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(54) DENTIFRICE COMPOSITIONS

(71) We, UNILEVER LIMITED, a company organised under the laws of Great Britain, of Unilever House, Blackfriars, London, E.C.4, England, do hereby declare the invention for which we pray that a patent may be granted to us and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to dentifrice compositions.

In our application 1,186,706 (which will hereinafter be referred to as the previous application) there is described a dentifrice composition containing as the sole or principal cleansing and polishing ingredient from 5% to 50% by weight of the dentifrice of particulate dehydrated silica gel having an average particle diameter in the range from 2 to 20 microns and a surface area of at least 600 square metres per gram. The dehydrated silica gels therein defined have a good cleansing ability and impart a high lustre to dental enamel without excessively abrading the tooth enamel structure. In the Examples 1 to 4 of the previous application various toothpaste formulae are given all containing Syloid 63, a silica xerogel having an average particle diameter in the range 8 to 13 microns, typically about 10 microns, and a surface area of about 700 square metres per gram.

It has now been found that a wide range of synthetic, amorphous, porous silica xerogels are effective as dentifrice cleansing and polishing agents and have, unexpectedly, low abrasiveness towards tooth enamel.

Thus improved silica-containing dentifrice compositions of the invention are those containing as a cleansing and polishing ingredient a synthetic, amorphous, porous silica xerogel having an average particle diameter in the range from 2 to 20 microns in an amount sufficient to give the dentifrice a dentin abrasion of at least 15 units as measured by the test described hereinafter.

Heretofore, the literature has disclosed the use of different natural and synthetic silicas as abrasives and polishing agents in various compositions, including toothpaste, either alone or together with other polishing agents (see, for example, German Patent 974,958; British Patent 995,351; Swiss Patent 280,671 and US Patent 3,250,680). Among such silicas, the natural materials having crystalline structure, e.g., quartz, tend to be unduly abrasive due to the hardness and the sharpness of the particles, thus inherently scratching or excessively abrading away tooth enamel when used in dentifrice applications. Other natural silicas, e.g., diatomaceous earth and glasses, having an amorphous structure, are difficult to obtain commercially in uniform size and tend to be excessively impure for cosmetic or dentifrice use. Further, some of the amorphous natural silicas also tend to be highly abrasive and thus unsuitable for dentifrice use.

The synthetic amorphous silicas suggested by the prior art, such as precipitated silicas, pyrogenic silicas, and aerogels, are also undesirable for dentifrice use either because of their initial small particle sizes or because of the ease in which they break down into small particle sizes resulting in poor cleaning ability. Thus pyrogenic silicas, e.g., the product marketed under the trademark Cabosil, show substantially no cleaning ability on human teeth when incorporated in a dentifrice paste base.

The synthetic and natural crystalline silicas, which are also suggested in the prior art, are too hard to be safely used in a dentifrice as the major abrasive component.

Considering that the intrinsic hardness (Mohs hardness) of silica particles ranges from 7 for crystalline material to about 5 for amorphous material, as compared to the softer tooth enamel and dentin, having values of 4—5 and 2—2.5, respectively, it is not surprising that the use of silicas as cleaning and polishing agents in dentifrices has not heretofore become widespread.

In accordance with the present invention there are provided dentifrice compositions containing as a cleansing and polishing ingredient a synthetic, amorphous, porous silica xerogel having an average particle diameter in the

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range from 2 to 20 microns, and preferably in the range from 3 to 15 microns. This silica is present in the dentifrice compositions in an amount sufficient to give the dentifrice a dentin abrasion value of at least 15 units as measured by the test described hereinafter, whereby the dentifrice provides good cleaning and polishing of the teeth.

Lesser amounts than contemplated will fail to furnish the desired polishing and cleaning effect as manifest when the dentin abrasion value is below the minimum set forth herein. The amount of silica xerogel sufficient to give the dentifrice a dentin abrasion value of at least 15 units generally lies in the range from 5% to 50% by weight of the total dentifrice and the preferred range is from 8% to 20% by weight of the dentifrice.

Preferably, silica xerogel is the sole or principal cleansing and polishing ingredient of the dentifrice.

Silica xerogel is intended herein to refer to synthetic, aggregated, amorphous, porous silica having an average particle diameter of from 2 to 20 microns, preferably from 3 to 15 microns, and generally a surface area of at least 300 square metres per gram. Unlike conventional crystalline silicas of comparable particle size, the silica xerogels of the present invention do not substantially abrade or scratch tooth enamel and have no more gritty feel than conventional dentifrice abrasives.

The xerogel particle structure is porous, almost sponge-like. This is most apparent around the periphery of the particle. The elementary silica particles making up the "walls" of the structure are relatively densely packed, and, as a result, the "walls" are strong enough to make the entire structure resistant to shear. The special degree of packing of the elementary silica particles in the xerogel, in contrast to silicas with higher or lesser degrees of packing, is a function of the conditions under which the xerogel is synthesized.

While it is not completely understood why the silica xerogel particle structure possesses extremely high cleaning and polishing ability without harmfully abrading the tooth enamel surface, it is believed that the explanation is as follows:

The abrasive and polishing action of a dentifrice abrasive particle depends on the toothbrush bristles rubbing it along the surface of the tooth and accretions thereon. The extent of abrasive action depends among other factors on the pressure applied to the abrasive particle through the toothbrush. If only a minimum pressure is employed, even a very hard, sharp particle, such as quartz, would be expected to have little deleterious effect. On the other hand, if a very soft otherwise comparable particle is employed, even vigorous toothbrushing would be inadequate to remove tooth stains and other deposits. Thus, if the abrasive particles of this invention were composed of only highly aggregated, closely packed, ultimate silica units, in a non-porous structure, they would be excessively abrasive for use under normal toothbrushing conditions. It is probable, however, that when the toothbrush pressure is high, abrasive action of the xerogel particles is accompanied by crumbling of the porous xerogel structure. The resultant particles are either themselves too small to produce an appreciable amount of abrasion or so like the particles from which they are derived that they, too, undergo further disruption if they are subjected to excessive pressure. It is probable that the smaller particles, either present initially or resulting from disintegration of larger particles, in large measure, contribute to the polishing action of the xerogel.

The silica xerogel particle also exhibits a porous sponge-like structure. The "walls" of this structure are made up of the same ultimate silica particles as those of the xerogel. However, the aerogel particles are less dense than the xerogel particles. The elementary silica particles which provide the structure of the aerogel "walls" are aggregated only loosely, and thus the structure can be broken down by the application of only moderate shearing and mechanical forces. As a consequence, the aerogel is not suitable for dentifrice abrasive applications. Not only will it break down too quickly under the force exerted through a toothbrush, but it probably undergoes substantial degradation under the forces encountered in normal toothpaste mixing operations.

The naturally occurring diatomaceous silicas are hard, non-uniform, frequently dense particles which are typical of these materials. While the particles may appear to be porous, the walls providing the structure are tightly packed and relatively thick. While these particles have cleaning ability, because of their dense structure, they are extremely abrasive. Thus, when the material is of a particle size suitable for dentifrice abrasive applications, it will scratch tooth enamel, making it totally unsuitable for use in an oral composition.

Further, diatomaceous silica particles are of non-uniform size and excessively impure. Therefore, such material cannot be used in an oral preparation, since no uniform product can be obtained without undue, costly procedures. Uniformity, of course, is essential in marketing an oral preparation.

The silica particles essential to this invention are reproducible in size, highly pure, and compatible with numerous oral health agents.

The silica xerogels of the present invention may be prepared by the addition of a mineral acid, e.g., sulfuric acid, to a sodium silicate solution to form a silica sol. The resulting gel formed therefrom on ageing is called a hydrogel. It consists of a three dimensional network of polymerized silica units. Each of these units, also referred to as ultimate particles, have an

approximately size of 5—15 millimicrons. Several different types of silica gels are obtained depending, among other factors, on the conditions of drying or, generally, the type of water displacement in the initial gel. Among them are the xerogels and the aerogels. In the preparation of the xerogels within the scope of this invention, the initial hydrogel is slowly washed and dried. In a preferred embodiment, the pH during this operation is kept at about 4. During the slow washing and drying step, a strong shrinkage of the network structure occurs reducing the average pore diameter. This microporous structure is the reason for the large surface area of the xerogel. The small size of the pores also contributes to the overall rigidity of xerogel particles making them ideal abrasive particles.

The physical properties and other methods of manufacturing silica xerogels of the invention are more fully illustrated at pages 127—174 of "The Colloid Chemistry of Silica and Silicates", R. K. Iler, (New York—Cornell University Press, 1955).

Examples of suitable silica xerogels for use in the dentifrice of the present invention are those available from Grace, Davison Chemical Company under the trade names, Syloid 73 and Syloid 404. Syloid 73 has an average particle diameter of about 5 microns, and Syloid 404 has an average particle diameter of about 6 microns.

In order to maintain short texture and thixotropic behaviour as well as generally desirable cosmetic properties, toothpaste compositions in accordance with the invention may contain in addition to the silica xerogel polishing and cleansing ingredient, a second less effective cleaning ingredient, for example, from 0.5% to 20%, and preferably from 2% to 15% by weight of the dentifrice, of a silica thickening agent, preferably a synthetic, amorphous, porous silica aerogel or pyrogenic silica which polish but do not clean satisfactorily when used alone and which have thickening and gelling properties.

Since the terms cleaning and polishing are words of art, it should be understood that as used herein, cleaning refers to the removal of food debris, dental plaque, calculus, tooth surface stains, etc., whereas polishing refers to the creation of a high lustre on the tooth surface without necessarily being able to clean said surface. A more comprehensive definition of cleaning and polishing can be found in Chapter 15 of "Cosmetics Science and Technology" published by Interscience, Inc., Second Printing, 1963.

The particulate synthetic silicas which may be used as optional ingredients in the present invention are characterised by an average particle diameter generally below about 4 microns. Typical examples thereof include Cabosil (pyrogenic silica) and Syloid 244 (aerogel) having an average particle diameter of about 0.02 and 3 microns, respectively.

The difference between silica gels operable in the present invention and the multitude of silica gels available which are inoperable can be further seen by reference to the details of manufacture. Silica xerogel and silica aerogel are prepared from a silica hydrosol. The silica hydrosol is made under specific conditions by the addition of weak alkali metal silicate to dilute acid solution. The hydrosol is relatively structureless and care must be exercised in its preparation, for example, not to form a precipitate. The hydrosol is allowed to set into a gel which is then termed a hydrogel. The properties of the hydrogel depends on many factors among which are time of ageing, water content, pH and temperature. Basically, the hydrogel is a hydrated amorphous silica gel. The method of dehydrating the hydrogel is another critical feature which will determine the characteristics of the ultimate product. Thus if water is removed suddenly at high temperatures, a weak structure with high pore volume is formed which has inadequate strength for it to suffice as the sole abrasive agent in a tooth paste. However, if the water is removed by relatively slow evaporation as by hot air drying, silica xerogel is obtained. It is during this slow dehydration that the silica hydrogel structure shrinks (essentially irreversibly) and the silica structure becomes increasingly dense and pore diameters are decreased. The particle formed by the aforesaid method will resist such physical forces as abrasion against a tooth surface, and is thus an effective abrasive when employed in a dentifrice. It also resists hydration and thereby retains structural strength and abrasiveness even though exposed to water and/or humectants in toothpaste formulations for a period of a year or more.

The pyrogenic silicas, which are in many ways similar to aerogel, are prepared by vapour phase hydrolysis of silicon tetrachloride in a hot gaseous environment such as about 1100°C. The particles of these materials are so small that they are essentially structureless and, therefore, cannot clean a tooth surface when used in a dentifrice composition.

The following Table I demonstrates the ineffectiveness of the silica aerogel as a cleaning agent in dentifrice compositions as compared to the silica xerogels which are within the scope of the present invention. The silica components are expressed as a percentage by weight of the total dentifrice composition.

TABLE I

Tabulation of Performance Data of Silica Materials in a Dentifrice Formulation

Concentration of Major Components	Enamel Abrasion (microns)	Dentin Abrasion (units)	Zein Abrasion	Lustre
15% Silica Aerogel I	3	5.1	None	54
20% Silica Xerogel II	3	11.8	Very Slight	57
20% Silica Xerogel III	2	18.4	Moderate	58
20% Silica Xerogel IV	3	23.5	Moderate	59
5% Silica Xerogel V 15% Silica Xerogel III	5	56.3	Substantial	57
10% Silica Xerogel VI 10% Silica Xerogel III	4	81.9	Substantial	58
14% Silica Xerogel VI 7.5% Silica Aerogel I	7	82.2	Moderate/Substantial	56
14% Silica Xerogel V 7.5% Silica Aerogel I	6	126.7	Substantial	51
25% Silica Xerogel VI	6	136.5	Very Substantial	54
25% Silica Xerogel V	7	155.4	Very Substantial	52

Referring to Table I, the major components, i.e., silica xerogel, silica aerogel and combinations thereof were mixed in a dentifrice composition in the stated concentrations. The dentifrice composition used contained the following materials in amounts designed to provide an acceptable toothpaste: carboxymethylcellulose, sorbitol (70% aqueous solution), sodium benzoate as a preservative, saccharin as a sweetener, a colourant, sodium lauryl sulphate, glycerin, and a flavour. The physical properties of the silicas used in Table I are shown in the following Table II.

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TABLE II

Typical Physical Properties of the Silica Materials of Table I

	Silica Aerogel I	Silica Xerogel II	Silica Xerogel III	Silica Xerogel IV	Silica Xerogel V	Silica Xerogel VI
Loss on Ignition (percent)	6.5	3.0	2.0	0.6	6.00	6.00
Particle Size (Diameter in Microns)	3.2	5.3	6.3	5.0	8.6	4.4
Colour (Hunter Reflectometer)	93	94	94	94	92	92
Surface Area (Square metres per gram)	300	370	340	330	700	700
Oil Adsorption (lbs per 100 lbs of silica)	300	170	170	225	90	90
pH (5% Slurry in H_2O)	7.0	7.2	7.0	7.0	3.8	3.8

The particles size distribution of the silica materials listed in Tables I and II are shown in the following Table III. For purposes of convenience, the average weight median diameters of the particles for each of the silica materials are also shown.

TABLE III

Particle Sizes of Silica Materials*
Cumulative Weight (%) — Oversize

Micron Size	Silica Aerogel I	Silica Xerogel II	Silica Xerogel III	Silica Xerogel IV	Silica Xerogel V	Silica Xerogel VI
25	0	0	3.4	0	3.5	1.0
19	0	0	6.4	0	13.4	1.0
17	0	0	6.4	0	17.7	1.3
15	0	5.3	8.8	0.3	26.5	1.5
13	0	11.3	12.3	0.9	33.3	1.5
11	0.15	23.4	20.0	2.4	41.3	1.5
9	0.3	24.0	31.7	8.4	49.1	1.6
7	0.6	25.8	45.0	22.8	57.1	2.3
5	8.4	55.9	64.1	47.5	68.5	30.8
3	56.1	87.6	86.8	85.1	85.8	80.0
1.6	78.1	93.8	93.4	92.6	92.9	90.0
Weight Median Diameter (microns)	3.2	5.3	6.3	5.0	8.6	4.4

*Values from Model B Coulter Counter, dual threshold technique.

The effectiveness of the cleaning ability of the various silica materials is shown in Table I under the columns entitled "Dentin" and "Zein" abrasion. The test procedures will be discussed in connection with the Examples.

It will be noted that when the silica aerogel and Xerogel II were below the accepted dentin abrasion units, which must be at least 15 for it to be acceptable as a cleaning agent, very little cleaning was achieved. More specifically, the zein abrasion test shows no, or very slight, cleaning for the silica aerogel and Xerogel II, whereas when the other silica xerogels were used, the zein abrasion was moderate to very substantial. Further, it will be noted under the heading entitled "Enamel Abrasion", there was only nominal loss of enamel when the silica xerogels of the invention were used despite the hardness of these materials. This was totally unexpected, since as brought out above, when natural occurring silicas, such as diatomaceous earth are used, the loss of enamel is exceptionally high because of the hardness of these materials.

The polishing effects of the aerogel and xerogel which are found under the heading "Lustre Index", are almost the same. Thus, the silica xerogel can be used alone as a cleaning and polishing agent or, if desired, in combination with another polishing agent such as the silica aerogel or pyrogenic silica.

Also amounts, preferably not exceeding 10% by weight of the dentifrice, of conventional dental cleansing ingredients, such as water-insoluble sodium metaphosphate, can be included. Such ingredients can have both cleansing and polishing properties.

The amounts of silica xerogels of the present invention which can be used in an oral composition depends on the amount necessary for

cleaning without excessive abrasion of the tooth surface. It has been found that because the silica xerogels of the present invention tend to cause less thickening of dentifrice humectant systems than when such systems incorporated aerogel or pyrogenic silicas, larger amounts of xerogel can be incorporated into such systems.

The dentifrice of the invention can also contain various optional ingredients as enumerated in the previous application.

In the examples illustrating the dentifrice compositions of the invention set forth below, various test procedures were employed and details of these will now be given.

Enamel abrasion testing was performed in the manner described in the previous application under the heading "Abrasion Test". The desirable region of enamel abrasion in this test is now considered to be from 1 to 10 microns. Most existing tooth pastes produce an abrasion of 1 to 10 microns.

The lustre test and cleansing test were those described in the previous application.

DENTIN ABRASION TEST.

A. *Preconditioning to remove surface debris:* The radidoactive (about one millcurie by exposing the teeth for 5 hours to a neutron flux of 10^{12} neutrons/cm^2, the temperature during irradiation not exceeding 40°C) specimens of dentin are transferred to the perspex troughs of the standard brushing machine, which was described in connection with the cleaning test and their surfaces cleaned of debris, etc. by brushing for 2,000 double brush strokes in a slurry of waterworks chalk tooth paste (20 g tooth paste+70 g of water).

B. *"Conditioning" the dentin surfaces:* Prior to a test run for any particular tooth paste, the specimen surface must be "conditioned" using a slurry of that tooth paste (20 g tooth paste +70 g water). The number of double brush strokes is 1,000. The slurry is poured into a graduated cylinder and the volume of slurry observed.

Since a constant weight of tooth paste is added to the trough, it may be necessary to make a small correction for the different volumes of tooth paste slurries used. This correction can be determined from the total measured volumes of slurry as described above.

C. *Test run:* After pouring away the "conditioning" slurry as detailed in Section B above, the troughs are washed thoroughly in distilled water. A slurry of the same toothpaste is then added to the troughs (20 g tooth paste +10 g water). After ensuring the specimen is adequately covered, it is brushed for 500 strokes. At the end of this run 15 ml of distilled water are added to the trough, mixed thoroughly with a glass rod, and a further 500 double brush strokes given. This procedure is repeated for a further three additions of 15 ml of distilled water. At the completion of the test, the dentin will have been brushed for 2,500 double brush strokes.

The active slurry is poured from the trough and any excess foam destroyed with a few drops of ether. After stirring, two 1 ml samples of the slurry are withdrawn with a pipette, and transferred to aluminium planchets 2.5 cm diameter. The slurries are dried under an infra-red lamp for one hour.

D. *Order for testing pastes:* The order for testing a series of tooth pastes is to start and finish with the waterworks chalk reference. This ensures that the wear rate (with respect to the reference) has not altered from the beginning and end of the whole run. Should there be large differences between the two values for the reference, the results should be discarded and a new set of irradiated specimens used to repeat the series.

E. *Radiotracer counting:* The radioactivity of the slurry samples is determined with a Geiger micro-counter. To avoid having to make corrections for decay in activity, the counts for all the samples are made within a short period of time. All counts for activity must be corrected for "dead time" and background errors.

F. *Calculation of results:* The dentin abrasion value for a particular tooth paste will be the ratio of the corrected counts for that paste to the average count for the reference.

For convenience the reference chalk paste (40% by weight of a coarse chalk) is given a dentin abrasion value of 100.00 units.

In the following examples of translucent and transparent tooth pastes, percentages are by weight.

EXAMPLE 1.

Ingredients	%
Silica Xerogel III	20.00
Sodium Carboxymethylcellulose	0.25
Saccharin	0.20
Sorbitol (70%)	70.04
Sodium Benzoate	0.08
Colourant (about 1% solution)	0.53
Flavour	1.15
Chloroform	0.75
21% Sodium Lauryl Sulphate—79% Glycerin Mixture	7.00
Total	100

Cleansing	:	Similar to the standard dentifrice
Lustre Increase Value	:	58
Abrasion Loss Value	:	2 microns
Dentin Abrasion Value	:	18.4 units

EXAMPLE 2.

Ingredients	%
Silica Xerogel IV	20.00
Sodium Carboxymethylcellulose	0.30
Saccharin	0.20
Sorbitol (70%)	69.99
Sodium Benzoate	0.08
Colourant (about 1% solution)	0.53
Flavour	1.15
Chloroform	0.75
21% Sodium Lauryl Sulphate—79% Glycerin Mixture	7.00
Total	100

Cleansing	:	Similar to the standard dentifrice
Lustre Increase Value	:	59
Abrasion Loss Value	:	3 microns
Dentin Abrasion Value	:	23.5 units

EXAMPLE 3.

Ingredients	%
Silica Xerogel V	5.00
Silica Xerogel III	15.00
Sodium Carboxymethylcellulose	0.60
Saccharin	0.20
Sorbitol (70%)	69.69
Sodium Benzoate	0.08
Colourant (about 1% solution)	0.53
21% Sodium Lauryl Sulphate—79% Glycerin Mixture	7.00
Flavour	1.15
Chloroform	0.75
Total	100

Cleansing	:	Better than the standard dentifrice
Lustre Increase Value	:	57
Abrasion Loss Value	:	5 microns
Dentin Abrasion Value	:	56.3 units

EXAMPLE 4.

Ingredients	%
Silica Xerogel VI	10.00
Silica Xerogel III	10.00
Sodium Carboxymethylcellulose	0.60
Saccharin	0.20
Sorbitol (70%)	69.69
Sodium Benzoate	0.08
Colourant (about 1% solution)	0.53
Flavour	1.15
Chloroform	0.75
21% Sodium Lauryl Sulphate—79% Glycerin Mixture	7.00
Total	100

Cleansing	:	Same as standard dentifrice
Lustre Increase Value	:	58
Abrasion Loss Value	:	4 microns
Dentin Abrasion Value	:	81.9 units

COMPARATIVE EXAMPLE A

Ingredients	%
Silica Aerogel I	15.00
Sodium Carboxymethylcellulose	0.15
Saccharin	0.20
Sorbitol (70%)	75.14
Sodium Benzoate	0.08
Colourant (about 1% solution)	0.53
Flavour	1.15
Chloroform	0.75
21% Sodium Lauryl Sulphate—79% Glycerin Mixture	7.00
Total	100

Cleansing	:	None, same as water brushing
Lustre Increase Value	:	54
Abrasion Loss Value	:	3 microns
Dentin Abrasion Value	:	5.1 units

This example demonstrates that the silica Aerogel I does not impart adequate cleansing ability to a dentifrice.

As mentioned above, in the previous application there is described and claimed a dentifrice composition containing as the sole or principal cleansing and polishing ingredient from 5% to 50% by weight of the dentifrice of particulate dehydrated silica gel having an average particle diameter in the range from 2 to 20 microns and a surface area of at least 600 square metres per gram. Such dentifrice compositions are hereby disclaimed.

Subject to the above disclaimer,

WHAT WE CLAIM IS:—

1. A dentifrice composition containing as a cleansing and polishing ingredient a synthetic, amorphous, porous silica xerogel having an average particle diameter in the range from 2 to 20 microns in an amount sufficient to give the dentifrice a dentin abrasion value of at least 15 units as measured by the test described hereinbefore.

2. A dentifrice composition as claimed in claim 1, wherein the amount of the silica xerogel is from 5% to 50% by weight of the dentifrice.

3. A dentifrice composition as claimed in claim 1, wherein the amount of the silica xerogel is from 8 to 20% by weight of the dentifrice.

4. A dentifrice composition as claimed in any of the preceding claims, wherein the silica xerogel has an average particle diameter in the range 3 to 15 microns.

5. A dentifrice composition as claimed in any of the preceding claims, wherein the silica xerogel is the sole or principal cleansing and polishing ingredient.

6. A dentifrice composition as claimed in

EXAMPLE 4.

Ingredients	%
Silica Xerogel VI	10.00
Silica Xerogel III	10.00
Sodium Carboxymethylcellulose	0.60
Saccharin	0.20
Sorbitol (70%)	69.69
Sodium Benzoate	0.08
Colourant (about 1% solution)	0.53
Flavour	1.15
Chloroform	0.75
21% Sodium Lauryl Sulphate—79% Glycerin Mixture	7.00
Total	100

Cleansing	:	Same as standard dentifrice
Lustre Increase Value	:	58
Abrasion Loss Value	:	4 microns
Dentin Abrasion Value	:	81.9 units

COMPARATIVE EXAMPLE A

Ingredients	%
Silica Aerogel I	15.00
Sodium Carboxymethylcellulose	0.15
Saccharin	0.20
Sorbitol (70%)	75.14
Sodium Benzoate	0.08
Colourant (about 1% solution)	0.53
Flavour	1.15
Chloroform	0.75
21% Sodium Lauryl Sulphate—79% Glycerin Mixture	7.00
Total	100

Cleansing	:	None, same as water brushing
Lustre Increase Value	:	54
Abrasion Loss Value	:	3 microns
Dentin Abrasion Value	:	5.1 units

This example demonstrates that the silica Aerogel I does not impart adequate cleansing ability to a dentifrice.

As mentioned above, in the previous application there is described and claimed a dentifrice composition containing as the sole or principal cleansing and polishing ingredient from 5% to 50% by weight of the dentifrice of particulate dehydrated silica gel having an average particle diameter in the range from 2 to 20 microns and a surface area of at least 600 square metres per gram. Such dentifrice compositions are hereby disclaimed.

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2. A dentifrice composition as claimed in claim 1, wherein the amount of the silica xerogel is from 5% to 50% by weight of the dentifrice.

3. A dentifrice composition as claimed in claim 1, wherein the amount of the silica xerogel is from 8 to 20% by weight of the dentifrice.

4. A dentifrice composition as claimed in any of the preceding claims, wherein the silica xerogel has an average particle diameter in the range 3 to 15 microns.

5. A dentifrice composition as claimed in any of the preceding claims, wherein the silica xerogel is the sole or principal cleansing and polishing ingredient.

6. A dentifrice composition as claimed in

* C L M S *

any one of the preceding claims, wherein the composition also contains a silica thickening agent.

7. A dentifrice composition as claimed in claim 6, wherein the thickening agent is a pyrogenic silica.

8. A dentifrice composition as claimed in claim 6, wherein the thickening agent is a silica aerogel.

9. A dentifrice composition as claimed in any of the preceding claims, containing up to 10% by weight of water-insoluble sodium metaphosphate.

10. A dentifrice composition as claimed in any of the preceding claims, wherein the silica xerogel has a surface area of at least 300 square metres per gram.

11. A dentifrice composition as claimed in claim 1 substantially as herein described with reference to any of Examples 1 to 4.

R. H. DOUCY,
Chartered Patent Agent.

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