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METHOD OF REMOVING MOLD

The invention relates to a method for removing mold by utilising a composition which comprises a peroxide and amorphous silica or colloidal silica. It is advantageous because it is free of chlorine, and it may be applied by spraying.

A black mold stain deposited on a ceiling, a tile joint, a plastic wall of a bathroom or in a triangular corner in a kitchen is difficult to remove with a cleanser or a detergent. Spray-type mold removers containing a hypochlorite are available in the market. Many patent publications describe mold removers containing hypochlorites or the like. This is because the ability of peroxides such as hydrogen peroxide, organic peracids and inorganic peracids to remove mold is so poor that they can not remove it completely. On the contrary, although mold removers comprising hypochlorites have excellent performance, they are very harmful to the eye and skin, and therefore spray-type removers are particularly unsuitable for use in

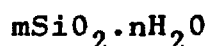
removing mold adhering to the ceiling, etc. Furthermore, they have a strong odor characteristic of chlorine which hampers their use in, for example, a narrow bathroom.

A mold remover composition for use in the invention comprises a peroxide and an amorphous silica of the general formula $m\text{SiO}_2 \cdot n\text{H}_2\text{O}$ (in which m is a positive interger and n is zero or a positive integer), or a colloidal silica produced by neutralization by an acid of a water-soluble silicate.

The use of a mold remover composition including amorphous silica will now be illustrated.

The inventors have made studies to increase the mold-removing effect of peroxides and found that when they are used together with an amorphous silica, there can be obtained an effect which cannot be obtained by the peroxide alone. The present invention is based on this finding.

According to one aspect of the present invention a method of removing mold from a surface comprising applying to the surface a composition comprising a peroxide and amorphous silica represented by the following general formula:



wherein m is an integer of 1 or above, and n is an integer of 0 or above.

Examples of the peroxides which can be used in the present invention include hydrogen peroxide, inorganic and organic peroxides capable of forming hydrogen peroxide in an aqueous solution, combinations thereof with activators, peroxymonosulfate, peroxydisulfate and organic peracids and salts thereof.

The peroxide is preferably used in a quantity of 0.5 to 95%, more preferably 5 to 90%, and still more preferably 30 to 90% (all percentages given are by weight).

Examples of the peroxides capable of forming hydrogen peroxide in an aqueous solution include: adducts of hydrogen peroxide with organic and inorganic compounds, such as hydrogen peroxide adducts of sodium carbonate, sodium tripolyphosphate, sodium pyrophosphate and urea, and $4\text{Na}_2\text{SO}_2 \cdot 2\text{H}_2\text{O}_2 \cdot \text{NaCl}$; and inorganic peroxides such as sodium perborate monohydrate, sodium perborate tetrahydrate, sodium peroxide and calcium peroxide; among which hydrogen peroxide adduct of sodium carbonate, sodium perborate

monohydrate and sodium perborate tetrahydrate are particularly preferred.

Examples of the activators used together therewith include compounds capable of forming hydrogen peroxide in an aqueous solution and forming organic peracids or active bleaching species by the reaction with the peroxide in an aqueous solution. Examples of the activators which can be used in the present invention include nitriles such as acetonitrile, malononitrile, phthalonitrile and benzoyliminodiacetonitrile; O-acetylated compounds such as glucose pentaacetate, octaacetylsucrose, triacetin, sorbitol hexaacetate, acetoxymethanesulfonate salt, triacetyl cyanurate and methyl chloroformate; N-acylated compounds such as N,N,N',N'-tetraacetylenediamine or tetraacetylglycoluril, N-benzoylimidazole, di-N-acetyldimethylglyoxime, 1-phenyl-3-acetylhydantoin, N,N-diacetylaniline, N-acetyldiglycolimide and diacetylmethylenediformamide; acid anhydrides such as phthalic anhydride, succinic anhydride, benzoic anhydride, glutaric anhydride, alkylsulfuric anhydride and anhydrides of a carboxylic acid with an organic sulfonic acid; sulfonyl oximes such as di(methanesulfonyl)-dimethylglyoxime; acylated phosphates such as diethylbenzoyl phosphate; organic phosphoric acid

azides such as diphenylphosphinic azide; disulfones such as diphenyl disulfone; and N-sulfonylimidazole, cyanamide and halogenated triazines. These activators may be used either alone or as a mixture of two or more of them.

The peroxide is preferably used in a quantity of 0.5% to 95%, more preferably, 5 to 90%, and still more preferably 30 to 90%. When used together with the activator, its quantity is preferably from 0.1 to 70%, more preferably 1 to 50%.

Examples of the peroxymonosulfates which can be used in the composition containing a peroxymonosulfate or a peroxydisulfate in the present invention include sodium peroxymonosulfate, potassium peroxymonosulfate and ammonium peroxymonosulfate, among which potassium peroxymonosulfate is particularly preferred. Usually, potassium peroxymonosulfate is commercially available in the form of a double salt of $\text{KHSO}_5:\text{KHSO}_4:\text{K}_2\text{SO}_4 = 2:1:1$ (theoretical available oxygen concentration: 5.2%, commercially available product: about 4.3%). Examples of the peroxydisulfates include sodium peroxydisulfate, potassium peroxydisulfate and ammonium peroxydisulfate, among which sodium and ammonium peroxydisulfates are particularly preferred.

The peroxide is preferably used in a quantity of 1 to 95%,

more preferably 5 to 90%, and still more preferably 30 to 90%.

Preferred organic peroxides used in the composition containing an organic peroxide in the present invention include organic peracids and alkali metal and alkaline earth metal salts thereof. Examples of such organic peracids include monoperacids of aliphatic carboxylic acids such as peracetic, perpropionic, perbutyric, percaproic and peroxyauric acids; monoperacids or diperacids of aliphatic dicarboxylic acids such as succinic, glutaric, adipic, azelaic, 1,9-nonanedicarboxylic, 1,10-decanedicarboxylic, 1,11-hendecane-dicarboxylic and 1,12-dodecanedicarboxylic acids; mono- and di-percarboxylic acids of aromatic carboxylic acids such as perbenzoic, monoperphthalic, diperphthalic, monoperterephthalic, diperterephthalic and p-chloroperbenzoic acids; and alkali metal and alkaline earth metal salts of these organic peracids, among which perphthalic acid and its salts, monoperacid and diperacid of dodecanedicarboxylic acid and their salts are preferred and magnesium monoperphthalate is particularly preferred.

The peroxide is preferably used in a quantity of 5 to 95%, more preferably 10 to 90%, and still more preferably 30 to 90%.

With regard to amorphous silica which is used

as the second component for the composition used in the present invention, the substance which is generally called silica and represented by the chemical formula, SiO_2 , can be classified into two groups. One is crystalline silica which has a definite crystalline structure and occurs in nature, such as quartz, and the other is non-crystalline or amorphous silica which is called hydrated silica, wet-process or synthetic silicic acid, is composed of a network structure of Si-O and does not have a definite crystalline structure. Any of synthetic amorphous silica produced by dry process, aerogel process and wet process or natural amorphous silica can be used in the present invention. Amorphous silica which is produced by dry process and has a specific surface area of 10 to 700 m^2/g , as measured by BET method, and an average particle size of 30 μ or below is preferred. It is possible that primary particles are agglomerated into secondary particles. Such particles can be used in the present invention. Amorphous silica is preferably used in a quantity of 0.1 to 50%, more preferably 0.5 to 30%.

When a buffering agent is added to the mold remover composition of the present invention to modify the pH thereof, the effect of the composition

can be further enhanced.

Examples of the buffering agents include alkali metal hydroxides such as sodium hydroxide and potassium hydroxide; amine derivatives such as ammonium hydroxide and mono-, di- or triethanolamine; alkali metal carbonates such as sodium carbonate and potassium carbonate; alkali metal orthophosphates such as sodium orthophosphate and potassium orthophosphate; orthophosphates such as ammonium orthophosphate; alkali metal silicates such as sodium silicate and potassium silicate; and silicates such as ammonium silicate.

The pH buffering agent is used in such a quantity as to adjust the pH to the optimum value which gives the best effect according to the type of the peroxide.

If necessary, further alkali metal halides and ammonium halides such as sodium chloride, potassium chloride, lithium chloride, ammonium chloride, sodium bromide, potassium bromide, lithium bromide and ammonium bromide; alkali metal sulfates such as sodium sulfate, potassium sulfate and lithium sulfate; ammonium sulfate; alkali metal bicarbonates such as sodium bicarbonate, potassium bicarbonate and lithium bicarbonate; ammonium bicarbonate; and alkali metal

salts and ammonium salt of condensed phosphoric acids such as alkali metal pyrophosphates (e.g. sodium pyrophosphate, potassium pyrophosphate and lithium pyrophosphate), ammonium pyrophosphate, alkali metal tripolyphosphates (e.g. sodium tripolyphosphate, potassium tripolyphosphate and lithium tripolyphosphate) and ammonium tripolyphosphate may be used.

The composition used in the present invention may optionally contain surfactants such as anionic, nonionic, cationic or amphoteric surfactants.

Examples of such anionic surfactants include C_{10} to C_{20} higher alcohol sulfates, salts of C_{10} to C_{22} carboxylic acids, sulfonated C_{10} to C_{22} α -olefin, alkylbenzene sulfonates containing an alkyl group having 10 to 22 carbon atoms, sodium alkylsulfo-succinates, C_{10} to C_{22} paraffinsulfonate, sulfate of ethylene oxide (1 to 100 mol) adduct of C_{10} to C_{22} higher alcohol and sulfate of C_8 to C_{22} alkyl-phenol polyethylene glycol ether.

Examples of such nonionic surfactants include C_{10} to C_{20} straight-chain or branched higher alcohol polyethylene (a degree of polymerization: 3 to 100) glycol ether, polyethylene (a degree of polymerization: 3 to 100) glycol ester of C_{10} to C_{22} carboxylic

acids, and C_8 to C_{22} alkylphenol polyethylene (a degree of polymerization: 3 to 100) glycol ether.

If necessary, solubilizing agents such as sodium p-toluenesulfonate, sodium xylenesulfonate and urea; high-molecular materials such as carboxymethylcellulose; polyvinylpyrrolidone and polyethylene glycol; aluminum silicate such as montmorillonite; magnesium silicate such as sepiolite and attapulgite, an abrasive such as calcium carbonate and silicon dioxide; and a pigment; a dye and a perfume may be further added.

In a preferred embodiment of the present invention, the mold remover composition is used by adding water _____

_____ to the composition in such a proportion as to give an available oxygen concentration of at least 0.1%, preferably at least 0.2% and a concentration of 0.5 to 50%, preferably 1 to 30% to form a solution, a slurry or a paste which is then immediately (within an hour, preferably 30 minutes) spread over or sprayed on the surface to be treated. It is particularly preferred to apply the composition in the form of slurry or paste, because the liquid will not be scattered, as it tends to be when sprayed on.

When the composition containing hydrogen peroxide

or an organic or inorganic peroxide capable of forming hydrogen peroxide in an aqueous solution is used, water is added to the composition in such a proportion as to give an available oxygen concentration of 0.1 to 10%, preferably 0.2 to 6% and a pH of 8 to 13, preferably 9 to 11.

When the composition used in the present invention contains a peroxymonosulfate or a peroxydisulfate, water is added thereto in such a proportion as to give an available oxygen concentration of 0.1 to 1.5%, preferably 0.2% to 1.0% and a pH of 5 to 13, preferably 6 to 11.

When the composition used in the present invention contains an organic peroxide, the preferred available oxygen concentration is 0.2 to 3% and the pH should be 5 to 11, preferably 6 to 10.

The concentration of the amorphous silica should preferably be 0.1 to 30%, more preferably 0.5 to 20% at the time of use.

The use of a mold remover composition including colloidal silica will now be illustrated.

In that case the method of the invention comprises applying to a surface to be treated a mold remover composition comprising a peroxide and colloidal silica formed by neutralizing a water-soluble silicate with an acid.

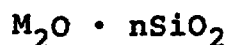
Examples of the peroxides which can be used in the present invention include peroxide compounds capable of forming hydrogen peroxide in an aqueous solution, such as hydrogen peroxide; sodium perborate (monohydrate and tetrahydrate); hydrogen peroxide adducts of sodium carbonate, sodium pyrophosphate, sodium tripolyphosphate and urea; sodium peroxide and calcium peroxide.

Examples of activators which can be used together therewith include compounds capable of forming hydrogen peroxide in an aqueous solution and forming organic peracids or active bleaching species by the reaction with the peroxide in an aqueous solution.

Examples of other peroxides include peroxymonosulfate, peroxydisulfate, monoperacids of aliphatic carboxylic acids such as peracetic, perpropionic, perbutyric, percaproic and peroxyauric acids, monoperacids or diperacids of aliphatic dicarboxylic acids such as succinic, glutaric, adipic, azelaic, 1,9-nonanedicarboxylic, 1,10-decanedicarboxylic, 1,11-hendecanedicarboxylic and

1,12-dodecanedicarboxylic acids, mono- and di-percarboxylic acids of aromatic carboxylic acids such as perbenzoic, monoperphthalic, diperphthalic, monoperterephthalic, di-perterephthalic and p-chloroperbenzoic acids, and alkali metal and alkaline earth metal salts of these organic peracids, among which monoperphthalic acid, diperphthalic acid, monoperacid and diperacid of dodecanedicarboxylic acid and their alkali metal and alkaline earth metal salts are preferred. The peracid may be used by itself or together with another peracid. As an oxidizing agent, potassium peroxymonosulfate having KHSO₅, KHSO₄ and K₂SO₄ in a mixing ratio of 2:1:1, such as "Oxone", (Registered Trademark of DuPont) and magnesium monoperphthalate hexahydrate, such as H-48 (tradename), are preferred.

The water-soluble silicate which can be used in the present invention can be represented by the following general formula:



wherein M is an alkali metal such as lithium, sodium or potassium, ammonium or substituted ammonium, and n is preferably a number of 0.5 to 4, among which lithium, sodium and potassium are particularly preferred.

These water-soluble silicates can be used in the form of an anhydride, a powder containing water of crystallization or an aqueous solution.

Sodium orthosilicate, sodium metasilicate, grade 1 sodium silicate, grade 2 sodium silicate and grade 3 sodium silicate are preferred as the water-soluble silicates. However, potassium, lithium and ammonium salts can also be used in the present invention.

Preferred acids which can be used in neutralizing the water-soluble silicate in the present invention are organic acids. However, inorganic acids and mixtures thereof with organic acids can also be used.

Examples of the organic acids include carboxylic acids such as acetic and butyric acids; hydroxycarboxylic acids such as citric, tartaric, malic and glycolic acids; aliphatic dicarboxylic acids such as oxalic acid, malonic acid, succinic acid, gluconic acid, adipic acid and pimelic acid and a compound having one or more carboxyl or sulfo groups on the benzene ring, such as benzoic, phthalic and benzenesulfonic acids. The benzene ring may be substituted with halogen, nitro or an alkyl group, and examples of the compounds containing such a substituent include toluenesulfonic, chlorobenzenecarboxylic and nitrophthalic acids. There may be used compounds which contain a naphthalene or heterocyclic ring in place of

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the benzene ring and are acidic in an aqueous solution. Among them, citric, malic, tartaric, succinic, gluconic, adipic, pimelic, phthalic and benzoic acids are preferred. A surfactant of the acid type such as an alkylbenzenesulfonic acid, an olefinsulfonic acid, paraffinsulfonic acid, an alkylphosphoric acid and a long-chain fatty acid, and a monomer to polymerize such as maleic anhydride, acrylic acid, methacrylic acid and crotonic acid, a homopolymer and a copolymer of each before mentioned monomer in which the acidic compound has not yet been neutralized may be used. The organic acid may be used by itself or together with another organic acid.

Examples of the inorganic acids include hydrochloric, sulfuric, nitric, phosphoric and boric acids.

Colloidal silica used in the present invention can be prepared by any of conventional methods without particular limitation. For example, colloidal silica can be obtained by dissolving 0.1 to 10% (in terms of SiO_2) of a water-soluble silicate in water and adding a neutralization equivalent of an acid thereto with stirring.

The ingredients used in the present invention function as a mold remover merely by mixing a peroxide (a) with a colloidal silica solution (b) as formed by neutralizing a water-soluble silicate with an acid. The peroxides are

substantially unstable in the form of an aqueous solution and cannot be preserved as an aqueous solution over a long period of time except as a hydrogen peroxide solution. Usually, they are supplied in the form of powder or as solid. Accordingly, it is desirable to mix the component (a) with the component (b) immediately before their use.

The composition used in the present invention may optionally contain surfactant, solvent, alkali or buffering agent, acid, chelating agent, high-molecular weight compound, abrasive, solubilizing agent, perfume, dye or preservation (components (c)). These ingredients may be added to any of the components (a) and (b). However, it is preferred that solid ingredients are added to the component (a) and liquid or highly hygroscopic ingredients are added to the component (b). For certain reasons, the aforementioned optional ingredients may be separately prepared as a third component (c), and the components (a), (b) and (c) may be mixed together at the point of their use.

The composition used in the present invention may optionally contain surfactants such as anionic or nonionic surfactants. However, other surfactants such as cationic, amphoteric or zwitter ion surfactants can also be used, if desired.

Examples of the anionic surfactants include salts such as C_{10} to C_{22} alkylbenzenesulfonates, C_{10} to C_{22} α -olefinsulfonates, and C_{10} to C_{22} alkanesulfonates, salts of C_{10} to C_{22} higher fatty acids, those of sulfates of C_{10} to C_{22} higher alcohols, those of C_{10} to C_{22} alkylethoxy sulfates, those of C_{10} to C_{22} α -sulfofatty acids, those of C_{10} to C_{22} α -sulfofatty acid esters, those of C_{10} to C_{22} alkylphosphates and those of C_{10} to C_{22} alkylsulfosuccinic acids. Examples of the salts include sodium, potassium, ammonium and substituted ammonium salts.

Examples of the nonionic surfactants include ethylene oxide (1 to 100 mol) adducts of C_8 to C_{22} polyoxyethylene alkylphenyl ether, ethylene oxide (1 to 100 mol) adducts of C_{10} to C_{22} polyoxyethylene alkyl ether, ethylene oxide/propylene oxide block copolymer, polyoxyethylene polyoxypropylene alkyl ether, polyoxyethylene glycol, polypropylene glycol, higher fatty acid alkanolamides, higher fatty acid glycol esters and sucrose fatty acid esters.

Examples of the solvents include lower monohydric alcohols such as methanol, ethanol and propyl alcohol; alkylene glycols such as ethylene glycol, diethylene glycol; polyethylene glycol, dipropylene glycol and polypropylene glycol and mono- or diesters thereof,

such as methyl, ethyl, propyl and butyl esters.

Examples of the alkali or buffering agents include sodium carbonate, sodium bicarbonate, sodium silicate, sodium tripolyphosphate, sodium pyrophosphate, sodium orthophosphate, sodium borate and sodium hydroxide, and the corresponding lithium, potassium and ammonium salts.

Examples of the acids include the aforementioned inorganic and organic acids which can be used in the neutralization of the water-soluble silicate.

Examples of the chelating agents include sodium nitrilotriacetate and sodium ethylenediaminetetraacetate.

Examples of the high-molecular weight compounds include polyacrylic acid, polymethacrylic acid, polyvinyl alcohol, polyvinyl acetate, carboxymethylcellulose, hydroxyethylcellulose, polyethylene glycol, polypropylene glycol and ethylene oxide/propylene oxide polymer.

Materials similar to silicon dioxide formed from an aqueous solution of a water-soluble silicate and an acidic substance according to the present invention are commercially available as colloidal silica in the form of powder or dispersion. Colloidal silica in the form of powder includes wet-process and dry-process colloidal silica powders. However, when an aqueous solution is prepared from the colloidal silica previously prepared in the form of powder, its effect is inferior

and such an aqueous solution is not preferred in view of the following points. Household detergents, particularly those to be sprayed on the surface of hard material are usually filled in a spray can. When an aqueous solution prepared from the colloidal silica in the form of powder is used, clogging takes place in a spray nozzle, so that the aqueous solution can no longer be sprayed. Although commercially available stable silicon dioxide solutions contain SiO_2 at a concentration of as high as 20 to 40 %, their viscosity is 50 cP or below at 20°C, and therefore they do not cause clogging of the spray nozzle when used as such. However, their cleaning effects are inferior than that of the aqueous solution of colloidal silica powder.

The aqueous solution of colloidal silica as formed by neutralizing a water-soluble silicate with an acid used in the present invention is clear of translucent and may occasionally cause precipitation during long-term storage. However, the aqueous solution used in the present invention can be used irrespective of the presence or the absence of the precipitate.

The colloidal solution used in the present invention contains colloidal silica and neutral salts formed as by-product from at least one neutralization equivalent of an acid. On the other hand, commercially available

colloidal silica powders and sol solutions contain substantially no neutral salts, and even when the neutral salt is added to the aqueous solution of commercially available colloidal powder or commercially available sol solution, the effect of the present invention can not be obtained. Thus the effect of the present invention is not due to the neutral salt.

The first feature of the colloidal silicon dioxide solution formed by neutralizing a water-soluble silicate with an acid according to the present invention is that it is effective even with a SiO_2 content smaller than that of commercially available colloidal silica powder. The second feature thereof is that even when the solutions are stored over a long period of time, the aqueous solution used in the present invention does not cause clogging of the nozzle of a spray can, while the dispersion of commercially available colloidal silica powder forms precipitates which can not be fully re-dispersed merely by shaking by users at home, its effect is not uniform and the dispersion causes clogging of the spray nozzle.

The quantity of the peroxide in the composition comprising the peroxide (a) and the colloidal silicon dioxide dispersion (b) as formed by neutralizing a water-soluble silicate with an acid is preferably 3 to 30%,

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more preferably 5 to 25%. The quantity of the colloidal silica is preferably 0.1 to 10 %, more preferably 0.5 to 3% in terms of SiO_2 .

In a preferred embodiment of the present invention, the composition is diluted to give an available oxygen concentration of at least 0.1 %, preferably at least 0.2 % and a concentration of 0.5 to 50 %, preferably 1 to 30 % at the point of its use.

The composition is advantageously free from chlorine. Therefore it does not have the smell of chlorine, and does not generate chlorine gas in contact with an acidic substance such as a detergent. It is not poisonous. Moreover the composition used in the invention, in particular in the second embodiment, is suitable for spraying. It can be repeatedly used with spraying, providing a quick effectiveness.

Brief Description of Drawing

Fig. 1 shows a relation between an amount of deposits and a removing extent of mold, tested in Examples.

[Example]

The following examples will further illustrate the present invention, though they are not to be construed as limiting the present invention in any way.

Mold removal ratio:

The mold removal ratio was determined in such a manner that a porous earthenware plate was inoculated with Cladosporium herbarum, incubated at 30°C for 7 days and used as a model moldy plate and reflectances before and after treatment were measured.

Calculation formula:

$$\text{Mold removing ratio (\%)} = (RW - RS) / (RO - RS) \times 100$$

where

RO: the reflectance of the porous plate before inoculation with mold,

RS: the reflectance of the moldy plate before treatment.

RW: the reflectance of the moldy plate after treatment.

Measuring instrument:

NDR-101DP color difference meter, manufactured by Nippon Denshoku Kogyo K.K.

Examples 1

Each of the liquid compositions formulated as shown in Table 1 (in which the amounts of the various ingredients are given by weight) was sprayed on or applied to the moldy plate and the mold removal ratio after 15 min was measured. The pH of each composition was adjusted to 8.0 with NaOH. The results are shown in Table 1.

Table 1

	Comp. Ex. 1	Present invention 1	Present invention 2	Present invention 3	Comp. Ex. 2	Comp. Ex. 3
sodium- hypochlorite	3.0	-	-	-	-	-
H-48 *1	-	10.0	10.0	10.0	10.0	10.0
Aerosil *2	-	1.0	2.0	4.0	-	-
crystalline silica	-	-	-	-	-	4.0
water	B *3	B	B	B	B	B
pH	13.6	8.0	8.0	8.0	8.0	8.0
irritating odor	emit	no	no	no	no	no
mold removal ratio (%)	92	65	89	92	43	40

Note: *1: magnesium monoperphthalate hexahydrate
(a product of Interlox)

*2: Aerosil (Registered Trade Mark for silicon having
a specific surface area: $200 \text{ m}^2/\text{g}$, particle size:
 12μ) (a product of Nippon Aerosil)

*3: B is the abbreviation for balance
(quantity to make the whole 100)

Example 2

Each of the liquid compositions formulated as shown in Table 2 (in which the amount of the ingredients are given by weight) was sprayed on or applied to the moldy plate and the mold removal ratio after 15 min was measured. The pH of each composition was adjusted with NaOH. The results are shown in Table 2.

Table 2

	Comp. Ex. 4	Present invention 4	Comp. Ex. 5	Present invention 5	Comp. Ex. 6	Present invention 6
hydrogen peroxide	4.0	4.0	-	-	-	-
triacetin	3.0	3.0	-	-	-	-
p-chloroperbenzoic acid	-	-	5.0	5.0	-	-
OXONE*	-	-	-	-	15.0	15.0
Aerosil	-	4.0	-	4.0	-	4.0
water	B	B	B	B	B	B
pH	10.0	10.0	8.0	8.0	9.0	9.0
mold removal ratio (%)	50	90	53	88	34	92

Note: * OXONE: potassium peroxydisulfate double salt (a product of Du Pont)

Example 3

Each of the liquid compositions formulated as shown in Table 3 (in which the amounts of the ingredients are given by weight) was sprayed on or applied to moldy objects and mold removability was organoleptically evaluated after 15 min.

When the compositions of Comparative Examples 7 and 8 were used, the objects were extremely moldy and some mold was left intact, while when the compositions 7 to 10 of the present invention were used, the mold was removed and good mold removal results were obtained.

Table 3

	Comp. Ex. 7	Comp. Ex. 8	Present invention 7	Present invention 8	Present invention 9	Present invention 10
H-48	10.0	-	10.0	-	-	10.0
PC *1	-	15.0	-	15.0	-	-
GPac *2	-	5.0	-	5.0	-	-
OXONE	-	-	-	-	15.0	10.0
sodium carbonate	8.0	-	8.0	-	-	5.0
sodium hydroxide	-	3.0	-	3.0	3.0	-
Nipsil *3	-	-	4.0	-	2.0	2.0
Finesil *4	-	-	-	4.0	-	-
*5 sepiolite	-	-	-	-	-	2.0
polysodium acrylate	-	-	-	-	1.0	-
carboxy- methyl- cellulose	-	-	-	-	1.0	-
polyoxy- ethylene lauryl ether	1.0	-	1.0	-	1.0	-
sodium dode- cylbenzene- sulfonate	-	1.0	-	1.0	-	-

Note: *1 PC: hydrogen peroxide adduct of sodium carbonate.

*2 GPac: glucose pentaacetate

*3 Nipsil (silica having a specific surface area:
235 m²/g, particle size: 1.5) (a product of
Nippon Silica)

*4 Finesil (silica having a specific surface area:
180 m²/g, particle size: 1) (a product of
Tokuyama Soda)

*5 sepiolite: magnesium silicate
(a product of Takeda Yakuhin)

Example 4

Each of a mixture consisting of a peroxide powder mixture (A) and the colloidal silica (B) used in the present invention and a mixture consisting of the mixture (A) and other colloidal silica (C) (comparative products) was put into a trigger type spray can for commercially available Glass My Pet, and uniformly sprayed five times. The sprayed plate was allowed to stand upright for 30 min to determine the mold removal ratio*.

The quantity of a deposit on the surface of a tile was determined in the following manner. A tile of 9.5 cm x 9.5 cm (90.25 cm²) was allowed to stand upright.

Each of the above solutions was put into a trigger type spray can for commercially available liquid Glass My Pet and was uniformly sprayed on the tile five times. After the tile was left to stand for one hr, the quantity of a deposit on the surface of the tile was measured. The results are shown in Table 4.

(A) Peroxide powder mixture

H-48	10 g
Oxone (Registered Trade Mark)	5 g
sodium carbonate	2.1 g

H-48: magnesium monoperphthalate hexahydrate
(a product of Interlox)

Oxone: potassium peroxymonosulfate

(KHSO_5 : KHSO_4 : K_2SO_4 = 2:1:1) (a product
of du Pont)

(B) Colloidal silica

2. g of grade 2 sodium silicate was dissolved in 110 g of ion-exchanged water. While stirring, 1.5 g of 50 % citric acid was gradually added thereto.

(C) Comparative products

Each of the following colloidal silicas was dispersed in 110g of ion-exchanged water.

- (1) No addition
- (2) Syloid 266 (Registered Trade Mark) 3.6 g
- (3) Aerosil 300 2.0 g

- (4) Carboxymethylcellulose 0.5 g
(5) Bentone EW (Registered Trade Mark) 0.6 g

Each of the components (B) and (C-2) to (C-5) was used in such a quantity that each of the (A)/(B) mixture and the (A)/(C) mixture had a viscosity of 10 to 20 cP at 20°C.

* Mold removal ratio:

The mold removal ratio was determined in such a manner that a porous earthenware plate was inoculated with Cladosporium herberum, incubated at 30°C for 10 days and used as a model moldy plate to measure reflectances before and after the treatment.

Calculation formula:

$$\text{Mold removal ratio (\%)} = (RW - RS) / (RO - RS) \times 100$$

RO: the reflectance of the porous plate before inoculation with mold.

RS: the reflectance of the moldy plate before the treatment.

RW: the reflectance of the moldy plate after the treatment.

Measuring instrument:

NDR-101DP color difference meter,

manufactured by Nippon Denshoku Kogyo K. K.

Table 4

	Additive (g)	Mold removal ratio (%)	Quantity of deposit on tile (g)	Relative quantity of deposit
Comp. Ex. 9	No addition	15	0.4	1
Comp. Ex. 10	Syloid 266 3.6	20	1.6	4
Comp. Ex. 11	Aerosil 300 2.0	50	2.5	6.25
Comp. Ex. 12	Carboxymethyl-cellulose 0.5	15	1.8	4.5
Comp. Ex. 13	Bentone EW 0.6	21	2.4	6
Present invention 11	Grade 2 sodium silicate neutralized with citric acid 0.54*	80	4.2	10.5

* in terms of SiO_2

Syloid 266 (a product of Fuji Davison): wet-process silicon dioxide powder.

Aerosil 300 (a product of Nippon Aerosil): dry-process silicon dioxide powder.

Carboxymethylcellulose: degree of substitution of 1.64

(organic thickener)

Bentone EW (a product of National Lead Chemical): aluminum silicate inorganic thickener.

Spraying was conducted once a day (five consecutive runs per day) to examine the clogging of the spray nozzle. Even after the spraying was conducted for 25 days, the nozzle was in order, when the products of Comparative Example 9 and the present invention were used. However, when the products of Comparative Examples 2 to 5 were used, sprayability deteriorated on the seventh to ninth day and spraying could no longer be conducted on the tenth to twelfth day.

In this example, a heavily moldy plate was used to examine the mold removal effect. Figure 1 shows the relationship between the quantity of the deposit on the tile wall surface and the mold removal ratio. The quantity of the deposit and the mold removal ratio are roughly proportional when wet-process colloidal silica, dry-process colloidal silica and colloidal silica formed by the neutralization of grade 2 sodium silicate with citric acid are used. Although the dry-process colloidal silica is used in a quantity less than that of the wet-process colloidal silica, both the quantity of the deposit and the mold removal ratio of the former are high. Although the quantity of the citric acid-neutralized sodium silicate system (the present invention) is less than that of the dry-process colloidal silica, both the quantity of the deposit and the mold removal

ratio are much higher. Although addition of a thickener generally serves to increase the quantity of the deposit, a mere thickener can not always increase the mold removal ratio, even when it does increase the quantity of the deposit.

Example 5

The following powder mixture (A) and the following colloidal silica dispersion (B) were prepared and mixed with each other at the point of use to prepare a mold remover. This product is not only effective in removing mold, but also applicable to stain removal of clothing and cleaning of wall surfaces which are yellowed due to adherence of tobacco smoke or scattered oil.

(A)	Oxone	15 g
	sodium carbonate	2.6 g
(B)	sodium metasilicate	1.2 g
	malic acid	1.0 g
	water	100 cc

CLAIMS:

1. A method of removing mold from a surface, comprising applying to the surface a composition which comprises a peroxide and an amorphous silica of the general formula $m(\text{SiO}_2) \cdot n(\text{H}_2\text{O})$ in which m is a positive integer and n is zero or a positive integer; or a colloidal silica dispersion formed by neutralization by an acid of a water-soluble silicate.

2. A method as claimed in claim 1, in which the composition comprises 0.5 to 95 wt.% of peroxide and 0.1 to 50 wt.% of amorphous silica.

3. A method as claimed in claim 1 or 2 in which said amorphous silica is a synthetic amorphous silica having an average particle size of 30 microns or smaller and a specific surface area of 10 to 700 m^2/g according to the BET method.

4. A method according to any preceding claim in which said composition comprises 3 to 30 wt.% of peroxide and 0.1 to 10 wt.% of a colloidal silica dispersion.



5. A method according to claim 1 or 4 in which said water-soluble silicate has a formula of $M_2O \cdot n(SiO_2)$ in which M is Li, Na or K and n is from 0.5 to 4.

6. A method according to claim 1,4 or 5 in which said water-soluble silicate is sodium orthosilicate, sodium metasilicate, grade 1 sodium silicate, grade 2 sodium silicate or grade 3 sodium silicate.

7. A method as claimed in claim 1 in which said acid is an organic acid.

8. A method as claimed in claim 7, in which said acid is citric acid, malic acid, tartaric acid, succinic acid, gluconic acid, adipic acid, pimelic acid, phthalic acid or benzoic acid.

9. A method according to any preceding claim wherein the composition is applied to the surface in the form of an aqueous solution, a slurry or a paste.

