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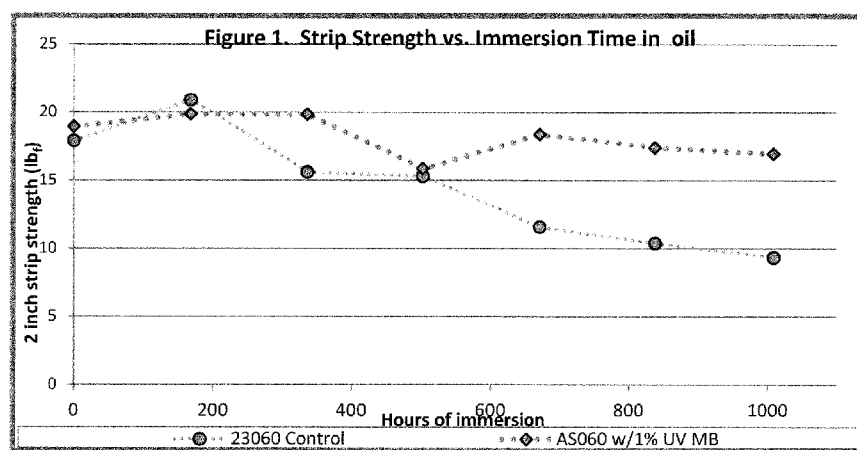
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(54) Title: ITEMS MADE WITH CORROSION RESISTANT NONWOVEN FABRICS

**FIG. 1**

(57) **Abstract:** Compounds can be added in an extruder making yarns used to make fabrics, added in an extruder used to make fabrics such as spunbonded or hydro entangled fabrics, coated on the surface of yarns used to make fabric, or coated on the surface of fabrics to improve fabric performance specifically to resist corrosion or degradation when exposed to harsh environments. Fabrics with these added compounds will maintain their tensile properties over a longer period of exposure time than fabrics without the compounds. Items such as filter media, fiberglass reinforced parts, geotextiles, and home furnishings can be made with these fabrics that will resist corrosion or degradation.



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DESCRIPTION

ITEMS MADE WITH CORROSION RESISTANT NONWOVEN FABRICS

CROSS-REFERENCE TO A RELATED APPLICATION

This application claims the benefit of U.S. provisional application Serial No. 62/338,838, filed May 19, 2016, which is incorporated herein by reference in its entirety.

FIELD OF THE INVENTION

This invention relates to items made with fabrics with enhanced corrosion resistance. Compounds can be added in an extruder making yarns used to make fabrics, added in an extruder used to make fabrics such as spunbonded, melt blown, dry laid, wet laid, or hydro entangled fabrics, coated on the surface of yarns used to make fabric or coated on the surface of fabrics to improve fabric performance specifically to resist corrosion or degradation when exposed to harsh environments. Fabrics with these added compounds will maintain their tensile properties over a longer period of exposure time than fabrics without the compounds. Items can be made with these fabrics that will resist corrosion or degradation.

BACKGROUND

Filters used in many applications are typically made of several layers of fabric or other media. Spunbond fabrics are commonly used as a prefilter or support layer. Melt blown, dry laid, and wet laid fabrics are frequently used as a filter layer. The layers are frequently exposed to hot corrosive liquid environments and will decompose or degrade over time. Fabrics are also used as a layer in fiberglass composites as veils. Veils provide several benefits including but not limited to protecting pultrusion dies, adding a protective layer near the surface of the fiberglass composite part and enhancing the surface appearance of the part. Additives can be added when making yarns used to make fabrics or to fabrics that enhance their ability to resist corrosion or improve the fabrics' resistance to heat and light degradation. A fabric that has improved corrosion resistance will provide longer filter media life and longer fiberglass composite part life. Fabrics are also used in home furnishings and are frequently white. Fabrics with antioxidants will maintain their color for a longer period of

time in this application. Silt fences are used in outdoor environments and exposed to ultraviolet light (sunlight). Fabrics with enhanced ultraviolet light protection will last longer in outdoor environments.

Fabrics are used in many different applications. Some of these applications include the enhancement of properties that impact the performance of composites such as filtration media and composites made of fiberglass. Limitations exist based on the environment that the application is conducted in or the environment that the composites are exposed to. For example, in liquid filtration applications, media is exposed to hot lubrication or hydraulic oil that may be mostly made of glycols which would dissolve polyester fabrics. Strong inorganic acids will also eventually dissolve nylon fabrics. Currently, polyester and nylon nonwovens are commonly used as layers in filtration media and as veils in fiberglass composites. Some common nonwovens used in these two applications are staple products that are hydro-entangled, wet laid fabrics, dry laid fabrics, melt blown fabrics, and spunbond fabrics. All of these have different limitations in specific uses. For example, polyester spunbond and melt blown fabrics will dissolve when exposed to hot glycol based hydraulic fluids or hot engine lube oil contaminated with a small amount of ethylene glycol based coolant. Apertured spunlace polyester fabric incorporated into a fiberglass reinforced part as a veil will also degrade or lose tensile strength when exposed to ultraviolet (UV) light and/or sunlight over a period of time. It would be advantageous to have an improved fabric that would retain more tensile strength compared to the current fabrics when used in specific applications and when exposed to harsh environments such as excessive heat, sunlight or chemicals or a combination of any of these that would cause the current fabric to degrade or corrode.

BRIEF SUMMARY

Embodiments of the subject invention relate to items made with fabrics with compounds such as stabilizers or antioxidants added to them for improved corrosion resistance and resistance to degradation. Many different stabilizers or antioxidants can be used either by adding them in the melt while using an extrusion spinning system to make yarn for use in weaving or knitting processes; or using nonwoven processes such as spunbonding, wet laying, dry laying, or melt blowing to make improved fabrics. Other nonwoven processes can use fiber that has stabilizers or antioxidants in them through the addition of compounds in previous process steps such as extrusion spinning prior to making the fabrics. Stabilizers or

antioxidants can also be topically applied to any of these fabrics or as a topical finish to yarns used to make fabrics to achieve similar results.

In one embodiment, a spunbonded fabric with a stabilizer or antioxidants added to it can be used as a layer in filter media that demonstrates retention of tensile properties over a longer period of time when compared to fabric with no stabilizer or antioxidants when the fabrics are exposed to oil (for example oil that has a pH of around 5.2 or hot oil at a temperature of 90 °C or at least 90 °C and a pH of around 5.2).

In another embodiment, a melt blown fabric with a stabilizer or antioxidants added to it can be used as a layer in filter media that demonstrates retention of tensile properties over a longer period of time when compared to melt blown fabric with no stabilizer or antioxidants when the fabrics are exposed to oil (for example oil that has a pH of around 5.2 or hot oil at a temperature of 90 °C or at least 90 °C and a pH of around 5.2). In yet another embodiment, staple yarn with a stabilizer or antioxidants added to it can be used to make dry laid or wet laid fabrics to use as a layer in filter media that demonstrates retention of tensile properties over a longer period of time when compared dry laid or wet laid fabrics with no stabilizer or antioxidants when the fabrics are exposed to oil (for example oil that has a pH of around 5.2 or hot oil at a temperature of 90 °C or at least 90 °C and a pH of around 5.2).

In another embodiment, a fabric with stabilizer or antioxidants added to it can be used as a veil in a reinforced fiberglass part to provide better protection to the fiberglass reinforced part when it is exposed to sunlight (including ultraviolet (UV) radiation) and/or an artificial UV radiation source.

In yet another embodiment, a stabilizer or antioxidant can be topically applied to fabrics to demonstrate retention of tensile properties or to provide better retention of properties of fiberglass reinforced parts when exposed to sunlight and/or an artificial UV radiation source.

White and colored fabrics are used in home furnishing and rug binding applications. There is a need in the art to enhance the color of these fabrics and to reduce the amount of yellowing or discoloring of these fabrics when exposed to adverse conditions such as heat and light.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows a plot of strip strength (pounds-force) versus immersion time in oil (hours).

DETAILED DESCRIPTION

In the following detailed description of the subject invention and its preferred embodiments, specific terms are used in describing the invention; however, these are used in a descriptive sense only and not for the purpose of limitation. It will be apparent to the skilled artisan having the benefit of the instant disclosure that the invention is susceptible to numerous variations and modifications within its spirit and scope. When the term “about” is used herein, in conjunction with a numerical value, it is understood that the value can be in a range of 95% of the value to 105% of the value, i.e. the value can be +/- 5% of the stated value. For example, “about 1 kg” means from 0.95 kg to 1.05 kg.

Items can be made using fabrics with improved corrosion resistance or with an improved ability to resist degradation, or both. Fabrics with enhanced capability to tolerate adverse environments can be created in several ways. One method is to introduce additives in an extruder when melt spinning fibers. These fibers are then made into yarns of various thread line deniers or properties. The yarns can then be processed further or made into fabrics using weaving, knitting or other processes. In another method, finishes with additives can be topically applied to yarns that make fabric to impart enhanced properties to the fabric. In yet another method, properties of spunbond and melt blown fabrics can be enhanced similarly by adding compounds into an extruder when making these fabrics. In another method, nonwoven fabrics made in a variety of ways, such as, but not limited to, by the processes of needle punching, stitch bonding, spunbonding, dry laying, wet laying, melt blowing, hydro entangling, and electrospinning, can be topically treated with a variety of compounds to enhance properties. Another method is to apply the compounds topically after nonwoven fabrics are made. Compounds would be selected based on the property or performance that is desired to be enhanced.

Fiberglass reinforced parts made using the pultrusion process commonly incorporate surfacing veils. Examples of the use of surfacing veils are given in U.S. Pat. No. 9,168,701 B2 to Ahmed; U.S. Patent No. 9,266,289 B2 to Gauchel et al; U.S. Patent 8,858,208 B2 to Gauchel et al; and U.S. Patent No. 8,123,887 B2 to Green. U.S. Patents 8,418,811, 8,632,708,

and 8,858,208 to Kelly et al describe the use of a colored, pigmented, painted veil and a resin formula designed from resin types known to have the combination of weathering performance and processing capability in the pultrusion process, and additive packages which minimize degradation of the resin on weathering and placing said resin and a veil on the exterior of a part to create a part with superior weathering characteristics. It would be advantageous to use a veil that has superior weathering characteristics in this and other pultrusion applications. A veil with superior weathering characteristics can be provided for this pultrusion application and other fiberglass reinforced part manufacturing methods as described in the current invention. The surfacing veils provide protection to dies, superior surface appearance, extended product life and better gloss retention. HALS, antioxidants, stabilizers, other additives or a combination of these additives can be added to an extruder or topically applied to make a surfacing veil that would enhance the performance of a fiberglass reinforced part. Other fiberglass part manufacturing methods that use veils, such as the resin transfer molding (RTM) method, can also be employed to make fiberglass reinforced parts with enhanced properties. In an embodiment, HALS or antioxidants can be added to a surfacing veil and the veil can be incorporated in a fiberglass reinforced part to provide better strength, better color, better color retention and better UV resistance to the part.

An example of a filter that uses fabrics is discussed in U.S. Patent No. 7,438,812 to Denton et al. This patent discusses a filter element that can be constructed to meet the recommended microfilter specifications of the Institute of Petroleum and to also have a longer life and higher efficiency than conventional aviation fuel microfilters satisfying these specifications. The outer and inner layers of the filter element can be a porous polymeric non-woven material having a thickness in the range of about 0.008 inch to about 0.017 inch such as a calendared polyester spun-bonded or a nylon non-woven material, such as Cerex®. Also, instead of non-woven materials, the inner and outer layers could instead be made of woven nylon or woven polyester, although these woven materials are usually more expensive than the non-woven alternatives and usually substantially thicker whereby they can negatively impact pleat density. It is advantageous if the fabrics used in this filtration application would have better corrosion resistance.

U.S. Patent No. 6,932,850 to Welch et al. describes a filter comprising a corrugated filter composite including first and second drainage layers and a filter medium positioned between them, with a cushioning layer. The cushioning layer is preferably formed of a thin,

very porous material. It is also preferably formed from a material which can be characterized as smooth or as smooth and tough. For example, it may be a non-abrasive, nonwoven material with a high tensile strength. A preferred material for the cushioning layer is a wet-laid polyester nonwoven material. Other preferred materials include a nylon spunbond material available from Cerex Advanced Fabrics, Inc. under the trade designation Cerex and a spunbond polyester material. It is advantageous if the fabrics used in this filtration application would have better corrosion resistance.

U.S. Patent No. 8,747,668 to Stanfel discusses separation media for separating water-hydrocarbon emulsions having low interfacial tensions. Separation media, separation modules and methods are provided for separating water from a water and hydrocarbon emulsion and include a fibrous nonwoven coalescence layer for receiving the water and hydrocarbon emulsion and coalescing the water present therein as a discontinuous phase to achieve coalesced water droplets having a size of 1 mm or greater, and a fibrous nonwoven drop retention layer downstream of the coalescence layer to allow separation thereof from the hydrocarbon. The drop retention layer is a fibrous nonwoven material. The principal function of the drop retention layer is to prevent re-emulsification of the coalesced water droplets obtained by the upstream coalescence layer. Thus, after passing through the drop retention layer, the coalesced water droplets will retain their coalesced size of at least 1 mm or greater. The drop retention layer can be formed of virtually any fiber that possesses or can be modified to possess a high surface area per unit weight. Synthetic fibers formed of fiber-forming polymeric materials may be employed such as fibers formed of polyesters, polyamides (e.g., nylon 6, nylon 6,6, nylon 6,12 and the like), polyolefins, polytetrafluoroethylene, and polyvinyl alcohol.

U.S. Patent No. 8,747,668 to Stanfel, et al. also discusses the need for a fibrous, porous coalescence media that removes water independent of hydrocarbon interfacial tension since this has become substantially more pronounced with mandated changes in diesel fuel quality. In the 2007 Heavy Duty Highway Diesel Rule, the EPA mandated respective reductions of particulate (PM_{2.5}) and nitrogen oxide (NO_x) emissions of 90% and 92%, with NO_x allowances to drop an additional 3% in 2010. At the time of the mandate release, sulfur sensitive exhaust after-treatment was considered necessary to meet 2007 emission goals. As a result, the 2007 Highway Rule also requires sulfur levels in diesel fuel to drop 97% to 15 ppm. The resulting ultra-low sulfur diesel fuel (ULSD) has been stripped of its native

lubricity and requires surfactant addition to meet engine wear control requirements. ULSD consistently manifests sub-25 interfacial tension hydrocarbons with water. EPA mandated diesel fuel requirements will cascade into off-road diesel, rail, and marine fuels as part of the EPA's tiered approach to emission control, indicating all non-gasoline transportation and power generation fuels will converge over time at sub-25 dynes/cm interfacial tension. Since this media is exposed to NO_x and acids derived from NO_x it is advantageous if the fabrics used in this filtration application would have better corrosion resistance.

Fabrics with improved corrosion resistance made using methods previously discussed can be substituted in current filter media to extend the life of filters used in hydraulic oil systems, lubrication oil systems, fuel and other filtration systems.

White and colored fabrics are used in home furnishing and rug binding applications. Antioxidants can be added to these fabric using methods previously described to enhance the color of these fabrics and to reduce the amount of yellowing or discoloring of these fabrics when exposed to adverse conditions such as heat and light.

In one embodiment, a masterbatch of a hindered amine light stabilizer (HALS) compounded in nylon 6 available from Clariant Masterbatches in Dalton, Georgia under the trade name CESA Light 7725 can be added to make a fabric that has a basis weight of 4 osy as measured by ASTM test method D3776, thickness of about 22.3 mils as measured using ASTM D1777, machine direction grab tensile strength of at least about 157 lbs_f as measured using ASTM D5034, machine direction grab elongation of about 91% as measured using ASTM D5034, cross direction grab tensile strength of at least about 119 lbs_f as measured using ASTM D5034, cross direction grab elongation of about 100% as measured using ASTM D5034, machine direction trapezoidal tear strength of at least about 49 lbs_f as measured by ASTM D5587, cross direction trapezoidal tear strength of at least about 34.2 lbs_f measured by ASTM D5587, air permeability of at least about 125 ft³/min/ft² as measured by ASTM D737 and a burst strength of at least about 109.4 PSI as measured by ASTM D3786. This fabric was tested for tensile strength retention when exposed to a xenon light source for 1000 hours as measured using ASTM D5034. This fabric retained at least about 87% of its machine direction grab strength as measured using ASTM D5034.

In another embodiment, a masterbatch containing a UV blocker in nylon 6 can be added to an extruder making a 0.85 osy spunbond nylon 6,6 fabric, Type 30, PBN-II®, commercially available from Cerex Advanced Fabrics, Inc. at 1%. This fabric will retain

96% of its machine direction grab strength as measured by ASTM D5034 when exposed to a xenon light source for 1000 hours compared to a similar fabric with no UV blocker added to it that retained 86% of its machine direction grab strength as measured by ASTM D5034 when exposed to a xenon light source for 1000 hours.

These fabrics will pass the criteria for NSF/ANSI Standard 61, 2007-a which is the nationally (in the United States) recognized health standard for all devices, components, and materials that contact drinking water. These fabrics will also pass the criteria for SW-846, Third Edition which is the EPA standard for allowing wastes to be treated as non-hazardous waste.

Other polymers or combinations of polymers including but not limited to polyester and polypropylene can be used to make a similar fabric. The fabric can be made from filaments that comprise more than one polymer such as bicomponent or tricomponent filaments. The Type 30 fabric is thermally bonded with the pattern illustrated in registered United States Trademark 2,163,116. This fabric is sold under the trademarks PBN-II® and OIL SHARK® and is available from Cerex Advanced Fabrics, Inc. Other patterns can also be used. Examples of fabrics that can be used with other patterns are a diamond patterned fabric sold under the trademarks ORION® and OIL SHARK® available from Cerex Advanced Fabrics, Inc. and a herringbone patterned fabric sold under the trademarks SPECTRAMAX® and OIL SHARK® available from Cerex Advanced Fabrics, Inc.

In many embodiments, a fabric can include a UV stabilizer or blocker. Such a UV stabilizer or blocker can be added to a nylon extrusion system for the fabric. The UV stabilizer or blocker can be, for example, a UV stabilizer (blocker) or an antioxidant sold under the trade names Cesa Light 7725™ and S-EED®, respectively, both available from Clariant Masterbatches, though embodiments are not limited thereto.

In yet another embodiment, a UV stabilizer (blocker) or an antioxidant sold under the trade names Cesa® Light 7725 and S-EED®, respectively, can be added in an extruder to a fabric that has a basis weight of 1.5 osy as measured by ASTM test method D3776, thickness of about 6.9 mils as measured using ASTM D1777, machine direction grab tensile strength of at least about 58 lbs_f as measured using ASTM D5034, machine direction grab elongation of about 54% as measured using ASTM D5034, cross direction grab tensile strength of at least about 38 lbs_f as measured using ASTM D5034, cross direction grab elongation of about 61% as measured using ASTM D5034, machine direction trapezoidal tear strength of at least about

14 lbs_f as measured by ASTM D5587, cross direction trapezoidal tear strength of at least about 10 lbs_f as measured by ASTM D5587, a burst strength of at least about 50 PSI as measured by ASTM D3786, a mean pore size of about 32.3 microns, air permeability of about 277 ft³/min/ft² as measured by ASTM D737, continuous nylon filaments, and wicks oil and water. The fabric is chemically bonded as described in US patent 3,516,900 and US patent 4,168,195. The surface of this fabric is smooth with no point bonds. Other polymers including but not limited to polyester and polypropylene can be used to make a similar fabric. The fabric can be made from filaments that comprise more than one polymer such as bicomponent or tricomponent filaments. This fabric is sold under the trademarks Cerex® and OIL SHARK® and is available from Cerex Advanced Fabrics, Inc.

In yet another embodiment, a UV stabilizer (blocker) or an antioxidant sold under the trade names Cesa® Light 7725 and S-EED®, respectively, can be added in an extruder making nylon 6 melt blown fabric that has a basis weight of 1.0 osy as measured by ASTM test method D3776, thickness of about 12 mils as measured using ASTM D1777, a mean pore size of about 20 microns and a bubble point of about 6 inches of water. Various basis weights of melt blown fabrics can be produced with varying properties such as thickness, bubble point and mean pore size. These fabrics will have better corrosion resistance when used as a layer in a filter media.

In another embodiment, staple yarn can be made with a UV stabilizer (blocker) or an antioxidant such as Cesa® Light 7725 and S-EED® added to it. The staple yarn can then be used to make dry laid and wet laid fabrics with enhanced corrosion resistance. These fabric can then be used as a layer in filter media to provide a filter media with better corrosion resistance.

Dyes or other materials that impart high visibility colors (e.g., orange and red) commonly include hazardous materials, for example, metals such as hexavalent chromium and/or lead. Only a few materials exist that can impart high visibility colors, do not contain these hazardous materials, and can tolerate the high temperatures required in processing polymer pellets into fabrics. In certain embodiments, a UV stabilizer (blocker) or an antioxidant sold under the trade names Cesa® Light 7725 and S-EED®, respectively, can be added in an extruder to make a nonwoven fabric that can include one or more dyes or other materials, thereby resulting in a nonwoven fabric with a high visibility color (e.g., orange or red) with improved corrosion or light resistance. Such a dye or other material does not

contain hazardous materials, such as hexavalent chromium or lead. In a particular embodiment, a combination of a UV stabilizer (blocker) or an antioxidant or both, can be added in an extruder to make a nonwoven fabric that can include a solvent red dye and a solvent orange dye to make a nonwoven fabric with a high visibility color (a shade of orange) with improved corrosion or light resistance. This fabric will pass the criteria for NSF/ANSI Standard 61 - 2007a (can be found at www.nsf.org), which is the nationally (in the United States) recognized health standard for all devices, components, and materials that contact drinking water. This fabric will also pass the criteria for SW-846, Third Edition, which is the EPA standard for allowing wastes to be treated as non-hazardous waste.

Many additives are currently available that can impart enhanced performance to fabrics via one or more of the previously mentioned methods. The fabric used as a layer in a filter media or as a veil in a fiberglass reinforced part can have incorporated therein or applied thereto from about 0.001 to about 35% by weight; for instance, from about 0.025 to about 10% by weight, for example, from about 0.1 to about 8% by weight, based on the total weight of the fabric, of additives such as stabilizers, antioxidants, UV absorbers, hindered amines, phosphites or phosphonites, benzofuran-2-ones, thiosynergists, polyamide stabilizers, metal stearates, nucleating agents, fillers, reinforcing agents, lubricants, emulsifiers, dyes, pigments, optical brighteners, flame retardants, antistatic agents, blowing agents and the like or mixtures thereof, such as but not limited to the specific materials listed in U.S. Patent No. 7,022,390 B2 hereby incorporated by reference in its entirety.

These additive compounds include but are not limited to antioxidants, alkylated monophenols, alkylthiomethylphenols, hydroquinones and alkylated hydroquinones, tocopherols, hydroxylated thiodiphenyl ethers, alkylidenebisphenols, benzyl compounds, hydroxybenzylated malonates, aromatic hydroxybenzyl compounds, triazine compounds, acylaminophenols, esters of β -(3,5-di-tert-butyl-4-hydroxyphenyl) dropionic acid with mono- or polyhydric alcohols, esters of β -5-tert-butyl-4-hydroxy-3-methylphenyl)propionic acid with mono- or polyhydric alcohols, esters of 3,5-di-tert-butyl-4-hydroxyphenyl acetic acid with mono- or polyhydric alcohols, amides of β -3,5-di-tert-butyl-4-hydroxyphenyl)propionic acid, ascorbic acid (vitamin C), aminic antioxidants, ultraviolet light absorbers and light stabilizers, 2-(2-Hydroxyphenyl)-2H-benzotriazoles, for example, known commercial hydroxyphenyl-2H-benzotriazoles and benzotriazoles as disclosed in, U.S. Pat. Nos. 3,004,896; 3,055,896; 3,072,585; 3,074,910; 3,189,615; 3,218,332; 3,230,194; 4,127,586;

4,226,763; 4,275,004; 4,278,589; 4,315,848; 4,347,180; 4,383,863; 4,675,352; 4,681,905, 4,853,471; 5,268,450; 5,278,314; 5,280,124; 5,319,091; 5,410,071; 5,436,349; 5,516,914; 5,554,760; 5,563,242; 5,574,166; 5,607,987 and 5,977,219, 2-hydroxybenzophenones, esters of substituted and unsubstituted benzoic acids, acrylates and malonates, nickel compounds and sterically hindered amine stabilizers.

The sterically hindered amine may also be one of the compounds described in U.S. Pat. No. 5,980,783, hereby incorporated by reference in its entirety. The sterically hindered amine may also be one of the compounds described in EP 782994, hereby incorporated by reference in its entirety. These additive compounds may also include sterically hindered amines substituted on the N-atom by a hydroxy-substituted alkoxy group, oxamides, tris-aryl-o-hydroxyphenyl-s-triazines, metal deactivators, phosphites and phosphonites, benzofuranones and indolinones; thiosynergists; peroxide scavengers; polyamide stabilizers; basic co-stabilizers; nucleating agents, fillers and reinforcing agents and dispersing agents, Other additives, such as, plasticizers, lubricants, emulsifiers, pigments, dyes, optical brighteners, rheology additives, catalysts, flow-control agents, slip agents, crosslinking agents, crosslinking boosters, halogen scavengers, smoke inhibitors, flameproofing agents, antistatic agents, clarifiers such as substituted and unsubstituted bisbenzylidene sorbitols, benzoxazinone ultraviolet light absorbers such as 2,2'-p-phenylene-bis(3,1-benzoxazin-4-one), Cyasorb® 3638 (CAS# 18600-59-4), and blowing agents can also be added.

A greater understanding of the present invention and of its many advantages may be had from the following examples, given by way of illustration. The following examples are illustrative of some of the methods, applications, embodiments, and variants of the present invention. They are, of course, not to be considered as limiting the invention. Numerous changes and modifications can be made with respect to the invention.

EXAMPLE 1

A masterbatch that contained a stabilizer, S-EED®, at a 15% loading by weight was added at 1% by weight to an extruder making 0.6 ounce per square yard, Cerex® Style 23060, spunbond nylon fabric. A fabric, identified as Style AS060, was produced that included this stabilizer at 0.15% concentration by weight. This fabric and a similar fabric made with no stabilizer were immersed in oil at a pH of about 5.2 at about 115 C for a period of about 1009 hours following protocol described in ASTM D543. Two inch strip tensile

properties were measured on seven specimens for each fabric approximately every seven days as per ASTM D5035. The results are listed in Table 1 below and plotted in Figure 1. The results show that after being immersed in oil for 1009 hours, the fabric made with the stabilizer, AS060, maintained 89.5% of its strip tensile strength compared to 52.2% of the strip tensile strength of the fabric that contained no stabilizer, 23060.

Table 1. Tensile properties of fabric immersed in oil after selected periods of time

Immersion Length (hours)	Type 23060 (0% stabilizer)	Type AS060 (0.075% stabilizer)
0	17.89	18.94
168.5	20.91	19.85
336.3	15.60	19.84
503.3	15.31	15.86
671.3	11.56	18.37
838.1	10.39	17.41
1009.0	9.34	16.95

EXAMPLE 2

A masterbatch that contained a light stabilizer at a 30% weight loading, Cesa Light® 1574, was added to an extruder making Cerex® Type 23 spunbond nylon fabric at 1% by weight. A fabric was produced that included this stabilizer (S-EED®) at 0.30% concentration by weight.

EXAMPLE 3

Copper is commonly used as a heat and light stabilizer when making nylon materials. Nylon spunbond or melt blown fabrics can be made with improved heat and light stability by increasing the amount of copper that is added in an extruder or in the resin fed to an extruder in a melt spinning or melt blowing processes.

EXAMPLE 4

Fabric can be topically treated with a solution of a stabilizer to enhance the resistance to corrosion when the fabric is exposed to harsh conditions such as heat, light, or corrosive

environments. Harsh conditions can include exposure at least 72 hours to heat at a temperature of at least 90 °F, exposure to sunlight and/or a an artificial UV radiation source (e.g., a UV lamp) for at least 72 hours, and/or exposure to corrosive chemicals. Such harsh conditions can be in combination with a liquid (e.g., exposed for at least 72 hours), such as oil, water, or an aqueous solution.

EXAMPLE 5

Antioxidants or light stabilizers can be added to an extruder along with TiO₂ and optical brighteners to make a white nylon spunbond fabric. Adding the antioxidants or the light stabilizers or both will allow the use of less TiO₂ and optical brightener to make a product that is as white as a product that requires more TiO₂ and optical brightener with no antioxidants or light stabilizers.

EXAMPLE 6

A masterbatch containing a UV blocker in nylon 6 can be added to an extruder making a 0.85 osy spunbond nylon 6,6 fabric, Type 30, PBN-II®, commercially available from Cerex Advanced Fabrics. Inc. at 1%. This fabric retained 96% of its machine direction grab strength as measured by ASTM D5034 when exposed to a xenon light source for 1000 hours compared to a similar fabric with no UV blocker added to it that retained 86% of its machine direction grab strength as measured by ASTM D5034 when exposed to a xenon light source for 1000 hours as measured using ASTM D5034. The fabric with the UV blocker additive can be incorporated into a fiberglass reinforced part by using it as a veil in a pultrusion process. The part made with the fabric with the UV blocker additive will have better UV resistance and color retention when exposed to sunlight and/or an artificial UV light source.

EXAMPLE 7

A masterbatch that contained a stabilizer, S-EED®, at a 15% loading by weight in a nylon 6 carrier can be added at 1% by weight to an extruder making 1 ounce per square yard nylon 6 melt blown fabric that has a 20 micron mean pore diameter and a thickness of .012 inches. A nylon melt blown fabric can be produced that includes this stabilizer at 0.15% concentration by weight.

It should be understood that the examples and embodiments described herein are for illustrative purposes only and that various modifications or changes in light thereof will be suggested to persons skilled in the art and are to be included within the spirit and purview of this application and the scope of the appended claims.

All patents, patent applications, provisional applications, and publications referred to or cited herein (including those in the “References” section, if present) are incorporated by reference in their entirety, including all figures and tables, to the extent they are not inconsistent with the explicit teachings of this specification.

CLAIMS

What is claimed is:

1. A filter medium, comprising a fabric layer comprising at least one of a stabilizer and an antioxidant, wherein the fabric layer maintains its tensile strength after exposure to a liquid for at least 72 hours and exposure for at least 72 hours to at least one of: a temperature of at least 90 °F; and UV radiation.
2. A fiberglass reinforced part, comprising a fabric layer comprising at least one of a stabilizer and an antioxidant, wherein the fabric layer maintains its tensile strength after exposure to a UV light source for at least 72 hours.
3. The filter medium according to any of claims 1-2, wherein the fabric layer comprises a spunbond fabric.
4. The filter medium according to any of claims 1-2, wherein the fabric layer comprises a melt blown fabric.
5. The filter medium according to any of claims 1-2, wherein the fabric layer comprises a woven fabric.
6. The filter medium according to any of claims 1-2, wherein the fabric layer comprises a hydroentangled fabric.
7. The filter medium according to any of claims 1-2, wherein the fabric layer comprises a wet laid fabric.
8. The filter medium according to any of claims 1-2, wherein the fabric layer comprises a dry laid fabric.

9. The filter medium according to any of claims 3-8, wherein the fabric comprises at least one of: nylon; polyester; and polypropylene.

10. A fabric comprising an additive configured to inhibit color degradation of the fabric, the additive comprising at least one of a light stabilizer and an antioxidant.

11. The fabric according to claim 10, wherein the fabric is a spunbond fabric.

12. The fabric according to claim 10, wherein the fabric is a melt blown fabric.

13. The fabric according to claim 10, wherein the fabric is a woven fabric.

14. The fabric according to claim 10, wherein the fabric is a hydroentangled fabric.

15. The fabric according to claim 10, wherein the fabric is a wet laid fabric.

16. The fabric according to claim 10, wherein the fabric is a dry laid fabric.

17. The filter medium according to any of claims 11-16, wherein the fabric comprises at least one of: nylon; polyester; and polypropylene.

18. A home furnishing comprising the fabric according to any of claims 10-17.

19. A method of forming a fabric layer of a filter medium, the method comprising:
adding to an extruder a polymer;
adding to the extruder an additive for improved corrosion resistance, the additive comprising at least one of an antioxidant and a stabilizer;
mixing the polymer and the additive to form a polymer/additive mixture; and
extruding the polymer/additive mixture to form the fabric layer.

20. A method of forming a filter medium, the method comprising: performing the method according to claim 19 to form a fabric layer; and using the fabric layer as part of the filter medium.

21. A method of forming a reinforced fiberglass part, the method comprising: performing the method according to claim 19 to form a fabric layer; and using the fabric layer as part of the reinforced fiberglass part.

22. A method of forming a home furnishing, the method comprising: performing the method according to claim 19 to form a fabric layer; and using the fabric layer as part of the home furnishing.

23. The method according to claim 22, wherein the additive imparts improved color and color retention properties to the home furnishing.

24. The method according to any of claims 19-23, wherein the fabric layer comprises a spunbond fabric.

25. The method according to any of claims 19-23, wherein the fabric layer comprises a melt blown fabric.

26. The method according to any of claims 19-23, wherein the fabric layer comprises a woven fabric.

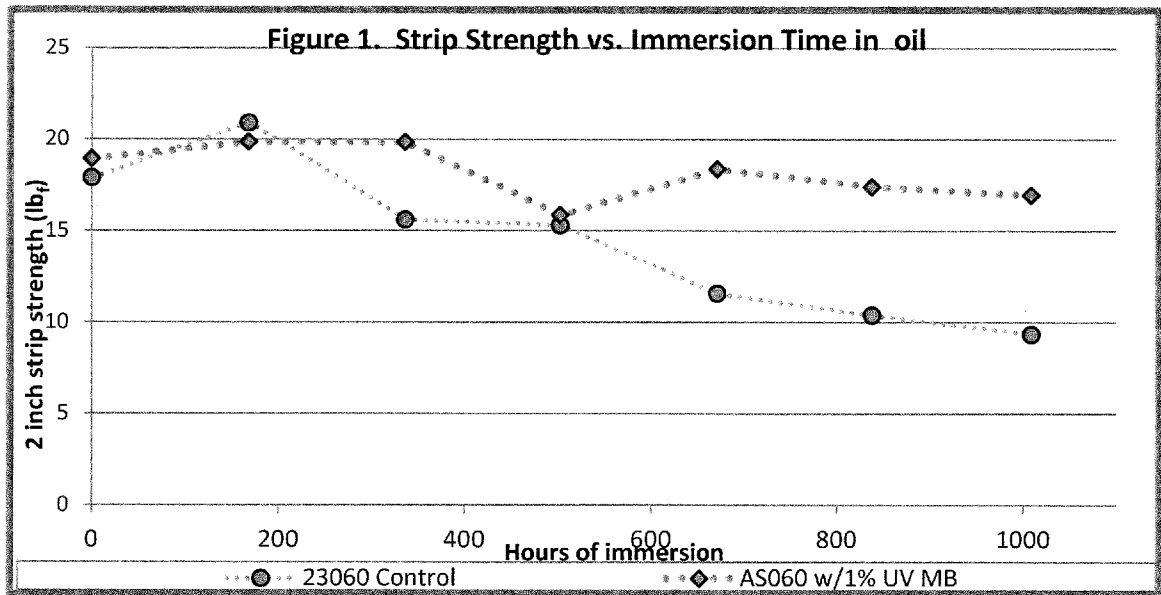
27. The method according to any of claims 19-23, wherein the fabric layer comprises a hydroentangled fabric.

28. The method according to any of claims 19-23, wherein the fabric layer comprises a wet laid fabric.

29. The method according to any of claims 19-23, wherein the fabric layer comprises a dry laid fabric.

30. The method according to any of claims 24-29, wherein the fabric comprises at least one of: nylon; polyester; and polypropylene.

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**FIG. 1**

A. CLASSIFICATION OF SUBJECT MATTER**D04H 1/498(2012.01)i, D04H 13/00(2006.01)i**

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

D04H 1/498; E02D 17/20; D04H 13/00; B32B 3/24; B32B 3/10; B29D 28/00; D21F 1/00; C08K 5/29; B32B 5/02

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS(KIPO internal) & Keywords: filter medium, fiberglass reinforced part, home furnishing, fabric layer, UV, tensile strength, stabilizer, antioxidant**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2015-0003920 A1 (CEREX ADVANCED FABRICS, INC.) 1 January 2015 See abstract; claims 1, 11, 19; and paragraphs [0002], [0013], [0058], [0067], [0069], [0113].	1-8, 10-17, 19-29
A	US 2009-0186189 A1 (WHITE, P. et al.) 23 July 2009 See abstract; claim 1; and paragraph [0068].	1-8, 10-17, 19-29
A	US 2012-0141728 A1 (PONSOLE, D. et al.) 7 June 2012 See abstract; and claims 1, 9.	1-8, 10-17, 19-29
A	US 2014-0272371 A1 (VOTIH PATENT GMBH) 18 September 2014 See abstract; and claims 1, 8, 9.	1-8, 10-17, 19-29
A	US 5464890 A (DIAZ-KOTTI, M. A. et al.) 7 November 1995 See abstract; and claims 1, 11-13.	1-8, 10-17, 19-29



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

13 January 2017 (13.01.2017)

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Name and mailing address of the ISA/KR

International Application Division

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INTERNATIONAL SEARCH REPORTInternational application No.
PCT/US2016/042914**Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)**

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☒ Claims Nos.: 9,18,30
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of any additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2016/042914

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