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[54] **SOIL RELEASE FOR 100% SYNTHETIC FIBERS**

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[58] **Field of Search** .....117/47, 138.5, 138.8 A, 139.5 R, 117/139.4, 76 T, 62; 8/115.6, 116.3

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[57] **ABSTRACT**

Soil release properties of a 100 percent synthetic textile are improved by impregnating the same with a mixture of polyacrylic acid and an essentially linear water-insoluble swellable synthetic polymer which absorbs at least 550 percent of water. Soil release properties of a 100 percent synthetic textile can also be improved by subjecting the textile to an alkaline scour followed by treatment with the water insoluble swellable polymer.

13 Claims, No Drawings

OIL RELEASE FOR 100% SYNTHETIC FIBERS

The present invention is concerned with the treatment of a textile material which is made up entirely of synthetic fibers in order to improve the soil or grease release properties thereof.

It is well known that oil- or grease-borne stains in fabrics composed of synthetic fiber, e.g., polyester fibers, are difficult to remove by laundering, due in at least some measure to the hydrophobic nature of the fibers. Oil-borne stains can usually be removed by dry cleaning but this is expensive and undesirable, particularly since an important advantage of fabrics containing synthetic fibers is that they retain their shape through laundering and need little, if any, ironing.

With the advent of durable press garments, whether of the "post-cured" or "pre-cured" type, there has been considerable research activity directed towards improving the grease or soil release properties of cellulosic fabrics, which usually comprise blends of cellulosic and synthetic fibers, because the nature of the durable press finish (e.g., aminoplast resin and catalyst) applied to the fabric tends to make soil, especially grease-type stains, more difficult to remove or release in laundering than would normally be the case without the finish. As a result of this research, various soil release agents have been developed for addition to durable press finishing compositions which greatly improve the soil release properties of cellulosic/polyester blend fabrics. However, it has been found that these soil release agents do not produce equally effective soil release on fabrics whose fiber content is entirely synthetic, e.g., 100 percent polyester fabric. In particular, the soil release ratings do not reach the desired value after laundering and/or the finish suffers from a lack of durability and is rendered ineffective as the fabric undergoes repeated washing. The exact reasons for this are not understood but the lack of durability of the soil release finish may be due to the fact that 100 percent synthetic fabrics are not normally provided with resin/catalyst durable press type finishes and these finishes may somehow improve adhesion of the soil release agent to the cellulosic/synthetic blends on which they are generally employed. Additionally, synthetic fibers, especially polyester fibers, do not have the highly reactive sites that characterize cellulose; the surfaces of synthetic fibers are of a somewhat lower energy than cellulosics and, therefore, less wettable; and the absorption of cellulosics is generally higher than for synthetics. Any one or all of these factors, or others, may well account for the difference in soil release results, particularly as to durability, between cellulosic/synthetic blend fabrics on the one hand and 100 percent synthetic fabrics on the other.

In view of the above, the principal object of the present invention is to provide 100 percent synthetic textiles which have improved grease or soil release properties. Another object is to provide a novel process and composition for imparting highly advantageous grease release characteristics to fabrics composed entirely of polyester and/or other synthetic fibers which normally present grease release problems. Other objects will also be apparent from the following description of the invention.

Broadly stated, the invention is based on the finding that soil release properties of fabrics or other textile forms whose fiber content is made up entirely of synthetic fibers can be improved, particularly as to durability to repeated laundering, by either of the following or a combination thereof:

1. scouring the textile in preparation for the application of the soil release finish using a special type of alkaline scour; and/or
2. utilizing as the soil release finish a combination of polyacrylic acid and another polymer, the latter being a water-insoluble swellable synthetic polymer which absorbs at least 5 times its weight of water when immersed in an aqueous detergent solution for 2 minutes at 140° F. Preferably, the last mentioned polymer is a copolymer of methacrylic acid and ethyl acrylate although other polymers can be used as discussed below. The best overall results are obtained by using a combination of features (1) and (2) but effective results are also obtainable when using only one of these features as described more fully below.

With respect to feature (2), it has surprisingly been found that the combination of polyacrylic acid, in solution or emulsion forms, and other swellable synthetic polymers results in a synergistic effect with outstanding soil release results. The effect is especially noticeable using polyacrylic acid with methacrylic acid/ethyl acrylate copolymer in amounts such that the polyacrylic acid is about 50 percent by weight of the copolymer. However, other proportions may also be used, for example, 10–90% polyacrylic acid to 90–10% methacrylic acid/ethyl acrylate copolymer. Other swellable polymers which meet the indicated water absorption test may also be used, in lieu of or in addition to the methacrylic acid/ethyl acrylate copolymer within the same general proportions. The commonly assigned U.S. application, Ser. No. 604,649, filed Dec. 27, 1966, now abandoned; Ser. No. 681,092, filed Nov. 7, 1967, now abandoned; Ser. No. 645,599, filed June 13, 1967, now abandoned; and Ser. No. 683,139, filed Nov. 15, 1967, now U.S. Pat. No. 3,521,993; describe soil release polymers which are suitable for present purposes and the subject matter of said applications is incorporated herein by reference. These polymers may be defined as polymers which absorb at least about five times their weight of water under alkaline conditions or, more specifically, at least about 550 percent by weight of water when immersed in an aqueous detergent solution for 2 minutes at 140° F. (pH about 8–12). Preferably, this polymer is an addition polymer of at least one ethylenically unsaturated monomer having one or more acid groups. Such monomers include, for example, acrylic acid, methacrylic acid, itaconic acid, maleic acid, fumaric acid and the like. Monomers which contain groups which readily hydrolyze in water to form acid groups also may be used, for example maleic anhydride. Preferably, the acid groups are all carboxylic acid groups. However, it is possible for a portion of them to be phosphoric acid (PO_4H_2) or sulfonic acid (SO_3H) groups as well, by using monomers such as styrene sulfonic acid and phosphoric acid ester of glycidyl allyl ether. The polymers may be manufactured by polymerizing the above monomers by any known means, for example with free radical or ionic catalysts. Alternatively, the polymers may be made by polymerizing an ethylenically unsaturated monomer such as acrylonitrile or an acrylic ester and then hydrolyzing or otherwise modifying the resulting polymer to convert the nitrile, ester or other groups to acid groups.

The polymers may contain relatively small amounts of monomers which do not include acid groups, for example olefins, e.g., ethylene and propylene, aromatic olefins such as styrene and various methyl styrenes, acrylic and methacrylic esters such as methyl methacrylate and ethyl acrylate, dienes such as butadiene and isoprene, vinyl halides, e.g., vinyl chloride and vinylidene chloride, other acrylic monomers such as acrylamide and acrylonitrile, methyl vinyl ether; and the like. In general, the proportion of such non-acid monomers should not exceed about 60 mole percent and preferably 40 percent. For maximum durability, it is preferred to use a system which leads to at least some degree of cross-linking so as to provide a matrix polymer with the other materials present.

Typical examples of water swellable polymers meeting the indicated requirements for present purposes include, in addition to polyacrylic acid and the copolymers of methacrylic acid and ethyl acrylate: copolymers of styrene and acrylic acid, copolymers of itaconic acid and acrylic acid; the copolymers of styrene, e.g., copolymers of styrene and maleic anhydride; and methacrylic acid and acrylic acid terpolymers such as terpolymers of methacrylic acid, butadiene and styrene; and terpolymers of monomethyl itaconate, acrylic acid and itaconic acid.

Preferably the water-absorbing polymer is one which absorbs at least about 550 percent by weight of water. This is evidenced by very substantial swelling of the polymer

although the polymer should not be soluble in alkaline solutions. The suitability of a polymer for use herein can be readily determined by measuring its water absorbing capacity or swellability. To do this, fabric treated with the polymer only is weighed, and the original weight of fabric is subtracted. The fabric is then immersed in detergent solution for two minutes at 140° F., blotted dry with paper towels and then weighed. A correction is made for the liquid absorption by the fabric itself by repeating the procedure with uncoated fabric. The swelling is equal to: (weight gain in coating/dry weight of coating) × 100. A typical detergent solution which may be used for this purpose is 0.15% TIDE detergent in water. TIDE comprises sodium lauryl sulfate 16%, alkyl alcohol sulfate 6%, sodium polyphosphate 30%, sodium pyrophosphate 17% and 31% sodium silicate and sodium sulfate combined.

The water absorbing (or swelling) characteristic of the soil release polymer is related to molecular weight. In general, low molecular weight polymers of the type described above are water soluble whereas higher molecular weight polymers are insoluble in water but will swell. For the most part, suitable polymers, including both the polyacrylic acid component and the other water-swellable polymer used therewith, will have a number average molecular weight of 1,000 to 3,000,000, although this is subject to some variation provided the desired degree of water absorption or swelling is realized without dissolution of the polymer.

Another factor affecting the water absorbing property or swellability of the polymer is the degree of cross-linking therein. The polymers used herein are essentially linear polymers. As noted above, a certain degree of cross-linking may be introduced into the polymers during subsequent treatments. Although such cross-linking is not absolutely essential, it is desirable for durability. However, excessive cross-linking tends to connect the polymer molecules into a rigid three dimensional network which will not swell and this is not particularly useful for present purposes. Suitable cross-linking agents are formaldehyde, polyfunctional alcohols, formaldehyde amine precondensates, polyfunctional epoxides, etc. These may be included as desired to improve durability.

The scour treatment of the inventions may be carried out in several ways using alkaline scouring media to give a surface to which the grease release finish adheres more strongly and thus gives greater durability to laundering. It appears that the present scouring methods, as distinguished from prior art scouring techniques, partially hydrolyze the surface of polyester fibers so as to make more —OH and —COOH groups available for reactivity. In any event, the alkaline pretreatments used herein make the surface of the fabric more wettable and hydrophilic. A test for the adequacy and effectiveness of the pretreatment is that the fabric, after scouring, must wet instantly with water, otherwise optimum soil release properties are not realized. Equivalent results cannot be obtained by replacing the alkaline pretreatment with a wetting agent before or with the application of the soil release finish.

The alkaline scour of the 100 percent synthetic fabric, according to the invention, is distinguishable from the conventional type of scouring to which synthetic fabrics are normally subjected before the application of finishing agents. In the conventional treatment, the fabric is given a detergent scour with or without small amounts of a solvent like xylene to remove surface dirt, oils, finishes, etc. The fabric, if a white is desired, is then bleached, neutralized, and tinted with dyes and optical brighteners for better whitening. The treatment is insufficient, however, to obtain the results needed for adhesion of grease release finishes.

According to the invention, it has been found that the following alkaline scours will give effective adhesion of the soil release finish and otherwise satisfactory results:

a. Caustic scour with the caustic dissolved in water and in the presence of organic solvent such as xylene. Concentrations of the order of 2–15% NaOH, preferably 3–7%, and elevated temperatures up to the boil may be used (e.g., 200°–212° F. for the aqueous scour). The time of treatment can be varied but generally will run in the area of 15–45 minutes, typically 30 minutes, the important requirement being that the fabric after treatment is characterized by instantaneous wetting with water. The treatment is usually accompanied by a fabric weight loss of from about 0.5% to 7% indicative, to some extent, of hydrolysis.

b. Silicate scour using preferably 1 to 10% aqueous solutions of dry high alkalinity (pH 10 to 12) sodium silicates of the sesqui-, ortho-and/or meta-silicate types. This treatment is advantageously carried out at the boil for a period long enough to give a fabric that instantaneously wets with water, e.g., 30 minutes for treatment at the boil. This treatment gives even better results than the caustic scour even though weight losses are usually lower and run from 0 to 2.5% by weight. Presumably the explanation does not depend on greater hydrolysis with silicates because this would mean a greater weight loss. The presence of silica (SiO_2), which is a powerful absorbent, might be part of the explanation, it being noted that the acid neutralized product of Na_2SiO_3 is H_2SiO_3, which may dehydrate to SiO_2.

It will be appreciated that, in the case of fabric scoured by caustic or silicate as noted above, the invention contemplates the possibility of using polyacrylic acid and/or any one or more of the soil release polymers referred to earlier as the primary soil release finish, the scour pretreatment resulting in a 100 percent synthetic fabric which demonstrates much more durable and otherwise better soil release properties.

In lieu of the scouring pretreatment but preferably in combination therewith for optimum results, the invention also contemplates using a mixture of polyacrylic acid and one or more of the other soil release polymers mentioned above for soil release purposes to produce a synergistic effect. As noted, the combination of caustic or alkaline silicate scour and polyacrylic acid/polymer finish gives the best results and is preferred from the standpoint of finish durability to laundering and soil release properties. However, just the use of the combination of polyacrylic acid and other polymer, preferably methacrylic acid/ethyl acrylate copolymer, on conventionally scoured 100 percent synthetic fabric gives highly improved soil release and may be adequate in many instances.

Additives may be included with the soil release finish to improve hand, grease release and durability. The use of plasticizers in the soil release finish employed herein represents a particularly important aspect of the invention in order to obtain optimum results as to grease release, hand and other important properties.

For present purposes, the term "plasticizer" is intended to mean any material which, when used as described herein, increases flexibility, workability or distensibility of the coating polymer. Plasticizers suitable for use are described in the copending application Ser. No. 733,332, filed May 31, 1968, now abandoned, by Maggiolo et al. and the subject matter of said application is incorporated herein by reference. Typically useful plasticizers are butyl hexyl phthalate, diisooctyl oleate, tri-2-ethylhexyl trimellitate, diisodecyl phthalate, triisodecyl trimellitate, trioctyldecyl trimellitate, triisooctyl trimellitate, diisodecyl adipate, tricresyl phosphate, diisooctyl sebacate, dicapryl phthalate, N-octyl-N-decyl adipate, di-2ethylhexyl azelate, triphenyl phosphate, butyl and butyl glycollic phthalate, methyl and ethyl glycollic phthalate, dihexyl azelate, tetrahydrofurfuryl oleate, diethylene glycol dipelargonate, dibutyl sebacate, butyl benzyl phthalate, dibutyl phthalate, di-2-ethylhexyl phthalate, epoxy tallate-Plastolein 9214, diisooctyl azelate, diisooctyl adipate, diisooctyl phthalate, tri (N-octyl/decyl) trimellitate, Plastolein 9066 LT, Plastolein 9750 polymeric (2200MW), Plastolein 9765 polymeric (3500MW), modified phthalate - Santicizer 213, Santicizer 481, modified phthalate - Santicizer 214, Plastolein 9078 LT, Plastolein 9232 epoxy, Santocet No. 1 - reactive plasticizer, Plastolein 9722 polymeric (1000MW), Plastolein 9717 polymeric (850MW), Plastolein 9730 polymeric (1100MW),

9-cyclohexyl stearic acid, 9-phenyl stearyl nitrile, 9-phenyl stearyl amine (primary), N,N-Dimethyl-9-stearyl amide, N-(2 Hydroxyethyl)-9-phenyl stearyl amide, 9-(4-hydroxy-phenyl) stearic acid, phthalic acid half ester of 1-hexadecyloxy-2-hydroxy dodecane, isophthalic acid half ester of 1-hexadecyloxy-2-hydroxy dodecane, n-hexadecyl-9-phenyl-stearate, 9-(4-biphenyl) stearic acid, 9-(4-phenoxyphenyl) stearic acid, 9-(4-benzylphenyl) stearic acid, and phenyl stearic acid.

Other additives which may be used herein include materials such as caprolactam blocked urethane prepolymer emulsions of nonionic nature containing a curing polyol (Nopco D602 and D607) are useful to improve durability to laundering. High molecular weight urethane emulsions of nonionic nature such as the Wyandotte products E–207A and E–503, are also useful in this regard. Acrylic terpolymers of low pH (e.g., 2–4) such as the material known as R–992 : 90 B (National Starch) and the polymers 2507 High Styrene Type and 2600 X140 Acrylic Type (both B. F. Goodrich) are useful additives to the soil release finish. This is also true for D–623 (Nopco) which is a one-component blocked urethane prepolymer emulsion which includes no curing polyol; acrylic and styrene/butadiene type polymers in anionic emulsion. Typically these various additives, for example, caprolactam blocked urethane prepolymers are used in concentrations (solids) of the order of 0.2 to 1.0%, and generally within the more limited range 0.4% to 0.7%. The Nopco urethanes may be prepared under U.S. Pat. No. 3,245,961.

The fabric may also be treated with primers before application of the soil release finish. Typical primers include those listed above under additives as well as epoxy silanes (e.g., Union Carbide's A–187, glycidoxy propyl trimethoxy silane). When used, the primers are generally applied in the form of aqueous solutions or dispersions in concentrations of 0.1 to 0.5%, preferably 0.2%, by weight. Solid pickup amounts to about 0.05 to 0.3% based on the dry fabric weight before treatment.

In a further embodiment of the invention, ammonia vapor has also been used to advantage in producing a fabric of good soil release properties. This is accomplished by padding the fabric with dispersion of the soil release polymer or mixture thereof, exposing the fabric while wet to steam and ammonia vapors and then drying and curing.

In a preferred embodiment, the invention involves impregnating the 100 percent synthetic fabric, advantageously but not necessarily after an alkaline scour as aforesaid, with an aqueous solution or dispersion of polyacrylic acid and a 60/40 copolymer of methacrylic acid and ethyl acrylate (referred to elsewhere herein for convenience as MAA/EA), a plasticizer and an additive as described above. The monomer proportions in the copolymer may be higher or lower than indicated (e.g., from 20-90% methacrylic acid) but the 60/40 copolymer seems to offer optimum results in the usual case. A particularly preferred composition for impregnating the fabric (by padding, spraying or otherwise), comprises, on a weight basis, from 1–3% of the MAA/EA copolymer (60/40), 0.5% to 1.5% solids of 100% polyacrylic acid (e.g., K–702, B. F. Goodrich) and from 1.0% to 3% solids of an aqueous plasticizer emulsion of triisodecyl trimellitate (e.g., Moreflex 530, Pfizer), and 0.4 to 0.7% solids of Nopco D–602 additive. Usually the amount of polyacrylic acid solids is about 50% of the MAA/EA copolymer while the amount of plasticizer solids is normally about the same as the amount of MAA/EA. These ratios are also generally applicable when other polymers are used in lieu of the MAA/EA although adjustments may be necessary to obtain optimum results with any particular set of components.

The fabric may be in the wet or dry state when padded with the soil release composition. However, if processed in the wet state, the solids pickup should be at least twice that for dry cloth. The treatment of wet fabric has the advantage of saving the step of drying the fabric before application but care must be taken to evenly squeeze out excess moisture from the fabric to insure uniform pickup when the fabric is treated in the wet state.

The amount of the composition applied to the fabric can be widely varied and is dependent on such factors as the nature and construction of the fabric, its intended use, etc. Usually, however, wet pickup will fall in the range of 30–100% by weight of the fabric if the latter is initially in the dry state while pickup should be higher if the fabric is treated wet as aforesaid. After impregnation, this fabric is dried, usually at 190°–300° F. for 1–5 minutes, and cured at 300°–380° F. for a few seconds to 15 minutes. The drying procedure provides a degree of partial cure, usually about 25 percent, and forms at least some cross-linking in the soil release finish.

The invention may be used to improve the soil release properties of any type of 100 percent synthetic fabric, e.g., knitted, woven, nonwoven or combinations thereof. It is of particular advantage in the case of fabrics made up entirely of polyester fibers although 100 percent nylon and acrylic fabrics or fabrics composed of blends of polyester, nylon, acrylic and/or other hydrophobic synthetic fibers may also be effectively processed according to the invention.

The invention is illustrated by the following examples wherein parts and/or percentages are on a weight basis in a water solution or dispersion. Soil release properties were determined in these examples by soiling the fabric specimens with black oil, mineral oil, clean motor oil and French dressing. After soiling, the specimens were washed in a home laundry agitator type top loading automatic washing machine set at 140° F. on the wash/wear cycle using a low sudsing detergent (e.g., "ADD," pH about 10). After washing in a 35 minute total cycle on the wash-wear cycle, the specimens were tumble dried at 150°–170° F. After conditioning, the specimens were placed on a black surface under a fluorescent light. The specimens were visually rated against a series of photographic standards with numerical ratings as follows:

Class 5 —No staining
Class 4 —Slight, but not appreciable staining
Class 3 —Noticeable staining
Class 2 —Very noticeable staining
Class 1 —Very extreme staining

In the examples given, where data is shown for 10 or 20 launderings, the fabric specimen was laundered nine or 19 times, respectively, stained and washed one time before rating. These extensive "prelaunderings" were used to determine durability of the soil release finish to repeated washing. In all examples, unless otherwise indicated, conventionally scoured fabrics were employed. The conventional or regular scouring procedure usually consists of scouring cloth at 203° F. for about ½ to 1 hour in an emulsifier or detergent to remove any oils or dirt. A typical procedure involves: 0.13% Hipochem MS (a phosphate ester made by High Point Chemical Co.) emulsifier and 0.02% Hypochem Hipochem ST (tetrasodium salt of ethylene diamine tetraacetic acid made by High Point Chemical Co.)- sequestrant.

EXAMPLE 1

A. A 100% Dacron tricot was padded with an aqueous dispersion (8% solids) of methacrylic acid/ethyl acrylate copolymer (60/40), dried for 2 minutes at 200° F. and then cured at 350° F. for 2 minutes.

B. The procedure of paragraph (A) was repeated on a similar 100 percent Dacron tricot using an aqueous solution (8 percent solids) of polyacrylic acid.

C. The procedure of paragraph (A) was repeated using an aqueous dispersion of polyacrylic acid (5 percent solids) and 3 percent solids methacrylic acid/ethyl acrylate copolymer.

The thus treated fabric specimens (approximately 75 percent wet pickup in each case) were then soiled and tested for soil removal. The following results were obtained (after 10 launderings):

Treatment	Black Oil	Mineral Oil	Clean Motor Oil	French Dressing
A	2.5	5	5	5
B	3.0	4	3	4
C	4.0	5	5	5

This shows the synergistic effect obtained with the combination of polyacrylic acid and MAA/EA copolymer in durability of finish and soil release, it being noted that only 3% MAA/EA is used with 5 percent polyacrylic acid in Treatment A and the results of this treatment are as good as, or better than, Treatment A where 8% MAA/EA is used and much better than Treatment B where 8 percent polyacrylic acid is used.

EXAMPLE 2

A. 100% Dacron tricot was padded with an aqueous 1 percent (solids) dispersion of the methacrylic acid/ethyl acrylate copolymer used in Example 1 and left wet (i.e., the drying and curing of Example 1 were omitted;

B. Paragraph (A) of this example was repeated except that a 1 percent solution of polyacrylic acid was used in lieu of the copolymer, the fabric being left wet;

C. Paragraph (A) of this example was repeated except that the pad comprised 1 percent (solids) of the copolymer and 1 percent solids polyacrylic acid, the fabric being left wet.

The wet fabric specimens were all exposed to vapors of steam and ammonia (600 cc. NH_4OH in 20 gals. water) at approximately 190° F. for 5 minutes, dried 2 minutes at 200° F. and cured 2 minutes at 350° F.

On testing for stain removal of black oil as in Example 1, the following results were obtained after 10 launderings:

Treatment	Rating
A	3
B	1
C	4

These results show the improvement obtaining from the combination of (1) MAA/EA copolymer and polyacrylic acid for the finish and (2) ammonia vapor treatment.

EXAMPLE 3

Example 1 was repeated using bar on bar tricot fabric composed of 57% T-57 Dacron and 43 percent nylon and the following pad composition:

A. 1% solids MAA/EA copolymer in water

B. 1% solids AA in water

C. 1% solids AA plus 1% solids MAA/EA copolymer in water.

As will be recognized, the abbreviations "MAA/EA" and "AA" have been used above and are employed elsewhere herein, for convenience, to designate, respectively, the 60/40 methacrylic acid/ethyl acrylate copolymer and polyacrylic acid.

The results of stain removal after 10 launderings were as follows:

Treatment	Black Oil	Mineral Oil	Clean Motor Oil	French Dressing
A	2.5	4.5	3.0	4.5
B	1.0	2.5	2.5	2.5
C	4.0	5.0	5.0	5.0
Untreated	1.0	2.5	1.0	1.0

Here again, the improvement resulting from the combined use of MAA/EA and AA are to be noted. It should also be noted that the ratings of the untreated fabrics used in this example apply to the other examples which use the same fabric and the same scour.

EXAMPLE 4

A. A bar on bar tricot composed of 57% T-57 Dacron/43% nylon was padded with 0.5% solids AA, 0.5% solids MAA/EA, and 2.0% solids emulsified TIDTM in water and left wet.

B. Paragraph (A) of this example was repeated on another similar fabric using a pad of 0.5% solids AA, 1.0% solids MAA/EA, and 2.0% solids emulsified TIDTM in water.

C. Paragraph (A) of this example was repeated using a pad of 1.0% solids MAA/EA, plus 2.0% solids emulsified TIDTM in water.

The "TIDTM" referred to above was an emulsion of Morflex 530 (triisodecyl trimellitate).

All of the fabric specimens were exposed while wet to vapors of steam and ammonia (600 cc. NH_4OH per 20 gals. water) at approximately 190° F. for 2 minutes, dried 2 minutes at 200° F. and cured 2 minutes at 350° F.

The results of stain removal (10 launderings) are given below:

Treatment	Black Oil	Clean Motor Oil
A	2.5	3.0
B	4.0	5.0
C	3.0	5.0

In the above example, the TIDTM functioned to improve hand while it will be noted that better soil release was attained with Treatment (B) using the higher total solids of MAA/EA plus AA vs. Treatment (A). The ratio of 50% AA on the weight of the MAA/EA to produce a synergistic effect is also noted in Treatment (B).

EXAMPLE 5

A. 100% Dacron tricot was padded with the following composition:

1% solids MAA/EA, 0.5% solids AA and
1% solids emulsified TIDTM

B. A similar fabric was padded with the following composition:

1% solids MAA/EA, 0.5% solids AA and
1% solids phenyl stearic acid

Both fabrics were scoured before application of soil release with 3% NaOH solution at 180° F., 15 minutes (2.5% weight loss) rinsed, neutralized in 1% acetic acid, rinsed, dried 2 minutes at 200° F.

Both fabrics, after padding with the indicated soil release compositions, were dried 2 minutes at 200° F. and cured 45 seconds at 380° F.

Results of stain removal (10 launderings) were as follows:

Treatment	Black Oil	Mineral Oil	Clean Motor Oil	French Dressing
A	4	5	5	5
B	3	4.5	5	4.5

The TITDM and phenyl stearic acid used in this example gave the fabric a softer hand. In both instances the soil release was good, it being noted that black oil is an extremely severe test soil.

EXAMPLE 6

Fabric: 57% T-57 Dacron/43% Nylon bar on bar tricot.

Procedures: A. Caustic scoured as in Example 5, then padded with 1% solids MAA/EA, 0.5% solids AA and 1% solids emulsified TIDTM in water.

B. Same as A except no caustic scour.

Results of stain removal, 10 launderings.

Treatment	Black Oil	Mineral Oil	Clean Motor Oil	French Dressing
A	4.0	4.0	5.0	4.0
B	3.0	4.0	3.0	4.0

This example shows the advantage of caustic scour before treatment with the soil release finish.

EXAMPLE 7

Fabric: 57% T-57 Dacron/43% Nylon bar on bar tricot

Procedures:

A. Scour for 30 minutes at 203° F. in 10 percent solids solution in water of anhydrous sodium metasilicate, rinsed, neutralized in 2 percent acetic acid at room temperature, rinsed and dried 2 minutes at 200° F.

B. Regular scour.

The fabrics obtained by scouring procedures A and B were both padded with 1 percent solids MAA/EA plus 0.5 percent solids AA and 1 percent solids emulsified TIDTM, dried 2 minutes at 250° F. and cured 45 seconds at 380° F.

Results of stain removal after 1, 10 and 15 launderings were as follows:

	Black Oil			Mineral Oil			Clean Motor Oil			French Dressing		
	1	10	15	1	10	15	1	10	15	1	10	15
Treatment:												
A	4.5	3.0	4.0	5.0	4.5	4.5	5.0	5.0	5.0	5.0	4.5	4.0
B	3.0	2.5	2.5	5.0	4.0	4.0	5.0	4.0	3.0	5.0	4.0	3.0

These results point up the advantage of an alkaline silicate scour over the conventional scour.

EXAMPLE 8

Fabric: 57% T–57 Dacron/43% Nylon bar on bar tricot.

Procedures:

A. Pad 3.0% solids MAA/EA, 1.5% solids AA and 3.0% solids emulsified TIDTM in water.

B. Pad same as A except add 0.64% solids Nopco D-607 urethane.

C. Prime fabric with 0.64% solids aqueous dispersion of Nopco D-607, dry 2-1/2 minutes at 250° F. Then apply A finish.

In each instance, the fabric after application of A, B or C, was dried 2½ minutes at 250° F. and cured 45 seconds at 380° F. The results of stain removal after 1, 10 and 20 launderings are shown below:

	Black Oil			Mineral Oil			Clean Motor Oil			French Dressing		
	1	10	20	1	10	20	1	10	20	1	10	20
Treatment:												
A	4.5	4.0	2.5	5.0	3.0	2.5	5.0	4.5	2.5	5.0	4.0	2.5
B	4.0	4.0	3.0	5.0	5.0	5.0	5.0	5.0	4.5	5.0	5.0	4.0
C	4.0	4.0	3.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	4.5

It is to be noted that the urethane additive, whether added with the grease release finish or as a primer therefor, improved the durability of the soil release properties on extended launderings.

EXAMPLE 9

Fabric: 57% T–57 Dacron/43% Nylon bar on bar tricot

Procedures:

A. Pad on 3.0% solids MAA/EA, plus 1.5% solids AA plus 3.0% solids emulsified TIDTM in water.

B. Pad on 0.2% aqueous solution of epoxy silane A-187 (Union Carbide), dry 2½ minutes at 250° F. Then apply A finish.

In each instance, the fabric after Procedure A or B, was dried 2½ minutes at 250° F., and cured for 45 seconds at 380° F.

The results of stain removal after one and 10 launderings were:

Treatment	Black Oil		Mineral Oil		Clean Motor Oil		French Dressing	
	1	10	1	10	1	10	1	10
A	4.5	4.0	5.0	3.0	5.0	4.5	5.0	4.0
B	4.0	4.0	5.0	5.0	5.0	5.0	5.0	5.0

These results show that use of a silane primer is beneficial to the results obtained.

EXAMPLE 10

Fabric: 57% T–57 Dacron/43% Nylon bar on bar tricot.

Procedures:

A. Regular scour as in Example 7.

B. Scoured in 10% anhydrous sodium metasilicate aqueous solution 30 minutes at 203° F., rinsed, neutralized in 2% acetic acid, rinsed and dried 2½ minutes at 250° F. (1.2% weight loss).

C. Scoured in 5% caustic (NaOH) solution for 30 minutes at 203° F., rinsed, neutralized in 2% acetic acid, rinsed, and dried 2½ minutes at 250° F.

All fabrics, after scouring as indicated, were padded with 3% solids MAA/EA, 1.5% solids AA, and 3.0% solids emulsified TIDTM, dried 2 minutes at 250° F. and cured 45 seconds at 380° F.

The results of stain removal after 10 and 20 launderings:

Treatment	Black Oil		Mineral Oil		Clean Motor Oil		French Dressing	
	10	20	10	20	10	20	10	20
A	3.0	2.5	3.0	2.5	3.0	2.5	3.0	2.5
B	4.0	4.5	4.0	4.0	5.0	5.0	4.0	4.0
C	4.0	3.0	4.0	4.0	4.0	4.0	3.0	3.0

These results show the superiority of the alkaline scours B and C over regular scouring in giving better and more durable grease release over extended launderings.

EXAMPLE 11

Fabrics:

A. 100% T–51 disperse dyeable Dacron polyester

B. 100% T–62 basic dyeable Dacron polyester

C. 100% disperse dyeable Fortrel polyester

Procedure: All fabrics were padded with 3.0% solids MAA/EA, plus 1.5% solids AA, plus 3.0% solids emulsified TIDTM in water, dried 2 minutes at 250° F. and cured 45 seconds at 380° F.

The results of stain removal after ten launderings were:

Fabric	Black Oil	Mineral Oil	Clean Motor Oil	French Dressing
A	2.5	2.5	2.5	2.5
B	4.5	5.0	5.0	5.0
C	2.5	3.0	3.0	3.0

This example shows that there is some variation in effect depending on the synthetic fibers employed. In particular, the basic dyeable Dacron fibers seem to give a better effect than the disperse dyeable polyester fibers. This may be due to greater wettability in the basic dyeable fibers or a higher energy surface which is more compatible to the soil release finish.

EXAMPLE 12

Fabric: 57% Dacron/43% Nylon bar on bar tricot.

Procedure:

A. Pad 3.0% solids MAA/EA, 1.5% solids AA, and 3% solids emulsified TIDTM.

B. Same as A except include add 0.42% solids Nopco D–602 urethane in pad composition. All fabrics before soil release application were scoured 30 minutes at 203° F. in a 10% anhydrous sodium metasilicate solution, rinsed, neutralized in 2% acetic acid, rinsed and dried 3½ minutes at 250° F. (1.9% weight loss).

The soil release finish was dried 2 minutes at 250° F. and cured 45 seconds at 380° F.

The results of stain removal after 10 and 20 launderings were:

Treatment	Black Oil		Mineral Oil		Clean Motor Oil		French Dressing	
	10	20	10	20	10	20	10	20
A	4.0	3.0	3.0	4.0	3.0	4.0	3.0	4.0
B	4.0	4.0	4.5	4.5	5.0	4.5	5.0	4.5

The above results show that the urethane additive improves the durability of the finish to laundering.

EXAMPLE 13

Fabric: 57% Dacron/43% Nylon bar on bar tricot.

Procedures:

A. Scour in 3% aqueous anhydrous sodium orthosilicate to 0.75% weight loss.

B. Scour in 6.0% aqueous anhydrous sodium metasilicate to 1.5% weight loss.

C. Scour in 10% aqueous liquid sodium silicate to 0.25% weight loss.

D. Scour in 15% aqueous liquid potassium silicate, no measurable weight loss. All scouring treatments were for 30 minutes at 203° F. after which the fabrics were rinsed, neutralized in 2% acetic acid, rinsed and dried 2½ minutes at 250° F.

All fabrics were then padded with 2.0% solids MAA/EA, 1.0% solids AA, and 2.0% solids emulsified TIDTM, dried 2 minutes at 250° F. and cured 45 seconds at 380° F.

The results of stain removal after 10 and 20 launderings were:

Treatment	Black Oil		Mineral Oil		Clean Motor Oil		French Dressing	
	10	20	10	20	10	20	10	20
A	4.0	4.0	5.0	4.5	5.0	5.0	5.0	5.0
B	4.0	4.0	5.0	4.5	5.0	5.0	5.0	5.0
C	3.0	3.0	5.0	4.5	5.0	4.5	5.0	4.5
D	3.0	3.0	5.0	4.5	5.0	4.5	5.0	4.5

The above results show the superiority in performance of products involving procedures (A) and (B) using the more alkaline treatments with slight weight losses.

EXAMPLE 14

Fabric: 57% T-62 Dacron/43% Nylon bar on bar tricot.

Procedures:

A. Aqueous pad composition containing 2% solids MAA/EA plus 1% solids AA, plus 2% solids emulsified TIDTM.

B. Same pad as A except include in the pad add 0.42% solids E-207A from Wyandotte Co.) a completely reacted high molecular weight urethane polymer in nonionic emulsion.

C. Same pad as A except include add 0.4% solids E-503 from (Wyandotte Co.), a completely reacted high molecular weight urethane polymer in nonionic emulsion.

All fabrics were padded, dried 2½ minutes at 250° F. and cured 45 seconds at 380° F.

The results of stain removal after 10 and 20 launderings were:

Treatment	Black Oil		Mineral Oil		Clean Motor Oil		French Dressing	
	10	20	10	20	10	20	10	20
A	2.5	2.5	4.0	3.0	4.0	3.0	4.0	3.0
B	2.5	3.0	4.5	5.0	4.0	4.5	4.5	4.5
C	2.5	3.0	4.0	4.0	4.0	4.0	4.0	4.5

These results again show the improved durability of the finish to extended launderings when a urethane polymer is used as an additive.

EXAMPLE 15

Fabric: 100% Nylon tricot.

Procedure:

A. Aqueous pad composition containing 1% solids MAA/EA plus 1% solids emulsified TIDTM.

B. Aqueous pad containing 1% solids AA plus 1% solids emulsified TIDTM.

C. Aqueous pad containing 1% solids MAA/EA, plus 0.5% solids AA, and 1.0% solids emulsified TIDTM.

All fabrics were padded, dried 2 minutes at 250° F. and cured 45 seconds at 380° F.

The results of stain removal after one and 10 launderings were:

Treatment	Black Oil	
	1	10
A	1.0	1.0
B	3.0	3.0
C	4.0	5.0

These results show the synergistic effect of using the combination of MAA/EA and AA on Nylon. After 20 launderings, fabric C had a 5 rating.

EXAMPLE 16

Fabric: 57% T-57 Dacron/43% Nylon bar on bar tricot

Procedures:

A. Regular scoured fabric, 38 lbs., left wet for soil release finish.

B. Silicate scour, 38 lbs. cloth scoured in a 6% solution of anhydrous sodium metasilicate in 360 gals. water volume at 203° F., 30 minutes in a commercial dye beck, rinsed with water, neutralized in 0.6% acetic acid, rinsed in water, squeezed and left wet for soil release finish (1% weight loss).

All fabrics were padded in wet state with aqueous dispersion containing 2.0% solids MAA/EA, 1% solids AA, 2.0% solids emulsified TIDTM, and 0.42% Nopco D-602 urethane. All were dried in a commercial pin tenter frame at 23 yards/min. speed at 225° to 300° F. in a graduated temperature oven, and then passed at the same speed into a gas heated over for 15 seconds at 380° F. (cloth temperature).

All fabrics were stained with nine oily stains, and given 1, 10 and 20 launderings.

The results of stain removal were:

	3-1 Oil	Bacon Fat	Fr. Dress.	Motor Oil	Mineral Oil	Butter	Mayonnaise	Corn Oil	Black Oil
Treatment									
ONE LAUNDERING									
A	5	5	5	4.5	5	5	5	5	2.5
B	5	5	5	5	5	5	5	5	4
Reg. scoured, no soil release	1	1	1	1	1	1	1	1	1
Silicate scoured, no soil release	4.5	3	3	3	3	3	3	3	3
TEN LAUNDERINGS									
A	4.5	2	2	2	4	3	2	2	2
B	5	4.5	4.5	5	4.5	4.5	4.5	4.5	4.5
Reg. scoured, no soil release	1	1	1	1	1	1	1	1	1
Silicate scoured, no soil release	4.5	2	3	3	3	3	3	2	3
TWENTY LAUNDERINGS									
A	3	2.5	2.5	3	3	3	3	2.5	1
B	5	4	5	5	5	5	5	5	3
Reg. scoured, no soil release	1	1	1	1	3	1	1	1	1
Silicate scoured, no soil release	4	3	3	3	4	3	3	3	1.5

These results demonstrate the outstanding durability of the silicate treated fabric and the significant advantages of this scouring treatment over the regular scour for grease release.

EXAMPLE 17

Fabric: 57% T-62 Dacron/43% Nylon bar on bar tricot
Procedures:

A. 55 yards scoured in a standard commercial dye beck in 360 gals. water with regular scour.

B. 50 yards scoured in beck containing 360 gals. water containing: Xylene emulsifier — 0.143% Hipochem MS (High Point Chemical Co.) Sequestrant — 0.018% Hipochem ST (High Point Chemical Co.) Emulsifier — 0.143% Caustic — 0.143% Xylene — 0.72% Boil 1 hour

C. 50 yards regular scoured fabric were scoured in 360 gals. water containing 1.5% anhydrous sodium metasilicate and processed the same as in Example 16 for the silicate process.

All fabrics were bleached with acid chlorine type bleach before the above scours. All fabrics were tinted together with blue dye and optical brightener, after the above scours, and left in the wet state.

All fabrics were then padded wet (after squeezing with padder rolls) with an aqueous pad composition containing 2.2% solids MAA/EA, 1.1% solids AA, 2.2% solids emulsified TIDTM, and 0.46% solids Nopco D-602 urethane. They were then dried in a commercial pin tenter frame at 25 yards/min. under the same conditions as in Example 16.

All fabrics were stained with the same stains as in Example 16 and washed the same. The results on the scours B and C were similar to Scour B in example 16, and showed the superior performance of the two alkaline scours opposite the regular Scour A. On Scour B, the following additional stains were applied and completely removed in laundering at 110° F.:

urine
anti-perspirants
egg yolk
grape juice
ketchup
coffee
blood (dried on cloth overnight)

It will be appreciated that various modifications may be made in the invention described herein. Hence the scope of the invention is defined in the following claims herein.

We claim:

1. A process for improving the soil release properties of a 100 percent synthetic textile which comprises impregnating the same with a mixture consisting essentially of 10 to 90 percent of polyacrylic acid and 90 to 10 percent of an essentially linear water-insoluble swellable synthetic polymer of an ethylenically unsaturated monomer having at least one acid group which polymer absorbs at least 550 percent of water when immersed in an aqueous solution for 2 minutes at 140° F. then drying and curing.

2. The process of claim 1 wherein the polymer is a copolymer of methacrylic acid and ethyl acrylate.

3. The process of claim 2 wherein said textile is a fabric comprising polyester fibers.

4. The process of claim 1 wherein said mixture is applied to said textile as an aqueous composition.

5. The process of claim 1 wherein the textile, after impregnating but before drying, is exposed to treatment with steam and ammonia vapor.

6. The process of claim 1 wherein said mixture includes a plasticizer.

7. The process of claim 1 wherein said mixture includes a further additive for improving hand, soil release and durability.

8. The process of claim 1 wherein the synthetic textile comprises basic dyeable polyester fibers.

9. The process of claim 1 wherein the synthetic textile comprises synthetic fibers which have been modified to have increased surface energy.

10. The product obtained by the process of claim 1.

11. A process for imparting soil release properties to a 100 percent synthetic textile which comprises subjecting said textile to an alkaline scour until said textile is immediately wettable and then applying a soil release finish thereto consisting essentially of 10 to 90 percent of polyacrylic acid and 90 to 10 percent of an essentially linear water-insoluble, swellable synthetic polymer which absorbs at least 550 percent of its weight of water when immersed in an aqueous detergent solution for 2 minutes at 140° F. then drying and curing.

12. The process of claim 11 wherein the scour is selected from the group consisting of caustic and silicate.

13. The product obtained by the process of claim 11.

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