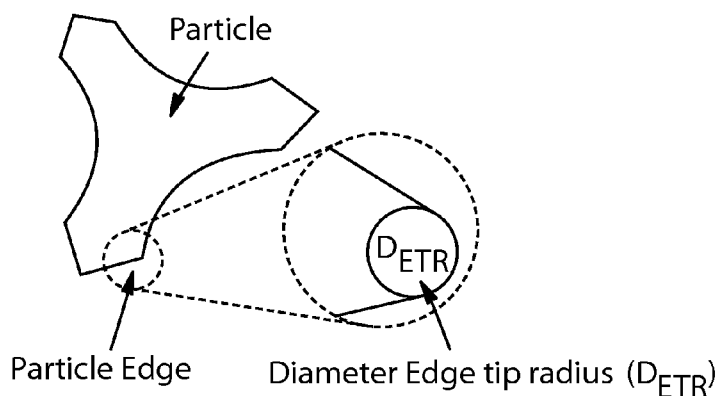




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(54) **Title:** LIQUID CLEANING AND/OR CLEANSING COMPOSITION**Fig. 1**

(57) **Abstract:** A liquid cleaning and/or cleansing composition comprising abrasive cleaning foam particles derived from grinding a foam structure, wherein said abrasive cleaning foam particles comprise a thermoplastic material having a raw material density of greater than 1.15, and the foam having a coefficient of expansion of from 8 to 14.



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## LIQUID CLEANING AND/OR CLEANSING COMPOSITION

## TECHNICAL FIELD

5 The present invention relates to liquid compositions for cleaning and/or cleansing a variety of inanimate and animate surfaces, including hard surfaces in and around the house, dish surfaces, teeth hard and soft tissue surface of the oral cavity, such as teeth, gums, tongue and buccal surfaces, human and animal skin, car and vehicles surfaces, etc. More specifically, the present invention relates to liquid scouring compositions comprising suitable particles for cleaning  
10 and/or cleansing.

## BACKGROUND OF THE INVENTION

Scouring compositions such as particulate compositions or liquid (incl. gel, paste-type)  
15 compositions containing abrasive components are well known in the art. Such compositions are used for cleaning and/or cleansing a variety of surfaces; especially those surfaces that tend to become soiled with difficult to remove stains and soils.

Amongst the currently known scouring compositions, the most popular ones are based on  
20 abrasive particles with shapes varying from spherical to irregular. The most common abrasive particles are either inorganic like carbonate salt, clay, silica, silicate, shale ash, perlite and quartz sand or organic polymeric beads like polypropylene, PVC, melamine, urea, polyacrylate and derivatives, polyurethane, and come in the form of liquid composition having a creamy consistency with the abrasive particles suspended therein.

25

However, there still remains a need to further improve abrasive containing compositions.

It is thus an objective of the present invention to provide a liquid cleaning and/or cleansing composition suitable to clean/cleanse a variety of surfaces, including inanimate and animate  
30 surfaces, such hard surfaces in and around the house, dish surfaces, hard and soft tissue surface of the oral cavity, such as teeth, gums, tongue and buccal surfaces, human and animal skin, etc., wherein the composition provides excellent cleaning/cleansing performance, and surface safety profile.

It has been found that the above objective can be met by the composition according to the present invention.

It is an advantage of the compositions according to the present invention that they may be used to clean/cleanse inanimate and animate surfaces made of a variety of materials like glazed and non-glazed ceramic tiles, enamel, stainless steel, Inox®, Formica®, vinyl, no-wax vinyl, linoleum, melamine, glass, plastics, painted surfaces, human and animal skin, hair, hard and soft tissue surface of the oral cavity, such as teeth enamel, gums, tongue and buccal surfaces, and the like.

A further advantage of the present invention is that in the compositions herein, the particles can be formulated at very low levels, whilst still providing the above benefits.

#### SUMMARY OF THE INVENTION

The present invention is directed to a liquid cleaning and/or cleansing composition comprising abrasive cleaning foam particles derived from grinding a foam structure, wherein said abrasive cleaning foam particles comprise a thermoplastic material having a raw material density of greater than 1.15, and the foam having a coefficient of expansion of from 8 to 12.

The present invention further encompasses a process of cleaning and/or cleansing a surface with a liquid, cleaning and/or cleansing composition comprising abrasive cleaning particles, wherein said surface is contacted with said composition, preferably wherein said composition is applied onto said surface.

The present invention further encompasses a process of making abrasive cleaning particles for abrasive containing liquid compositions.

#### BRIEF DESCRIPTION OF THE FIGURES

Fig. 1 is drawing showing an illustration how to calculate the tip radius.

Fig. 2 is drawing showing an illustration how to calculate foam strut aspect ratio.

Fig. 3 is a schematic drawing showing extrusion foaming with an extrusion die orifice having circular cross-section.

Fig. 4 is a schematic drawing showing extrusion foaming with an extrusion die orifice having rectangular cross-section.

5

## DETAILED DESCRIPTION OF THE INVENTION

### The liquid cleaning/cleansing composition

The compositions according to the present invention are designed as cleaners/cleansers for a variety of inanimate and animate surfaces. Preferably, the compositions herein are suitable for  
10 cleaning/cleansing surfaces selected from the group consisting of inanimate surfaces and animate surfaces.

In a preferred embodiment, the compositions herein are suitable for cleaning/cleansing inanimate surfaces selected from the group consisting of household hard surfaces; dish surfaces; surfaces  
15 like leather or synthetic leather; and automotive vehicle surfaces.

In a highly preferred embodiment, the compositions herein are suitable to clean household hard surfaces.

20 By "household hard surface", it is meant herein any kind of surface typically found in and around houses like kitchens, bathrooms, e.g., floors, walls, tiles, windows, cupboards, sinks, showers, shower plastified curtains, wash basins, WCs, fixtures and fittings and the like made of different materials like ceramic, vinyl, no-wax vinyl, linoleum, melamine, glass, Inox®, Formica®, any plastics, plastified wood, metal or any painted or varnished or sealed surface and the like.  
25 Household hard surfaces also include household appliances including, but not limited to refrigerators, freezers, washing machines, automatic dryers, ovens, microwave ovens, dishwashers and so on. Such hard surfaces may be found both in private households as well as in commercial, institutional and industrial environments.

30 By "dish surfaces" it is meant herein any kind of surfaces found in dish cleaning, such as dishes, cutlery, cutting boards, pans, and the like. Such dish surfaces may be found both in private households as well as in commercial, institutional and industrial environments.

By "abrasive foam particles" it is meant herein that the abrasive particles are derived from fragmenting a foam structure into non-spherical and/or non-rolling particles.

5 In another preferred embodiment, the compositions herein are suitable for cleaning/cleansing animate surfaces selected from the group consisting of human skin; animal skin; human hair; animal hair; and teeth.

The compositions according to the present invention are liquid compositions as opposed to a solid or a gas. Liquid compositions include compositions having a water-like viscosity as well as  
10 thickened compositions, such as gels and pastes.

In a preferred embodiment herein, the liquid compositions herein are aqueous compositions. Therefore, they may comprise from 65% to 99.5% by weight of the total composition of water, preferably from 75% to 98% and more preferably from 80% to 95%.

15 In another preferred embodiment herein, the liquid compositions herein are mostly non-aqueous compositions although they may comprise from 0% to 10% by weight of the total composition of water, preferably from 0% to 5%, more preferably from 0% to 1% and most preferably 0% by weight of the total composition of water.

20 In a preferred embodiment herein, the compositions herein are neutral compositions, and thus have a pH, as is measured at 25°C, of 6 - 8, more preferably 6.5 - 7.5, even more preferably 7.

In other preferred embodiment compositions have pH preferably above pH 4 and alternatively  
25 have pH preferably below pH 9.

Accordingly, the compositions herein may comprise suitable bases and acids to adjust the pH.

A suitable base to be used herein is an organic and/or inorganic base. Suitable bases for use  
30 herein are the caustic alkalis, such as sodium hydroxide, potassium hydroxide and/or lithium hydroxide, and/or the alkali metal oxides such, as sodium and/or potassium oxide or mixtures thereof. A preferred base is a caustic alkali, more preferably sodium hydroxide and/or potassium hydroxide.

Other suitable bases include ammonia, ammonium carbonate, all available carbonate salts such as  $K_2CO_3$ ,  $Na_2CO_3$ ,  $CaCO_3$ ,  $MgCO_3$ , etc., alkanolamines (as e.g. monoethanolamine), urea and urea derivatives, polyamine, etc.

5

Typical levels of such bases, when present, are of from 0.01% to 5.0% by weight of the total composition, preferably from 0.05% to 3.0% and more preferably from 0.1% to 0.6 %.

The compositions herein may comprise an acid to trim its pH to the required level, despite the presence of an acid, if any, the compositions herein will maintain their preferably neutral pH as described herein above. A suitable acid for use herein is an organic and/or an inorganic acid. A preferred organic acid for use herein has a pKa of less than 6. A suitable organic acid is selected from the group consisting of citric acid, lactic acid, glycolic acid, succinic acid, glutaric acid and adipic acid and a mixture thereof. A mixture of said acids may be commercially available from BASF under the trade name Sokalan® DCS. A suitable inorganic acid is selected from the group consisting hydrochloric acid, sulphuric acid, phosphoric acid and a mixture thereof.

15

A typical level of such an acid, when present, is of from 0.01% to 5.0% by weight of the total composition, preferably from 0.04% to 3.0% and more preferably from 0.05% to 1.5 %.

20

In a preferred embodiment according to the present invention the compositions herein are thickened compositions. Preferably, the liquid compositions herein have a viscosity of up to 7500 cps at  $20\text{ s}^{-1}$ , more preferably from 5000 cps to 50 cps, yet more preferably from 2000 cps to 50 cps and most preferably from 1500 cps to 300 cps at  $20\text{ s}^{-1}$  and  $20^\circ\text{C}$  when measured with a Rheometer, model AR 1000 (Supplied by TA Instruments) with a 4 cm conic spindle in stainless steel,  $2^\circ$  angle (linear increment from 0.1 to  $100\text{ sec}^{-1}$  in max. 8 minutes).

25

In another preferred embodiment according to the present invention the compositions herein have a water-like viscosity. By “water-like viscosity” it is meant herein a viscosity that is close to that of water. Preferably the liquid compositions herein have a viscosity of up to 50 cps at 60 rpm, more preferably from 0 cps to 30 cps, yet more preferably from 0 cps to 20 cps and most preferably from 0 cps to 10 cps at 60 rpm and  $20^\circ\text{C}$  when measured with a Brookfield digital viscometer model DV II, with spindle 2.

30

Abrasive cleaning particles

The liquid cleaning and/or cleansing composition herein comprise abrasive cleaning particles that are selected or synthesized to feature very effective shapes, e.g. defined by macroshape and mesoshape descriptors whereas effective shape of particles are obtained by reducing a foam material into particles.

5 The applicant has found that non-spherical and/or non-rolling (sharp) abrasive cleaning particles provide good soil removal and low surface damage. The applicant has found that very specific particle shapes can be obtained from foam structures and incidentally, the shape of the resulting particles promote effective sliding of the abrasive particles vs. more typical abrasive particles e.g. produced from un-foamed material where rolling movement is rather promoted and is less effective in displacing soil from the surface. Therefore it is the object of this invention to  
10 synthesize and select carefully the abrasive accordingly to its shape and especially, it is the object of this invention to describe the foam structure and the process to reduce foam into efficient particles.

The applicant has found that non-rolling and sharp abrasive cleaning particles provide good soil removal and low surface damage. Indeed the applicant has found that very specific particle  
15 shapes, e.g. defined by circularity, promote effective sliding of the abrasive particles vs. typical abrasive particles, where rolling movement is rather promoted and which are less effective in displacing soil from the surface.

Additionally, the abrasive particles have preferably a multitude of sharp edges which are typical  
20 features of particles produced from foam structures defined by the present invention. The sharp edges of the non-spherical particles are defined by edges having a tip radius below 20  $\mu\text{m}$ , preferably below 8  $\mu\text{m}$ , most preferably from 5  $\mu\text{m}$  to 0.5  $\mu\text{m}$ . The tip radius is defined by the diameter of an imaginary circle fitting the curvature of the edge extremity. The applicant has found that particles obtained from grinding foams typically feature particles with sharp edges  
25 that are the result of the foaming process. Blowing agents, either gas or volatilized solvent optionally with/without addition of tensioactifs or polymeric agents, help during the foaming process to sharpen the foam material edges (or struts) owing to the curvature of the expanding bubble.



Figure 1. is an illustration of tip radius.

The abrasive particles are composed of the same foam material from which they are produced. Incidentally, the abrasive material may be produced from a thermoplastic material having a raw material density of greater than 1.15, preferably greater than 1.20, more preferably greater than 1.22, even more preferably greater than 1.24, and a foam coefficient of expansion of from 8 to 14, preferably from 9 to 12, more preferably from 9.5 to 11, as measured according to the method described herein. It has been surprisingly found that particles generated from such foam, particularly when the thermoplastic material is a biodegradable thermoplastic as described below, meet the required mechanical strength properties to provide excellent cleaning. A lower foam expansion range e.g.: typically below 8, typically will lead to produce after grinding the foam, un-effective rolling particles inherently to the low cell structuring, low open-cell character of the produced foam. On the contrary, an excessive foam expansion e.g.: typically above 14 leads to create a high foam structure, possibly with some degree of open-cell, but the excessive stretching and thinning of the foam vertex and membrane. The particles that are derived from excessively expanded foam are mechanically too fragile to perform as effective abrasive and in practice, bend or break in contact to the soil during the cleaning process. This is also the case when using a thermoplastic with excessively low material density e.g.: 1.15 which impacts significantly the mechanical performance.

Preferably thermoplastic material comprises, preferably consists of, a biodegradable thermoplastic material selected from the group consisting of biodegradable polyesters preferably selected from the group consisting of polyhydroxy-alkanoates preferably selected from polyhydroxyButyrate, polyhydroxyButyrate-co-valerate, polyhydroxyButyrate-co-hexanoate polyhydroxyButyrate-co-octanoate, and mixtures thereof, poly(lactic acid), poly(glycolic acid), polycaprolactone, polyesteramide, aliphatic copolyesters, aromatic copolyesters, and mixtures thereof; thermoplastic starch; cellulose esters particularly cellulose acetate and/or nitrocellulose and their derivatives; and mixtures thereof; preferably a blend of a biodegradable polyester and a thermoplastic starch.

In a highly preferred embodiment the thermoplastic material consists of a biodegradable thermoplastic material selected from biodegradable petroleum-based polyesters preferably selected from the group consisting of polycaprolactone, polyesteramide, aliphatic copolyesters, aromatic copolyesters, and mixtures thereof; thermoplastic starch; cellulose esters particularly

cellulose acetate and/or nitrocellulose and their derivatives; and mixtures thereof; preferably a blend of biodegradable petroleum-based polyester and a thermoplastic starch, preferably a blend of polycaprolactone and a thermoplastic starch. Particles derived from such materials have been found to provide the required cleaning and surface safety performance as well as excellent biodegradation into the environment.

In an embodiment, the foaming material is used with or without filler. However, it is preferred for the foaming material to comprise a plurality of filler particles.

Foaming processes and foam structures are typically achieved via a gas expansion process, e.g.: either by injecting gas or solvent within the abrasive precursor and allowing expansion by pressure drop and/or increase of temperature, e.g.: extrusion foaming process. In that case, thermoplastic material in a form of pure polymer or polymer blend or plasticized polymers etc. are usually used. Typical examples of alternative thermoplastic polymers can be found in extrusion foaming or gas foaming literature (for examples see the books “Thermoplastic Foam Extrusion” by James L. Throne or “Foam Extrusion: Principles and Practice by Shau-Tarng Lee). Typical gases used in such processes are air, nitrogen, carbon dioxide or organic solvents such as pentane, cyclopentane, etc with or without inclusion of nucleation and foam stabilizing agents. In most cases, a controlled amount of gas is allowed to dissolve into the polymer / polymeric mix into in melted phase whereas the skilled operator can control accurately the foaming parameters e.g.: formulation, time/temperature/pressure cycle parameters to target specific foam structures.

Particularly preferred foaming processes and foam structures are also typically achieved by simultaneous polymerization, with or without crosslinking of monomers, coupled with in-situ production of expanding gas.

The applicant has found that efficacious and safe cleaning particles can be produced from foams with very specific structural parameters as described below. Indeed the applicant has found that the structure of the foam allows the shape parameters of the cleaning particles to be controlled and the applicant has demonstrated that the particle shape parameters greatly impact the cleaning performance of the particles. It is understood that the foam structural parameters described below have a direct impact on the desired particle shape after grinding of the foam into abrasive particles; hence the accurate control of the foam structure is a preferred and convenient means to synthesized efficient abrasive particles.

*Foam cell size:*

Similarly, the applicant has found that a good cleaning effect can be achieved with abrasive particles which have been made from foams featuring cell sizes ranging from 20 micrometers to 2000 micrometers. However the applicant has surprisingly found that a significantly better cleaning effect can be achieved with foams featuring cell sizes between 100-1000 micrometers, more preferably from 200 to 500 micrometers and most preferably from 300 to 450 micrometers. Foam cell size can be measured for instance using the protocol described in ASTM D3576.

*Foam closed cell content:*

Similarly, the applicant has found that a good cleaning effect can be achieved with abrasive particles which have been made from foams featuring close-cell structures. However, the applicant has surprisingly found that a significantly better cleaning effect can be achieved with abrasive cleaning particles, which have been reduces into particles from foams with open-cell structure. An open-cell foam structure presents the opportunity to form well defined sharp struts, which in turn produce effective abrasive particles. On the contrary, the presence of closed cells, wherein each cell is closed by foam material extending from each strut into a membrane-like material, produce after grinding into abrasive particles an abrasive population that contains a fraction of flat-shaped residue. This flat-shaped residue is not providing effective cleaning performance, and therefore, is undesirable feature. The shape of this flat-shaped residue is sub-optimal to deliver cleaning. Additionally, these membranes are inherently very fragile and are easily broken into significantly small particles, including undesirable dust, with sizes ranging from several hundred micrometers to sub-micrometer sizes during the grinding of the foam and also during use in the cleaning process. The applicant has found that foam structures with less than 50%, preferably less than 30%, and most preferably less than 15% of closed cells are desirable in producing effective abrasive cleaning particles.

*Foam strut aspect ratio:*

Similarly, the applicant has found that a good cleaning effect can be achieved with abrasive particles which have been made from the foams featuring struts with high aspect ratios. By struts, the applicant defines the elongated material that interconnect to form the cellular structure of the foam, which is best described as a pentagonal dodecahedron structure for the foams with density typically between 5 and 50 kg/m<sup>3</sup> targeted herein. The strut length (L) is typically counted as the distance between the geometrical centers of 2 interconnecting knots. The struts

thickness (T) is typically the projected strut thickness at the middle of the strut length. The applicant has understood that particles that are derived from foam presenting struts with excessively small L/T ratio present sub-optimal shapes for cleaning since likely to produce rounder particles that readily roll. On the contrary, the particles that are derived from foam presenting struts with excessively high L/T ratio also present sub-optimal shape for cleaning since they are likely to produce excessive amount of rod-like particles featuring low soil removal. Incidentally, the applicant has surprisingly found that significantly better cleaning effect can be achieved with struts having an L/T ratio ranging from 1.5 to 10, preferably from 2.0 to 8.0 and more preferably from 3.0 to 6.0 and most preferred from 3.5 to 4.5 as defined by Visiocell software.

Figure 2 Pentagonal dodecahedron structure with struts length (L) and thickness (T)

In a preferred embodiment, in order to favor the reduction of the foam into particles, the foam is sufficiently brittle, i.e. upon stress, the foam has little tendency to deform but rather will break into particles.

Efficient cleaning particles are therefore produced by grinding the foam structure with special care to target size and shape. Hence for instance, when large particle size is desired, foam with large cell size is desirable and vice-et-versa. Additionally, in order to preserve an optimal particle shape while grinding the foam structure, it is recommended to not target particle size excessively below the dimension of the cell size of the foam. Typically, the applicant recommends targeting particle size not below about half of the foam cell size. The applicant has found that excessive particle reduction e.g.: vis-à-vis the original foam structure and especially vis-à-vis the cell size yields rounder particles with sub-optimal cleaning efficiency.

In practice, the process to reduce the foam into particle population is set such as the amount of particles with size below half of the average foam cell size is below 30% by weight, preferably below 20% more preferably below 10% and most preferably no particles are detected, whereas the particle size weight proportion is defined by physical sieving method. Note: In order to proceed to the separation of the particles based on size related to half of the average foam cell size, a tolerance of 10% is accepted for the selection of the sieving mesh vis-à-vis the theoretical target sieving grid. The selected sieving mesh tolerance is valid for smaller available sieving mesh vs. the theoretical target size.

One suitable way of reducing the foam to the abrasive cleaning particles herein is to grind or mill the foam. Other suitable means include the use of eroding tools such as a high speed eroding wheel with dust collector wherein the surface of the wheel is engraved with a pattern or is coated with abrasive sandpaper or the like to promote the foam to form the abrasive cleaning particles herein.

Alternatively and in a highly preferred embodiment herein, the foam may be reduced to particles in several stages. First the bulk foam can be broken into pieces of a few cm dimensions by manually chopping or cutting, or using a mechanical tool such as a lumpbreaker, for example the Model 2036 from S Howes, Inc. of Silver Creek, NY.

In a highly preferred embodiment herein, in order to achieve the geometrical shape descriptors of the abrasive cleaning particles (i.e. solidity, circularity and/or roughness) the abrasive cleaning particles are obtained from foamed polymeric material, which is reduced into the abrasive particles preferably by grinding or milling as described herein later on.

Hardness of the abrasive particles:

Preferred abrasive cleaning particles suitable for used herein are hard enough to provide good cleaning/cleansing performance, whilst providing a good surface safety profile.

The hardness of the abrasive particles reduced from the foam can be modified by changing the raw material used to prepare the foam.

Preferred abrasive cleaning particles in the present invention have hardness from 3 to 50 kg/mm<sup>2</sup>, preferably from 4 to 25 kg/mm<sup>2</sup> and most preferably from 5 to 15 kg/mm<sup>2</sup> on the HV Vickers hardness.

Vickers Hardness test method:

Vickers hardness HV is measured at 23 °C according to standard methods ISO 14577-1, ISO 14577-2, ISO 14577-3. The Vickers hardness is measured from a solid block of the raw material at least 2 mm in thickness. The Vickers hardness micro indentation measurement is carried out by using the Micro-Hardness Tester (MHT), manufactured by CSM Instruments SA, Peseux, Switzerland.

As per the ISO 14577 instructions, the test surface should be flat and smooth, having a roughness (Ra) value less than 5% of the maximum indenter penetration depth. For a 200  $\mu\text{m}$  maximum depth this equates to a Ra value less than 10  $\mu\text{m}$ . As per ISO 14577, such a surface may be prepared by any suitable means, which may include cutting the block of test material with a new sharp microtome or scalpel blade, grinding, polishing or by casting melted material onto a flat, smooth casting form and allowing it to thoroughly solidify prior testing.

Suitable general settings for the Micro-Hardness Tester (MHT) are as follows:

Control mode: Displacement, Continuous

Maximum displacement: 200  $\mu\text{m}$

Approach speed: 20 nm/s

Zero point determination: at contact

Hold period to measure thermal drift at contact: 60s

Force application time: 30s

Frequency of data logging: at least every second

Hold time at maximum force: 30s

Force removal time: 30s

Shape / Material of indenter tip: Vickers Pyramid Shape / Diamond Tip

Alternatively, the abrasive cleaning particles in the present invention hardness may also expressed accordingly to the MOHS hardness scale. Preferably, the MOHS hardness is comprised between 0.5 and 3.5 and most preferably between 1 and 3. The MOHS hardness scale is an internationally recognized scale for measuring the hardness of a compound versus a compound of known hardness, see Encyclopedia of Chemical Technology, Kirk-Othmer, 4<sup>th</sup> Edition Vol 1, page 18 or Lide, D.R (ed) CRC Handbook of Chemistry and Physics, 73<sup>rd</sup> edition, Boca Raton, Fla.: The Rubber Company, 1992-1993. Many MOHS Test kits are commercially available containing material with known MOHS hardness. For measurement and selection of abrasive material with selected MOHS hardness, it is recommended to execute the MOHS hardness measurement with un-shaped particles e.g.: with spherical or granular forms of the abrasive material since MOHS measurement of shape particles will provide erroneous results.

In order to control that the foam-derived particles feature effective shape, it is useful in the present invention to define shape method and critical shape target parameters

5 The shape of the abrasive cleaning particle can be defined in many ways. The present invention defines cleaning particle shape in a form of particle, which reflects the geometrical proportions of a particle and more pragmatically of a particles population. Very recent analytical techniques allow an accurate simultaneous measurement of particle shape from a large number of particles, typically greater than 1000 particles (preferably above 100 00). This enables accurate tuning and/or selection of average particle population shape with discriminative performance. These  
10 measurements analyse of particle shape are conducted using Occhio Nano 500 Particle Characterisation Instrument with its accompanying software Callistro version 25 (Occhio s.a. Liege, Belgium). This instrument is used to prepare, disperse, image and analyse the particle samples, as per manufacturer's instructions, and the following instrument setting selections: White Requested = 180, vacuum time = 5000ms, sedimentation time = 5000ms, automatic  
15 threshold, number of particles counted/analyses = 8000 to 500000, minimum number of replicates/sample = 3, lens setting 1x/1.5x.

The applicant has considered although that the shape of particle of significant size play a critical role so in practice, the shape parameter are measured as mean shape of a particle population after  
20 exclusion of particles with size lower than 10 micrometers. Exclusion can be done either physically with help of sieve or preferably electronically via statistic filtering of particles with size diameter e.g.: "Area diameter" (the value of the diameter of a disc that has the same area A as the particle), below 10micrometers (cf. ISO 9276-6:2008(E) section 7)

25 In the present invention shape descriptors are calculations of geometrical descriptors/shape factors. Geometrical shape factors are ratios between two different geometrical properties, such properties are usually a measure of proportions of the image of the whole particle or a measure of the proportions of an ideal geometrical body enveloping the particle or forms an envelope around the particle. These results are macroshape descriptors similar to aspect ratio, however the  
30 Applicant has discovered that mesoshape descriptors - a specific sub-class of macroshape descriptor- are particularly critical to the cleaning effectiveness and surface safety performances of the abrasive cleaning particles, while more typical shape parameters such as aspect ratio was proved insufficient. These mesoshape descriptors are a great help in defining how different a particle is compared to an ideal geometrical shape, especially how different compared to a

sphere, and incidentally help define its ability for non-rolling, e.g.: sliding, effective cleaning movement pattern. The abrasive cleaning particles of the present invention are different from typical spherical or spherical-resembling e.g.: granular, abrasives forms. A good indicator of non-spherical e.g.: non-rolling particle can be the circularity descriptor as defined in ISO 9276-6:2008 wherein particle population with mean circularity below 0.75, preferably below 0.6 are typically non-rolling particles.

Preferably, the non-spherical particles herein have a multitude of sharp edges. The sharp edges of the non-spherical particles are defined by edge having a tip radius below 20  $\mu\text{m}$ , preferably below 8  $\mu\text{m}$ , most preferably below 5  $\mu\text{m}$ . The tip radius is defined by the diameter of an imaginary circle fitting the curvature of the edge extremity.

In a preferred embodiment, the abrasive cleaning particles have a mean ECD from 10  $\mu\text{m}$  to 1000  $\mu\text{m}$ , preferably from 50  $\mu\text{m}$  to 500  $\mu\text{m}$ , more preferably from 100  $\mu\text{m}$  to 350  $\mu\text{m}$  and most preferably from 150 to 250  $\mu\text{m}$ .

Indeed, the Applicant has found that the abrasive particle size can be critical to achieve efficient cleaning performance whereas excessively abrasive population with small particle sizes e.g.: typically below 10 microns feature polishing action vs. cleaning despite featuring a high number of particles per particle load in cleaner inherent to the small particle size. On the other hand, abrasive population with excessively high particle size, e.g.: typically above 1000 micrometers, delivers not optimal cleaning efficiency since the number of particles per particle load in cleaner decreases significantly inherently to the large particle size. Additionally, excessively small particle size are not desirable in cleaner / for cleaning task since in practice, small and numerous particles are often hard to remove from the various surface topologies which requires excessive effort to remove from the user unless leaving the surface with visible particles residue. On the other hand, excessively large particle are too easily detected visually or provide bad tactile experience while handling or using the cleaner. Therefore, the applicant defines herein an optimal particle size range that deliver both optimal cleaning performance and usage experience.

The abrasive particles have size defined by their area-equivalent diameter (9276-6:2008(E) section 7) also called Equivalent Circle Diameter ECD (ASTM F1877-05 Section 11.3.2). Mean ECD of particle population is calculated as the average of respective ECD of each particles of a particle population of at least 10 000 particles, preferably above 50 000 particles, more



preferably above 100 000 particles after excluding from the measurement and calculation the data of particles having area-equivalent diameter (ECD) of below 10 microns. Mean data are extracted from volume-based vs. number-based measurements.

5 In one preferred example, the size of the abrasive cleaning particles used in the present invention is modified during usage especially undergoing significant size reduction. Hence the particle remain visible or tactile detectable in liquid composition and at the start of the usage process to provide effective cleaning. As the cleaning process progresses, the abrasive particles disperse or break into smaller particles and become invisible to an eye or tactile undetectable.

10

It has surprisingly been found that the abrasive cleaning particles of the present invention show a good cleaning performance even at relatively low levels, such as preferably from 0.1% to 20% by weight of the total composition, preferably from 0.1% to 10%, more preferably from 0.5% to 5%, even more preferably from 1.0% to 3%, by weight of the total composition of said abrasive  
15 cleaning particles.

15

The particles used in the present invention can be white, transparent or colored by use of suitable dyes and/or pigments. Additionally suitable color stabilizing agents can be used to stabilize desired color. The abrasive particles are preferable color stable particles. By “color stable” it is  
20 meant herein that color of the particles used in the present invention will not turn yellow during storage and use.

20

In one preferred example, the abrasive cleaning particles used in the present invention remain visible when liquid composition is stored into a bottle while during the effective cleaning process  
25 abrasive particles disperse or break into smaller particles and become invisible to an eye.

25

#### Optional ingredients

The compositions according to the present invention may comprise a variety of optional ingredients depending on the technical benefit aimed for and the surface treated.

30

Suitable optional ingredients for use herein include chelating agents, surfactants, radical scavengers, perfumes, surface-modifying polymers, solvents, builders, buffers, bactericides, hydrotropes, colorants, stabilizers, bleaches, bleach activators, suds controlling agents like fatty

acids, enzymes, soil suspenders, brighteners, anti dusting agents, dispersants, pigments, and dyes.

#### Suspending aid

5 The abrasive cleaning particles present in the composition herein are solid particles in a liquid composition. Said abrasive cleaning particles may be suspended in the liquid composition. However, it is well within the scope of the present invention that such abrasive cleaning particles are not-stably suspended within the composition and either settle or float on top of the composition. In this case, a user may have to temporally suspend the abrasive cleaning particles  
10 by agitating (e.g., shaking or stirring) the composition prior to use.

However, it is preferred herein that the abrasive cleaning particles are stably suspended in the liquid compositions herein. Thus the compositions herein comprise a suspending aid.

15 The suspending aid herein may either be a compound specifically chosen to provide a suspension of the abrasive cleaning particles in the liquid compositions of the present invention, such as a structurant, or a compound that also provides another function, such as a thickener or a surfactant (as described herein elsewhere).

20 Any suitable organic and inorganic suspending aids typically used as gelling, thickening or suspending agents in cleaning/cleansing compositions and other detergent or cosmetic compositions may be used herein. Indeed, suitable organic suspending aids include polysaccharide polymers. In addition or as an alternative, polycarboxylate polymer thickeners may be used herein. Also, in addition or as an alternative of the above, layered silicate platelets  
25 e.g.: Hectorite, bentonite or montmorillonites can also be used. Suitable commercially available layered silicates are Laponite RD® or Optigel CL® available from Rockwood Additives.

Suitable polycarboxylate polymer thickeners include (preferably lightly) crosslinked polyacrylate. A particularly suitable polycarboxylate polymer thickeners is Carbopol  
30 commercially available from Lubrizol under the trade name Carbopol 674®.

Suitable polysaccharide polymers for use herein include substituted cellulose materials like carboxymethylcellulose, ethyl cellulose, hydroxyethyl cellulose, hydroxypropyl cellulose, hydroxymethyl cellulose, succinoglycan and naturally occurring polysaccharide polymers like

Xanthan gum, gellan gum, guar gum, locust bean gum, tragacanth gum, succinoglucan gum, or derivatives thereof, or mixtures thereof. Xanthan gum is commercially available from Kelco under the tradename Kelzan T.

5 Preferably the suspending aid herein is Xanthan gum. In an alternative embodiment, the suspending aid herein is a polycarboxylate polymer thickeners preferably a (preferably lightly) crosslinked polyacrylate. In a highly preferred embodiment herein, the liquid compositions comprise a combination of a polysaccharide polymer or a mixture thereof, preferably Xanthan gum, with a polycarboxylate polymer or a mixture thereof, preferably a crosslinked polyacrylate.

10 As a preferred example, Xanthan gum is preferably present at levels between 0.1% to 5% by weight of the total composition, more preferably from 0.5% to 2%, even more preferably from 0.8% to 1.2%.

#### 15 Organic Solvent

As an optional but highly preferred ingredient the composition herein comprises an organic solvents or mixtures thereof.

20 The compositions herein comprise from 0% to 30% by weight of the total composition of an organic solvent or a mixture thereof, more preferably 1.0% to 20% and most preferably, 2% to 15%.

25 Suitable solvents can be selected from the group consisting of: aliphatic alcohols, ethers and diethers having from 4 to 14 carbon atoms, preferably from 6 to 12 carbon atoms, and more preferably from 8 to 10 carbon atoms; glycols or alkoxyated glycols; glycol ethers; alkoxyated aromatic alcohols; aromatic alcohols; terpenes; and mixtures thereof. Aliphatic alcohols and glycol ether solvents are most preferred.

30 Aliphatic alcohols, of the formula R-OH wherein R is a linear or branched, saturated or unsaturated alkyl group of from 1 to 20 carbon atoms, preferably from 2 to 15 and more preferably from 5 to 12, are suitable solvents. Suitable aliphatic alcohols are methanol, ethanol, propanol, isopropanol or mixtures thereof. Among aliphatic alcohols, ethanol and isopropanol are most preferred because of their high vapour pressure and tendency to leave no residue.

Suitable glycols to be used herein are according to the formula  $\text{HO-CR}_1\text{R}_2\text{-OH}$  wherein  $\text{R}_1$  and  $\text{R}_2$  are independently H or a  $\text{C}_2\text{-C}_{10}$  saturated or unsaturated aliphatic hydrocarbon chain and/or cyclic. Suitable glycols to be used herein are dodecaneglycol and/or propanediol.

5 In one preferred embodiment, at least one glycol ether solvent is incorporated in the compositions of the present invention. Particularly preferred glycol ethers have a terminal  $\text{C}_3\text{-C}_6$  hydrocarbon attached to from one to three ethylene glycol or propylene glycol moieties to provide the appropriate degree of hydrophobicity and, preferably, surface activity. Examples of commercially available solvents based on ethylene glycol chemistry include mono-ethylene  
10 glycol n-hexyl ether (Hexyl Cellosolve®) available from Dow Chemical. Examples of commercially available solvents based on propylene glycol chemistry include the di-, and tri-propylene glycol derivatives of propyl and butyl alcohol, which are available from Arco under the trade names Arcosolv® and Dowanol®.

15 In the context of the present invention, preferred solvents are selected from the group consisting of mono-propylene glycol mono-propyl ether, di-propylene glycol mono-propyl ether, mono-propylene glycol mono-butyl ether, di-propylene glycol mono-propyl ether, di-propylene glycol mono-butyl ether; tri-propylene glycol mono-butyl ether; ethylene glycol mono-butyl ether; di-ethylene glycol mono-butyl ether, ethylene glycol mono-hexyl ether and di-ethylene glycol  
20 mono-hexyl ether, and mixtures thereof. "Butyl" includes normal butyl, isobutyl and tertiary butyl groups. Mono-propylene glycol and mono-propylene glycol mono-butyl ether are the most preferred cleaning solvent and are available under the tradenames Dowanol DPnP® and Dowanol DPnB®. Di-propylene glycol mono-t-butyl ether is commercially available from Arco Chemical under the tradename Arcosolv PTB®.

25

In a particularly preferred embodiment, the cleaning solvent is purified so as to minimize impurities. Such impurities include aldehydes, dimers, trimers, oligomers and other by-products. These have been found to deleteriously affect product odour, perfume solubility and end result. The inventors have also found that common commercial solvents, which contain low levels of  
30 aldehydes, can cause irreversible and irreparable yellowing of certain surfaces. By purifying the cleaning solvents so as to minimize or eliminate such impurities, surface damage is attenuated or eliminated.

Though not preferred, terpenes can be used in the present invention. Suitable terpenes to be used herein monocyclic terpenes, dicyclic terpenes and/or acyclic terpenes. Suitable terpenes are: D-limonene; pinene; pine oil; terpinene; terpene derivatives as menthol, terpineol, geraniol, thymol; and the citronella or citronellol types of ingredients.

5

Suitable alkoxyated aromatic alcohols to be used herein are according to the formula  $R-(A)_n-OH$  wherein R is an alkyl substituted or non-alkyl substituted aryl group of from 1 to 20 carbon atoms, preferably from 2 to 15 and more preferably from 2 to 10, wherein A is an alkoxy group preferably butoxy, propoxy and/or ethoxy, and n is an integer of from 1 to 5, preferably 1 to 2.

10 Suitable alkoxyated aromatic alcohols are benzoxyethanol and/or benzoxypropanol.

Suitable aromatic alcohols to be used herein are according to the formula  $R-OH$  wherein R is an alkyl substituted or non-alkyl substituted aryl group of from 1 to 20 carbon atoms, preferably from 1 to 15 and more preferably from 1 to 10. For example a suitable aromatic alcohol to be

15

#### Surfactants

The compositions herein may comprise a nonionic, anionic, zwitterionic, cationic and amphoteric surfactant or mixtures thereof. Suitable surfactants are those selected from the group

20 consisting of nonionic, anionic, zwitterionic, cationic and amphoteric surfactants, having hydrophobic chains containing from 8 to 18 carbon atoms. Examples of suitable surfactants are described in McCutcheon's Vol. 1: Emulsifiers and Detergents, North American Ed., McCutcheon Division, MC Publishing Co., 2002.

25 Preferably, the composition herein comprises from 0.01% to 20% by weight of the total composition of a surfactant or a mixture thereof, more preferably from 0.5% to 10%, and most preferably from 1% to 5%.

Non-ionic surfactants are highly preferred for use in the compositions of the present invention.

30 Non-limiting examples of suitable non-ionic surfactants include alcohol alkoxyates, alkyl polysaccharides, amine oxides, block copolymers of ethylene oxide and propylene oxide, fluoro surfactants and silicon based surfactants. Preferably, the aqueous compositions comprise from

0.01% to 20% by weight of the total composition of a non-ionic surfactant or a mixture thereof, more preferably from 0.5% to 10%, and most preferably from 1% to 5%.

A preferred class of non-ionic surfactants suitable for the present invention is alkyl ethoxylates.

5 The alkyl ethoxylates of the present invention are either linear or branched, and contain from 8 carbon atoms to 16 carbon atoms in the hydrophobic tail, and from 3 ethylene oxide units to 25 ethylene oxide units in the hydrophilic head group. Examples of alkyl ethoxylates include Neodol 91-6<sup>®</sup>, Neodol 91-8<sup>®</sup> supplied by the Shell Corporation (P.O. Box 2463, 1 Shell Plaza, Houston, Texas), and Alfonic 810-60<sup>®</sup> supplied by Condea Corporation, (900 Threadneedle  
10 P.O. Box 19029, Houston, TX). More preferred alkyl ethoxylates comprise from 9 to 12 carbon atoms in the hydrophobic tail, and from 4 to 9 oxide units in the hydrophilic head group. A most preferred alkyl ethoxylate is C<sub>9-11</sub> EO<sub>5</sub>, available from the Shell Chemical Company under the tradename Neodol 91-5<sup>®</sup>. Non-ionic ethoxylates can also be derived from branched alcohols. For example, alcohols can be made from branched olefin feedstocks such as propylene or  
15 butylene. In a preferred embodiment, the branched alcohol is either a 2-propyl-1-heptyl alcohol or 2-butyl-1-octyl alcohol. A desirable branched alcohol ethoxylate is 2-propyl-1-heptyl EO7/AO7, manufactured and sold by BASF Corporation under the tradename Lutensol XP 79 /XL 79<sup>®</sup>.

20 Another class of non-ionic surfactant suitable for the present invention is alkyl polysaccharides. Such surfactants are disclosed in U.S. Patent Nos. 4,565,647, 5,776,872, 5,883,062, and 5,906,973. Among alkyl polysaccharides, alkyl polyglycosides comprising five and/or six carbon sugar rings are preferred, those comprising six carbon sugar rings are more preferred, and those wherein the six carbon sugar ring is derived from glucose, i.e., alkyl polyglucosides ("APG"),  
25 are most preferred. The alkyl substituent in the APG chain length is preferably a saturated or unsaturated alkyl moiety containing from 8 to 16 carbon atoms, with an average chain length of 10 carbon atoms. C<sub>8</sub>-C<sub>16</sub> alkyl polyglucosides are commercially available from several suppliers (e.g., Simusol<sup>®</sup> surfactants from Seppic Corporation, 75 Quai d'Orsay, 75321 Paris, Cedex 7, France, and Glucopon 220<sup>®</sup>, Glucopon 225<sup>®</sup>, Glucopon 425<sup>®</sup>, Plantaren 2000 N<sup>®</sup>, and  
30 Plantaren 2000 N UP<sup>®</sup>, from Cognis Corporation, Postfach 13 01 64, D 40551, Dusseldorf, Germany).

Another class of non-ionic surfactant suitable for the present invention is amine oxide. Amine oxides, particularly those comprising from 10 carbon atoms to 16 carbon atoms in the hydrophobic tail, are beneficial because of their strong cleaning profile and effectiveness even at levels below 0.10%. Additionally C<sub>10-16</sub> amine oxides, especially C<sub>12-14</sub> amine oxides are excellent solubilizers of perfume. Alternative non-ionic detergent surfactants for use herein are alkoxyated alcohols generally comprising from 8 to 16 carbon atoms in the hydrophobic alkyl chain of the alcohol. Typical alkoxylation groups are propoxy groups or ethoxy groups in combination with propoxy groups, yielding alkyl ethoxy propoxylates. Such compounds are commercially available under the tradename Antarox<sup>®</sup> available from Rhodia (40 Rue de la Haie-Coq F-93306, Aubervilliers Cédex, France) and under the tradename Nonidet<sup>®</sup> available from Shell Chemical.

The condensation products of ethylene oxide with a hydrophobic base formed by the condensation of propylene oxide with propylene glycol are also suitable for use herein. The hydrophobic portion of these compounds will preferably have a molecular weight of from 1500 to 1800 and will exhibit water insolubility. The addition of polyoxyethylene moieties to this hydrophobic portion tends to increase the water solubility of the molecule as a whole, and the liquid character of the product is retained up to the point where the polyoxyethylene content is about 50% of the total weight of the condensation product, which corresponds to condensation with up to 40 moles of ethylene oxide. Examples of compounds of this type include certain of the commercially available Pluronic<sup>®</sup> surfactants, marketed by BASF. Chemically, such surfactants have the structure (EO)<sub>x</sub>(PO)<sub>y</sub>(EO)<sub>z</sub> or (PO)<sub>x</sub>(EO)<sub>y</sub>(PO)<sub>z</sub> wherein x, y, and z are from 1 to 100, preferably 3 to 50. Pluronic<sup>®</sup> surfactants known to be good wetting surfactants are more preferred. A description of the Pluronic<sup>®</sup> surfactants, and properties thereof, including wetting properties, can be found in the brochure entitled "BASF Performance Chemicals Plutonic<sup>®</sup> & Tetronic<sup>®</sup> Surfactants", available from BASF.

Other suitable though not preferred non-ionic surfactants include the polyethylene oxide condensates of alkyl phenols, e.g., the condensation products of alkyl phenols having an alkyl group containing from 6 to 12 carbon atoms in either a straight chain or branched chain configuration, with ethylene oxide, the said ethylene oxide being present in amounts equal to 5 to 25 moles of ethylene oxide per mole of alkyl phenol. The alkyl substituent in such compounds can be derived from oligomerized propylene, diisobutylene, or from other sources of *iso*-octane

*n*-octane, *iso*-nonane or *n*-nonane. Other non-ionic surfactants that can be used include those derived from natural sources such as sugars and include C<sub>8</sub>-C<sub>16</sub> N-alkyl glucose amide surfactants.

- 5     Suitable anionic surfactants for use herein are all those commonly known by those skilled in the art. Preferably, the anionic surfactants for use herein include alkyl sulphonates, alkyl aryl sulphonates, alkyl sulphates, alkyl alkoxyated sulphates, C<sub>6</sub>-C<sub>20</sub> alkyl alkoxyated linear or branched diphenyl oxide disulphonates, or mixtures thereof.
- 10    Suitable alkyl sulphonates for use herein include water-soluble salts or acids of the formula RSO<sub>3</sub>M wherein R is a C<sub>6</sub>-C<sub>20</sub> linear or branched, saturated or unsaturated alkyl group, preferably a C<sub>8</sub>-C<sub>18</sub> alkyl group and more preferably a C<sub>10</sub>-C<sub>16</sub> alkyl group, and M is H or a cation, e.g., an alkali metal cation (e.g., sodium, potassium, lithium), or ammonium or substituted ammonium (e.g., methyl-, dimethyl-, and trimethyl ammonium cations and
- 15    quaternary ammonium cations, such as tetramethyl-ammonium and dimethyl piperdinium cations and quaternary ammonium cations derived from alkylamines such as ethylamine, diethylamine, triethylamine, and mixtures thereof, and the like).

- 20    Suitable alkyl aryl sulphonates for use herein include water-soluble salts or acids of the formula RSO<sub>3</sub>M wherein R is an aryl, preferably a benzyl, substituted by a C<sub>6</sub>-C<sub>20</sub> linear or branched saturated or unsaturated alkyl group, preferably a C<sub>8</sub>-C<sub>18</sub> alkyl group and more preferably a C<sub>10</sub>-C<sub>16</sub> alkyl group, and M is H or a cation, e.g., an alkali metal cation (e.g., sodium, potassium, lithium, calcium, magnesium and the like) or ammonium or substituted ammonium (e.g., methyl-, dimethyl-, and trimethyl ammonium cations and quaternary ammonium cations, such as
- 25    tetramethyl-ammonium and dimethyl piperdinium cations and quaternary ammonium cations derived from alkylamines such as ethylamine, diethylamine, triethylamine, and mixtures thereof, and the like).

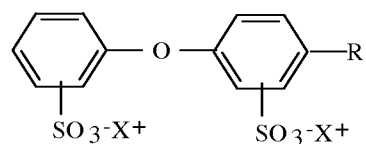
- 30    An example of a C<sub>14</sub>-C<sub>16</sub> alkyl sulphonate is Hostapur® SAS available from Hoechst. An example of commercially available alkyl aryl sulphonate is Lauryl aryl sulphonate from Su.Ma.. Particularly preferred alkyl aryl sulphonates are alkyl benzene sulphonates commercially available under trade name Nansa® available from Albright&Wilson.



Suitable alkyl sulphate surfactants for use herein are according to the formula  $R_1SO_4M$  wherein  $R_1$  represents a hydrocarbon group selected from the group consisting of straight or branched alkyl radicals containing from 6 to 20 carbon atoms and alkyl phenyl radicals containing from 6 to 18 carbon atoms in the alkyl group.  $M$  is H or a cation, e.g., an alkali metal cation (e.g., sodium, potassium, lithium, calcium, magnesium and the like) or ammonium or substituted ammonium (e.g., methyl-, dimethyl-, and trimethyl ammonium cations and quaternary ammonium cations, such as tetramethyl-ammonium and dimethyl piperdinium cations and quaternary ammonium cations derived from alkylamines such as ethylamine, diethylamine, triethylamine, and mixtures thereof, and the like). Particularly preferred branched alkyl sulphates to be used herein are those containing from 10 to 14 total carbon atoms like Isalchem 123 AS®. Isalchem 123 AS® commercially available from Enichem is a  $C_{12-13}$  surfactant which is 94% branched. This material can be described as  $CH_3-(CH_2)_m-CH(CH_2OSO_3Na)-(CH_2)_n-CH_3$  where  $n+m=8-9$ . Also preferred alkyl sulphates are the alkyl sulphates where the alkyl chain comprises a total of 12 carbon atoms, i.e., sodium 2-butyl octyl sulphate. Such alkyl sulphate is commercially available from Condea under the trade name Isofol® 12S. Particularly suitable liner alkyl sulphonates include  $C_{12}-C_{16}$  paraffin sulphonate like Hostapur® SAS commercially available from Hoechst.

Suitable alkyl alkoxyated sulphate surfactants for use herein are according to the formula  $RO(A)_mSO_3M$  wherein  $R$  is an unsubstituted  $C_6-C_{20}$  alkyl or hydroxyalkyl group having a  $C_6-C_{20}$  alkyl component, preferably a  $C_{12}-C_{20}$  alkyl or hydroxyalkyl, more preferably  $C_{12}-C_{18}$  alkyl or hydroxyalkyl,  $A$  is an ethoxy or propoxy unit,  $m$  is greater than zero, typically between 0.5 and 6, more preferably between 0.5 and 3, and  $M$  is H or a cation which can be, for example, a metal cation (e.g., sodium, potassium, lithium, calcium, magnesium, etc.), ammonium or substituted-ammonium cation. Alkyl ethoxylated sulfates as well as alkyl propoxylated sulfates are contemplated herein. Specific examples of substituted ammonium cations include methyl-, dimethyl-, trimethyl-ammonium and quaternary ammonium cations, such as tetramethyl-ammonium, dimethyl piperdinium and cations derived from alkanolamines such as ethylamine, diethylamine, triethylamine, mixtures thereof, and the like. Exemplary surfactants are  $C_{12}-C_{18}$  alkyl polyethoxylate (1.0) sulfate ( $C_{12}-C_{18}E(1.0)SM$ ),  $C_{12}-C_{18}$  alkyl polyethoxylate (2.25) sulfate ( $C_{12}-C_{18}E(2.25)SM$ ),  $C_{12}-C_{18}$  alkyl polyethoxylate (3.0) sulfate ( $C_{12}-C_{18}E(3.0)SM$ ),  $C_{12}-C_{18}$  alkyl polyethoxylate (4.0) sulfate ( $C_{12}-C_{18}E(4.0)SM$ ), wherein  $M$  is conveniently selected from sodium and potassium.

Suitable C<sub>6</sub>-C<sub>20</sub> alkyl alkoxyated linear or branched diphenyl oxide disulphonate surfactants for use herein are according to the following formula:



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wherein R is a C<sub>6</sub>-C<sub>20</sub> linear or branched, saturated or unsaturated alkyl group, preferably a C<sub>12</sub>-C<sub>18</sub> alkyl group and more preferably a C<sub>14</sub>-C<sub>16</sub> alkyl group, and X<sup>+</sup> is H or a cation, e.g., an alkali metal cation (e.g., sodium, potassium, lithium, calcium, magnesium and the like). Particularly suitable C<sub>6</sub>-C<sub>20</sub> alkyl alkoxyated linear or branched diphenyl oxide disulphonate surfactants to be used herein are the C<sub>12</sub> branched di phenyl oxide disulphonic acid and C<sub>16</sub> linear di phenyl oxide disulphonate sodium salt respectively commercially available by DOW under the trade name Dowfax 2A1® and Dowfax 8390®.

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Other anionic surfactants useful herein include salts (including, for example, sodium, potassium, ammonium, and substituted ammonium salts such as mono-, di- and triethanolamine salts) of soap, C<sub>8</sub>-C<sub>24</sub> olefinsulfonates, sulphonated polycarboxylic acids prepared by sulphonation of the pyrolyzed product of alkaline earth metal citrates, e.g., as described in British patent specification No. 1,082,179, C<sub>8</sub>-C<sub>24</sub> alkylpolyglycoethersulfates (containing up to 10 moles of ethylene oxide); alkyl ester sulfonates such as C<sub>14</sub>-C<sub>16</sub> methyl ester sulfonates; acyl glycerol sulfonates, fatty oleyl glycerol sulfates, alkyl phenol ethylene oxide ether sulfates, alkyl phosphates, isethionates such as the acyl isethionates, N-acyl taurates, alkyl succinamates and sulfosuccinates, monoesters of sulfosuccinate (especially saturated and unsaturated C<sub>12</sub>-C<sub>18</sub> monoesters) diesters of sulfosuccinate (especially saturated and unsaturated C<sub>6</sub>-C<sub>14</sub> diesters), acyl sarcosinates, sulfates of alkylpolysaccharides such as the sulfates of alkylpolyglucoside (the nonionic nonsulfated compounds being described below), alkyl polyethoxy carboxylates such as those of the formula RO(CH<sub>2</sub>CH<sub>2</sub>O)<sub>k</sub>CH<sub>2</sub>COO<sup>-</sup>M<sup>+</sup> wherein R is a C<sub>8</sub>-C<sub>22</sub> alkyl, k is an integer from 0 to 10, and M is a soluble salt-forming cation. Resin acids and hydrogenated resin acids are also suitable, such as rosin, hydrogenated rosin, and resin acids and hydrogenated resin acids present in or derived from tall oil. Further examples are given in "Surface Active Agents and Detergents" (Vol. I and II by Schwartz, Perry and Berch). A variety of such surfactants are also

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generally disclosed in U.S. Patent 3,929,678, issued December 30, 1975 to Laughlin, et al. at Column 23, line 58 through Column 29, line 23.

5 Zwitterionic surfactants represent another class of preferred surfactants within the context of the present invention.

Zwitterionic surfactants contain both cationic and anionic groups on the same molecule over a wide pH range. The typical cationic group is a quaternary ammonium group, although other positively charged groups like sulfonium and phosphonium groups can also be used. The typical  
10 anionic groups are carboxylates and sulfonates, preferably sulfonates, although other groups like sulfates, phosphates and the like, can be used. Some common examples of these detergents are described in the patent literature: U.S. Patent Nos. 2,082,275, 2,702,279 and 2,255,082.

A specific example of a zwitterionic surfactant is 3-(N-dodecyl-N,N-dimethyl)-2-  
15 hydroxypropane-1-sulfonate (Lauryl hydroxyl sultaine) available from the McIntyre Company (24601 Governors Highway, University Park, Illinois 60466, USA) under the tradename Mackam LHS®. Another specific zwitterionic surfactant is C<sub>12-14</sub> acylamidopropylene (hydroxypropylene) sulfobetaine that is available from McIntyre under the tradename Mackam 50-SB®. Other very useful zwitterionic surfactants include hydrocarbyl, e.g., fatty alkylene  
20 betaines. A highly preferred zwitterionic surfactant is Empigen BB®, a coco dimethyl betaine produced by Albright & Wilson. Another equally preferred zwitterionic surfactant is Mackam 35HP®, a coco amido propyl betaine produced by McIntyre.

Another class of preferred surfactants comprises the group consisting of amphoteric surfactants.  
25 One suitable amphoteric surfactant is a C<sub>8</sub>-C<sub>16</sub> amido alkylene glycinate surfactant ('ampho glycinate'). Another suitable amphoteric surfactant is a C<sub>8</sub>-C<sub>16</sub> amido alkylene propionate surfactant ('ampho propionate'). Other suitable, amphoteric surfactants are represented by surfactants such as dodecylbeta-alanine, N-alkyltaurines such as the one prepared by reacting dodecylamine with sodium isethionate according to the teaching of U.S. Patent No. 2,658,072,  
30 N-higher alkylaspartic acids such as those produced according to the teaching of U.S. Patent No. 2,438,091, and the products sold under the trade name "Miranol®", and described in U.S. Patent No. 2,528,378.

#### Chelating agents

One class of optional compounds for use herein includes chelating agents or mixtures thereof. Chelating agents can be incorporated in the compositions herein in amounts ranging from 0.0% to 10.0% by weight of the total composition, preferably 0.01% to 5.0%.

5     Suitable phosphonate chelating agents for use herein may include alkali metal ethane 1-hydroxy diphosphonates (HEDP), alkylene poly (alkylene phosphonate), as well as amino phosphonate compounds, including amino aminotri(methylene phosphonic acid) (ATMP), nitrilo trimethylene phosphonates (NTP), ethylene diamine tetra methylene phosphonates, and diethylene triamine penta methylene phosphonates (DTPMP). The phosphonate compounds may be present either in  
10    their acid form or as salts of different cations on some or all of their acid functionalities. Preferred phosphonate chelating agents to be used herein are diethylene triamine penta methylene phosphonate (DTPMP) and ethane 1-hydroxy diphosphonate (HEDP). Such phosphonate chelating agents are commercially available from Monsanto under the trade name DEQUEST<sup>®</sup>.

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Polyfunctionally-substituted aromatic chelating agents may also be useful in the compositions herein. See U.S. patent 3,812,044, issued May 21, 1974, to Connor et al. Preferred compounds of this type in acid form are dihydroxydisulfobenzenes such as 1,2-dihydroxy -3,5-disulfobenzene.

20    A preferred biodegradable chelating agent for use herein is ethylene diamine N,N'- disuccinic acid, or alkali metal, or alkaline earth, ammonium or substitutes ammonium salts thereof or mixtures thereof. Ethylenediamine N,N'- disuccinic acids, especially the (S,S) isomer have been extensively described in US patent 4, 704, 233, November 3, 1987, to Hartman and Perkins. Ethylenediamine N,N'- disuccinic acids is, for instance, commercially available under the  
25    tradename ssEDDS<sup>®</sup> from Palmer Research Laboratories.

Suitable amino carboxylates for use herein include ethylene diamine tetra acetates, diethylene triamine pentaacetates, diethylene triamine pentaacetate (DTPA), N-hydroxyethylethylenediamine triacetates, nitrilotri-acetates, ethylenediamine tetrapropionates,  
30    triethylenetetraaminehexa-acetates, ethanol-diglycines, propylene diamine tetracetic acid (PDTA) and methyl glycine di-acetic acid (MGDA), both in their acid form, or in their alkali metal, ammonium, and substituted ammonium salt forms. Particularly suitable amino carboxylates to be used herein are diethylene triamine penta acetic acid, propylene diamine

tetracetic acid (PDTA) which is, for instance, commercially available from BASF under the trade name Trilon FS<sup>®</sup> and methyl glycine di-acetic acid (MGDA).

Further carboxylate chelating agents for use herein include salicylic acid, aspartic acid, glutamic acid, glycine, malonic acid or mixtures thereof.

#### Radical scavenger

The compositions of the present invention may further comprise a radical scavenger or a mixture thereof.

Suitable radical scavengers for use herein include the well-known substituted mono and dihydroxy benzenes and their analogs, alkyl and aryl carboxylates and mixtures thereof. Preferred such radical scavengers for use herein include di-tert-butyl hydroxy toluene (BHT), hydroquinone, di-tert-butyl hydroquinone, mono-tert-butyl hydroquinone, tert-butyl-hydroxy anisole, benzoic acid, toluic acid, catechol, t-butyl catechol, benzylamine, 1,1,3-tris(2-methyl-4-hydroxy-5-t-butylphenyl) butane, n-propyl-gallate or mixtures thereof and highly preferred is di-tert-butyl hydroxy toluene. Such radical scavengers like N-propyl-gallate may be commercially available from Nipa Laboratories under the trade name Nipanox S1<sup>®</sup>.

Radical scavengers, when used, may be typically present herein in amounts up to 10% by weight of the total composition and preferably from 0.001% to 0.5%. The presence of radical scavengers may contribute to the chemical stability of the compositions of the present invention.

#### Perfume

Suitable perfume compounds and compositions for use herein are for example those described in EP-A-0 957 156 under the paragraph entitled "Perfume", on page 13. The compositions herein may comprise a perfume ingredient, or mixtures thereof, in amounts up to 5.0% by weight of the total composition, preferably in amounts of 0.1% to 1.5%.

#### Dye

The liquid compositions according to the present invention may be coloured. Accordingly, they may comprise a dye or a mixture thereof.

Delivery form of the compositions

The compositions herein may be packaged in a variety of suitable packaging known to those skilled in the art, such as plastic bottles for pouring liquid compositions, squeeze bottles or bottles equipped with a trigger sprayer for spraying liquid compositions. Alternatively, the paste-like compositions according to the present invention may be packaged in a tube.

In an alternative embodiment herein, the liquid composition herein is impregnated onto a substrate, preferably the substrate is in the form of a flexible, thin sheet or a block of material, such as a sponge.

Suitable substrates are woven or non-woven sheets, cellulosic material based sheets, sponge or foam with open cell structures e.g.: polyurethane foams, cellulosic foam, melamine foam, etc.

The process of cleaning a surface

The present invention encompasses a process of cleaning and/or cleansing a surface with a liquid composition according to the present invention. Suitable surfaces herein are described herein above under the heading "The liquid cleaning/cleansing composition".

In a preferred embodiment said surface is contacted with the composition according to the present invention, preferably wherein said composition is applied onto said surface.

In another preferred embodiment, the process herein comprises the steps of dispensing (e.g., by spraying, pouring, squeezing) the liquid composition according to the present invention from a container containing said liquid composition and thereafter cleaning and/or cleansing said surface.

The composition herein may be in its neat form or in its diluted form.

By "in its neat form", it is to be understood that said liquid composition is applied directly onto the surface to be treated without undergoing any dilution, i.e., the liquid composition herein is applied onto the surface as described herein.

By "diluted form", it is meant herein that said liquid composition is diluted by the user typically with water. The liquid composition is diluted prior to use to a typical dilution level of up to 10 times its weight of water. A usually recommended dilution level is a 10% dilution of the composition in water.

The composition herein may be applied using an appropriate implement, such as a mop, paper towel, brush (e.g., a toothbrush) or a cloth, soaked in the diluted or neat composition herein. Furthermore, once applied onto said surface said composition may be agitated over said surface  
5 using an appropriate implement. Indeed, said surface may be wiped using a mop, paper towel, brush or a cloth.

The process herein may additionally contain a rinsing step, preferably after the application of said composition. By “rinsing”, it is meant herein contacting the surface cleaned/cleansed with  
10 the process according to the present invention with substantial quantities of appropriate solvent, typically water, directly after the step of applying the liquid composition herein onto said surface. By “substantial quantities”, it is meant herein between 0.01 lt. and 1 lt. of water per m<sup>2</sup> of surface, more preferably between 0.1 lt. and 1 lt. of water per m<sup>2</sup> of surface.

15 In a preferred embodiment herein, process of cleaning is a process of cleaning household hard surfaces with a liquid composition according to present invention.

#### Process of generating the abrasive particles

In an embodiment, process of generating abrasive cleaning foam particles comprises the steps of:

- (i) generating a homogeneous solution comprising at least one thermoplastic material having raw material density of greater than 1.15, preferably greater than 1.20, preferably greater than 1.22, more preferably greater than 1.24;
- (ii) foaming said homogeneous solution by extrusion foaming through an extrusion die having a diameter sized such that the coefficient of expansion of the foam is from 8 to 14 from 9 to 12, preferably from 9.5 to 11,;
- (iii) fragmenting said foam to generate abrasive cleaning foam particles.

Preferably, following step (ii), the foam is fragmented into foam pellets of from 1mm to 100mm in size in the largest dimension followed by a further fragmenting step (iii) wherein said foam pellets are fragmented to generate abrasive cleaning foam particles having a mean area-equivalent diameter of from 100 to 350 microns.

Preferably, the extrusion die comprises an extrusion orifice that may be of any shape but preferably having a shape selected from the group consisting of square, rectangular, triangular,

trapezoidal, star-shaped, cross-shaped, circular, and combinations thereof, more preferably rectangular and/or circular.

Preferably, the extrusion die comprises an extrusion orifice having a circular cross-section and a diameter ( $D_e$ ) of from 1 to 50 millimeters, preferably from 2 to 20 millimeters and more preferably from 2 to 10 millimeters.

Alternatively, the extrusion die comprises an extrusion orifice having a rectangular cross-section wherein the horizontal length ( $L_h$ ) is from 10 to 1000 millimeters, preferably from 10 to 500 millimeters and more preferably from 10 to 200 millimeters, and preferably the vertical length ( $L_{vd}$ ) is from 1 to 50 millimeters, preferably from 1 to 20 millimeters, more preferably from 2 to 10 millimeters.

It is understood that the final shape of the foamed structure will depend on the shape of the orifice of the extrusion die. For example, a circular orifice will result in foams in the form of rods having a substantially cylindrical shape, whilst a rectangular orifice will result in foam structures in the form of sheets or buns. Provided the coefficient of expansion is maintained within the above ranges, the resulting particles after fragmentation of the foam will retain the required mechanical properties.

Preferably, the thermoplastic material is a biodegradable thermoplastic material selected from the group consisting of biodegradable polyesters preferably selected from the group consisting of polyhydroxy-alkanoates preferably selected from polyhydroxyButyrate, polyhydroxyButyrate-co-valerate, polyhydroxyButyrate-co-hexanoate, polyhydroxyButyrate-co-octanoate and mixtures thereof, poly(lactic acid), poly(glycolic acid), polycaprolactone, polyesteramide, aliphatic copolyesters, aromatic copolyesters, and mixtures thereof; thermoplastic starch; cellulose esters particularly cellulose acetate and/or nitrocellulose and their derivatives; and mixtures thereof; preferably a blend of a biodegradable polyester and a thermoplastic starch.

- 10 Preferably, the foaming step i comprises the step of adding filler particles to the homogeneous solution and step ii is achieved via extrusion foaming wherein the filler particles further act as nucleating agent to promote speed of crystallization, preferably the homogeneous solution of step i further comprising 3 to 15% by weight of a blowing agent at mixing temperature of from 80 to 240°C and pressure of from 0.5 to 30MPa prior to undergoing a depressurization step at a



rate of greater than 0.5MPa/s and preferably less 10MPa/s, more preferably the depressurization temperature ranging from the melt temperature of the thermoplastic material,  $T_m$ , to  $T_m - 60^\circ\text{C}$ .

Preferably step iii comprises the steps of converting the foam into foam pieces ranging from 1mm to 100mm in the larger dimension thereof followed by grinding said foam pieces into particles having a mean area-equivalent diameter ranging from 100 to 350 microns by means of a device selected from eroding wheel, roll grinder, rotor mill, blade mill, jet mill, and combinations thereof, wherein the grinding temperature is controlled to remain below  $T$ , wherein  $T = T_m - T_n$ , and  $T_n$  is  $30^\circ\text{C}$ , preferably  $50^\circ\text{C}$ , more preferably  $100^\circ\text{C}$ .

#### Coefficient of expansion measurement

When the foam is extruded in the form of a rod (e.g. via an extrusion die having an orifice with circular cross-section), the coefficient of expansion is measured by taking the ratio of the diameter of the extruded foam ( $D_f$ ) over the diameter of the extrusion die ( $D_e$ ) as seen in Fig. 3.

When the foam is extruded in the form of a sheet or a bun (e.g. via an extrusion die having an orifice with rectangular cross-section), the coefficient of expansion is measure by taking the ratio of the foam thickness of the extruded foam ( $L_f$ ) over the vertical length of the extruder die orifice ( $L_{vd}$ ) as seen in Fig. 4.

#### EXAMPLES

These following compositions were made comprising the listed ingredients in the listed proportions (weight %). Examples 1-20 herein are met to exemplify the present invention, but are not necessarily used to limit or otherwise define the scope of the present invention.

Abrasive particle used in the examples below were ground from foam (controlled foam structure e.g.: foam density, cell size, strut aspect ratio and % cell size content).

#### Examples shaped particle from grinding foam precursor

Example #	1	2	3	4	5	6	7
Raw material	PHBO	PHBH	PHB	PHB	PHB	PHBV	PHBV
Raw material density	1.23	1.23	1.17	1.25	1.25	1.24	1.24
Foam coefficient of expansion	8	9	12	10	14	9	10
Particle Mean ECD ( $\mu\text{m}$ )	200	150	200	250	400	150	200

Example #	8	9	10	11	12	13	14
Raw material	PHBV	PHBV	PHBV	PLA	PLA	PLA	PCL/PHBV
Raw material density	1.24	1.24	1.24	1.23	1.23	1.23	1.18
Foam coefficient of expansion	10	10	9	12	9	8	10
Particle Mean ECD (μm)	250	320	400	250	350	380	250

Example #	15	16	17	18	19	20
Raw material	PCL/PHBV	PBS	PBAT	PBAT	PBAT	TPS/PHBV
Raw material density	1.21	1.23	1.21	1.21	1.21	1.21
Foam coefficient of expansion	9	9	12	11	10	12
Particle Mean ECD (μm)	350	400	200	280	350	250

Symbol raw material :

5 PHBO = Polyhydroxybutyrate-co-Octanoate (Nodax from P&G)

PHBV = Polyhydroxybutyrate-co-Hexanoate (Nodax from P&G)

PHB = Polyhydroxybutyrate (CAS number 26063-00-3 ex.: from Tianan or Biomer e.g.: P240 (d=1.17) or P226 (d=1.25))

10 PHBV = Polyhydroxybutyrate-co-valerate (CAS number 80181-31-3 ex.: from Tianan or Biomer)

PLA = Polylactic acid (CAS number 26100-51-6 ex.: from NatureWorks)

PCL/PHBV=Polycaprolactone (CAS number 24980-41-4 ex.from Perstorp) blend with Polyhydroxybutyrate-co-valerate

PBS = Polybutylene succinate (CAS number 10034-55-6.ex.: from CSM)

15 PBAT = Polybutylene adipate terephthalate (CAS number 10034-55-6.ex.: from BASF)

TPS/PHBV = Thermoplastic starch (CAS number 9005-25-8 e.g.: from Aldrich) blend with Polyhydroxybutyrate-co-valerate.

- 5 These following compositions were made comprising the listed ingredients in the listed proportions (weight %). Examples 1-16 herein are meant to exemplify the present invention but are not necessarily used to limit or otherwise define the scope of the present invention.

Examples of abrasive-particle containing formulations:

10 Hard surface cleaner Bathroom composition:

% Weight	<b>1</b>	<b>2</b>	<b>3</b>
C9-C11 EO8 (Neodol 91-8®)	3	2.5	3.5
Alkyl Benzene sulfonate		1	
C12-14-dimethyl Aminoxide		1	
n-Butoxy Propoxy Propanol		2	2.5
Hydrogene Peroxide	3		
Hydrophobic ethoxylated polyurethane (Acusol 882®)	1.5	1	0.8
Lactic Acid	3		3.5
Citric Acid		3	0.5
Polysaccharide (Xanthan Gum, Keltrol CG-SFT® Kelco)	0.25	0.25	0.25
Perfume	0.35	0.35	0.35
Abrasive cleaning particle example #	1	2	6
Abrasive cleaning particle load %	1	1	1
Water (+ minor e.g.; pH adjusted to 3.5)	Balance	Balance	Balance

Hard surface cleaner Bathroom composition (cont.):

% Weight	<b>4</b>	<b>5</b>	<b>6</b>
Chloridric acid	2		
Linear C10 alkyl sulphate	1.3	2	3
n-Butoxy Propoxy Propanol	2		1.75
Citric Acid		3	3
PolyvinylPyrrolidone (Luviskol K60®)	0.1	0.1	0.1
NaOH		0.2	0.2
Perfume	0.4	0.4	0.4
Polysaccharide (Xanthan Gum Kelzan T®, Kelco)	0.3	0.35	0.35
Abrasive cleaning particle example #	9	10	11
Abrasive cleaning particle load %	2	2	2
Water (+ minor e.g.; pH adjusted to 3.1)	Balance	Balance	Balance

Hand-dishwashing detergent compositions:

% Weight	<b>7</b>	<b>8</b>	<b>9</b>
N-2-ethylhexyl sulfocuccinamate	3	3	3
C11EO5	7	14	
C11-EO7			7
C10-EO7	7		7
Trisodium Citrate	1	1	1
Potassium Carbonate	0.2	0.2	0.2
Perfume	1	1	1
Polysaccharide (Xanthan Gum Kelzan T®, Kelco)	0.35	0.35	0.35
Abrasive cleaning particle example #	1	6	9
Abrasive cleaning particle load %	1	2	5
Water (+ minor e.g.; pH adjusted to 8)	Balance	Balance	Balance

General degreaser composition:

% Weight	<b>10</b>	<b>11</b>
C9-C11 EO8 (Neodol 91-8®)	3	3
N-Butoxy Propoxy Propanol	15	15
Ethanol	10	5
Isopropanol		10
Polysaccharide (Xanthan Gum-glyoxal modified Optixan-T)	0.35	0.35
Abrasive cleaning particle example #	15	19
Abrasive cleaning particle load %	2	3
Water (+ minor e.g.; pH adjusted to 9)	Balance	Balance

5

Scouring composition:

% Weight	<b>12</b>	<b>13</b>	<b>14</b>
Sodium C13-16 prafin sulfonate	2.5	2.5	2.5
C12-14-EO7 (Lutensol AO7®)	0.5	0.5	0.5
Coconut Fatty Acid	0.3	0.3	0.3
Sodium Citrate	3.3	3.3	3.3
Sodium Carbonate	3	3	3
Orange terpenes	2.1	2.1	2.1
Benzyl Alcohol	1.5	1.5	
Polyacrylic acid 1.5Mw	0.75	0.75	0.75
Abrasive cleaning particle example #	1	6	19
Abrasive cleaning particle load %	5	5	5
Water (+ minor e.g.; pH adjusted to 7)	Balance	Balance	Balance

Liquid glass cleaner:

% Weight	<b>15</b>	<b>16</b>
Butoxypropanol	2	4
Ethanol	3	6

C12-14 sodium sulphate	0.24	
NaOH/Citric acid	To pH 9	To pH 9
Abrasive cleaning particle example #	5	5
Abrasive cleaning particle load %	0.5	0.5
Water (+ minor e.g.; pH adjusted to 9)	Balance	Balance

Cleaning wipe (Body cleansing wipe):

% Weight	17	18	19
C10 Amine Oxide	-	0.02	-
C12,14 Amine Oxide	0.4	-	-
Betaine (Rewoteric AM CAS 15 U)	-	-	0.2
C9,11 A5EO (Neodol E 91.5®)	-	0.1	-
C9,11 A8EO (Neodol E 91.8®)	-	-	0.8
C12,14 A5EO	0.125	-	-
2-Ethyl Hexyl Sulphate	-	0.05	0.6
Silicone	0.001	0.003	0.003
EtOH	9.4	8.0	9.5
Propylene Glycol Butyl Ether	0.55	1.2	-
Geraniol	-	-	0.1
Citric acid	1.5	-	-
Lactic acid	-		1.5
Perfume	0.25	0.15	0.15
Abrasive cleaning particle example #	2	6	7
Abrasive cleaning particle load %	5	3	3
Nonwoven : Spunlace 100% viscose 50gsm (lotion loading fact)			(x3.5)
Nonwoven : Airlaid walkisoft (70% cellulose, 12% Viscose, 18% binder) 80gsm (lotion loading factor)		(x3.5)	
Carded thermobonded (70% polypropylene, 30% rayon), 70gsm (Lotion loading factor)	(x3.5)		

5 Cleaning wipe (Body cleansing wipe):

% Weight	<b>20</b>
Benzalkonium Chloride (Alkaquat DMB-451® )	0.1
Cocamine Oxide (C10/C16 alkyl dimethyl amine oxide; AO-1214 LP supplied by Procter & Gamble Co.)	0.5
Pyroglutamic Acid (pidolidone) (2-pyrrolidone-5 carboxylic acid)	4

Ethanol-denatured 200 proof (SD alcohol 40®)	10
DC Antiform H-10 (dimethicone)	0.03
Sodium Benzoate	0.2
Tetrasodium EDTA (Hampene 220®)	0.1
Sodium Chloride	0.4
Perfume	0.01
Abrasive cleaning particle example #	11
Abrasive cleaning particle load %	2
Water and minors	Balance
The above wipes lotion composition is loaded onto a water-insoluble substrate, being a patterned hydroentangled non-woven substrate having a basis weight of 56 gram per square meter comprising 70% polyester and 30% rayon approximately 6.5 inches wide by 7.5 inches long with a caliper of about 0.80 mm. Optionally, the substrate can be pre-coated with dimethicone (Dow Corning 200 Fluid 5cst) using conventional substrate coating techniques. Lotion to wipe weight ratio of about 2:1 using conventional substrate coating techniques	

The dimensions and values disclosed herein are not to be understood as being strictly limited to the exact numerical values recited. Instead, unless otherwise specified, each such dimension is intended to mean both the recited value and a functionally equivalent range surrounding that value. For example, a dimension disclosed as “40 mm” is intended to mean “about 40 mm.”

## CLAIMS

What is claimed is:

1. A liquid cleaning and/or cleansing composition comprising abrasive cleaning foam particles derived from grinding a foam structure, wherein said abrasive cleaning foam particles comprise a thermoplastic material having a raw material density of greater than 1.15, and the foam having a coefficient of expansion of from 8 to 14.
2. A liquid cleaning and/or cleansing composition according to claim 1 wherein the thermoplastic material consists of a biodegradable thermoplastic material selected from the group consisting of biodegradable polyesters preferably selected from the group consisting of polyhydroxy-alkanoates preferably selected from polyhydroxyButyrate, polyhydroxyButyrate-co-valerate, polyhydroxyButyrate-co-hexanoate and mixtures thereof, poly(lactic acid), poly(glycolic acid), polycaprolactone, polyesteramide, aliphatic copolyesters, aromatic copolyesters, and mixtures thereof; thermoplastic starch; cellulose esters particularly cellulose acetate and/or nitrocellulose and their derivatives; and mixtures thereof; preferably a blend of a biodegradable polyester and a thermoplastic starch.
3. A liquid cleaning and/or cleansing composition according to any of the preceding claims wherein the thermoplastic material consists of a biodegradable thermoplastic material selected from biodegradable petroleum-based polyesters preferably selected from the group consisting of polycaprolactone, polyesteramide, aliphatic copolyesters, aromatic copolyesters, and mixtures thereof; thermoplastic starch; cellulose esters particularly cellulose acetate and/or nitrocellulose and their derivatives; and mixtures thereof; preferably a blend of biodegradable petroleum-based polyester and a thermoplastic starch, preferably a blend of polycaprolactone and a thermoplastic starch, preferably a blend of polycaprolactone with polyhydroxy-alkanoates.
4. A liquid cleaning and/or cleansing composition according to any of the preceding claims wherein the abrasive cleaning foam particles are biodegradable particles having a biodegradability rate of greater than 50% according to ASTM6400 test method.

5. A liquid cleaning and/or cleansing composition according to any of the preceding claims, wherein the abrasive cleaning foam particles consist of a biodegradable thermoplastic material having a raw material density of greater than 1.20, preferably greater than 1.22, more preferably greater than 1.24.
6. A liquid cleaning and/or cleansing composition according to any preceding claims, wherein the coefficient of expansion is from 9 to 12, preferably from 9.5 to 11.
7. A liquid cleaning and/or cleansing composition according to any of the preceding claims, wherein the abrasive cleaning foam particles are comprised at a level of from 0.5% to less than 5%, preferably from 1% to 4%, more preferably from 1% to 3%, by weight of the composition.
8. A liquid cleaning and/or cleansing composition according to any of the preceding claims, wherein the abrasive cleaning foam particles are derived from grinding a foam generated by extrusion foaming.
9. A method of cleaning a hard surface, soiled with a hydrophobic soil, with a composition according to any of the preceding claims, said method comprising the steps of applying said composition onto a surface, optionally allowing said composition to stand for an effective period of time onto said surface to allow the abrasive cleaning foam particles to deposit on the surface / soil interface, applying a mechanical action enabling the abrasive cleaning foam particles to penetrate the surface / soil interface and detach the soil from said surface, followed by optional rinsing of the surface.
10. A process of generating abrasive cleaning foam particles according to claims 1 to 8, said process comprising the steps of:
  - (i) generating a homogeneous solution comprising at least one thermoplastic material having raw material density of greater than 1.15;
  - (ii) foaming said homogeneous solution by extrusion foaming through an extrusion die having an orifice sized such that the coefficient of expansion of the foam is from 8 to 14;
  - (iii) fragmenting said foam to generate abrasive cleaning foam particles.



11. A process according to claim 10 wherein following step (ii), the foam is fragmented into foam pellets of from 1mm to 100mm in size in the largest dimension followed by a further fragmenting in step (iii) wherein said foam pellets are fragmented to generate abrasive cleaning foam particles having a mean area-equivalent diameter of from 100 to 350 microns.
12. A process according to claims 10 or 11 wherein the extrusion die orifice has a circular cross-section and a diameter of from 1 to 50 millimeters, preferably from 2 to 20 millimeters and more preferably from 2 to 10 millimeters.
13. A process according to claims 10 or 11 wherein the extrusion die orifice has a rectangular cross-section and a horizontal length (Lh) of from 10 to 1000 millimeters, preferably from 10 to 500 millimeters and more preferably from 10 to 200 millimeters and the vertical length (Lvd) is preferably from 1 to 50 millimeters, more preferably from 1 to 20 millimeters and more preferably from 2 to 10 millimeters.
14. A process according to claims 10 to 13 wherein the coefficient of expansion is from 9 to 12, preferably from 9.5 to 11.
15. A process according to claims 10 to 14 wherein the thermoplastic material comprises, preferably consists of, a biodegradable thermoplastic material having a raw material density of greater than 1.20, preferably greater than 1.22, more preferably greater than 1.24.
16. A process according to claim 15 wherein the biodegradable thermoplastic material is selected from the group consisting of biodegradable polyesters preferably selected from the group consisting of polyhydroxy-alkanoates preferably selected from polyhydroxyButyrate, polyhydroxyButyrate-co-valerate, polyhydroxyButyrate-co-hexanoate, polyhydroxyButyrate-co-hexanoate and mixtures thereof, poly(lactic acid), poly(glycolic acid), polycaprolactone, polyesteramide, aliphatic copolyesters, aromatic copolyesters, and mixtures thereof; thermoplastic starch; cellulose esters particularly cellulose acetate and/or nitrocellulose and their derivatives; and mixtures thereof; preferably a blend of a biodegradable polyester and a thermoplastic starch.

17. A process according to claims 10 to 16 wherein the foaming step i comprises the step of adding filler particles to the homogeneous solution and step ii is achieved via extrusion foaming wherein the filler particles further act as nucleating agent to promote speed of crystallization, preferably the homogeneous solution of step i further comprising 3 to 15% by weight of a blowing agent at mixing temperature of from 80 to 240°C and pressure of from 0.5 to 30MPa prior to undergoing a depressurization step at a rate of greater than 0.5MPa/s and preferably less 10MPa/s, more preferably the depressurization temperature ranging from the melt temperature of the thermoplastic material,  $T_m$ , to  $T_m - 60^\circ\text{C}$ .

1/2

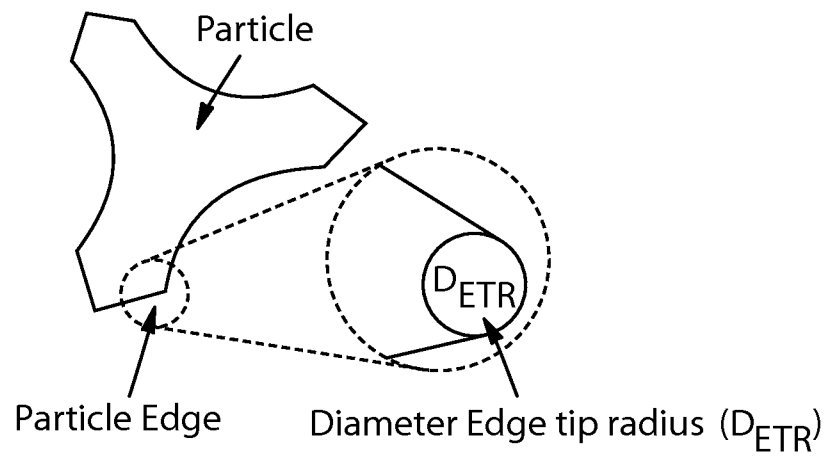


Fig. 1

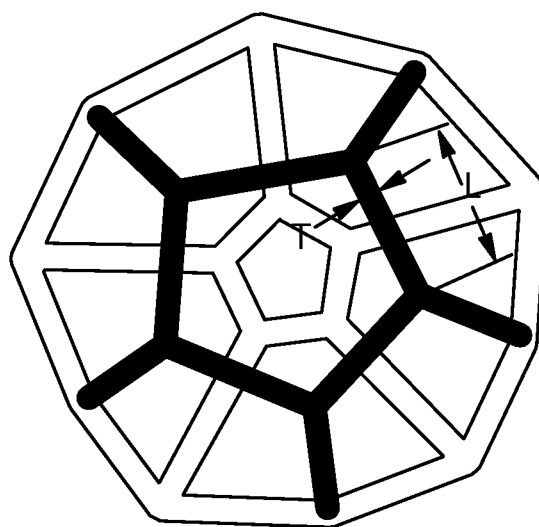


Fig. 2

2/2

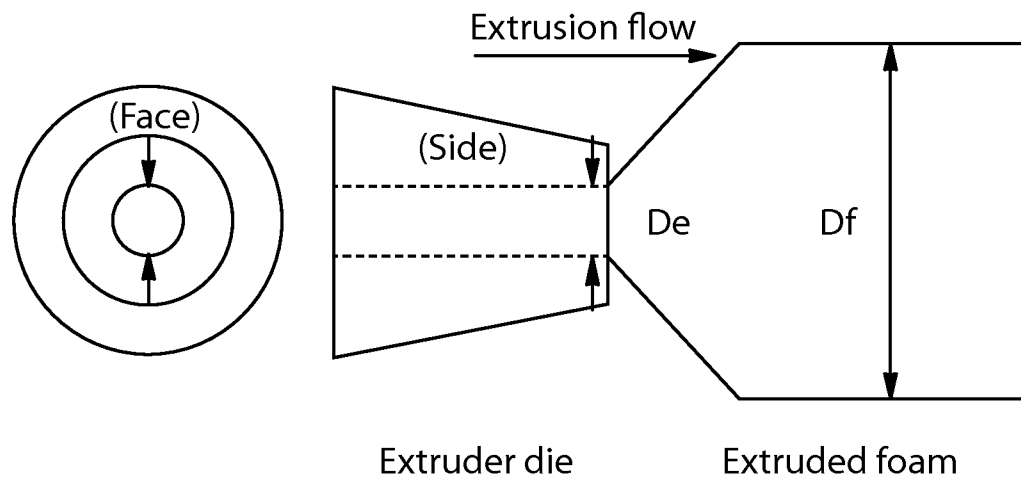


Fig. 3

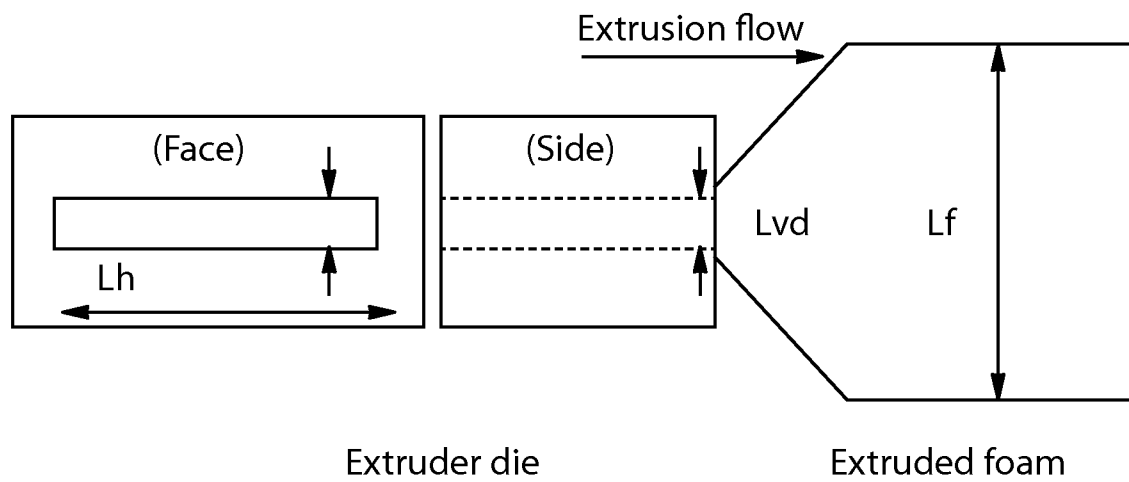


Fig. 4

# INTERNATIONAL SEARCH REPORT

International application No  
PCT/US2014/039715

A. CLASSIFICATION OF SUBJECT MATTER  
INV. C11D3/14 C11D3/37 C11D17/00  
ADD.

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

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)  
C11D

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

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

EP0-Internal, WPI Data

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2012/317735 A1 (GONZALES DENIS ALFRED [BE] ET AL) 20 December 2012 (2012-12-20) claims paragraph [0072] - paragraph [0084] paragraph [0073] paragraph [0050] - paragraph [0057] -----	1-17
X	US 2012/317736 A1 (GONZALES DENIS ALFRED [BE] ET AL) 20 December 2012 (2012-12-20) claims paragraph [0072] - paragraph [0083] paragraph [0049] -----	1-17

☐

Further documents are listed in the continuation of Box C.

☒

See patent family annex.

\* Special categories of cited documents :

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

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

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

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

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

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

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

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

"&" document member of the same patent family

Date of the actual completion of the international search

30 September 2014

Date of mailing of the international search report

13/10/2014

Name and mailing address of the ISA/

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# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2014/039715

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2012317735 A1	20-12-2012	CA 2839953 A1	27-12-2012
		CN 103608445 A	26-02-2014
		EP 2721133 A1	23-04-2014
		EP 2721134 A1	23-04-2014
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