COLLODAL SILICA CLEANSING COMPOSITIONS
AND METHOD

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ABSTRACT OF THE DISCLOSURE

A mixture of colloidal silica of less than about 20 microns, inert filler and water provides an outstanding cleaner particularly for carpets and the like, especially when vigorously applied, and after a short drying period is readily removable.

The present invention relates in general to dry cleansing compositions and in particular to the provision of dry, cleaning composition advantageously and beneficially adapted for use in connection with the treatment of textile fabrics such as carpets, rugs, and the like.

As is well-known, liquid compositions specifically adapted for use in operations associated with the cleansing of formed textile fabrics such as carpet and rug shampoos although enjoying relatively widespread commercial exploitation are nevertheless found in practice to suffer from one or more disadvantages which in many instances, prove intolerable. Among the disadvantages found to characterize many of the liquid cleansing formulations heretofore provided there may be mentioned in particular their tendency to cause shrinking, wicking, matting etc. As will be readily apparent, occurrence of one or more of such phenomena to any appreciable extent can result in severe and permanent damage to the fabric under treatment thereby giving rise to significant economic losses. The tendency of shrinking and matting are of course self-evident; wicking on the other hand, has reference to that condition which obtains when the water present in the cleansing formulation is imbibed into or otherwise taken up by the carpet backing layer with consequent solubilization of color bodies present therein; such color bodies gravitate or migrate—most probably by capillary action—to the outer regions of the carpet fiber; in addition to actual physical impairment of the fabric, the effect of redeposition of color bodies in this manner are invariably manifested in the form of unsightly or otherwise esthetically displeasing staining and discoloration of the carpet. Moreover, it is usually found that such condition can be rectified, if at all, solely by resort to special cleansing techniques, usually at considerable expense.

Liquid carpet cleansing formulations of the type heretofore promulgated for use, whether domestic or industrial, prove further objectionable from the standpoint of carpet resoiling. Thus, such compositions characteristically yield sticky, tacky deposits e.g., detergent residues, thereby enhancing unavoidably the tendency of the carpet to accumulate soil. Mitigation of such problems usually requires the observance of inordinately protracted drying intervals prior to resumption of traffic. The foregoing can of course prove highly impracticable and particularly in those instances where the carpet is situated in a "public" thoroughfare as would be the case with commercial establishments such as theatres, office buildings etc.

A further deterrent to the use of liquid shampoos arises from the tendency of aqueous environments to give rise to mildew formation with the consequent evolution of malodorous substances, and continued recurrence of such a condition can, of course, lead to complete ruination of the carpet material. The adverse effects attributable to excess moisture are in no way necessarily confined to the textile fabrics under treatment; thus, the cleansing composition in the ordinary course of usage contact metallic articles, such as furniture legs, lamp bases, etc., and thus rusting becomes a serious problem. Again, certain precautionary measures must be observed in order to minimize any possibility of rust damage, e.g., thorough wiping, protective coatings etc.

In an effort to overcome or otherwise ameliorate the foregoing and related problems, considerable industrial activity has centered around the research and development of cleansing compositions substantially dry in nature, i.e., wherein the amount of moisture is confined within predetermined limits thereby leading to substantial reductions in drying time requirements, the latter permitting more immediate resumption of traffic upon fabrics treated therewith. Although providing some measure of improvement, the compositions heretofore provided are found in a great number of instances to be deficient or otherwise sub-optimum in one or more important desiderata among which there may be mentioned, cleansing power, facility of use, drying time etc. Thus, many of the techniques promulgated in this connection involve as an essential expeditious the use of organic solvents, detergents etc. in order to provide compositions having the requisite cleansing as well as other desirable properties. Aside from the cost factor, i.e., the expense associated with the use of such substances in the amounts necessary often proves economically prohibitive, it is found in practice that the drying period required for complete evaporation of solvent tends to vitiate any advantage which might otherwise accrue.

Thus, the primary object of the present invention resides in the provision of cleansing compositions wherein the foregoing and related disadvantages are eliminated or at least mitigated to a substantial extent.

Another object of the present invention resides in the provision of cleansing compositions essentially dry in nature wherein any requirement for the use of copious quantities of aqueous media is completely obviated.

Yet another object of the present invention resides in the provision of dry cleansing compositions wherein any necessity for the use of detergents, solvents and related addenda is eliminated.

A further object of the present invention resides in the provision of dry cleansing compositions wherein any problems associated with shrinking, wicking, matting etc. are substantially eliminated.

A still further object of the present invention resides in the provision of dry cleansing compositions having superior cleansing potential and devoid of any tendency to yield tacky residues thereby permitting immediate resumption of traffic on fabrics treated therewith.

Other objects and advantages of the present invention will become more apparent hereinafter as the description proceeds.

The attainment of the foregoing and related objects is made possible in accordance with the present invention which, in its broader aspects, includes the provision of dry cleansing compositions containing as essential ingredients:

(a) A minor amount of colloidal silica having an average particle size falling within the range of from about .01 to about 20 microns and

(b) A major amount of an inert, finely divided carrier having a bulk density with the range of about 6 to about 22 pounds per cubic foot.

As indicated, the silica material preferred for use in accordance with the present invention has an average particle size ranging from about .01 to about 20 microns.
with a range of about 2 to about 9 microns being particularly preferred. Experimental evidence indicates particle size to be a critical factor as regards potential cleansing and abrasive efficiency of the silica granule. Thus, silica granules having an average particle size substantially in excess of 20 microns are found to be markedly inferior both in terms of cleansing and abrasive efficiency as well as capacity to augment the soil-resistance properties of carpets treated therewith. Thus, in addition to providing optimum cleansing effects, silica particles falling within the aforesaid ranges lead to manifold improvement in such carpet properties as soil-resistance, wear, endurance, toughness etc. It is postulated in explanation thereof that the silica particles tend to embed themselves in and thus fill the void and interstices present in the fibrous material comprising the carpet, in effect blocking those sites which would otherwise serve as reservoirs for soil, dust, grease etc. As will be readily evident, the useful life of the life of the fabric, in view of the “protective” action of the silica particles can be significantly enhanced. Moreover, actual carpet cleaning is greatly facilitated in view of the substantial reduction in actual embedding of dirt particles, the latter tending to agglomerate at the surface of the fabric being thus rendered more accessible to removal operations e.g., vacuuming.

As is well-known, colloidal or amorphous silica is available commercially in a wide variety of grades and forms depending for example upon the process of manufacture employed. Thus, the silica may be of the pyrogenic type, a suitable representative including Cab-O-Sil marketed commercially from the Cabot Corp. A precipitated type of colloidal silica eminently suitable for use herein is available commercially from the Philadelphia Quartz Co. under the trademark designation “Quos”; suitable synthetic silicas, include for example the Syloid available commercially from W. R. Grace Co. e.g., Syloid 74, 244 etc. In general, the particle size of the pyrogenic and precipitated silicas falls within the lower portion of the range stated while the synthetics are usually provided in the larger particle size range. In addition, it will be understood that the silica materials of the type described and regardless of origin may be employed in admixture of two or more, the advisability of so proceeding being completely within the discretion of the processor.

In order to assure the attainment of optimum results, it is recommended practice to utilize the silica material in amounts ranging from about 0.2% to about 1.5% by weight of total composition with a range of 0.5% to 3% being particularly preferred. It will be understood that the present invention contemplates that extraordinary circumstances, special requirements etc. may well dictate departures from the aforesaid ranges in order to achieve desired results. Thus, the concentration range stipulated should be interpreted as representing in essence, the locus of values found to provide optimum advantage for the vast majority of problems likely to be encountered in practice.

Compositions constituted in accordance with the present invention contain as a further critical ingredient a major amount of an inert, finely divided carrier material. In general, it is preferable that such material be neutral in coloration e.g., whitish-grayish in order to assure ready visual comprehension and discernment as to the extent of the carpet area being treated; this situation obtains since most carpeting is of such coloration as to provide pronounced contrast with white.

Employing the carrier material in the aforesaid color form offers the additional advantage that the user is able to observe the color change of the particles from white to gray as the carrier material picks up soil from the carpet during actual cleansing.

In accordance with preferred practice, it is recommended that the carrier material conform with predetermined bulk density requirements i.e., have a bulk density of from about 6 to about 22 pounds per cubic foot. Bulk density is of importance being related to the density of the particle material and thus the latter’s capacity to absorb soil.

The particle size of the carrier material should likewise be confined within predetermined values in order to assure optimum performance. In general, it has been ascertained that the proportion of carrier particles having a size smaller than about 2 microns should be minimized and should in any event comprise less than about 1.0% of the total weight carrier material present. As regards maximum dimension, it is recommended that the particle size of the carrier material not exceed 40 microns at least to any appreciable extent. Although slight deparatures from the aforesaid ranges can be tolerated in certain circumstances, it will usually be found that any such occasions are exceptional. Thus, compliance with the aforesaid particle size limitations is found to assure that provision of a material which may be readily and easily distributed on the carpet material while being conducive to expeditions retrieval e.g., as by vacuuming. If the particle size of a substantial portion of the carrier material is substantially smaller than 2 microns, severe dusting problems are likely to arise during application of the composition to the textile fabric selected for treatment. On the other hand, should the particle size of the carrier material exceed 40 microns to any appreciable extent, efficient application of cleansing composition is rendered extremely difficult if not practically impossible; in addition, as will be understood, the efficiency of the cleansing composition is directly related to the surface area and thus particle size of the granules present. Thus, increased particle size tend correspondingly to detract from the effectiveness of the composition.

As specific examples of inert carrier materials found to be particularly beneficial for use in the practice of the present invention there may be mentioned without necessary limitation, calcined, uncalcined and flux calcined diatomaceous earth, sawdust, talc, trituated corn, cob, fuller’s earth and the like. Diatomaceous earth is particularly efficacious for use here in view of its advantageous bulk density, coloration and particle size. A particularly effective type of diatomaceous earth comprises uncalcined diatomaceous mineral filler known as snow floss. A further example of carrier material found to be particularly suitable comprises diatomaceous silica flatting agent available commercially from the Johns-Manville Co. under the tradename Celite 219.

In general, it is recommended practice to employ the carrier material in major amounts; accordingly, the carrier material is preferably employed in proportions ranging from about 35 to about 70% by weight of total composition with a range of about 40 to 65% being preferably preferred. Again, it will be understood that special circumstances may well dictate the propriety of departing from the aforesaid ranges.

The compositions of the present invention are provided in the form of a dry free-flowing powder. In formulating such compositions, the quantities of water employed are confined to minimum values; thus, optimum compositions completely devoid of any tendency to yield sticky residues may be readily fabricated despite the use of water in amounts ranging from about 30% to about 55% by weight of total composition.

The aforesaid ingredients namely the silica, carrier and water comprise of course the critical ingredients of the instant compositions, i.e., the instant compositions improved described herein depend critically thereupon. However, it will be understood that one or more additional ingredients of a purely optional nature may likewise be included for purposes of achieving or augmenting one or more desired properties. Thus, lubricant substances may be added such as silicone oils for purposes of minimizing inter-particle friction and for purposes of facilitating application of such particles to the material to be treated. Other optional ingredients of conventional types include insecticides, preservatives, germicides, opti
cal brighteners, anti-statics etc. The amount of any such ingredient employed is not of critical import although recommended practice would suggest their use in small amounts i.e. from 0 to 1% by weight of composition. It will be understood that choice of optional ingredients in addition to those specifically enumerated may be employed in the compositions provided herein, the salient requirement being, of course, that any such ingredient be completely devoid of any tendency to deleteriously affect or otherwise impair the properties and characteristics of the parent composition.

In some instances, it may be desired to include one or more surfactant materials of the type conventionally employed in the preparation of carpet cleansing compositions. Such materials are well-known in the art being extensively described in prior art publications both patent and otherwise. However, as previously mentioned, the use of such materials inherently involves certain disadvantages: the more problematical being those associated with the deposition of tacky or sticky residues. Accordingly, considerable caution should be exercised as regards surfactant selection; in any event, the surfactant material should exhibit the property of drying to a fluffy residue capable of ready removal by vacuuming. In general, surfactants of the anionic type, e.g., the alkali metal alkyl sulfates wherein the alkyl group contains from 10 to 18 carbon atoms are preferred for use. Surfactant materials falling within this category may be represented, according to the following structural formula:

$$ROSO_3^-$$

wherein $R$ comprises an aliphatic hydrocarbon group i.e., alkyl and alkylkenyl, such group containing preferably from 10 to 18 carbon atoms, and $X$ represents a water-solubilizing cation e.g., alkali metal such as sodium, potassium, lithium, ammonium, substituted ammonium, amine salts etc.

Another class of surfactant material suitable for use herein comprises the alkali metal alkylol sarcocinates which may be represented according to the following structural formula:

$$R_2\text{CON}\left(CH_2\right)_n\text{CH}_2\text{COO}^-$$

wherein $R_2$ comprises an aliphatic hydrocarbon group containing from 12 to 18 carbon atoms and wherein $X$ has the above defined significance.

Yet another class of surfactant material found to be suitable comprises water-soluble higher alkyl aryl sulfonates wherein the alkyl group contains from 8 to 15 carbon atoms. The higher alkyl benzene sulfonates prove particularly advantageous. The higher alkyl substituent present on the aryl nucleus may be branched or straight-chained including for example tertiary octyl, decyl, lauryl, tetradecyl, etc. The sulfonate surfactant materials are likewise preferably employed in the form of their salts with water-solubilizing cations of the type hereinbefore described. Although anionic type surfactants are preferred for use, it will be understood that the subject invention is not limited thereto. Thus, non-anionic, cationic and amphoteric detergents are likewise eminently suitable for use.

The compositions of the present invention are particularly and beneficially adapted for use in the cleansing of formed textile fabrics and more particularly, to heavy durable fabrics as a nap or pile of the type which in the ordinary course of events would not be subjected to dry cleaning. Such compositions are particularly advantageous in the treatment of rugs and carpets. In any event, the formed textile fabric may be of vegetable, synthetic or animal origin including mixtures of same. The term “synthetic fabrics” as employed in the context of the present invention has reference to a wide variety of materials among which may be mentioned viscos rayon, acetate rayon, nylon, as well as fibers derived from polyester and acrylic type polymers. Specific examples of polyester fibers which lend themselves admirably for treatment in accordance with the present invention there may be mentioned the commercially available Duracron and Zephran fibers. Acrylic type fibers include for example Crelan, Acrilan, Orlon and the like. Other fibers of a vegetable or animal origin include cotton, jute, ramie, wool, etc.

The compositions of the present invention are specifically designed for use as vacuuming aids i.e., may be applied to carpets and rugs prior to vacuuming for purposes of controlling buildup of soil. In practice, the cleansing composition is applied to the surface to be treated and allowed to stand for periods of time consonant with efficacious cleansing, the latter in turn depending to a great extent upon the severity of the cleansing problem confronted. In general, standing periods ranging from several minutes e.g., 5 to 15 minutes to about 24 hours will be found sufficient to effectively negotiate the broad spectrum of cleaning problems likely to be encountered in practice. In any event, the progress and extent of cleansing action can be detected by observing the color change occurring in the cleaner composition particles due to the takeup of soil. The cleansing composition may thereafter be readily and easily removed by simple vacuuming. The treated carpet surface is thereupon ready for immediate resumption of traffic in view of the complete absence of any requirement for drying. The compositions described herein are particularly advantageous in that they are beneficially adapted to be subjected to vigorous scrubbing action once applied to the carpet surface. Such rubbing action may be implemented according to conventional means, i.e., manually or by use of powered mechanical devices provided for such use e.g., rotary action, mechanically driven brush means. The latter represents a particularly efficacious mode of proceeding being conducive to truly optimum cleansing effects.

The following examples are given for purposes of illustration only and are not to be considered as necessarily constituting a limitation on the present invention. All parts given are by weight unless otherwise specified.

**EXAMPLE I**

A series of compositions is prepared employing varying quantities and types of colloidal silicas and inert filler. Each of the compositions is applied to nylon and wool test carpet samples. In each instance, the cleansing composition is subjected to vigorous rubbing and scouring action, the latter effected by the water driven brush means, i.e., power driven rotary brush means and on other test samples, manually i.e., by hand brush. After 15 minutes the composition is removed by vacuuming. The effectiveness of each of the compositions is thereafter evaluated by noting the difference in brightness i.e., the soiled carpet area as compared with brightness measurements taken both before and after the cleansing treatment. The compositions tested are itemized in the following table:

<table>
<thead>
<tr>
<th>Table I</th>
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</thead>
<tbody>
<tr>
<td>Example No.</td>
</tr>
<tr>
<td>Ingredient</td>
</tr>
<tr>
<td>Colloidal silica</td>
</tr>
<tr>
<td>Cab-O-Sil M-5</td>
</tr>
<tr>
<td>Quino</td>
</tr>
<tr>
<td>Inert filler</td>
</tr>
<tr>
<td>1. (a) snow from</td>
</tr>
<tr>
<td>2. Diammonium phosphate</td>
</tr>
<tr>
<td>Water</td>
</tr>
</tbody>
</table>

1. Syntex 264 silica; average particle size 3 microns.
2. Cab-O-Sil M-5; average particle size 0.002 microns.
3. Quino; average particle size 0.008 microns.
4. Diammonium phosphate; average particle size 3 microns.
5. Smooth filler; average particle size 3 microns.
6. Diammonium phosphate; average particle size 3 microns.
7. Diammonium phosphate; average particle size 3 microns.

In each case, the composition tested provides markedly superior cleansing activity while imparting to the carpet surface exceptional resistance to soiling despite immediate resumption of traffic. Moreover, the carpet samples are totally devoid of anything in the nature of tacky deposits.
Upon completion of the testing, careful examination of each of the carpet samples reveals no detectable shrinking, wicking, matting, or other undesired effect. In contradistinction, repetition of the aforesaid procedure under identical conditions of testing but employing commercially available organic solvent-containing cleaner compositions of the so-called "dry" type, leads to inferior results in terms of cleaning capability. In addition, extensive drying periods for complete expulsion of solvent are mandatory prior to resumption of traffic. Otherwise, severe resoiling and matting of the carpet samples obtains. Results similar to those described in the foregoing examples are obtained when the procedures described therein are repeated but employing as an additional ingredient of the cleaning composition from 0.1 to 6.0% of one or more surfactant materials of the type described hereinbefore. Apparently, the surfactant compound functions in a highly effective manner as a dust suppressant. Moreover, the inclusion of minor quantities of brightener, cleansing agent such as typified by perchlorenethylene, lubricity agents, coloring agents and/or perfumes, in nowise deleteriously effects or otherwise detracts from the overall effectiveness of the parent composition.

The exemplified compositions likewise provide improvements when applied to the carpet surface and allowed to stand for periods ranging up to about 45 minutes. Although less effective by comparison to procedures involving vigorous scouring action, the results are nevertheless beneficial.

What is claimed is:

1. A cleansing composition substantially dry in nature containing as essential ingredients
   (a) a minor amount of colloidal silica having an average particle size falling within the range of from about .01 to about 20 microns;
   (b) a major amount of an inert, finely divided carrier having a bulk density within the range of from about 6 to about 22 pounds per cubic foot and
   (c) from 30% to 55% water.

2. A composition according to claim 1 wherein said silica has present in amounts ranging from 0.1% to 8% of total composition.

3. A composition according to claim 1 wherein said inert filler is present in amounts ranging from about 35% to about 70% by weight of total composition.

4. A composition according to claim 1 wherein said silica comprises a synthetic silica.

5. A composition according to claim 1 wherein said silica comprises a pyrogenic silica.

6. A composition according to claim 1 wherein said silica comprises a precipitated silica.

7. A composition according to claim 1 wherein said inert filler is selected from the group consisting of calcined, uncalcined, and flux-calcined diatomaceous earth.

8. A composition according to claim 2, wherein said inert filler comprises uncalcined diatomaceous earth.

9. A composition according to claim 1, wherein said inert filler comprises diatomaceous earth.

10. A composition according to claim 1, wherein said inert filler comprises talc.

11. A composition according to claim 1, wherein said inert filler comprises wood dust.

12. A composition according to claim 1, wherein said inert filler comprises a mixture of uncalcined diatomaceous earth and diatomaceous silica flattening agent.

13. A process of cleansing which comprises applying to a carpet or similar surface the composition of claim 1, subjecting said composition to vigorous scouring action while in place on said surface and thereafter removing said composition from said surface.

14. A process according to claim 13, wherein said composition is removed by a vacuuming means.

15. A process which comprises applying to a carpet or similar surface the composition of claim 1, allowing said composition to stand for a time sufficient to cleanse said textile fabric, and thereafter removing said composition.

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