United States Patent Office 3,177,055 Patented Apr. 6, 1965

3,177,055

CLEANING PAD

William T. Ruckle, Lancaster, and Moses Sparks, Jr., Manheim Township, Lancaster County, Pa., assignors to Armstrong Cork Company, Lancaster, Pa., a corporation of Pennsylvania

No Drawing. Filed Feb. 28, 1962, Ser. No. 176,403
10 Claims. (Cl. 51—295)

This invention relates generally to a cleaning pad and more particularly to a fibrous, non-woven cleaning pad. Still more particularly, the invention relates to a cleaning pad capable of releasing a controlled amount of a cleansing agent for a short period of time, whereupon the pad may be used to wash and rinse away suds and foam.

There has long been a need for a simple, efficient, disposable cleaning pad which can be used to wash and scrub a restricted area of a floor, wall, or other surface or object. Such pad should be inexpensive, be capable of use with a small amount of water, and be an efficient cleaning device. It is the primary object of the present invention to supply such a cleaning pad. It is a further object of the present invention to present an inexpensive disposable cleaning pad to be used in the household. It is a further object of the present invention to present a method for making such a cleaning pad.

These objects are accomplished in a straightforward and effective manner. The invention contemplates a cleaning pad formed from an air-laid fibrous blend containing 60–80% by weight cellulosic fibers and 40–20% by weight rayon fibers. The fibrous blend is formed into a web by air-conveying the blend to a felt-forming foraminous member. The web is impregnated with a saturant which comprises a mixture of 30–60% by weight butyl rubber, 5–20% by weight carboxylated butadiene-styrene rubber, a curing agent for the carboxylated butadiene-styrene rubber, and 0.5–10% by weight of an anionic synthetic detergent in which a portion of the molecule is oleophilic and a portion is hydrophilic and ionizable. Embedded in the rubber-based impregnant coating the fibers is a finely-divided inorganic abrasive. One of the rubbers in the coating is cured.

The cellulosic fibers in the fibrous blend used to make the product of the present invention may be any of those fibers normally used in papermaking processes. These include cotton, cotton linters, wood fibers, bagasse, sulfite pulp, kraft, and other chemically treated wood fibers, and in fact any cellulosic fibers which lend themselves to the making of an air-laid felt. These fibers will generally be cleaned and refined and will have a fiber length in general in the range of 1 mm. to 10 mm. although lengths of 3 mm. to 6 mm. are preferred. Bleached cotton linters is the cellulosic fiber of choice.

The other fiber in the fibrous blend must be rayon fiber. The term rayon as used herein is meant to define rayon staple fibers of regenerated cellulose, particularly that made by the viscose process. The rayon fibers are necessary in the present invention to impart a harshness and toughness to the fibrous web which will more effectively maintain the web structure during the scrubbing and rubbing processes over rough surfaces when the product is in use. Amounts of rayon fibers below the stated minimum do not impart sufficient strength during rough handling to the web, while amounts of rayon above the stated maximum reduce the water absorption and water resistance of the product.

All fibers may be fed, if desirable, into a conventional garnet machine to loosen, fluff, and separate the fibers from the form in which they are shipped. The actual blending of the two kinds of fibers may also be carried out in this or any other suitable fiber-blending device. The loose staple may then be placed in the feed box of a

"Rando-Webber" machine, or other device for laying down on a foraminous, felt-forming member an air-laid felt. The term air-laid is used in contrast to water-laid, and defines a relatively light and open web formed when the stream of air conveying the fibers passes through the foraminous member such as a wire allowing the fibers to form a felt on the moving surface of the foraminous member. The lightness and openness of the resulting felt can be controlled by varying such factors as speed of the foraminous member, amount of fibers fed into the moving air stream per unit time or unit volume of air, and subsequent pressing and rolling operations. For the purposes of the present invention, it is preferred that the resulting web has a weight in the range of about 3.5 to 6 ounces per square yard. The particular machine or device for forming the air-laid web is not critical to the present invention since many of these devices are known to the prior art. Patents describing such devices are U.S. 2,451,915, U.S. 2,700,188, U.S. 2,703,441, and U.S. 2,744,294.

Fiber thicknesses of the cellulosic fibers will generally vary in the range of 16 microns to 21 microns, while fiber thicknesses of the rayon will vary from 10 microns to 36 microns. It is not necessary that any of the fibers used in the present invention be crimped, although crimping will do no more than produce a web having a greater degree of openness, other conditions being the same.

The air-laid web is to be saturated with a water-based material which combines rubber to serve as a binder, and a synthetic detergent to serve as a cleansing agent when the final product is used. The great difficulty in such a system is to adjust the amount of a rubber-binding system which can serve as a strong binder and yet which will permit rapid wetting with subsequent release of all of the synthetic detergent which it contains. Rubber binders normally used to bond fibers in various air-laid and water-laid sheets are water resistant. The amount used must be adjusted to provide wet strength and resistance to mechanical abuse, but must also allow the web structure to absorb and hold water for suitable activation and discharge of detergent for the cleaning function.

This rubber binder system is a mixture of a butyl rubber and a carboxylated butadiene-styrene copolymer. By butyl rubber is meant a synthetic rubber produced by copolymerization of isobutene with a small proportion of a multi-olefinic unsaturate having 4–14 carbon atoms per molecule such as isoprene, or sometimes butadiene. Generally speaking, about 98% by weight of isobutene is used with 2% of isoprene. Polymerization is carried out at relatively low temperatures of less than about 50° C. in a liquid hydrocarbon with aluminum chloride as a catalyst. Uncured butyl rubber is tacky but has good resistance to chemical attack and aging and thus serves as an excellent binder to provide the required strength and flexibility, and at the same time to allow water absorption in the connected fiber structure. The term butyl rubber is understood by those skilled in the art of rubber chemistry.

The other rubber is a carboxylated butadiene-styrene copolymer. It also provides bonding strength, but its chief function is to give resilience and recovery properties to the pad. In the making of this rubber, the copolymerization of butadiene and styrene is carried out in the normal manner to form the well-known SBR rubber. However, there is also added a small amount, less than 5% by weight of polymerizable ingredients, usually 1–3% by weight, of acrylic acid, or methacrylic acid, most usually the latter. Polymerization conditions remain unchanged and the only difference from the usual butadiene-styrene copolymer is that an occasional carboxyl group—a carboxylic acid group—occurs along the length of the polymer backbone. These occasional acid

groups serve as cross-linking sites in the rubber and allow the easy cure of the butadiene-styrene copolymer which otherwise requires a sulphur-containing curing system and substantially elevated temperatures. These carboxylated butadiene-styrene copolymers are known items of commerce and are readily available from several manufacturers.

The saturant used to coat the fibers in accordance with the present invention will contain 30–60% by weight butyl rubber on a dry basis, in the form of a latex, and 5–20% by weight carboxylated butadiene-styrene copolymer, on a dry basis, in the form of a latex. Thus the ratio of butyl rubber to carboxylated butadiene-styrene rubber is in the range of 3:2 to 12:1, preferably 3:1. A simple blending of the latices of the two kinds of rubber to produce the proper amounts of rubber on a dry basis will suffice.

A curing agent, or curing system, for the carboxylated butadiene-styrene copolymer should also be added. Metal oxides such as magnesium oxide, zinc oxide, and mixtures thereof, will react with the rubber at the acid site and thus cross-link it. Diepoxides, many of which are readily available in commerce, will also cure the rubber. Additionally, such amine-containing resins as melamine-formaldehyde resins, and urea-formaldehyde resins can serve as curing or cross-linking agents. It is one of the advantages of using the carboxylated butadiene-styrene copolymer that it is so easily cured by such a wide variety of ingredients. Generally speaking, the saturant will contain 1–10% by weight of a curing agent for the carboxylated rubber on a dry basis. For each 100 parts of the carboxylated rubber, the curing agent will generally be present in an amount of about 5–15 parts by weight.

The saturant must also contain a synthetic detergent. These materials, sometimes called syndets, have a cleansing action as good or better than soap. The synthetic detergents are surface-active agents having structurally unsymmetrical molecules which contain both hydrophilic, or water-soluble, groups and oleophilic, or oil-soluble, groups, the latter being, normally, hydrocarbon chains. There are three kinds of synthetic detergents, anionic, cationic, and nonionic. The cationic detergents cannot be used in the present application since they coagulate the rubber particles in the latex in the saturant and prevent saturation. Although nonionic detergents may be used in this system, they are generally low foaming detergents. In a product of this type, some foam or suds is desirable from a product acceptance point of view. For these reasons the anionic synthetic detergents are usually the agents to be used in the saturant of the present invention to supply the cleansing action for the final product. A wide variety of anionic synthetic detergents is usable. As examples there may be mentioned the sodium alkyl aryl sulfonates such as the sulfonates of dodecylbenzene, the sodium salt of a naphthalene sulfonic acid which has been condensed with formaldehyde, the triethanolamine salt of alcohol sulfates, sodium alkyl naphthalene sulfonates, and the sodium salts of alcohol sulfates and secondary alcohol sulfates. The alkyl groups in these compounds will contain 1–18 carbon atoms and are exemplified by the methyl through the stearyl groups. The aryl groups in such compounds are generally the phenyl and benzyl groups.

The amount of synthetic detergent to be used in the saturant will generally be in the range of 0.5–10% by weight of the total saturant. The synthetic detergent added to the saturant for the purposes of accomplishing a cleansing action in the final product must be differentiated frrom any synthetic detergent or wetting agent present in the saturant to bring about the wetting of the solids in dispersion. Small amounts of wetting agents such as the anionic synthetic detergents or nonionic synthetic detergents, usually less than 1% by weight, are frequently added to dispersions in order that stability may be imparted to the dispersion. The saturant to be used in making the present product will contain at least 10 and normally 50 or 100 times as much synthetic detergent as that normally contained in a dispersion.

In addition to the synthetic detergent, there will generally be present in the saturant and in the rubber coating deposited on the fibers an inorganic cleansing or sequestering agent to enhance the cleansing action of the synthetic detergent. This additional cleansing agent will be present, when it is used, in an amount at least equal to that of the synthetic detergent. Hence the saturant will contain 0.5–10% by weight of the cleansing agent. As examples of the cleansing agent there may be mentioned trisodium phosphate, sodium tripolyphosphate, tetrasodium or tetrapotassium pyrophosphate, sodium borate, carbonate or sulfate and sodium metasilicate.

The saturant can also contain additional ingredients to aid in the impregnation of the web. Carboxy methyl cellulose may be used to increase the viscosity and thicken the saturating dispersion in addition to increasing the softness of the final product. A catalyst is required when a melamine-formaldehyde or urea-formaldehyde resin is used as the cross-linking agent. These catalysts are known and may be ammonium and buffered magnesium salts such as the chlorides hydroxylamine hydrochloride and the like. Small amounts, usually less than 1% by weight, of ammonium hydroxide may be added to condition the dispersion and stabilize it. As mentioned earlier, small amounts, again usually less than 1% by weight, of wetting agents may also be added as stabilizers and dispersants.

As an additional feature of the saturant, there may be added a finely-divided scouring agent in the nature of an abrasive. Suitable powders and rouges may be added to aid the final product in cleaning and removing recalcitrant stains, spots, and blemishes from the surface to be cleaned. The preferred scouring agent is finely-divided silicon dioxide, preferably in a size range of 40 to 150 microns. When used, the scouring agent is added in relatively large amounts, preferably within the range of about 5–50% by weight of the saturant. The particle size of the scouring agent is sufficiently small that the particles remain in suspension aided by the wetting agents and thickeners as described earlier. Alternatively, the scouring agent may be added after the web has been impregnated with the saturant. The scouring agent may be sprayed in dry form onto the wet web whereupon the dry particles adhere to the rubber coating over the fibers.

Impregnation of the web with saturant is readily accomplished. The saturant may be sprayed on the web, or the web may be dipped into a bath of the saturant, preferably while remaining on a wire backing. Press rolls may be used to squeeze excess saturant out of the web in order to achieve the desired degree of pickup. This pickup will be in the range of about 100–300% by wet weight, based on the non-saturated and dry weight of the web. The dry weight pickup will be in the range of 20–50%. The press rolls may be adjusted to squeeze the saturated web to a greater or lesser degree, depending on whether less or more of the saturant should be retained in the web. In addition to adjusting the amount of saturant, the press rolls insure complete penetration of the saturant throughout the fibers. If desirable, excess saturant may be removed from the web by vacuum extraction.

The impregnated web is then ready for drying. Heat is applied preferably by impingement of hot air on the saturated web. The air temperature will generally be in the range of about 200–350° F., and preferably 250–300° F. Drying proceeds swiftly, being accomplished in a matter of minutes at the preferred temperature of 250–300° F. The carboxylated butadiene-styrene copolymer immediately cures once the water has been removed from the web. Too great a degree of cure is undesirable since it increases the harshness of the hand of the finished sheet. A period of 4 minutes will suffice both for drying and curing at the preferred temperature. Lower temper-

atures require longer times while higher temperatures allow shortening of the time for drying and curing.

After drying and curing, the product may be cut into suitable size sheets for final use. Depending on the size of the cleansing job, the finished product may be cut into sheets measuring 12" x 12", 6" x 6", 3" x 3", or in any other convenient shape. The precise area or size of the sheet is not critical. Usually the sheets will measure about .040" in thickness. To use the sheet, it is wetted with water to the extent desired and rubbed over the area to be cleaned. The sudsing and cleansing action coupled with the abrasive action will remove most kinds of soil and stain. When cleaning has been accomplished, the sheet may be squeezed several times under running water or while held under the surface of water in order that all the synthetic detergent may be removed. The wet sheet may then be used to wipe up the foam and suds and dirt, leaving a clean surface behind. As a final step, the sheet may be wrung out and used to mop up the last vestiges of water in order that the cleaned site will rapidly dry.

The following examples illustrate several embodiments of the invention. All parts are by weight unless otherwise stated.

Example 1

A blend of 70 parts bleached cotton linters which have been hammer-milled to an approximate 1/16" fiber length, and 30 parts of 3" 15 denier rayon hi-crimp fibers was random air-laid into a web sheet having equal strength in all directions. The basis weight of the sheet was 4 to 4.5 ounces per square yard.

A saturant was made using a butyl rubber latex and a carboxylated butadiene-styrene latex as the binder system. Following is the formulation of the saturant on a dry basis.

Ingredients:	Dry parts
Butyl latex	75
Carboxylated butadiene-styrene latex	25
Ammonium hydroxide, conc.	1
Nonionic wetting agent (nonyl benzene polyether alcohol)	1
Carboxy methyl cellulose	6
Melamine-formaldehyde resin	8
Accelerator (ammonium chloride)	0.5
Synthetic detergent (dodecyl benzene sulfonate)	5
Sodium tri-polyphosphate	5
Silica, 200 mesh	100

The saturant contained 10% by weight total dry solids.

The web was passed through the saturant, the excess was removed by vacuum, and the web was squeezed through soft rubber rolls to effect complete penetration of the saturant throughout the web and to accomplish a 35% by weight pickup, dry weight.

The web was then dried for 4 minutes in a hot air oven maintained at 250–300° F.

When the resulting sheet was cut into smaller sheets measuring 6" x 9", the smaller pieces served as excellent cleansing sheets in that good sudsing and cleaning action was accomplished on wetting, followed by easy rinsing to remove the resulting suds. On squeezing dry, the sheet served to damp-dry the cleaned area.

Example 2

Example 1 was repeated except that the bleached cotton linters were replaced with bleached sulfite pulp, and the saturant had the following formula:

Ingredients:	Dry parts
Butyl latex	65
Carboxylated butadiene-styrene latex	15
Ammonium hydroxide	1
Nonionic wetting agent (polyether alcohol)	1
Carboxy methyl cellulose	12

Melamine-formaldehyde	10
Accelerator (ammonium chloride)	2
Sodium lauryl sulfate	5
Sodium tri-polyphosphate	10
Silica, 100 mesh	100

When cut into pieces, an excellent cleaning pad resulted.

Example 3

Example 2 was repeated with the following saturant:

Ingredients:	Dry parts
Butyl rubber latex	120
Carboxylated butadiene-styrene latex	40
Ammonium hydroxide	0.5
Nonionic wetting agent (polyether alcohol)	1
Carboxy methyl cellulose	4
Zinc oxide	5
N-coco-beta-aminopropionate, sodium salt	6
Trisodium phosphate	8
Silica, 325 mesh	100

An excellent cleaning pad resulted.

We claim:

1. The method of making a cleaning pad comprising forming a fibrous blend containing 60—80% by weight cellulosic fibers and 40—20% by weight rayon staple fibers, forming a dry-laid web from said blend by depositing said blend from a stream of air on a felt-forming foraminous member, coating the fibers in said web with a saturant comprising a dispersed mixture of

(*a*) 30–60% by weight butyl rubber consisting essentially of a tacky copolymer of isobutene and a small proportion of a multi-olefinic unsaturate selected from the group consisting of isoprene and butadiene,

(*b*) 5–20% by weight carboxylated butadiene-styrene rubber consisting essentially of a copolymer of butadiene, styrene and less than about 5% by weight of an acid selected from the group consisting of acrylic acid and methacrylic acid,

(*c*) a curing agent for said carboxylated butadiene-styrene rubber,

(*d*) 0.5–10% by weight of an anionic synthetic detergent in which a portion of the molecule is oleo philic and a portion is hydrophilic and ionizable said detergent being selected from the group consisting of the salts of alkyl aryl sulfonates and alcohol sulfates in which the hydrocarbon chains of said compounds contain 1–18 carbon atoms and said aryl groups are selected from the class consisting of phenyl and benzyl groups,

embedding in the coating on the fibers a finely-divided inorganic abrasive, and heating the coated web to remove water therefrom and to cure only said carboxylated butadiene-styrene rubber.

2. The method according to claim 1 wherein said fibrous blend contains 70 parts cellulosic fiber and 30 parts of rayon fibers.

3. The method according to claim 2 wherein said cellulosic fibers comprise bleached cotton linters.

4. The method of saturating an air-laid fibrous sheet comprising a blend of 60–80% by weight cellulosic fibers and 40–20% by weight rayon staple fibers with a rubber binder to form a cleaning pad which will release a synthetic detergent on subsequent wetting with water which comprises forming a saturant containing 30–60% by weight butyl rubber consisting essentially of a tacky copolymer of isobutene and a small proportion of a multi-olefinic unsaturate selected from the group consisting of isoprene and butadiene, 5–20% by weight carboxylated butadiene-styrene rubber consisting essentially of a copolymer of butadiene, styrene and less than about 5% by weight of an acid selected from the group consisting of acrylic acid and methacrylic acid, a curing agent for said carboxylated butadiene-styrene rubber, 0.5–10% by weight of an anionic synthetic detergent in which a por-

tion of the molecule is oleophilic and a portion is hydrophilic and ionizable, said detergent being selected from the group consisting of the salts of alkyl aryl sulfonates and alcohol sulfates in which the hydrocarbon chains of said compounds contain 1–18 carbon atoms and said aryl groups are selected from the class consisting of phenyl and benzyl groups, 0.5–10% by weight of an additional cleansing and chelating agent selected from the group consisting of trisodium phosphate, sodium tripolyphosphate, tetrasodium pyrophosphate, tetrapotassium pyrophosphate, sodium borate, sodium carbonate, sodium sulfate and sodium metasilicate, saturating said sheet with said saturant, and heating the saturated web to remove water therefrom and to cure only said carboxylated butadiene-styrene rubber.

5. An air-laid fibrous sheet comprising a blend of 60–80% by weight cellulosic fibers and 40–20% by weight rayon staple fibers wherein the fibers are coated with a synthetic rubber composition containing 30–60% by weight butyl rubber consisting essentially of a tacky copolymer of isobutene and a small proportion of a multiolefinic unsaturate selected from the group consisting of isoprene and butadiene, 5–20% by weight carboxylated butadiene-styrene rubber consisting essentially of a copolymer of butadiene, styrene and less than about 5% by weight of an acid selected from the group consisting of acrylic acid and methacrylic acid, a curing agent only for said carboxylated butadiene-styrene rubber, 0.5–10% by weight of an anionic synthetic detergent in which a portion of the molecule is oleophilic and a portion is hydrophilic and ionizable, said detergent being selected from the group consisting of salts of alkyl aryl sulfonates and alcohol sulfates in which the hydrocarbon chains of said compounds contain 1–18 carbon atoms and said aryl groups are selected from the class consisting of phenyl and benzyl groups, and 0.5–10% by weight of an additional cleansing and chelating agent selected from the group consisting of trisodium phosphate, sodium tripolyphosphate, tetrasodium pyrophosphate, tetrapotassium pyrophosphate, sodium borates, sodium carbonate, sodium sulfate, and sodium metasilicate.

6. A fibrous sheet according to claim 5 wherein said cellulosic fibers comprise bleached cotton linters.

7. A fibrous sheet according to claim 5 containing a finely divided inorganic abrasive material.

8. A product according to claim 5 wherein said synthetic rubber coating has a ratio of butyl rubber to carboxylated butadiene-styrene latex of 3:1, by weight.

9. A cleaning pad comprising an air-laid fibrous sheet comprising a blend of 60–80% by weight cellulosic fibers and 40–20% by weight rayon staple fibers and a coating composition on said fibers, the composition comprising 30–60% by weight butyl rubber consisting essentially of a tacky copolymer of isobutene and a small proportion of a multi-olefinic unsaturate selected from the group consisting of isoprene and butadiene, 5–20% by weight carboxylated butadiene-styrene rubber consisting essentially of a copolymer of butadiene, styrene and less than about 5% by weight of an acid selected from the class consisting of acrylic acid and methacrylic acid, a curing agent only for said carboxylated butadiene-styrene rubber, and 0.5–10% by weight of an anionic synthetic detergent in which a portion of the molecule is oleophilic and a portion is hydrophilic and ionizable, said detergent being selected from the group consisting of salts of alkyl aryl sulfonates and alcohol sulfates in which the hydrocarbon chains of said compounds contain 1–18 carbon atoms and said aryl groups are selected from the class consisting of phenyl and benzyl groups.

10. A cleaning pad according to claim 9 wherein only said carboxylated butadiene-styrene rubber component of said coating composition is in a cured condition.

References Cited in the file of this patent

UNITED STATES PATENTS

2,483,135	Goldsmith et al.	Sept. 27, 1949
2,621,355	Fisher	Dec. 16, 1952
2,784,132	Maisel	Mar. 5, 1957
2,810,426	Till et al.	Oct. 22, 1957
2,893,854	Rinker et al.	July 7, 1959
2,958,593	Hoover et al.	Nov. 1, 1960
2,978,426	Zapp	Apr. 4, 1961
3,011,882	Quinan	Dec. 5, 1961
3,016,294	Haywood	Jan. 9, 1962