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(54) Title: MACHINE DISHWASHING DETERGENT COMPOSITIONS

(57) Abstract

There is provided a detergent composition, suitable for use in a machine dishwashing method, containing from 1 % to 80 % by weight of detergent builder compound, an oxygen-releasing bleaching agent such that the level of available oxygen in the composition measured according to the method herein is from 0.3 % to 2.5 %, from 0.05 % to 2.5 % by weight of a paraffin oil, from 0.005 % to 3 % by weight of a heavy metal ion sequestrant.

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MACHINE DISHWASHING DETERGENT COMPOSITIONS

Technical Field

The present invention relates to detergent compositions, suitable for use in machine dishwashing, exhibiting good bleachable stain removal and enhanced anti silver-tarnishing properties, and to a process for making said compositions.

Background of the Invention

Detergent compositions designed for use in automatic dishwasher machines are well known, and a consistent effort has been made by detergent manufacturers to improve the cleaning and/or rinsing efficiency of said compositions on dishes and glassware, as reflected by numerous patent publications.

The present invention is concerned with the silver-tarnishing problem encountered when detergent compositions which contain oxygen-bleaching species are employed in machine dishwashing methods.

The satisfactory removal of bleachable soils such as tea, fruit juice and coloured vegetable soils, such as carotenoid soils is a particular challenge to the formulator of a machine dishwashing detergent composition. Traditionally, the removal of such soils has been enabled by the use of bleach components such as oxygen and chlorine bleaches.

A problem encountered with the use of such bleaches is the tarnishing of any silverware components of the washload. Oxygen bleaches tend to give rise to the problem of tarnishing more than chlorine bleaches. The level of tarnishing observed can range from slight discolouration of the silverware to the formation of a dense black coating on the surface of the silverware.

The formulator thus faces the dual challenge of formulating a product which maximises bleachable soil cleaning but minimises the occurrence of tarnishing of silverware components of the washload.

The Applicants have found that the problem of tarnishing can be particularly severe when an oxygen bleaching species is employed especially when the formulation has a pH below 9.6. Oxygen bleaching species are however, preferred over chlorine bleaches for reasons of environmental compatibility.

It has been found that enhanced anti-silver tarnishing as well as good cleaning performance can be achieved through control of oxygen-bleaching power, and the inclusion of a paraffin oil, and a heavy metal ion sequestrant into the detergent compositions.

Preferably, the rate of release of the oxygen bleach is also controlled. The rate of release of oxygen bleach is

preferably rapid enough to provide satisfactory cleaning, but not so rapid that tarnishing is enabled.

It is an object of the present invention to provide compositions, suitable for use in machine dishwashing methods, having enhanced anti-silver tarnishing properties, as well as good cleaning performance, particularly bleachable soil removal performance.

The present invention also encompasses a making process for the detergent compositions herein, which optimizes the anti silver-tarnishing performance of the resulting compositions.

EPA 150 387 discloses chlorine-bleach based machine dishwashing compositions containing a paraffin wax as suds suppressor. EPA 186 088 discloses machine dishwashing compositions based on carbonates and silicates, and optionally chlorine or oxygen bleaches containing paraffin oils as dust binders.

Summary of the Invention

- from 1% to 80% by weight of a detergent builder compound
- from 0.05% to 2.5% by weight, preferably 0.1% to 0.6% by weight of a paraffin oil.
- an oxygen-releasing bleaching agent such that the level of available oxygen measured according to the method herein is from 0.3% to 2.5%, preferably 0.5% to 1.7%
- from 0.005% to 3% by weight of a heavy metal ion sequestrant.

Preferably, the rate of release of said available oxygen is such that the available oxygen is completely released from the composition in a time interval of from 3.5 minutes to

10.0 minutes, using the test protocol described in the present description.

Detailed Description of the Invention

The present compositions contain as essential components a detergent builder compound, an oxygen-releasing bleaching species, a heavy metal ion sequestrant and a paraffin oil. The level of available oxygen is controlled. Preferably, the rate of release of available oxygen is also controlled.

Builder

The first essential component of the detergent compositions of the present invention is a detergent builder compound preferably present at a level of from 1% to 80% by weight, more preferably from 10% to 70% by weight, most preferably from 20% to 60% weight of the composition.

The level of alkali metal carbonate or bicarbonate in the present compositions should preferably be inferior to 7%, more preferably inferior to 5%, by weight of the total composition. Most preferably the present composition should be free of alkali metal carbonate or bicarbonate species.

Suitable detergent builder compounds include, but are not restricted to monomeric polycarboxylates, or their acid forms homo or copolymeric polycarboxylic acids or their salts in which the polycarboxylic acid comprises at least two carboxylic radicals separated from each other by not more that two carbon atoms, carbonates, bicarbonates, borates, phosphates, silicates and mixtures of any of the foregoing.

Suitable monomeric or oligomeric carboxylate builders can be selected from a wide range of compounds but such compounds preferably have a first carboxyl logarithmic acidity/constant (pK_1) of less than 9, preferably of between 2 and 8.5, more preferably of between 4 and 7.5.

The logarithmic acidity constant is defined by reference to the equilibrium

$$H^+ + A^- \rightleftharpoons HA$$

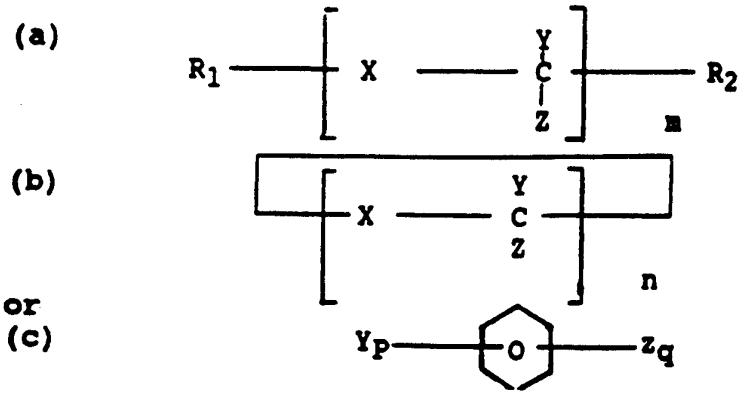
where A is the fully ionized carboxylate anion of the builder salt.
The equilibrium constant for dilute solutions is therefore given by the expression

$$K_1 = \frac{[HA]}{[H^+][A^-]}$$

and $pK_1 = \log_{10}K$.
For the purposes of this specification, acidity constants are defined at 25°C and at zero ionic strength. Literature values are taken where possible (see Stability Constants of Metal-Ion Complexes, Special Publication No. 25, The Chemical Society, London): where doubt arises they are determined by potentiometric titration using a glass electrode.

The carboxylate or polycarboxylate builder can be momomeric or oligomeric in type although monomeric polycarboxylates are generally preferred for reasons of cost and performance.

Monomeric and oligomeric builders can be selected from acyclic, alicyclic, heterocyclic and aromatic carboxylates having the general formulae



wherein R_1 represents H, C_{1-30} alkyl or alkenyl optionally substituted by hydroxy, carboxy, sulfo or phosphono groups or attached to a polyethylenoxy moiety containing up to 20 ethyleneoxy groups; R_2 represents H, C_{1-4} alkyl, alkenyl or hydroxy alkyl, or alkaryl, sulfo, or phosphono groups;
X represents a single bond; O; S; SO; SO_2; or NR_1;
Y represents H; carboxy;hydroxy; carboxymethyloxy; or C_{1-30} alkyl or alkenyl optionally substituted by hydroxy or carboxy groups;
Z represents H; or carboxy;
m is an integer from 1 to 10;
n is an integer from 3 to 6;
p, q are integers from 0 to 6, p + q being from 1 to 6; and wherein, X, Y, and Z each have the same or different representations when repeated in a given molecular formula, and wherein at least one Y or Z in a molecule contain a carboxyl group.

Suitable carboxylates containing one carboxy group include the water soluble salts of lactic acid, glycolic acid and ether derivatives thereof as disclosed in Belgian Patent Nos. 831,368, 821,369 and 821,370. Polycarboxylates containing two carboxy groups include the water-soluble salts of succinic acid, malonic acid, (ethylenedioxy) diacetic acid, maleic acid, diglycolic acid, tartaric acid,

tartronic acid and fumaric acid, as well as the ether carboxylates described in German Offenlegenschrift 2,446,686, and 2,446,687 and U.S. Patent No. 3,935,257 and the sulfinyl carboxylates described in Belgian Patent No. 840,623. Polycarboxylates containing three carboxy groups include, in particular, water-soluble citrates, aconitrates and citraconates as well as succinate derivatives such as the carboxymethyloxysuccinates described in British Patent No. 1,379,241, lactoxysuccinates described in British Patent No. 1,389,732, and aminosuccinates described in Netherlands Application 7205873, and the oxypolycarboxylate materials such as 2-oxa-1,1,3-propane tricarboxylates described in British Patent No. 1,387,447.

Polycarboxylates containing four carboxy groups include oxydisuccinates disclosed in British Patent No. 1,261,829, 1,1,2,2-ethane tetracarboxylates, 1,1,3,3-propane tetracarboxylates and 1,1,2,3-propane tetracarboxylates. Polycarboxylates containing sulfo substituents include the sulfosuccinate derivatives disclosed in British Patent Nos. 1,398,421 and 1,398,422 and in U.S. Patent No. 3,936,448, and the sulfonated pyrolysed citrates described in British Patent No. 1,439,000.

Alicyclic and heterocyclic polycarboxylates include cyclopentane-cis,cis,cis-tetracarboxylates, cyclopentadienide pentacarboxylates, 2,3,4,5-tetrahydrofuran - cis, cis, cis-tetracarboxylates, 2,5-tetrahydrofuran - cis - dicarboxylates, 2,2,5,5-tetrahydrofuran - tetracarboxylates, 1,2,3,4,5,6-hexane - hexacarboxylates and carboxymethyl derivatives of polyhydric alcohols such as sorbitol, mannitol and xylitol. Aromatic polycarboxylates include mellitic acid, pyromellitic acid and the phthalic acid derivatives disclosed in British Patent No. 1,425,343.

Of the above, the preferred polycarboxylates are hydroxycarboxylates containing up to three carboxy groups per molecule, more particularly citrates.

The parent acids of the monomeric or oligomeric polycarboxylate chelating agents or mixtures thereof with their salts, e.g. citric acid or citrate/citric acid mixtures are also contemplated as components of builder systems of detergent compositions in accordance with the present invention.

Other suitable water soluble organic salts are the homo- or co-polymeric polycarboxylic acids or their salts in which the polycarboxylic acid comprises at least two carboxyl radicals separated from each other by not more than two carbon atoms. Polymers of the latter type are disclosed in GB-A-1,596,756. Examples of such salts are polyacrylates of MWt 2000-5000 and their copolymers with maleic anhydride, such copolymers having a molecular weight of from 20,000 to 70,000, especially about 40,000. These materials are normally used at levels of from 0.5% to 10% by weight more preferably from 0.75% to 8%, most preferably from 1% to 6% by weight of the composition.

Water-soluble detergent builders include, but are not limited to, the alkali metal, ammonium and alkanolammonium salts of polyphosphates (exemplified by the tripolyphosphates, pyrophosphates, and glassy polymeric meta-phosphates), phytic acid, silicates, carbonates (including bicarbonates and sesquicarbonates), and sulfates. The levels of incorporation of carbonates or bicarbonates or mixtures thereof, is however preferably limited to less than 7% by weight of the composition.

Borate builders, as well as builders containing borate-forming materials that can produce borate under detergent storage or wash conditions can also be used but are not

preferred at wash conditions less that about 50°C, especially less than about 40°C.

Specific examples of phosphate builders are the alkali metal tripolyphosphates, sodium, potassium and ammonium pyrophosphate, sodium and potassium and ammonium pyrophosphate, sodium and potassium orthophosphate, sodium polymeta/phosphate in which the degree of polymerization ranges from about 6 to 21, and salts of phytic acid.

Suitable silicates include the water soluble sodium silicates with an SiO_2: Na_2O ratio of from 1.0 to 2.8, with ratios of from 1.6 to 2.4 being preferred, and 2.0 ratio being most preferred. The silicates may be in the form of either the anhydrous salt or a hydrated salt. Sodium silicate with an SiO_2: Na_2O ratio of 2.0 is the most preferred silicate.

Silicates are preferably present in the machine dishwashing detergent compositions at the invention at a level of from 5% to 50% by weight of the composition, more preferably from 10% to 40% by weight, most preferably from 12% to 25% by weight.

Examples of such less water soluble builders include the crystalline layered silicates and the largely water insoluble sodium aluminosilicates.

Crystalline layered sodium silicates have the general formula

$$NaMSi_xO_{x+1}.yH_2O$$

wherein M is sodium or hydrogen, x is a number from 1.9 to 4 and y is a number from 0 to 20. Crystalline layered sodium silicates of this type are disclosed in EP-A-0164514 and methods for their preparation are disclosed in DE-A-

3417649 and DE-A-3742043. For the purpose of the present invention, x in the general formula above has a value of 2, 3 or 4 and is preferably 2. More preferably M is sodium and y is 0 and preferred examples of this formula comprise the α -, ß -, γ - and δ - forms of $Na_2Si_2O_5$. These materials are available from Hoechst AG FRG as respectively NaSKS-5, NaSKS-7, NaSKS-11 and NaSKS-6. The most preferred material is δ-$Na_2Si_2O_5$, NaSKS-6.

The crystalline layered sodium silicate material is preferably present in granular detergent compositions as a particulate in intimate admixture with a solid, water-soluble ionisable material. The solid, water-soluble ionisable material is selected from organic acids, organic and inorganic acid salts and mixtures thereof. The primary requirement is that the material should contain at least one functional acidic group of which the pKa should be less than 9, providing a capability for at least partial neutralisation of the hydroxyl ions released by the crystalline layered silicate.

The incorporation in the particulate of other ingredients additional to the crystalline layered silicate and ionisable water soluble compound can be advantageous particularly in the processing of the particulate and also in enhancing the stability of detergent compositions in which the particulates are included. In particular, certain types of agglomerates may require the addition of one or more binder agents in order to assist in binding the silicate and ionisable water soluble material so as to produce particulates with acceptable physical characteristics.

The crystalline layered sodium silicate containing particulates can take a variety of physical forms such as extrudates, marumes, agglomerates, flakes or compacted granules. A preferred process for preparing compacted

granules comprising crystalline layered silicate and a solid, water-soluble ionisable material has been disclosed in the commonly assigned British Application No. 9108639.7 filed on 23 April 1991.

Suitable aluminosilicate zeolites have the unit cell formula $Na_z[(AlO_2)_z(SiO_2)y]$. XH_2O wherein z and y are at least 6; the molar ratio of z to y is from 1.0 to 0.5 and x is at least 5, preferably from 7.5 to 276, more preferably from 10 to 264. The aluminosilicate material are in hydrated form and are preferably crystalline, containing from 10% to 28%, more preferably from 18% to 22% water in bound form.

The above aluminosilicate ion exchange materials are further characterised by a particle size diameter of from 0.1 to 10 micrometers, preferably from 0.2 to 4 micrometers. The term "particle size diameter" herein represents the average particle size diameter of a given ion exchange material as determined by conventional analytical techniques such as, for example, microscopic determination utilizing a scanning electron microscope or by means of a laser granulometer. The aluminosilicate ion exchange materials are further characterised by their calcium ion exchange capacity, which is at least 200 mg equivalent of $CaCO_3$ water hardness/g of aluminosilicate, calculated on an anhydrous basis, and which generally is in the range of from 300 mg eq./g to 352 mg eq./g. The aluminosilicate ion exchange materials herein are still further characterised by their calcium ion exchange rate which is at least 130 mg equivalent of $CaCO_3$/ litre / minute / (g/litre) [2 grains Ca^{++}/ gallon/ minute/ gram/ gallon)] of aluminosilicate (anhydrous basis), and which generally lies within the range of from 130 mg equivalent of $CaCO_3$/ litre/ minute/ (gram/litre) [2 grains/ gallon/ minute/ (gram/ gallon)] to 390 mg equivalent of $CaCO_3$/

litre/ minute/ (gram/litre) [4 grains/ gallon/ minute/ (gram/ gallon)], based on calcium ion hardness.

Optimum aluminosilicates for builder purposes exhibit a calcium ion exchange rate of at least 260 mg equivalent of $CaCO_3$/litre/ minute/ (gram/litre) [4 grains/gallon/minute/ (gram/ gallon)].

The aluminosilicate ion exchange materials can be naturally occurring materials, but are preferably synthetically derived. A method for producing aluminosilicate ion exchange materials is discussed in US Patent No. 3,985,669. Synthetic crystalline aluminosilicate ion exchange materials are available under the designations Zeolite A, Zeolite B, Zeolite P, Zeolite X, Zeolite HS and mixtures thereof. Zeolite A has the formula

$$Na_{12}[AlO_2)_{12}(SiO_2)_{12}]. xH_2O$$

wherein x is from 20 to 30, especially 27. Zeolite X has the formula $Na_{86}[(AlO_2)_{86}(SiO_2)_{106}]$. 276 H_2O has the formula $Na_6[(AlO_2)_6(SiO_2)_6]$ 7.5 H_2O).

Oxygen-releasing bleaching agent

The second essential feature of the invention is a bleaching agent selected from oxygen-releasing agents such as inorganic perhydrate salts, peroxyacid bleach precursors, organic peroxyacids and mixtures thereof.

Examples of inorganic perhydrate salts include perborate, percarbonate, perphosphate, persulfate and persilicate salts. The inorganic perhydrate salts are normally the alkali metal salts. The inorganic perhydrate salt may be included as the crystalline solid without additional protection. For certain perhydrate salts however, the preferred executions of such granular compositions utilize

a coated form of the material which provides better storage stability for the perhydrate salt in the granular product.

Sodium perborate, which is the most preferred perhydrate for inclusion in the detergent compositions in accordance with the invention, can be in the form of the monohydrate of nominal formula $NaBO_2H_2O_2$ or the tetrahydrate $NaBO_2H_2O_2.3H_2O$.

The perborate tetrahydrate species is preferred over the monohydrate species because of its slow disolution and therefore better controlled release of available oxygen.

Sodium percarbonate, which is another preferred perhydrate for inclusion in detergent compositions in accordance with the invention, is an addition compound having a formula corresponding to $2Na_2CO_3.3H_2O_2$, and is available commercially as a crystalline solid. The percarbonate is most preferably incorporated into such compositions in coated form. The most preferred coating material comprises mixed salt of an alkali metal sulphate and carbonate. Such coatings together with coating processes have previously been described in GB-1,466,799, granted to Interox on 9th March 1977. The weight ratio of the mixed salt coating material to percarbonate lies in the range from 1 : 200 to 1 : 4, more preferably from 1 : 99 to 1 : 9, and most preferably from 1 : 49 to 1 : 19. Preferably, the mixed salt is of sodium sulphate and sodium carbonate which has the general formula $Na_2SO_4.n.Na_2CO_3$ wherein n is form 0.1 to 3, preferably n is from 0.3 to 1.0 and most preferably n is from 0.2 to 0.5.
Another suitable coating material is sodium silicate of SiO_2 : Na_2O ratio from 1.6 : 1 to 3.4 : 1, preferably 2.8 : 1, applied as an aqueous solution to give a level of from 2% to 10%, (normally from 3% to 5%) of silicate solids by weight of the percarbonate. Magnesium silicate can also be included in the coating. Other suitable coating materials

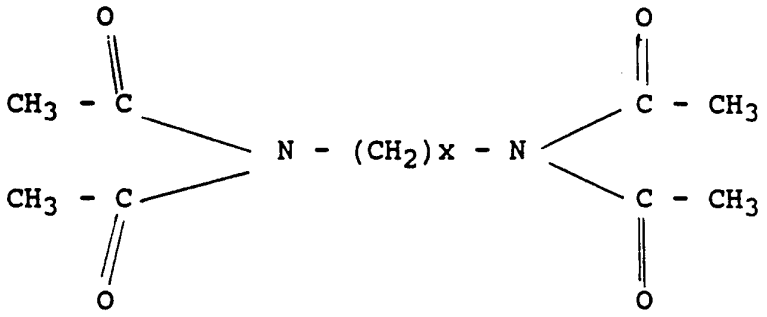
include the alkali and alkaline earth metal sulphates and carbonates.

Potassium peroxymonopersulfate is another inorganic perhydrate salt of particular usefulness in the machine dishwashing detergent compositions.

The level of inorganic perhydrate salt is typically from 2% to 25%, more preferably from 3.5% to 20% by weight of the total composition.

Peroxyacid bleach precursors are preferably used in combination with the above perhydrate salts. The bleach precursors useful herein contain one or more N- or O- acyl groups, which precursors can be selected from a wide range of classes. Suitable classes include anhydrides, esters, imides and acylated derivatives of imidazoles and oximes, and examples of useful materials within these classes are disclosed in GB-A-1586789. The most preferred classes are esters such as are disclosed in GB-A-836988, 864798, 1147871 and 2143231 and imides such as are disclosed in GB-A-855735 & 1246338.

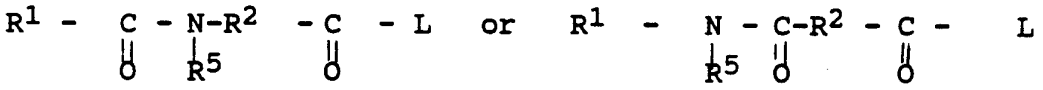
Particularly preferred precursor compounds are the N,N,N^1,N^1 tetra acetylated compounds of formula



wherein x can be O or an integer between 1 & 6.

Examples include tetra acetyl methylene diamine (TAMD) in which x=1, tetra acetyl ethylene diamine (TAED) in which x=2 and tetraacetyl hexylene diamine (TAHD) in which x=6. These and analogous compounds are described in GB-A-907356. The most preferred peroxyacid bleach precursor is TAED.

Another preferred class of peroxyacid bleach precursor compounds are the amide substituted compounds of the following general formulae:

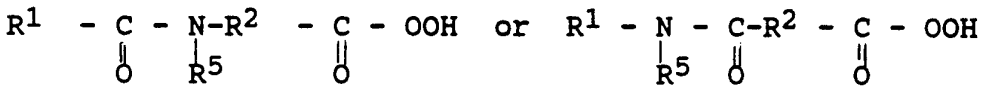


wherein R^1 is an aryl or alkaryl group with from about 1 to about 14 carbon atoms, R^2 is an alkylene, arylene, and alkarylene group containing from about 1 to 14 carbon atoms, and R^5 is H or an alkyl, aryl, or alkaryl group containing 1 to 10 carbon atoms and L can be essentially any leaving group. R^1 preferably contains from about 6 to 12 carbon atoms. R^2 preferably contains from about 4 to 8 carbon atoms. R^1 may be straight chain or branched alkyl, substituted aryl or alkylaryl containing branching, substitution, or both and may be sourced from either synthetic sources or natural sources including for example, tallow fat. Analogous structural variations are permissible for R^2. The substitution can include alkyl, aryl, halogen, nitrogen, sulphur and other typical substituent groups or organic compounds. R^5 is preferably H or methyl. R^1 and R^5 should not contain more than 18 carbon atoms total. Amide substituted bleach activator compounds of this type are described in EP-A-0170386.

Other peroxyacid bleach precursor compounds include sodium nonanoyloxy benzene sulfonate, sodium trimethyl hexanoyloxy benzene sulfonate and sodium acetoxy benzene sulfonate.

The peroxyacid bleach precursors are normally incorporated at levels up to 7% by weight of active material, more preferably from 1% to 5% by weight of active material, of the total composition.

The bleaching species herein may also contain organic peroxyacids of which a particularly preferred class are the amide substituted peroxyacids of general formula :



where R^1, R^2 and R^5 are as defined previously for the corresponding amide substituted peroxyacid bleach precursor compounds.

Other organic peroxyacids include diperoxy dodecanedioic acid, diperoxy tetra decanedioic acid, diperoxyhexadecanedioic acid, mono- and diperazelaic acid, mono- and diperbrassylic acid, monoperoxy phthalic acid, perbenzoic acid, and their salts as disclosed in, for example, EP-A-0341947.

The peroxyacids can be used at levels up to 7% by weight, more preferably from 1% to 5% by weight of the composition.

Total Available Oxygen (AvO) Level and Rate of Release of AvO

It has been found that, for optimal anti-silver tarnishing performance, the level of available oxygen in the present compositions, measured in units of % available oxygen by weight of the composition, should be carefully controlled; the level of available oxygen should be in the range from 0.3% to 2.5%, preferably from 0.5% to 1.7%, more preferably

from 0.6% to 1.2%, most preferably from 0.7% to 1.1%, measured according to the method described hereunder.

The rate of release of available oxygen is preferably also controlled; the rate of release of available oxygen from the compositions herein preferably should be such that, when using the method described hereinafter, the available oxygen is not completely released from the composition until after 3.5 minutes, preferably the available oxygen is released in a time interval of from 3.5 minutes to 10.0 minutes, more preferably from 4.0 minutes to 9.0 minutes, most preferably from 5.0 minutes to 8.5 minutes.

The control of available oxygen release rate can be achieved by various means.

Said means can include careful choice of the oxygen-releasing species on the basis of its having a suitable dissolution profile. And, in particular careful choice of particle size and grade of bleach to provide acceptable dissolution characteristics.

Said means can also include coating the bleaching agent with a coating designed to provide said controlled rate of release. The coating may therefore, for example, comprise a poorly water soluble material, or be a coating of sufficient thickness that the kinetics of dissolution of the thick coating provide the controlled rate of release.

The coating material may be applied using various methods. The coating material is typically present at a weight ratio of coating material to bleaching agent of from 1:99 to 1:2, preferably from 1:49 to 1:9.

A preferred coating material comprises the paraffin oil herein.

A particularly preferred coated bleaching agent particle comprises a bleaching agent, preferably an inorganic perhydrate salt particle, with a dual coating comprising an inner wax (paraffin) coating and an outer silica coating, wherein the wax (paraffin) typically has a melting point in the range 50°C to 90°C. This dual coating allows for improved particle flow and for improved control over rate of dissolution in the wash solution.

One method for applying the coating material involves agglomeration. Any conventional agglomerator/mixer may be used including but not limted to pan, rotary drum and vertical blender types. Molten coating compositions may also be applied either by being poured onto, or spray atomized onto a moving bed of bleaching agent.

Other means of providing controlled release may include mechanical means for altering the physical characteristics of the bleaching agent to control its solubility and rate of release, particularly for oxygen bleach compounds in dry form; suitable protocols could include compaction, mechanical injection, manual injection, solubility adjustment of the bleaching compound by selected particle size etc. Compaction of the oxygen bleaching agent is a particularly preferred means of control of rate of release of oxygen herein. Additional protocols could include ionic strength adjustment for regulating the rate of dissolution of the bleaching compound.

A further controlled release means could involve blending of the bleaching compound with a less soluble or hydrophobic compound acting as a carrier, for example clays, zeolite, polymeric resins etc.

The rate of release can be measured according to the method now described:

Method for Measuring Level of Total Available Oxygen (AvO) and Rate of Release, in a Machine Dishwashing Detergent Composition

Method

1. A beaker of water (typically 2L) is placed on a stirrer Hotplate, and the stirrer speed is selected to ensure that the product is evenly dispersed through the solution.

2. The detergent composition (typically 8g of product which has been sampled down from a bulk supply using a Pascal sampler), is added and simultaneously a stop clock is started.

3. The temperature control should be adjusted so as to maintain a constant temperature of 20°C throughout the experiment.

4. Samples are taken from the detergent solution at 2 minute time intervals for 20 mins, starting after 1 minute, and are titrated by the "titration procedure" described below to determine the level of available oxygen at each point.

Titration Procedure

1. An aliquot from the detergent solution (above) and 2ml sulphuric acid are added into a stirred beaker

2. Approximately 0.2g ammonium molybdate catalyst (tetra hydrate form) are added

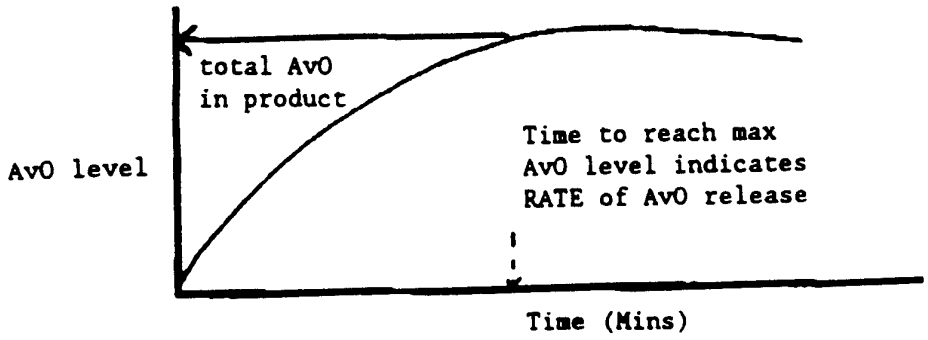
3. 3mls of 10% sodium iodide solution are added

4. Titration with sodium thiosulphate is conducted until the end point. The end point can be seen using either of two procedures. First procedure consists simply in seeing the yellow iodine colour fading to clear. The second and preferred procedure consists of adding soluble starch when the yellow colour is becoming faint, turning the solution blue. More thiosulphate is added until the end point is reached (blue starch complex is decolourised).

The level of AvO, measured in units of % available oxygen by weight, for the sample at each time interval corresponds to the amount of titre according to the following equation

$$AvO = \frac{\text{Vol } S_2O_3 \text{ (ml)}}{1} \times \text{Molarity} \times \frac{1}{2} \times \frac{16}{1} \times \frac{1}{\text{sample mass (g)}}$$

AvO level is plotted versus time as follows



The paraffin oil

The present compositions must contain from 0.05% to 2.5%, preferably from 0.1% to 0.6% by weight of the total composition of a paraffin oil typically a predominantly branched aliphatic hydrocarbon having a number of carbon atoms in the range of from 20 to 50; preferred paraffin oil

selected from predominantly branched C_{25-45} species with a ratio of cyclic to noncyclic hydrocarbons of from 1:10 to 2:1, preferably from 1:5 to 1:1. A paraffin oil meeting these characteristics, having a ratio of cyclic to noncyclic hydrocarbons of about 32:68, is sold by Wintershall, Salzbergen, Germany, under the trade name WINOG 70.

The heavy metal ion sequestrant

It is an essential feature of the detergent compositions of the invention that they further contain narrowly defined levels of a heavy metal ion sequestrant, such levels being in the range 0.005% to 3%, preferably 0.01 to 1%, most preferably 0.05% to 0.8%, by weight of the total composition.

Suitable heavy-metal sequestrant for use herein include organic phosphonates, such as amino alkylene poly (alkylene phosphonate), alkali metal ethane 1-hydroxy disphosphonates, nitrilo trimethylene phosphonates.

Preferred among above species are diethylene triamine penta (methylene phosphonate), hexamethylene diamine tetra (methylene phosphonate) and hydroxy-ethylene 1,1 diphosphonate.

The phosphonate compounds may be present either in their acid form or as a complex of either an alkali or alkaline metal ion, the molar ratio of said metal ion to said phosphonate compound being at least 1:1. Such complexes are described in US-A-4,259,200. Preferably, the organic phosphonate compounds are in the form of their magnesium salt.

Other suitable sequestrant for inclusion in the compositions in accordance with the invention include

nitrilotriacetic acid and polyaminocarboxylic acids such as ethylenediaminotetracetic acid, ethylenetriamine pentacetic acid, ethylenediamine disuccinic acid or the water soluble alkali metal salts thereof. Especially preferred is ethylenediamine-N,N'-disuccinic acid (EDDS) or the alkali metal, alkaline earth metal, ammonium, or substituted ammonium salts thereof, or mixtures thereof. Preferred EDDS compounds are the free acid form and the sodium or magnesium salt or complex thereof. Examples of such preferred sodium salts of EDDS include Na_2EDDS and Na_3EDDS. Examples of such preferred magnesium complexes of EDDS include MgEDDS and Mg_2EDDS. The magnesium complexes are the most preferred for inclusion in compositions in accordance with the invention.

Still other suitable sequestrants for use herein are iminodiacetic acid derivatives such as 2-hydroxyethyl diacetic acid or glyceryl imino diacetic acid, described in EPA 317 542 and EPA 399 133.

The heavy metal ion sequestrant herein can consist of a mixture of the above described species.

Optional Ingredients

In addition to the essential ingredients described hereinabove, the compositions of the invention may comprise additional ingredients, which are often quite desirable ones.

Optional chlorine bleach components

Chlorine bleaches include the alkali metal hypochlorites and chlorinated cyanuric acid salts. The use of chlorine bleaches in the composition of the invention is optional and preferably minimized, and more preferably the present compositions contain no chlorine bleach.

A highly preferred component of the compositions of the invention is a surfactant system comprising surfactant selected from anionic, cationic, nonionic ampholytic and zwitterionic surfactants and mixtures thereof. The surfactant system is preferably present at a level of from 0.5% to 30% by weight, more preferably 1% to 25% by weight, most preferably from 2% to 20% by weight of the compositions.

A typical listing of anionic, nonionic, ampholytic and zwitterionic classes, and species of these surfactants, is given in U.S.P. 3,929,678 issued to Laughlin and Heuring on December, 30, 1975. A list of suitable cationic surfactants is given in U.S.P. 4,259,217 issued to Murphy on March 31,1981. A listing of surfactants typically included in automatic dishwashing detergent compositions is given in EP-A-0414 549.

Sulphonate and sulphate surfactants are useful herein. Sulphonates include alkyl benzene sulphonates having from 5 to 15 carbon atoms in the alkyl radical, and alpha-sulphonated methyl fatty acid testers in which the fatty acid is derived from a C_6-C18 fatty source. Preferred sulphate surfactants are alkyl sulphates having from 6 to 16, preferably 6 to 10 carbon atoms in the alkyl radical.

Useful surfactant system comprises a mixture of two alkyl sulphate materials whose respective mean chain lengths differ from each other. The cation in each instance is again an alkali metal, preferably sodium.The alkyl sulfate salts may be derived from natural or synthetic hydrocarbon sources.

The C_6-C_{16} alkyl ethoxysulfate salt comprises a primary alkyl ethoxysulfate which is derived from the condensation product of a C_6-C_{16} alcohol condensed with an average of

from one to seven ethylene oxide groups, per mole. Preferred are the C_6-C_{10} alkyl ethoxysulfate salts with an average of from one to five ethoxy groups per mole.

Other anionic surfactants suitable for the purposes of the invention are the alkali metal sarcosinates of formula

$$R\text{-}CON\ (R^1)\ CH_2\ COOM$$

wherein R is a C_5-C_{17} linear or branched alkyl or alkenyl group, R^1 is a C_1-C_4 alkyl group and M is an alkali metal ion. Preferred examples are the lauroyl, Cocoyl (C_{12}-C_{14}), myristyl and oleyl methyl sarcosinates in the form of their sodium salts.

Another class of anionic surfactants useful herein are the alkyl ester sulfonate surfactants which include linear esters of C_8-C_{20} carboxylic acids (i.e., fatty acids) which are sulfonated with gaseous SO_3 according to "The Journal of the American Oil Chemists Society," 52 (1975), pp. 323-329. Suitable starting materials would include natural fatty substances as derived from tallow, palm oil, etc.

The preferred alkyl ester sulfonate surfactants have the structural formula:

$$R^3 - \underset{SO_3M}{CH} - \overset{O}{\overset{\|}{C}} \quad OR^4$$

wherein R^3 is a C_8-C_{20} hydrocarbyl, preferably an alkyl, or combination thereof, R^4 is a C_1-C_6 hydrocarbyl, preferably an alkyl, or combination thereof, and M is a cation which forms a water soluble salt with the alkyl ester sulfonate. Suitable salt-forming cations include metals such as sodium, potassium, and lithium, and substituted or unsubstituted ammonium cations, such as monoethanolamine, diethanolamine, and triethanolamine. Preferably, R^3 is C_{10}-C_{16} alkyl, and $R^4$is methyl, ethyl or isopropyl. Especially preferred are the methyl ester sulfonates wherein R^3 is C_{10}-C_{16} alkyl.

One preferred class of nonionic surfactants useful in the present invention comprises the water soluble ethoxylated C_6-C_{16} fatty alcohols and C_6-C_{16} mixed ethoxylated/propoxylated fatty alcohols and mixtures thereof. Preferably the ethoxylated fatty alcohols are the C_{10}-C_{16} ethoxylated fatty alcohols with a degree of ethoxylation of from 3 to 50, most preferably these are the C_{12}-C_{16} ethoxylated fatty alcohols with a degree of ethoxylation from 3 to 40. Preferably the mixed ethoxylated/propoxylated fatty alcohols have an alkyl chain length of from 10 to 16 carbon atoms, a degree of ethoxylation of from 3 to 30 and a degree of propoxylation of from 1 to 10.

Thus C6-C16 alcohol itself can be obtained from natural or synthetic sources. Thus, C6-C16 alcohols, derived from natural fats, or Ziegler olefin build-up, or OXO synthesis can form suitable sources for the alkyl group. Examples of synthetically derived materials include Dobanol 25 (RTM) sold by Shell Chemicals (UK) Ltd which is a blend of C_{12}-C_{15} alcohols, Ethyl 24 sold by the Ethyl Corporation which is a blend of C_{12}-C_{15} alcohols, and a blend of C_{13}-C_{15} alcohols in the ratio 67% C_{13}, 33% C_{15} sold under the trade name Lutensol by BASF GmbH and Synperonic (RTM) by ICI Ltd., and Lial 125 sold by Liquichimica Italiana. Examples of naturally occuring materials from which the alcohols can be derived are coconut oil and palm kernel oil and the corresponding fatty acids.

Another class of nonionic surfactants comprises alkyl polyglucoside compounds of general formula

$$RO\ (C_nH_{2n}O)_tZ_x$$

wherein Z is a moiety derived from glucose; R is a saturated hydrophobic alkyl group that contains from 6 to 16 carbon atoms preferably from 6 to 14 carbon atoms; t is from 0 to 10 and n is 2 or 3; x is from 1.1 to 4, the compounds including less than 10% unreacted fatty alcohol and less than 50% short chain alkyl polyglucosides. Compounds of this type and their use in detergent compositions are disclosed in EP-B 0070074, 0070077, 0075996 and 0094118.

Another preferred nonionic surfactant is a polyhydroxy fatty acid amide surfactant compound having the structural formula:

$$R^2 - \overset{O}{\overset{\|}{C}} - \overset{R^1}{N} - Z$$

wherein R^1 is H, C_1-C_4 hydrocarbyl, 2-hydroxy ethyl, 2-hydroxy propyl, or a mixture thereof, preferably C_1-C_4 alkyl, more preferably C_1 or C_2 alkyl, most preferably C_1 alkyl (ie., methyl); and R^2 is a C_5-C_{15} hydrocarbyl, preferably straight chain C_5-C_{13} alkyl or alkenyl, more preferably straight chain C_5-C_{11} alkyl or alkenyl, most preferably straight chain C_5-C_9 alkyl or alkenyl, or mixture thereof: and Z is a polyhydroxyhydrocarbyl having linear hydrocarbyl chain with at least 3 hydroxyls directly connected to the chain, or an alkoxylated derivative (preferably ethoxylated or propoxylated) thereof. Z preferably will be derived from a reducing sugar in a reductive amination reaction; more preferably Z is a glycityl. Suitable reducing sugars include glucose, fructose, maltose, lactose, galactose, mannose, and xylose. As raw materials, high dextrose corn syrup, high fructose corn syrup, and high maltose corn syrup can be utilized as well as the individual sugars listed above. These corn syrups may yield a mix of sugar components for Z. It should be understood that it is by no means intended to

exclude other suitable raw materials. Z preferably will be selected from the group consisting of $-CH_2-(CHOH)_n-CH_2OH$, $-CH(CH_2OH)-(CHOH)_{n-1}-CH_2OH$, $-CH_2-(CHOH)_2(CHOR')(CHOH)-CH_2OH$, where n is an integer from 3 to 5, inclusive, and R' is H or a cyclic or aliphatic monosaccharide, and alkoxylated derivatives thereof. Most preferred are glycityls wherein n is 4, particularly - $CH_2-(CHOH)_4-CH_2OH$.

In Formula (I), R^1 can be, for example, N-methyl, N-ethyl, N-propyl, N-isopropyl, N-butyl, N-2-hydroxy ethyl, or N-2-hydroxy propyl.

$R^2-CO-N<$ can be, for example, cocamide, stearamide, oleamide, lauramide, myristamide, capricamide, palmitamide, or tallowamide.

Z can be 1-deoxyglucityl, 2-deoxyfrucittyl, 1-deoxymaltityl, 1-deoxylactityl, 1-deoxygalactityl or 1-deoxymannityl, or 1-deoxymalto-triotityl. Preferred compounds are N-methyl N-1deoxyglucityl $C_{14}-C_{18}$ fatty acid amides.

A further class of surfactants are the semi-polar surfactants such as amine oxides. Suitable amine oxides are selected from mono C_6-C_{20}, preferably C_6-C_{10} N-alkyl or alkenyl amine oxides and propylene-1,3-diamine dioxides wherein the remaining N positions are substituted by methyl, hydroxyethyl or hydroxpropyl groups.

Cationic surfactants can also be used in the detergent compositions herein and suitable quaternary ammonium surfactants are selected from mono C_6-C_{16}, preferably C_6-C_{10} N-alkyl or alkenyl ammonium surfactants wherein remaining N positions are substituted by methyl, hydroxyethyl or hydroxypropyl groups.

Another optional ingredient useful in detergent compositions is one or more enzymes.

Preferred enzymatic materials include amylases, neutral and alkaline proteases, lipases, and esterases conventionally incorporated into detergent compositions. Suitable enzymes are discussed in US Patents 3,519,570 and 3,533,139.

Preferred commercially available protease enzymes include those sold under the tradenames Alcalase and Savinase by Novo Industries A/S (Denmark) and Maxatase by International Bio-Synthetics, Inc. (The Netherlands). Protease enzyme may be incorporated into the compositions in accordance with the invention at a level of from 0.005% to 2% active enzyme by weight of the composition.

Preferred amylases include, for example, -amylases obtained from a special strain of B licheniforms, described in more detail in GB 1,269,839 (Novo). Preferred commercially available amylases include for example, Rapidase, sold by International Bio-Synthetics Inc, and Termamyl, sold by Novo Industries A/S. The invention at a level of from 0.001% to 2% active enzyme by weight of the composition.

A preferred lipase is derived from Pseudomonas pseudoalcaligenes, which is described in Granted European Patent, EP-B-0218272.

Another preferred lipase herein is obtained by cloning the gene from Humicola lanuginosa and expressing the gene is Aspergillus oryza, as host, as described in European Patent Application, EP-A-0258068, which is commercially available from Novo Industri A/S, Bagsvaerd, Denmark, under the trade name Lipolase. This lipase is also described in U.S. Patent 4,810,414, Huge-Jensen et al, issued March 7, 1989.

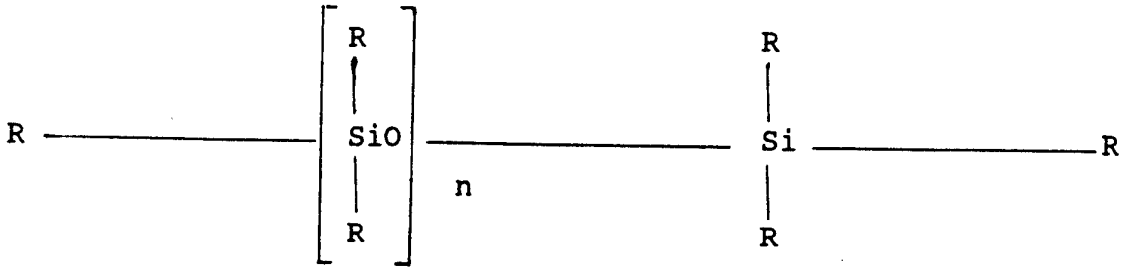
Another optional ingredient is a lime soap dispersant compound, present at a level of from 0.05% to 40% by weight, more preferably 0.1% to 20% by weight, most preferably from 0.25% to 10% by weight of the compositions.

A lime soap dispersant is a material that prevents the precipitation of alkali metal, ammonium or amine salts of fatty acids by calcium or magnesium ions. Preferred lime soap dispersants include C13-15 ethoxylated alcohol sulphates with an average degree of ethoxylation of 3.

Another optional component of the detergent compositions of the invention is a silicone suds controlling agent present at levels of from 0.01% to 5% by weight, more preferably from 0.05% to 3% by weight, most preferably from 0.05% to 1% by weight of the composition.

By silicone suds controlling agent it is meant any suds controlling agent which comprises a silicone antifoam compound. Thus silicone suds controlling agents include agents containing silicone-silica mixtures and particulates in which the silicone, or silicone-silica mixture, is incorporated in a water-soluble or water-dispersible carrier material. Alternatively, the silicone suds controlling agents may comprise silicone, or silicone-silica mixutes dissolved or dispersed in a liquid carrier and applied by spraying on to one or more of the other components of the detergent composition.
In industrial practice the term "silicone" has become a generic term which encompasses a variety of relatively high molecular weight polymers containing siloxane units and hydrocarbyl group of various types.

Generally, the silicone antifoam compounds can be described as siloxanes having the general structure :



where each R independently can be an alkyl or an aryl radical. Examples of such substituents are methyl, ethyl, propyl, isobutyl, and phenyl. Preferred polydiorganosiloxanes are polydimethylsiloxanes having trimethylsilyl endblocking units and having a viscosity at 25°C of from 5 x 10^{-5} m^2/s to 0.1m^2/s i.e. a value of n in the range 40 to 1500. These are preferred because of their ready availability and their relatively low cost.

A preferred type of silicone suds controlling agent useful in the compositions herein comprises a mixture of an alkylated siloxane of the type hereinabove disclosed and solid silica.

The solid silica can be a fumed silica, a precipitated silica or a silica made by the gelformation technique. The silica particles suitable have an average particle size of from 0.1 to 50 micrometers, preferably from 1 to 20 micrometers and a surface area of at least 50m^2/g. These silica particles can be rendered hydrophobic by treating them with dialkylsilyl groups and/or trialkylsilyl groups either bonded directly onto the silica or by means of a silicone resin. It is preferred to employ a silica the particles of which have been rendered hydrophobic with dimethyl and/or trimethyl silyl groups. The suds controlling agents for inclusion in the detergent compositions in accordance with the invention suitably contain an amount of silica such that the weight ratio of

silica to silicone lies in the range from 1:100 to 3:10, preferably from 1:50 to 1:7.

A preferred silicone suds controlling agent is represented by a hydrophobic silanated (most preferably trimethyl-silanated)silica having a particle size in the range from 10 nanometers to 20 nanometers and a specific surface area above 50 m^2/g, intimately admixed with dimethyl silicone fluid having a molecular weight in the range from about 500 to about 200,000 at a weight ratio of silicone to silanated silica of from about 1:1 to about 1:2.

Another preferred silicone suds controlling agent is disclosed in Bartollota et Al. US Patent 3,933,672. Other particularly useful suds suppressors are the self-emulsifying silicone suds suppressors, described in German Patent Application DTOS 2,646,126 published April 28, 1977. An example of such a compound is DC0544, commercially available from Dow Corning, which is a siloxane/glycol copolymer.

A highly preferred silicone suds controlling agent is a particulate of the type disclosed in EP-A-0210731 comprising a silicone antifoam and an organic material having a melting point in the range 50° to 85°C, wherein the organic material comprises a monoester of glycerol and a fatty acid having a carbon chain containing from 12 to 20 carbon atoms. EP-A-0210721 discloses similar particulate suds controlling agents wherein the organic material however, is a fatty acid or alcohol having a carbon chain containing from 12 to 20 carbon atoms, or a mixture thereof, with a melting point of from 45°C to 80°C.

Other highly preferred silicone suds controlling agents are described in copending European Application 91870007.1 in the name of the Procter and Gamble Company which discloses granular suds controlling agents comprising a silicone

antifoam compound, a carrier material an organic coating material and glycerol at a weight ratio of glycerol: silicone antifoam compound of 1:2 to 3:1. Copending European Application 91201342.0 also discloses highly preferred granular suds controlling agents comprising a silicone antifoam compound, a carrier material, an organic coating material and crystalline or amorphous aluminosilicate at a weight ratio of aluminosilicate: silicone antifoam compound of 1:3 to 3:1. Ther preferred carrier material in both of the above described highly preferred granular suds controlling agents is starch.

The preferred methods of incorporation of the silicone suds controlling agents comprise either application of the silicone suds controlling agent in liquid form by spray-on to one or more of the major components of the composition or alternatively the formation of the silicone suds controlling agents into separate particulates that can then be mixed with the other solid components of the composition. The incorporation of the suds controlling agents as separate particulates also permits the inclusion therein of other suds controlling materials such as C_{20}-C_{24} fatty acids, microcrystalline waxes and high MWt copolymers of ethylene oxide and propylene oxide which would otherwise adversely affect the dispersibility of the matrix. Techniques for forming such suds controlling particulates are disclosed in the previously mentioned Bartolotta et al US Patent No. 3,933,672.

Other optional ingredients suitable for inclusion in the compositions of the invention include antiredeposition, and soil-suspension agents, corrosion inhibitors, perfumes, colours and filler salts, with sodium sulfate being a preferred filler salt.

Form of the compositions

The compositions of the invention can be formulated in any desirable form such as powders, granulates, pastes, liquids, gels and tablets, granular forms being preferred.

The bulk density of the granular detergent compositions in accordance with the present invention is typically of at least 650 g/litre, more usually at least 700 g/litre and more preferably from 800 g/litre to 1200 g/litre.

Bulk density is measured by means of a simple funnel and cup device consisting of a conical funnel moulded rigidly on a base and provided with a flap valve at its lower extremity to allow the contents of the funnel to be emptied into an axially aligned cylindrial cup disposed below the funnel. The funnel is 130 mm and 40 mm at its respective upper and lower extremities. It is mounted so that the lower extremity is 140 mm above the upper surface of the base. The cup has an overall height of 90 mm, an internal height of 87 mm and an internal diameter of 84 mm. Its nominal volume is 500 ml.

To carry out a measurement, the funnel is filled with powder by hand pouring, the flap valve is opened and powder allowed to overfill the cup. The filled cup is removed from the frame and excess powder removed from the cup by passing a straight edged implement e.g. a knife, across its upper edge. The filled cup is then weighed and the value obtained for the weight of powder doubled to provide the bulk density in g/litre. Replicate measurements are made as required.

The particle size of the components of granular compositions in accordance with the invention should preferably be such that no more that 5% of particles are

greater than 1.4mm in diameter and not more than 5% of particles are less than 0.15mm in diameter.

Generally, if the detergent compositions are in liquid form the liquid should be thixotropic (ie; exhibit high viscosity when subjected to low stress and lower viscosity when subjected to high stress), or at least have very high viscosity, for example, of from 1,000 to 10,000,000 centipoise. In many cases it is desirable to include a viscosity control agent or a thixotropic agent to provide a suitable liquid product form. Suitable thixotropic or viscosity control agents include methyl cellulose, carboxymethylcellulose, starch, polyvinyl, pyrrolidone, gelatin, colloidal silica, and natural or synthetic clay minerals.

Pasty compositions in accordance with the invention generally have viscosities of about 5,000 centipoise and up to several hundred million centipoise. In order to provide satisfaction pasty compositions a small amount of a solvent or solubilizing agent or of a gel-forming agent can be included. Most commonly, water is used in this context and forms the continuous phase of a concentrated dispersion. Certain nonionic surfactants at high levels form a gel in the presence of small amount of water and other solvents. Such gelled compositions also envisaged in the present invention.

pH of the compositions

The pH of a 1% solution of the present compositions is preferably from 9.6 to 12, preferably from 9.8 to 11.5, most preferably from 10.0 to 11.0.

Making process for the compositions herein

A preferred making process for the compositions herein comprises pre-mixing of the paraffin oil with a dispersing agent and the resultive intimate pre-mix being sprayed onto the remainder of the composition. The dispersing agent can advantageously consist of a nonionic surfactant such as described hereinabove, which therefore serves two functions in the present composition.

A preferred dispersing agent is Plurafac LF404 sold by BASF.

An alternate route consists in spraying the intimate mixture of paraffin oil and dispersing agent onto the particles of bleaching agent, resulting in a reduction in the rate of dissolution in water of said bleaching agent and therefore providing a control over the rate of release of available oxygen. The coated particles of bleaching agent are then dry-mixed with the remainder of the composition.

In another process embodiment herein, the particle of bleaching agents are compacted before being dry-mixed with the remainder of the composition . This technique slows down the dissolution rate in water, and is therefore advantageously applied to otherwise fast dissolving species like perborate monohydrate.

In this embodiment, the paraffin oil is typically compacted along with the bleaching species, and optionally other ingredients like sodium sulphate and/or binders. The resulting particles are then dry-mixed with the remainder of the ingredients.

EXAMPLES

The following examples illustrate the present invention.

In the following detergent compositions, the abbreviated identifications have the following meanings:

Citrate:	Tri-Sodium citrate dihydrate
Phosphate:	Sodium tripolyphosphate
MA/AA:	Copolymers of 1:4 maleic/acrylic acid, average molecular weight about 80,000
Silicate:	Amorphous Sodium Silicate (SiO_2:Na_2O ratio normally follows)
Protease:	Proteolytic enzyme sold under the trade name Savinase by Novo Industries A/S
Amylase:	Amylolytic enzyme sold under the trade name Termamyl by Novo Industries A/S
Nonionic:	C_{13}-C_{15} mixed ethoxylated/propoxylated fatty alcohol with an average degree of ethoxylation of 3.8 and an average degree of propoxylation of 4.5 sold under the trade name Plurafac LF404 by BASF GmbH.
Anionic :	C_{6-10} alkyl ethoxysulfate with 1-5 ethoxy groups per mole
Sulphate:	Anhydrous Sodium Sulphate
Suds suppressor:	12% silicone/silica, 18% stearyl alcohol, 70% starch, in granular form
TAED:	Tetraacetyl ethylene diamine
DTPMP :	Diethylene triamine penta (methylene phosphonic acid)
EDDS :	Ethylene diamine-N,N disuccinic acid [S,S isomer]

The following machine dishwashing detergent compositions according to the invention are prepared (parts by weight):

Ingredients	Parts by weight I	II	III
citrate	38.0	35.0	40.0
MA/AA	4.0	6.0	2.0
2 ratio silicate (2.0 ratio)	26.0	30.0	20.0
AvO level	0.8	0.8	1.0
Perborate monohydrate (1)	-	5.05	-
Perborate tetrahydrate	8.0	-	9.0
TAED	3.8	2.2	3.0
Paraffin oil (2)	0.5	0.5	0.3
Protease	2.0	2.5	2.2
Amylase	1.5	0.5	1.0
Lipase	-	-	2.0
Nonionic (3)	1.5	1.0	1.5
Anionic	-	3.0	-
DTPMP	0.1	0.2	0.1
EDDS	-	-	0.1
Limesoap dispersant (4)	-	-	2.5
Suds suppressor	-	1.0	-
Sulphate	balance to 100		
pH	10.7	10.7	10.7

(1) Pre-compacted before incorporation

(2) WINOG 70 ex Wintershall

(3) Pre-mixed with the paraffin oil before incorporation

(4) Lutensol AO12 ex BASF

Comparative testing 1

The following comparative testing was conducted; the composition of Example I was compared for anti-silver tarnishing performance, to Compositions A and B. Composition A contains no paraffin oil or heavy metal ion sequestrant. Composition B contains paraffin but no heavy metal ion sequestrant.

Ingredients	Parts by weight		
	Example I	Composition A	Composition b
citrate	38.0	38.0	38.0
MA/AA	4.0	4.0	4.0
2 ratio silicate (2.0 ratio)	26.0	26.0	26.0
AvO level	0.8	1.5	0.8
Perborate monohydrate	-	11.0	-
Perborate tetrahydrate	8.0	-	8.0
TAED	3.8	2.5	3.8
Paraffin oil	0.5	-	0.5
DTPMP	0.13	-	-
Protease	2.0	2.0	2.0
Amylase	1.5	1.5	1.5
Nonionic	1.5	1.5	1.5
Sulphate	--------	balance to	100 ----

The test protocol employed comprised machine testing, using a Bosch Siemens dishwasher, 20g product dosage, 65°C economy cycles, and 20 cycles.

Performance was graded by 4 expert panellists through visual inspection according to the following scale :

where 0 = no tarnish (shiny silver)
1 = very slight tarnish
2 = tarnish
3 = very tarnished
4 = severe tarnish (black coverage)

Results were as follows : (average of the 4 gradings from the panellists)

Example I	Comp. A	Comp. B
0.5	4.0	1.5

The composition of Example I shows superior anti-silver tarnishing performance over Compositions A and B, in accord with the invention.

WHAT IS CLAIMED IS:

1. A detergent composition containing
   - from 1% to 80% by weight of detergent builder compound
   - an oxygen-releasing bleaching agent such that the level of available oxygen in the composition measured according to the method herein is from 0.3% to 2.5%
   - from 0.05% to 2.5% by weight of a paraffin oil
   - from 0.005% to 3% by weight of a heavy metal ion sequestrant.

2. A composition according to claim 1 wherein the paraffin oil is present at a level of from 0.1% to 0.6% by weight.

3. A composition according to claims 1-2 wherein the paraffin oil is selected from predominantly branched aliphatic hydrocarbons having from 20 to 50, preferably 25 to 45 carbon atoms, with a ratio of cyclic to noncyclic hydrocarbons of from 1:5 to 1:1.

4. A composition according to claims 1-3 wherein the heavy metal ion sequestrant is present at levels of from 0.01% to 1% by weight.

5. A composition according to claims 1-3 wherein the heavy metal ion sequestrant is present at levels of from 0.05% to 0.8% by weight.

6. A composition according to claims 1-5 wherein the heavy metal ion sequestrant is an organic phosphonate.

7. A composition according to claims 1-6 wherein said level available oxygen is from 0.5% to 1.7%.

8. A composition according to claims 1-7 wherein the rate of release of the available oxygen is such that the available oxygen is completely released from the composition in a time interval of from 3.5 minutes to 10 minutes, using the test protocol described in the present description.

9. A composition according to claims 1-8 wherein the bleaching agent comprises in combination an inorganic perhydrate salt and a peroxyacid bleach precursor.

10. A composition according to claims 1-9 which has a pH in the range of 9.6 to 12.

INTERNATIONAL SEARCH REPORT

In. .ational application No.
PCT/US94/00570

A. CLASSIFICATION OF SUBJECT MATTER

IPC(5) :C11D 7/18, 7/24, 7/36; C23G 1/18
US CL :252/104, 139, 388
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)

U.S. : 252/104, 139, 388

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

NONE

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

NONE

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US, A, 4,237,024 (FEDECHKO) 02 DECEMBER 1980.	NONE
A	US, A, 4,568,476 (KIELMAN et al) 04 FEBRUARY 1986.	NONE
A	US, A, 4,619,779 (HARDY) 28 OCTOBER 1986.	NONE
A	US, A, 4,620,936 (KIELMAN et al.) 04 NOVEMBER 1986.	NONE
A	US, A, 4,820,440 (HEMM et al.) 11 APRIL 1989.	NONE
A	US, A, 4,859,358 (GABRIEL) 22 AUGUST 1989.	NONE
A	US, A, 5,045,225 (ARONSON et al.) 03 SEPTEMBER 1991.	NONE

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

*	Special categories of cited documents:	"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
"A"	document defining the general state of the art which is not considered to be of particular relevance	"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
"E"	earlier document published on or after the international filing date	"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
"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)	"&"	document member of the same patent family
"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		

Date of the actual completion of the international search	Date of mailing of the international search report
21 MARCH 1994	18 APR 1994
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231	Authorized officer DENNIS L. ALBRECHT
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