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(54) **Iron-complexing alkaline detergent builder.**

(57) Triethanolamine, when added to an alkaline detergent builder in accordance with the present invention, results in a product which reduces or removes iron residues from fabrics by forming complexes with said iron residues during initial detergency operations in commercial laundering processes.

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"Iron-Complexing Alkaline Detergent Builder"

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Statement of the Invention

This invention relates to laundry operations and more particularly to commercial laundering compositions wherein an iron-complexing material is added to an alkaline detergent builder resulting in a product which removes or reduces iron residues from fabrics during initial detergency operations.

Background and Summary of the Invention

In commercial laundry operations, an alkaline detergent builder is frequently used to enhance the effectiveness of surfactant-containing detergents. Such enhancement may be achieved by any one of several mechanisms including suspending the soils in the aqueous phase, increasing the soil pH to thereby improve soil dispersibility or solubility, forming a protective ionic barrier between the soil and the laundry, and the like.

The alkaline builder is generally provided as a discrete product or a part of a compounded or formulated detergent.

The builder will contain one or more alkaline materials, such, for example, as sodium metasilicate, sodium carbonate, or sodium hydroxide, and may contain other ingredients for providing specific benefits.

It is not uncommon to find, in the typical commercial laundry process, varying degrees of iron residues, originating from rust spots, blood, fecal residue, iron in the water supply, and iron as part of the soil, among others. Iron, as a portion of the soil, is common in mechanics and motor oil soils as well as playground dirt. If the iron residues are permitted to remain in the laundry, service life of the fabric containing the residue may be severely shortened due to an accumulation of resulting stains and greying dinginess.

When iron is present in solution in the water at concentrations as low as 1 part in 10 million, off-color fabrics often result due to precipitated ferric hydroxides on the fabrics under the typical alkaline conditions encountered in commercial laundry washing. As the iron content increases, the off-color nature of the fabrics is proportionately aggravated. Since no subsequent operations in commercial laundry washing cycles are suitable for the removal of insoluble and dehydrated ferric hydroxides, the off-color due to iron build-up becomes more and more pronounced with each additional washing to often cause white fabrics to turn progressively yellower. Such yellowing of

fabrics caused by iron residues is described in U.S. Pat. No. 3,515,673, for example.

Furthermore, removal of the iron by means of detergents is inefficient. In the final rinse, removal of discolorations caused by iron residues may be effected by treating the laundry with an iron-removing sour such, for example, as sodium bifluoride or oxalic acid. This treatment however, does not improve the effectiveness of the detergent to remove soil from the laundry, nor to lessen potential damage resulting to the fabric when iron is present in the laundry to catalyze bleach action during laundry bleaching cycles.

When iron-reducing sours are used as a pretreatment, several rinses are often needed prior to the wash operation to remove the acidic material from the fabric. The expense of the additional water, energy, and time required to pretreat the laundry with these sours militates against their usage except when the laundry is considered to be excessively iron-discolored.

By adding an effective amount of a material, which I have found, when added to the detergent builder, forms an iron complex with the iron residues contained within the fabrics, removal of the iron residues therefrom is readily effected during initial detergency operations. By thus initially removing the iron residues, the detergent's soil-removing capabilities are enhanced resulting in a

brighter and cleaner laundry, and a savings of much time and money is realized by eliminating various process steps heretofore required prior to the detergency operation.

Additionally, it is recognized in the art that certain metal ions, such as those of iron, for example, serve to catalyze the decomposition of bleaching agents resulting in localized action of the bleaching agent on the fabric rather than the soil. Thus, removal of the iron residues from fabrics in the initial detergency operation also serves to lessen the opportunity for iron-catalyzed fabric bleach damage.

Detailed Description of the Invention

An iron-complexing alkaline builder comprises the following:

Example I

Parts by weight

Component	Effective Range	Preferred
Anhydrous Sodium Metasilicate	25 to 99	91.8
Triethanolamine, 85%, tech. grade	1 to 25	8.2

Balance to 100 parts, if necessary or desirable, may comprise other alkaline detergent builders, such as sodium hydroxide, sodium carbonate, sodium polysilicate, sodium orthosilicate, potassium carbonate, potassium polysilicate, ammonium polycarboxylate, sodium polycarboxylate, potassium

polycarboxylate, lithium polycarboxylate and the like; as well as carboxymethyl cellulose, optical brighteners, etc.

Total alkalinity of the preferred iron-complexing alkaline builder above is equivalent to a 46.6% solution of Na_2O or a 77.5% solution of NaOH. Thus, a ½% solution of the above preferred iron-complexing alkaline builder would have the equivalent alkalinity of a 0.30% solution of NaOH and since commercial laundering operations limit alkaline builders of the type envisaged by the present invention to a maximum of ½% builder, at no time does the caustic concentration in the washwheel approach those high levels currently used.

Sodium metasilicate is a commonly used non-phosphorous inorganic alkaline detergent builder. Carboxymethyl cellulose is often used as a soil suspending or anti-redeposition agent. The optical brightener may be anionic, cationic, or nonionic.

A sample fabric was prepared by treating 65/35 polyester/cotton (Testfabric Style 7406, Testfabric Inc., Middlesex, NJ) with ferrous sulfate adjusted to an alkaline pH and air oxidized to form a strong ferric oxide residue. The treated fabric was rinsed and dried and cut into sections to afford comparative washing thereamong using a commercial washer/extractor (25 lb. load capacity) with a 25 lb. load of clean and dry cotton ballast fabric therein.

One sample fabric was washed using the iron-complexing alkaline builder of Example I with Innovator® Plus, an

industrial laundry detergent product of Pennwalt Corp., Philadelphia, PA., assignee of the present invention; a second sample fabric was washed under identical conditions using the anhydrous sodium metasilicate with Innovator® Plus.

The wash process used for the comparative washings comprised the following steps:

(1) A 6-minute "break" operation at 110°F using 2 oz. of Innovator Plus and 4 oz. of (a) the inventive iron-complexing alkaline builder of Example I, or, in lieu thereof (b) the anhydrous sodium metasilicate without the inventive iron-complexing alkaline builder of Example I, both at a 5 inch water level in the washwheel

(2) a 1-minute drain

(3) a 2-minute rinse at 110°F with clear water at a 10" water level

(4) a 1-minute drain

(5) a 1-minute extract operation, spinning the fabric to remove excess water

(6) a 2-minute rinse at 110°F with clear water at a 10" water level

(7) a final 2-minute extraction.

All test samples were removed from the washer/extractor and dried 10 minutes in a home-type electric drier. The dried samples were then evaluated using a Hunter relectometer, the values obtained therefrom presented in I below:

Table I

Fabric Sample Data

Fabric Sample	Reflectance Reading (% reflectance)	Iron Removal, %	Total Alkalinity, % (equivalent NaOH)
Untreated fabric	89.1	-	-
Stained fabric	70.3	-	-
Washed with Innovator Plus + anh. Na_2SiO_3	77.7	39.4	-
Washed with Innovator Plus + preferred alkaline detergent builder of Example I*	80.9	56.4	0.30

*based on a ½% solution

$$\% \text{ Iron Removal} = \frac{(\text{Reflectance reading for washed sample}) - (\text{Reflectance reading for stained, unwashed sample})}{(\text{Reflectance reading for untreated sample}) - (\text{Reflectance reading for stained, unwashed sample})} \times 100$$

All reflectance readings were obtained using a fluorescence filter to eliminate any higher values which may have resulted due to the presence of the optical brightener.

Additional fabric samples were tested for iron-removal properties using iron-complexing alkaline detergent builders of alkaline silicate-triethanolamine at exceedingly low caustic levels at the washwheel. The fabric samples were prepared by soaking 5" x 10" swatches of 65/35

polyester/cotton fabric (Testfabric Style 7402) in a bath of 0.05% ferric chloride in deionized water for three hours. The swatches were rinsed under running tap water and dried in a typical home drier.

Table II below summarizes the results:

Table II

Fabric Sample Data

Sample No.	% Anh. Na_2SiO_3	TEA* (85%)	TEA (98%)	Reflectance Readings**			% Iron Removal	Total Alkalinity (equivalent NaOH)
				Unstained	Stained, Unwashed	Stained, Washed		
1	100	-	-	88.5	79.0	81.3	24.5	-
2	98	2	-	88.5	79.4	82.8	37.4	0.16
3	96	4	-	88.5	77.9	81.9	36.8	0.16
4	90	10	-	88.5	78.2	82.7	43.6	0.15
5	80	20	-	88.5	78.5	83.0	45.6	0.13
6	94	-	6	88.5	78.5	82.8	43.6	0.15

*Triethanolamine

**All data for unstained; stained and unwashed; and stained and washed samples were obtained by averaging 8 samples.

Data for Samples No. 2 through No. 6 were obtained with the iron-complexing alkaline detergent builder (¼%) of Example I.

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Each swatch was measured for reflectance before and after treating with the ferric chloride on a Hunter reflectometer (Model D40). The swatches were then sewn into bags with 50 g. of ½" stainless steel balls sewn inside each one. Each bag was then placed into individual launderometer canisters with 200 ml. of test solution (prepared by dissolving 2.5g. of each sample to be tested and evaluated, i.e., Sample No. 1 through Sample No. 6, in 1000 ml. of deionized water) and each rotated for 30 minutes at 120°F. After removing the swatches from the launderometer, each swatch was thoroughly rinsed under running tap water, the stainless steel balls removed, and the fabric dried in a home drier.

Reflectance was again measured and percent iron removal calculated.

Total alkalinity of my product, based on equivalent NaOH, does not exceed 0.30%, while yet producing exceptional iron removal, and oftentimes, only about ½ such total alkalinity is required to obtain good iron removal properties.

It is apparent from the above description that I have provided improved commercial laundering compositions wherein optimal iron-complexing properties are achieved at much lower caustic concentrations than heretofore required, thus permitting certain fabrics, particularly polyesters, to

remain completely undamaged and undegraded by otherwise higher caustic levels.

It is understood of course that the invention is not intended to be limited to those grades or purities of triethanolamine used herein, i.e., 85% and 98%, which grades are readily commercially available and therefore of greater commercial interest.

I CLAIM:

1. A laundering composition for laundering operations comprising a major proportion of an alkaline detergent builder with a minor proportion of triethanolamine mixed therewith to form a product, said product forming an iron complex with iron residues contained within a fabric being laundered by said laundering composition and with solubilized iron in water used in a washwheel in said laundering operations, said product providing a caustic concentration in said washwheel when dissolved in said laundering water at or below about 0.30% based on equivalent NaOH.

2. Composition of claim 1 wherein said alkaline detergent builder is selected from the group consisting of organic and inorganic alkaline detergent builders.

3. Composition of claim 2 wherein said organic and inorganic alkaline detergent builders is selected from the group consisting of sodium hydroxide, sodium carbonate, sodium polysilicate, potassium carbonate, potassium polysilicate, ammonium polycarboxylate, sodium polycarboxylate, potassium polycarboxylate and lithium polycarboxylate.

4. Composition of claim 1 wherein said alkaline detergent builder is sodium metasilicate.

5. Composition of claim 1 comprising, parts by weight, 75 to 99 sodium metasilicate and 1 to 25 triethanolamine,

technical grade, balance to 100 parts of one or more alkaline detergent builders of claim 3.

6. Composition of claim 5 comprising, parts by weight, 91.8 sodium metasilicate and 8.2 triethanolamine, technical grade.

7. Composition of claim 1 comprising, parts by weight, 91.8 anhydrous sodium metasilicate; 8.2 triethanolamine, technical grade, and minor amounts of anti-redeposition and optical brightening agents.

8. Composition of claim 1 wherein said major proportion of alkaline detergent builder and minor proportion of triethanolamine mixed therewith yields a product which forms said iron complex with said iron residues in said fabric during initial detergency operations.

9. A laundering composition for laundering operations comprising, parts by weight, 25 to 99 anhydrous sodium metasilicate and 1 to 25 triethanolamine, technical grade, said sodium metasilicate and triethanolamine mixed to form a product which forms an iron complex with iron residues contained within fabrics laundered by said laundering composition and with solubilized iron in water in a washwheel in said laundering operations, said complex being formed during initial detergency operations, said fabrics treated with said laundering composition exhibiting higher reflectance values and iron removal values than similar compositions devoid of said triethanolamine, said

triethanolamine and sodium metasilicate forming a product when dissolved in said water in said washwheel providing a total alkalinity not exceeding about 0.30% equivalent of NaOH.

10. A laundering composition for laundering operations comprising a major proportion of an alkaline detergent builder with a minor proportion of triethanolamine mixed therewith to form a product, said product forming an iron complex with iron residues contained within a fabric being laundered by said laundering composition and with solubilized iron in water used in a washwheel in said laundering operations, said product providing a caustic concentration in said washwheel when dissolved in said laundering water at or below about 0.16% based on equivalent NaOH, said alkaline detergent builder comprising sodium metasilicate 80 to 98 parts by weight, balance triethanolamine to form 100 parts by weight, such that said caustic concentration ranges between about 0.13 and 0.16 to yield iron removal percentages between 36.8 and 45.6 with reflectance value readings in proportion thereto.