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METHOD OF LAUNDERING FABRICS

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ABSTRACT OF THE DISCLOSURE

Method for improving the brightness of fabrics which comprises forming a solution of a built detergent composition in water having a hardness of from 0 to 5 grains per gallon, said detergent composition containing, as the builder component, 50% of a mixture consisting of 30% by weight sodium polyacrylate having a weight average molecular weight of 100,000 and 20% by weight of poly (N,N-dicarboxymethyl acrylamide) having a weight average molecular weight of 50,000, and laundering said articles in said laundering solution.

The present invention relates to water-soluble laundry detergent builder compositions comprising blends of a water-soluble acrylic or methacrylic acid polymer or salt such as sodium polyacrylate with a water-soluble complexing polymer having N-carboxymethyl amine or N-carboxymethyl amide ligands or a water-soluble salt of the complexing polymer. The invention further relates to detergent compositions comprising an organic detergent surfactant combined with the said builders to augment the cleaning and laundry brightening power of the detergent surfactant.

Materials useful for enhancing the cleansing power of detergents are known. These materials, commonly referred to as "builders," include inorganic and organic compounds. Examples of known builder materials are water-soluble inorganic alkaline salts which can be used alone or in combination, including alkali metal carbonates, borates, phosphates, polyphosphates, bicarbonates and silicates.

Known organic builder materials include alkali metal, ammonium, or substituted ammonium salts of ethylenediamine tetraacetic acid and nitrilotriacetic acid. Alkali metal salts of phytic acid are also suitable as organic builders.

Despite the ever expanding list of builders, certain disadvantages are recognized in known builder compounds. Perhaps the most widely acknowledged limitation regards a series of more commonly used condensed inorganic polyphosphate compounds such as alkali metal tripolyphosphate, and higher condensed phosphates such as tetra-alkali metal pyrophosphate. When used in aqueous detergent compositions these compounds have a tendency to hydrolyze into orthophosphates or other less condensed phosphorous compounds which are relatively inferior builders.

U.S. Pat. No. 3,308,067 issued Mar. 7, 1967 to Diehl teaches the use of complex polyelectrolytes such as poly

(itaconic acid) as detergent builders. These polyelectrolytes are polymers having complex monomeric units consisting of a polymerizable ethylenic moiety having not less than two carboxylic radicals pendant thereto. Carter et al., U.S. Pat. 3,463,734 issued Aug. 26, 1969 discloses builder compositions comprising poly(itaconic acid) blended with a polyphosphate, a polyphosphonate or a nitrilotriacetate. Kessler et al., U.S. Pat. 3,332,880 issued July 25, 1967 discloses detergent compositions prepared from a special blend of sulfonate surface active materials which may include inorganic or organic builders such as polyphosphates or nitrilotri- or diacetates, polymaleates, polyitaconates, polyacrylates, phytates or polyphosphonates. U.S. Pat. 3,509,059 issued Apr. 28, 1970 to Renold discloses in situ polymerized carboxylic monomers as dispersing agents for polyphosphate built liquid detergent compositions.

Generally stated, the detergent builder compositions of this invention comprise, in weight percent, based on total weight:

(a) From about 20 to about 80 percent of a water-soluble, high molecular weight (40,000 to 12,000,000) complexing polymer having N-carboxymethyl amine or N-carboxymethyl amide ligands or a water-soluble salt thereof together with

(b) From about 80 to about 20 percent of a water-soluble acrylic or methacrylic acid polymer or water-soluble salt thereof.

The acrylic or methacrylic acid polymers which may be used in practicing the invention are water-soluble polyacrylic acid, polymethacrylic acid, acrylic acid-methacrylic acid copolymers, hydrolyzed polyacrylamide, hydrolyzed polymethacrylamide, hydrolyzed acrylamide-methacrylamide copolymers, hydrolyzed polyacrylonitrile, hydrolyzed polymethacrylonitrile hydrolyzed acrylonitrile-methacrylonitrile copolymers, mixtures of any two or more of the said polymers or the water-soluble salts of these polymers, or polymer mixtures; such as the respective alkali metal (e.g., sodium, potassium), ammonium or amine salts. The acrylic polymer builder component has a weight average molecular weight of from about 1,000 to about 15,000,000 and is preferably within the range of from 1,000 to 120,000. The preferred polymer is polyacrylic acid or sodium polyacrylate having a weight average molecular weight within the range of about 80,000 to 120,000. These polymers are commercially available, and methods for their preparation are well known in the art.

The water-soluble complexing polymer builders used in the builder compositions in accordance with one embodiment of this invention are known, per se, to the art. A number of suitable polymeric builders for the purposes of this invention are disclosed in each of Gunderson et al. U.S. Pats. 3,285,886 and 3,331,773 issued Nov. 15, 1966 and July 18, 1967 respectively. The entire disclosure of each of these patents is incorporated herein by reference. Of the polymers disclosed in the Gunderson et al. patents, the polymer presently preferred for the purposes of the present invention is poly(N,N-dicarboxymethyl-acrylamide) having molecular weight of from about 40,000 to about 12,000,000; especially about 50,000 to about 3,000,000. An additional example of a suitable

polymeric complexing builder is poly(N,N-dicarboxymethyl vinyl amine) and its water-soluble salts such as the disodium salt. Water-soluble salts of other like complexing polymers may also be used. Examples of suitable water-soluble polymer salts are the alkali metal (e.g., sodium or potassium), ammonium or amine salts.

In accordance with the present invention the N-carboxymethyl amine and/or N-carboxymethyl amide side chain groups in the complexing polymer builder ingredient must constitute at least about 10, preferably at least about 50, and most preferably from about 80 to 100 (for example 95) percent (on a numerical basis) of the reactive side chains in the complexing polymer used.

The builder compositions of the present invention may be used in combination with most any water-soluble detergent surfactant. Representative classes of suitable detergent surfactants include alkali metal soaps, anionic synthetic detergents, nonionic synthetic detergents, Zwitterionic synthetic detergents and ampholytic synthetic detergents. All of these detergent surfactants are known in the art. For the sake of brevity, reference is made to the disclosure of Chaffee et al., U.S. Pat. 3,324,038 issued June 6, 1967, especially at column 2, line 40 through column 5, line 7. The entire disclosure of the said Chaffee, U.S. Pat. 3,324,038 is also hereby incorporated herein by reference.

The detergent surfactant may be present in the amounts ranging from about 5 to about 100 parts by weight and preferably from about 10 to about 50 parts by weight, per 100 parts by weight of the detergent builder composition. The detergent compositions of this invention may include any of the known fillers or diluents such as sodium chloride, sodium sulfate and the like, soil suspending agents such as carboxymethyl cellulose, and other known detergent additives known in the art such sodium hydroxide, potassium hydroxide, bactericides, optical brighteners, chelating agents, dyes, sequestering agents, and corrosion inhibitors, such as alkali metal silicates.

A typical water-soluble detergent base composition with which the present builder may be usefully combined includes about 32 weight percent of linear alkyl, aryl or alkaryl sulfonate, about 2 weight percent of sodium carboxymethyl cellulose, about 14 weight percent of sodium metasilicate pentahydrate, and about 52 weight percent of sodium chloride diluent.

The detergent compositions of this invention may be prepared and stored or used as a dry powder or granular mixture, as tablets or like agglomerates, or in aqueous solutions containing up to 90 or 95 percent by weight, based on total solution weight, of water or water-cosolvent (e.g., alcohol) mixtures.

The present invention will be further illustrated by the following specific but non-limiting examples.

In the examples all parts are parts by weight unless otherwise specifically stated. Where "hard water" is used in various solutions throughout the following examples X grains of hardness means X grains of $CaCO_3$ plus $MgCO_3$ are in solution per gallon of water. The ratio of $CaCO_3$ to $MgCO_3$ is 2:1 by weight, and X is a specified number such as 10. "Hard water" solutions were prepared from a stock solution of artifically prepared 200 grain per gallon hard water. Zero hardness solutions were prepared with deionized water.

The laundry detergent base composition (containing no builder) used in each of the examples was formulated as follows:

TABLE I.—DETERGENT BASE COMPOSITION

Component:	Percent by weight
Linear dodecyl benzene sulfonate	32
Sodium carboxymethyl cellulose	2
Sodium metasilicate pentahydrate	14
Sodium chloride	52

Detergent compositions containing equal parts by weight of the aforesaid base composition and of various builder compositions were prepared and tested for laundering ability at various builder concentrations in aqueous solutions made up from deionized water (zero hardness) and water having hardness of 5 to 20 grains per gallon. The laundering ability of the detergent solutions was determined by laundering duplicate test specimens prepared as hereinafter described to simulate white laundry goods soiled by human body oil and grime. Test specimens were prepared by initially saturating 6" by 6" white cotton swatches with an agitated solution have the following composition:

TABLE II.—SIMULATED SOIL SOLUTION

Component:	Percent by weight
Carbon black	0.125
Virgin olive oil	5.000
Carbon tetrachloride	94.875

The saturated cotton swatches were removed from the soil solution, dried, and manually rubbed to effect a uniform black oil coating on the swatches. Duplicate soiled specimens were thereafter laundered in a Tergotometer using the various detergent solutions at a temperature of 140° Fahrenheit and a speed of 150 revolutions per minute. After a 15 minute wash cycle, the specimens were removed from the Tergotometer, water rinsed and dried to substantial dryness.

The substantially dry laundered test swatches were then tested for brightness using a Photovolt Reflectometer equipped with a 15° head and no filter. The reflectometer was set at 0 percent brightness using a unlaundered swatch soiled with carbon black and olive oil, and was set at 100 percent brightness using an unsoiled cotton swatch placed over white paper. Ten brightness observations, including 5 for each of the two duplicate laundered swatches, were made and averaged in each test.

The following detergent formulae were tested in accordance with the foregoing procedure:

Comparative Formula A (no builder)

Component:	Percent by weight
Base composition of Table I	50.0
Sodium chloride	50.0

Comparative Formula B (sodium polyacrylate builder)

Component:	Percent by weight
Base composition of Table I	50.0
Sodium polyacrylate (weight average molecular weight of 100,000)	50.0

Comparative Formula C (complexing polymer builder)

Component:	Percent by weight
Base composition of Table I	50.0
Poly(N,N-dicarboxymethylacrylamide) (weight average molecular weight of 50,000)	50.0

Comparative Formula D (complexing polymer builder)

Component:	Percent by weight
Base composition of Table I	50.0
Poly(N,N-dicarboxymethylacrylamide) (weight average molecular weight of 3,000,000)	50.0

Example 1

Component:	Percent by weight
Base composition of Table I	50.0
Polyacrylate of Formula B	10.0
Complexing of Table I	40.0

Example 2

Component:	Percent by weight
Base composition of Table I	50.0
Polyacrylate of Formula B	30.0
Complexing polymer of Formula C	20.0

Example 3

Component:	Percent by weight
Base composition of Table I	50.0
Complexing polymer of Formula D	40.0
Polyacrylate of Formula B	10.0

Example 4

Component:	Percent by weight
Base composition of Table I	50.0
Complexing polymer of Formula D	20.0
Polyacrylate of Formula B	30.0

Results of the laundering tests are shown in the following Table III.

TABLE III.—PERCENT BRIGHTNESS AT VARYING BUILDER CONCENTRATIONS AND WITH VARINESS WATER HARDNESS

	Builder concentration (weight percent)									
	.10					.06				
Solution water hardness (grains per gallon)	0	5	10	15	20	0	5	10	15	20
Test Formula:										
A	55	47.5	40.5	40	39.5	53	44.5	36	33.5	31
B	66	65	64.5	64	63.5	61.5	61	60.5	60.5	60
C	55	54.5	52.5	51.5	50	39	44.5	49	54	58.5
D	49	48	47.5	46.5	45.5	48	47.5	47	46.5	46
Examples:										
1	70	59	41.5	23.5	6	61	45.5	30	14.5	0
2	75	68	59	50	41.5	70	60	49	38.5	27.5
3	70	60.5	43	26	8.5	59.5	44.5	29.5	14	0
4	75	68.5	61.5	54.5	47.5	70	65	49.5	33	17.5

The following conclusions were drawn from the results of the evaluations as reflected in the data shown in Table III:

(1) At a builder concentration of 0.10% the combination of 20% sodium polyacrylate and 80% complexing polymer (50,000 molecular weight) as the builder (Example 1) gave better results than the use of 100% of either builder alone (Comparative Formulae B and C, respectively) at zero hardness. The combination of 60% polyacrylate and 40% of the same complexing polymer (Example 2) gave similar synergistic performance at water hardness levels up to above 5 grains per gallon. At water hardness levels up to between 10 to 15 grains per gallon, the addition of about 1.5 parts of polyacrylate for each part of this complexing polymer (Example 2) enhanced the builder activity of the latter (Comparative Formula C). The addition of 0.25 part of polyacrylate (Example 1) enhanced builder activity of the complexing polymer at water hardness levels up to just above 5 grains per gallon.

(2) At a builder concentration of 0.06% the combination of 60% polyacrylate and 40% of 50,000 molecular weight complexing polymer (Example 2) again provides synergistic results in zero water hardness solutions. The results also show that addition of about 0.25 of polyacrylate for each part by weight of the complexing polymer (Example 1) enhances the builder activity of the latter at water hardness levels up to about 5 grains per gallon; whereas the addition of 1.5 parts of polyacrylate per part of complexing polymer (Example 2) enhances the latter's building activity at water hardness levels of up to about 10 grains per gallon.

(3) The combination of 80% of the 3,000,000 molecular weight complexing polymer and 20% polyacrylate (Example 3) gives synergistic builder activity better than either material alone (Comparative Formulae D and B, respectively) at zero water hardness and builder concentration of 0.10%. At these same concentrations the combination of 40% of the same complexing polymer with 60% polyacrylate (Example 4) gives synergistic results at water hardness levels of up to above 5 grains per gallon. This same example shows that the addition of about 1.5 parts of polyacrylate for each part of the complexing polymer enhances the builder activity of the latter at all water hardness levels up to 20 grains per gallon. The addition of 0.25 part of polyacrylate (Example 3) enhances the builder activity of the complexing polymer at water hardness levels of up to between 5 and 10 grains per gallon.

(4) When the builder concentration is 0.06% the combination of 40% of the 3,000,000 molecular weight complexing polymer and 60% polyacrylate (Example 4) again gives synergistic results at a water hardness of up to above 5 grains per gallon. This example also demonstrates enhancement of the building activity of the complexing polymer by addition of 1.5 parts of polyacrylate in 0.06% builder solutions using water having hardness levels of up to above 10 grains per gallon. Example 3 shows that the addition of 0.25 part of polyacrylate in 0.06% builder solutions enhances the building activity of the complexing polymer at zero water hardness and at water hardness levels up to about 3 to 3.5 grains per gallon.

It is understood that the foregoing detailed description is given merely by way of illustration and that various modifications may be made thereto without departing from the spirit or scope of the present invention.

What is claimed is:

1. A method for improving the brightness of articles, which method consists essentially of forming a laundering solution of 0.10% by weight of a built detergent composition in water having a water hardness from 0 to 5 grains per gallon, said builder detergent consisting of 50% by weight of a detergent consisting essentially of 32 parts by weight linear dodecyl benzene sulfonate, 2 parts by weight sodium carboxymethyl cellulose, 14 parts by weight sodium metasilicate pentahydrate, and 52 parts by weight sodium chloride, and 50% by weight of a builder consisting essentially of 30% by weight sodium polyacrylate having a weight average molecular weight of 100,000 and 20% by weight poly (N,N-dicarboxymethyl acrylamide) having a weight average molecular weight of 50,000, and laundering said articles in said laundering solution.

2. A method for improving the brightness of articles which method consists essentially of forming a laundering solution of 0.06% to 0.10% by weight of a built detergent composition in water having a water hardness from 0 to 5 grains per gallon, said builder detergent consisting of 50% by weight of a detergent consisting essentially of 32 parts by weight linear dodecyl benzene sulfonate, 2 parts by weight sodium carboxymethyl cellulose, 14 parts by weight sodium metasilicate pentahydrate, and 52 parts by weight sodium chloride, and 50% by weight of a builder consisting essentially of 20% by weight sodium polyacrylate having a weight average molecular weight of 100,000 and 30% by weight poly (N,N-dicarboxymethyl acrylamide) having a weight average molecular weight of 3,000,000, and laundering said articles in said laundering solution.

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