This can be desirable if the particles are designed to be a fabric treatment composition. The perfume microcapsules can be those described in U.S. Patent Pub. 2008/0305982.

[0070] The dryer sheet can comprise about 0.1% to about 20%, alternatively about 0.1% to about 10%, alternatively about 1% to about 15%, alternatively 2% to about 10%, alternatively combinations thereof and any whole percentages within any of the aforementioned ranges, of encapsulated perfume by weight of the dryer sheet.

[0071] The dryer sheet can comprise perfume microcapsules but be free of or essentially free of unencapsulated perfume. The particles may comprise about 0.1% to about 20%, alternatively about 1% to about 15%, alternatively about 2% to about 10%, alternatively combinations thereof and any whole percentages within any of the aforementioned ranges, of encapsulated perfume by weight of the dryer sheet.

EXAMPLES

General washing and drying conditions

[0072] The following examples involve testing conducted to evaluate the impact of dryer sheets on airborne fiber release from vented tumble dryers. Each test involved four washing and drying cycles of a new unsoiled laundry load comprising 10 cotton T-shirts (Fruit of the Loom® Original T-shirt, product code 61-082, size L, 100% cotton, density 145 g/m^2) and 10 polyester T-shirts (Fruit of the Loom® Performance T-shirt, product code 61-390, size L, 100% polyester, density 140 g/m^2).

[0073] All tests involved North American washing conditions and were conducted using 102.6 ppm (6 grains per U.S. gallon) hardness water and a High Efficiency top-loader washing machine Maytag® Bravo (Model MVWX655DW1). Tests were conducted using the customized North America Median program (Cycle settings: Medium soil, Fabric Conditioner knob set to "ON", Extra rinse knob set to "OFF", Washing temperature: 25°C, Main wash volume: 38 L, Rinse temperature: 15°C, Rinse volume: 43 L, and 52 minutes total duration). The test garments were washed and rinsed using these conditions, and the same conditions were used for two washout cycles afterwards conducted without fabrics and products to clean the machine. All tests were conducted using sets of four identical machines fed by the same water supply. Treatments were rotated between the four washing machines and conducted in triplicate for four consecutive washing cycles. After each wash cycle, the wash loads were dried using Indesit® vented tumble dryers (model IDV75) for one hour on the high heat setting. The detergent was added to the drum of the washing machine at the start of each cycle. In legs where they are present, dryer sheets are added to the damp laundry load at the start of each drying cycle.

General method for the quantification of fiber release from the vented tumble dryer

[0074] During the drying step of each cycle, released fibers were collected from the exhaust of the tumble dryer using a 20 μm CellMicroSieve® (BioDesign Inc., Carmel, N.Y., U.S.A.), attached to the dryer exhaust using a 100 mm plastic pipe connector (model 414c, Manrose Manufacturing Ltd., U.K.). The CellMicroSieve® was connected to one side of the plastic pipe connector using 450 mm long, 10 mm wide cable ties (product 90526, Screwfix Direct Ltd., U.K.). At the end of each drying cycle, the built-in lint filter designed to safely collect fibers produced by the dryer for safe disposal in household waste was cleaned and its fiber contents suspended in around 1L of cold tap water. The CellMicroSieve® attached to collect fibers released from the dryer exhaust was washed thoroughly and its fiber contents suspended in around 3L of cold tap water. The fibers collected at both the lint filter and dryer exhaust were quantified gravimetrically by filtration onto white filter paper using the protocol described in Lant NJ, Hayward AS, Peththawadu MMD, Sheridan KJ, Dean JR. Microfiber release from real soiled consumer laundry and the impact of fabric care products and washing conditions. PLoS One. 2020;15: 1-18. doi: 10.1371/journal.pone.0233332.

[0075] Results are presented as average fiber release in ppm (mg microfiber collected per kg fabric load) across all four wash cycles and three replicates of each treatment, i.e. n=12 per leg. Also given is the percentage change in fiber release for the Invention relative to the Comparative Reference. Statistically significant differences at 95% confidence level are denoted by the letter 's' following the percentage change, based on Student's t-test and a p-value < 0.05.

Example 1

[0076] This test evaluated the impact of using one or three Bounce® Outdoor Fresh dryer sheets (22.8 cm x 16.2 cm) and one Bounce® WrinkleGuard Mega dryer sheet (32 cm x 22 cm) during the tumble drying process compared to drying without a dryer sheet. These are commercial products manufactured by Procter & Gamble and sold in the USA with the following ingredients listing:

Bounce® dryer sheets - ingredients
Polyester Sheet
Dialkylester Dimethyl Ammonium Methosulfate
Fatty Acids, C16-18 And C18-Unsatd.
Bentonite
Fragrances

Results

[0077]

	Comparative	**Inventive 1**	**Inventive 2**	**Inventive 3**
Detergent	1 Tide® Pod	1 Tide® Pod	1 Tide® Pod	1 Tide® Pod
Dryer sheet	None	1 Bounce® Outdoor Fresh	3 Bounce® Outdoor Fresh	1 Bounce® WrinkleGuard Mega sheet Outdoor Fresh
1. Average fiber collection - dryer lint filter (ppm) (% Change vs Reference)	110.96	113.41 (+2.2)	105.48 (-4.9)	110.11 (-0.8)
2. Average fiber release - dryer exhaust (ppm) (% Change vs Reference)	48.47	41.64 (-14.1s)	31.57 (-34.9s)	33.66 (-30.6s)

[0078] Results show that the use of tumble dryer sheets in accordance with the invention significantly reduced the level of airborne fibers released from the dryer exhaust by 14.1-34.9% relative to the comparative example which did not involve dryer sheet use. The use of dryer sheets did not have any significant impact on airborne fiber collection on the dryer lint filter.

[0079] The data concludes that different types and quantities of tumble dryer sheet significantly reduce airborne fiber pollution but without any impact on the collection of fibers by the lint filter. This is a surprising result, as a dryer sheet containing lubricant might be expected to increase fiber release from textiles. Without wishing to be bound by theory, it is believed that the dryer sheets are acting as 'fiber magnets' during the drying cycle collecting liberated fibers that would otherwise be released from the appliance. This hypothesis is supported by visual inspection of the dryer sheets at the end of the drying cycle; they are noticeably contaminated with black (cotton) and royal blue (polyester) textile fibers identical to those present on the test wash loads.

Claims

1. Use of a dryer sheet to reduce airborne fibers release during the treatment of fabrics in a vented tumble dryer.

2. Use of a dryer sheet according to claim 1 wherein the treatment is drying.

3. Use of a dryer sheet according to any of claims 1 or 2 wherein the sheet comprises a non-woven substrate.

4. Use of a dryer sheet according to the preceding claim wherein the non-woven substrate comprises polyester.

5. Use of a dryer sheet according to claim 3 claim wherein the non-woven substrate comprises natural fibers.

6. Use of a dryer sheet according to the preceding claim wherein the natural fibers comprise cellulosic fibers.

7. Use of a dryer sheet according to any of the preceding claims wherein said sheet comprises a fabric treatment composition.

8. Use of a dryer sheet according to the preceding claim wherein the fabric treatment composition comprises a softening composition.

9. Use of a dryer sheet according to the preceding claim wherein said fabric softening composition comprises a quaternary ammonium softening compound.

10. Use of a dryer sheet according to any of claims 8 or 9 wherein said fabric softening composition comprises a fatty acid.

11. Use of a dryer sheet according to any of claims 7 to 10 wherein said fabric treatment composition comprises a perfume.

12. Use of a dryer sheet according to any of the preceding claims wherein the fabrics have been subjected to a first fabric treatment process wherein the first treatment process comprises a rinse stage in presence of a fabric softening composition prior to drying.

13. Use according to any of the preceding claims wherein the first fabric treatment process takes place in a washing machine.

14. Use according to any of claims 12 or 13 wherein the fabric softening composition is delivered into the last rinse stage.

Patentansprüche

1. Verwendung eines Trocknertuchs, um eine Freisetzung von Fasern in der Luft während der Behandlung von Textilien in einem Ablufttrommeltrockner zu reduzieren.

2. Verwendung eines Trocknertuchs nach Anspruch 1, wobei die Behandlung Trocknen ist.

3. Verwendung eines Trocknertuchs nach einem der Ansprüche 1 oder 2, wobei das Tuch ein Vliessubstrat umfasst.

4. Verwendung eines Trocknertuchs nach dem vorstehenden Anspruch, wobei das Vliessubstrat Polyester umfasst.

5. Verwendung eines Trocknertuchs nach Anspruch 3, wobei das Vliessubstrat Naturfasern umfasst.

6. Verwendung eines Trocknertuchs nach dem vorstehenden Anspruch, wobei die Naturfasern Cellulosefasern umfassen.

7. Verwendung eines Trocknertuchs nach einem der vorstehenden Ansprüche, wobei das Tuch eine Textilbehandlungszusammensetzung umfasst.

8. Verwendung eines Trocknertuchs nach dem vorstehenden Anspruch, wobei die Textilbehandlungszusammensetzung eine Weichmacherzusammensetzung umfasst.

9. Verwendung eines Trocknertuchs nach dem vorstehenden Anspruch, wobei die Textilweichmacherzusammensetzung eine weichmachende quartäre Ammoniumverbindung umfasst.

10. Verwendung eines Trocknertuchs nach einem der Ansprüche 8 oder 9, wobei die Textilweichmacherzusammensetzung eine Fettsäure umfasst.

11. Verwendung eines Trocknertuchs nach einem der Ansprüche 7 bis 10, wobei die Textilbehandlungszusammensetzung einen Duftstoff umfasst.

12. Verwendung eines Trocknertuchs nach einem der vorstehenden Ansprüche, wobei die Textilien einem ersten Textilbehandlungsverfahren unterzogen wurden, wobei das erste Behandlungsverfahren vor dem Trocknen eine Spülstufe in Gegenwart einer Textilweichmacherzusammensetzung umfasst.

13. Verwendung nach einem der vorstehenden Ansprüche, wobei das erste Textilbehandlungsverfahren in einer Waschmaschine stattfindet.

14. Verwendung nach einem der Ansprüche 12 oder 13, wobei die Textilweichmacherzusammensetzung in die letzte Spülstufe abgegeben wird.

Revendications

1. Utilisation d'une feuille pour séchoir pour réduire une libération de fibres en suspension dans l'air pendant le traitement de tissus dans un séchoir par culbutage à évacuation d'air.

2. Utilisation d'une feuille pour séchoir selon la revendication 1 dans laquelle le traitement est un séchage.

3. Utilisation d'une feuille pour séchoir selon l'une quelconque des revendications 1 ou 2 dans laquelle la feuille comprend un substrat non tissé.

4. Utilisation d'une feuille pour séchoir selon la revendication précédente dans laquelle le substrat non tissé comprend du polyester.

5. Utilisation d'une feuille pour séchoir selon la revendication 3 dans laquelle le substrat non tissé comprend des fibres naturelles.

6. Utilisation d'une feuille pour séchoir selon la revendication précédente dans laquelle les fibres naturelles comprennent des fibres cellulosiques.

7. Utilisation d'une feuille pour séchoir selon l'une quelconque des revendications précédentes dans laquelle ladite feuille comprend une composition de traitement de tissus.

8. Utilisation d'une feuille pour séchoir selon la revendication précédente dans laquelle la composition de traitement de tissus comprend une composition adoucissante.

9. Utilisation d'une feuille pour séchoir selon la revendication précédente dans laquelle ladite composition adoucissante pour tissus comprend un composé adoucissant ammonium quaternaire.

10. Utilisation d'une feuille pour séchoir selon l'une quelconque des revendications 8 ou 9 dans laquelle ladite composition adoucissante pour tissus comprend un acide gras.

11. Utilisation d'une feuille pour séchoir selon l'une quelconque des revendications 7 à 10 dans laquelle ladite composition de traitement de tissus comprend un parfum.

12. Utilisation d'une feuille pour séchoir selon l'une quelconque des revendications précédentes dans laquelle les tissus ont été soumis à un premier procédé de traitement de tissus dans laquelle le premier procédé de traitement comprend une phase de rinçage en présence d'une composition adoucissante pour tissus avant séchage.

13. Utilisation selon l'une quelconque des revendications précédentes dans laquelle le premier procédé de traitement de tissus se déroule dans un lave-linge.

14. Utilisation selon l'une quelconque des revendications 12 ou 13 dans laquelle la composition adoucissante pour tissus est délivrée dans la dernière phase de rinçage.

REFERENCES CITED IN THE DESCRIPTION

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