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Polysorbate, Polyvinyl Alcohol, Potassium Benzoate, Povidone, Propyl 3,4,5-trihydroxybenzoate, Propylene Carbonate, Propylene Glycol, alginates, Sodium Benzoate, Sodium Borate, Sodium Citrate, methane sulfonic acid, (which is neutralized in the formulation but provides a useful pH 5 adjustment downwards to offset the pH rise ferrate(VI) can cause in certain cases, e.g. when ferrate(VI) does not have anything else to react with and so reacts with water: i.e.

$$2K_2FeO_4+3H_2O\rightarrow 2FeOOH+O_2\uparrow +4KOH.$$

Sodium Lauryl Sulfate, Sodium thiosulfate (this reagent will instantly reduce ferrate to ferrous/ferric, and so is a way to quickly discharge ferrate(VI) when desired), Sorbitan derivatives, Starch, Stearyl Alcohol, Sulphur Dioxide, Thymol, Triethanolamine, Triethyl Citrate, Saccharin, diatomaceous earth, ethylene glycol, one or more Cellosolves, aliphatic hydrocharbons, aromatic hydrocarbons, pigments, dyes, phosphates, phosphonates, phosphate esters, phosphinics, and Zinc Oxide, either alone, or more typically, in combination

Ferrate(VI) can be combined with other sterilizing agents, for example with glutaraldehyde, ortho-phthaldehyde, 1-Hexadecylpyridinium chloride monohydrate, Chlorhexidine, Chlorhexidine Acetate, Chlorobutanol, Chlorocresol, Ethylparaben, Methylphenol, Phenoxyethanol, paraformaldehyde, bleach, formaldeyde, hypochlorite, peroxide, ozone, chloro and/or bromo isocyanuric acid(s), copper ion, calcium hypochlorite, and cetrimide. Some of these sterilizing agents would be more stable in the presence of ferrate(VI) than others. For example, hypochlorite, bleach, and 1-Hexadecylpyridinium chloride monohydrate are stable in the presence of ferrate(VI) but paraformaldehyde and formaldeyde would be oxidized by ferrate(VI) and so would be less compatible.

Some nonlimiting of consumer products include, for 35 example: a skin care lotion comprising one or more of a moisturizer, an antioxidant blend, vitamins E, A, and C, glycerin, cetearyl alcohol, petrolatum, mineral oil, ceteareth-20, tocopheryl acetate, magnesium ascorbyl phosphate, retinyl palmitate, dimethicone, cyclopentasiloxane, glyceryl dilau- 40 rate, lecithin, stearic acid, aluminum starch octenylsuccinate, carbomer, methylparaben, propylparaben, alcohol, DMDM hydantoin, sodium hydroxide, and fragrance; a hair conditioner comprising one or more of cetrimonium chloride, Quaterium-18, potassium chloride, disodium EDTA, TEA-dode- 45 cylbenzenesulfonate, ascorbic acid, tocophenyl ethyl ether, methylchloroisothiazolinone, hydrolyzed wheat protein, hydrolyzed soy protein, and methylisothiazolinone; a hair shampoo comprising one or more of sodium laureth sulfate, sodium lauryl sulfate, cocamidopropyl betaine, sodium chlo- 50 ride, citric acid, sodium citrate, passiflora incarnata flower extract, anthemis nobilus flower extract, and PEG-60.

For some applications, it is desirable to include a metal ion ligand, or blend of ligands, where "ligand" refers to the normal inorganic chemistry terminology as any ion, atom or 55 molecule that bonds (or "coordinates") to a metal ion, in this case to the ferrate(VI) products of use giving ferric or ferrous ions. One or more ligands are preferred in the formulation when it is desirable to prevent the ferric and/or ferrous ions from forming a ferric oxide "rust" colored stain in its used and 60 instead render the ferric ion product either water soluble, an easily dispersible solid, and/or essentially colorless. Preferably the ligand is a metal ion complexing ligand, i.e. binding the metal ion at least with one bond, and most preferably a metal ion chelating agent where two or more points from a 65 single molecule bond to the ferric or ferrous ion. And it is preferred to incorporate this ligand along with a ferrate treat-

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ment during use. Collectively these compounds are referred to as ligands. Preferred are those ligands that result in solubilization of ferric iron, and most preferred are those ligands that also buffer the pH. Ligands also buffer the free metal ion activities in aqueous solution, aqueous-based foams or emulsions, in thin moist films, and the like. The metal ion complexing ligand can be applied before, during, or after a ferrate treatment. In some embodiments, the chelating agent is present in a ferrate composition. Chelating agents that form coordinate covalent bonds to and chelate Fe^{III} ions are especially preferred. This solubilization of iron by ligands can be especially desirable to prevent rust stains. Desferriferrioxamine B, aminocarboxylates such as EDTA, HEDTA, CDTA, NTA, glycine, and the like, hydroxamic acids, catecholates, mono, di and tricarboxylic acids such as malonic acid, citric acid, succinic acid (least preferred due to the weak metal ion complexing nature of this ion), tartaric acids, gluconic acid, oxalic acid, amino phosphonate compounds, Dequest 2010^{TM} and other oxidation resistant chelating phosphonates, and the 20 like are examples of chelating agents capable of strongly solubilizing ferric ion. Alkyl and alkylamino phosphonates, such as HEDP (Dequest 2010®) are most preferred.

Particularly desirable ligand and pH buffering components in some ferrate(VI) compositions are mono, di, tri, tetra, penta, meta, or poly phosphates, phosphonates, and/or phosphinic compounds used singularly or in any combination. Especially preferred is orthophosphate (PO₄³⁻), phosphonate (HPO₃⁼), and phosphinates (H₂PO₂⁼), including their acids, salts and esters, including its protonated forms, i.e. monobasic $(H_2PO_4^{3-})$, dibasic HPO_4^{2-} or tribasic forms, as well as phosphoric acid, and/or polyphosphates and phosphate glasses. Phosphates are most preferred because they are already fully oxidized and therefore immune to further oxidation. On the other hand, sterically hindered phosphonates and phosphinics are also effective where such steric hindrance groups are provided by alkyl, alky lauryl, and/or aryl groups; collectively referred to as "R" groups. R groups can be linear and/or branched hydrocarbons of one to 40 carbons total, although normally each R group would contain no more than 18 carbons. An oxidatively resistant phosphonate example is Dequest® 2010. Many pH buffers do not bond to metal ions and so are not ligands. Such compounds are still useful in the invention as pH buffers, normally present at least in part in acidic form to neutralize the hydroxide ions formed during the reactions, for example bleaching reactions, provided by ferrate.

The function of a pH buffer or metal ion ligand are several. These functions will be illustrated using orthophosphate ion to illustrate. First, only white or colorless species are formed. In aqueous environments, including bulk water, films, foams, emulsions, etc. environments, light purple ferric iron, Fe³⁺, hydrolyzes strongly to form "oxyhydroxy" ferric species, such as FeOOH, Fe(OH)₂⁴⁺, Fe₂O₃, Fe₃O₄, and the like, which are yellow, orange, red, black, and/or brown compounds, including mixtures and variations of these colors, known in the terminology of whitening or bleaching as color bodies, or stains. Extensive hydrolysis leads to formation of solid precipitates of stains or adherent surface scales, or inclusions held within the porosity of materials, corresponding to ferric oxyhydroxy solids to precipitate as colored deposits often orange, rust brown, yellow, or black in color. Spectroscopically this color is seen in the UV/Visible spectrum as electronic absorption bands in the visible range, or tailing from the UV into the visible range. To any one skilled in the art of UV/Visible spectroscopy of ferric compounds such electronic absorption bands corresponds to ligand to metal charge transfer bands CT_{M_L} electronic transitions. Hence