

August
1958

U. S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS
WASHINGTON 25, D.C.

Letter
Circular
LC1031

DETERGENTS AND DETERGENT AIDS

Contents

	Page
1. Introduction	2
2. Soaps	2
3. Synthetic Detergents	4
4. Alkaline Cleansers	5
5. Water Softeners	5
6. Bleaches	6
7. Bluing and Whitening Agents	6
8. Starches	7
9. Specifications	7
10. References	9

1. Introduction

This Letter Circular provides general nontechnical information concerning cleaning and laundering materials and furnishes references for those who wish further information on these subjects.

The National Bureau of Standards has no publication which gives recommended formulas for, or describes in detail the manufacture of, detergents and detergent aids. These materials are manufactured by chemical processes which require careful control and special equipment to insure satisfactory products.

Various reference books give formulas for making different types of soaps and detergents and describe the operations involved and the equipment required. These books, some of which are listed at the end of this circular, also describe the raw materials used, the various processes of saponifying oils or fats, recovery of glycerin, etc.

2. Soaps

Soaps are cleaning agents made by the action of alkali on fats or fatty acids. Strictly speaking, all metallic salts of the higher fatty acids are soaps; but the fatty-acid salts of the alkali (sodium and potassium) metals and of certain organic bases such as triethanolamine are the only ones that are soluble in water, and therefore the only ones commonly used as cleansers in aqueous solutions.

Home-made soap. Soap that is satisfactory for some household cleaning operations can be made from kitchen or garbage grease. However, the quality of the soap depends not only upon the character of the grease used, but also to a considerable extent on the other materials and the process employed. Soap made from kitchen grease is generally softer and darker in color than commercial soaps. A simple formula for the manufacture of soap in the home is frequently found on commercial packages of lye. In general, it probably will be found more satisfactory to buy ready-made soap than to attempt to manufacture it on a small scale. It should be noted that soap making is a chemical process requiring careful control and special equipment for the production of a high-grade, completely saponified product containing no free alkali. Such control is not possible with the usual household equipment.

Toilet soap. Toilet soaps must be neutral, that is, neither acid nor alkaline, and should lather freely. This result is achieved by using coconut oil as a substantial part of the fat content and omitting all builders.

Milled toilet soaps are prepared by compressing a pure, dry, powdered soap into cakes. Since the perfume is mixed in the process of milling, more delicate perfumes can be used. The milled toilet soaps are generally hard, fairly expensive, and have very little waste in use.

Floating toilet soaps have air incorporated into them in the manufacturing process. These air bubbles make the soap lighter than water and increase the surface of the soap exposed to the water, thereby rendering it more soluble than a harder, close-grained soap. Floating soaps have a relatively high water content.

Liquid toilet soaps are water solutions, generally of a neutral, coconut-oil potash soap. Liquid soaps usually contain about 12 to 20 percent of soap.

Shaving soaps must have the qualities of a first-class toilet soap and be able to produce a copious lather. They are made from tallow, coconut oil, and stearic acid saponified with a mixture of caustic soda and caustic potash. They generally contain a gum or other material in colloidal form to aid in holding the lather and they are superfatted (contain an excess of free stearic acid).

Hand grit soaps are made by mixing a very fine abrasive (usually pumice or "silver" sand) into a toilet soap.

Germicidal soaps are used in hospitals, particularly by surgeons for pre-operative scrub-ups, but they are also very effective in the reduction of bacteria on the skin if used in the daily bath. The germicidal soaps may be in cake, paste, or liquid form. They are toilet soaps to which a bacteriostat, such as a chlorinated phenol has been added.

Laundry soap. Ordinary laundry soap is made of caustic soda and tallow, with or without the addition of some rosin. Grease, cottonseed oil, coconut oil, and hydrogenated fish and vegetable oils may replace the tallow. Builders, such as phosphates, silicates, borates, and carbonates, are added to increase the detergency and to help to soften the water.

Chip and powdered laundry soaps are made from the same materials as ordinary laundry soap without excess of alkaline salts. For fine laundry use they normally contain a considerable amount of coconut oil and no excess alkali. Built laundry soaps in powdered form are available for heavy-duty laundry use; they contain phosphates, silicates, borates, and carbonates to increase the detergency and to help to soften the water.

Soap powder. Soap powder is a mixture of sodium carbonate and soap in powdered form. It might be noted that soap powder is much more alkaline than powdered soap, with which it is often confused. It may also contain other alkaline salts, such as silicates, phosphates, and borates. Soap powder is intended for use on floors, etc. and not for laundry use.

Scouring powder and scouring cake soap. Scouring soap, either powdered or cake, is a mixture of soap and an insoluble abrasive, such as pumice, volcanic ash, quartz, or feldspar. The coarseness of the abrasive, which is incorporated into the soap, varies with the intended use of the product.

3. Synthetic Detergents

Synthetic detergents are cleaning agents produced by organic synthesis. The powdered, granular and flake varieties are divided into built (heavy-duty) and unbuilt (light-duty) detergents. The light-duty detergents usually contain 30 to 40 percent active ingredient and are suitable for dishwashing and light laundry work, especially woolens, synthetics, and silks. The heavy-duty detergents contain about 20 percent active ingredient and one or more builders. As the name implies, these products are most suitable for heavily soiled cotton fabrics and for general cleaning purposes.

Liquid detergents are marketed for heavy-duty use, fine laundry, dishwashing, and as germicidal toilet compounds. They are compounded according to the intended use.

In hard water, soap precipitates calcium and magnesium salts as a curd which builds up and tends to give clothes a greyish coat.

4. Alkaline Cleansers

Alkaline salts in themselves are cleaners and water softening agents. They include ammonia, borates, carbonates, caustic soda (lye), phosphates, silicates, etc. Most of them are also frequently used as "builders" in soaps.

Ammonia is used in cleaning glass and as a water softener in washing clothes. Borax, soda ash, washing soda, phosphates, and silicates are used to increase the detergency of soaps and as water softeners. Caustic soda is used in making soaps and also is used, either alone or mixed with aluminum turnings, as a drainpipe cleaner. It must be handled with caution because it has a very corrosive action and is poisonous.

Detergents for use in mechanical dishwashing machines usually contain one or more of the following alkaline cleansers: Sodium carbonates, sodium silicates, sodium phosphates, chlorinated phosphates, and borax.

Inasmuch as alkaline salts are generally less costly than soaps and synthetic detergents, their use as "builders" should result in a product of lower cost. The presence of builders is objectionable in a soap to be used in washing woollens and silks, because of the high alkalinity of most builders. However, builders are desirable and valuable for heavy duty laundry and cleaning.

5. Water Softeners

"Hard" water contains mineral salts such as calcium and magnesium sulfate, which combine with soap to form insoluble gummy compounds, thus impairing the washing properties of the fluid. These insoluble compounds waste the soap and are extremely difficult to remove by rinsing.

There are two types of water hardness: (1) "Temporary" hardness (calcium and magnesium bicarbonates) which can be removed by boiling or by the addition of lime water or slaked lime; and (2) "permanent hardness" (calcium and magnesium chlorides and sulfates) which is not affected by boiling, but can be removed by distillation, by the zeolite or similar process, or by the addition of chemicals. The zeolite process consists in passing "hard" water through certain clay-like substances (hydrated sodium aluminum silicates), known as zeolites, where a chemical change takes place which causes the calcium and magnesium to remain in the zeolite while the sodium compounds pass into the water. The most convenient household

method is the addition of chemicals. These softeners fall into two main categories: (1) Those which form a precipitate, such as sodium carbonate and trisodium phosphate; and (2) those which do not form a precipitate, such as the sodium metaphosphates. Because of this non-precipitating characteristic and because they do not increase the alkalinity of the wash water, the metaphosphates are generally the most satisfactory chemical water softeners. It is important to keep in mind that all chemical water softeners should be dissolved in the hot water before the soap is added.

The recommended amount of softener for water of various "grains hardness" is sometimes printed on commercial packages. If water is obtained from a public water system, the degree of hardness can be ascertained from the water department. If it is well water, the degree of hardness can be obtained by having the water analyzed. The degree of hardness should be checked periodically because it is not constant.

6. Bleaches

The process of whitening by treatment with chemicals or exposure to the sun is called bleaching. Often a discoloration can be removed merely by moistening and spreading the cloth in the sun. The chemicals most commonly used are:

Sodium hypochlorite (Javel water) - for fibers of vegetable origin, i.e. cotton and linen

Hydrogen peroxide - a mild bleach for any material

Oxalic acid (POISON) - may be used for any fabric, except weighted silk

These must all be removed by thorough rinsing with water after the bleaching has been accomplished.

7. Bluing and Whitening Agents

Bluing is an insoluble blue pigment or an aniline dye used to neutralize the natural yellowness of "white" materials. Bluing water should be made just before using and the clothes should not be permitted to stand in it. If an excess of blue color results, it may be removed by boiling the material in fresh water. The "optical bleaches" or whitening agents are fluorescent dyes which absorb ultraviolet light and re-emit it as a blue radiation, thus giving the appearance of whiteness by masking stains and discolorations.

8. Starches

Selection of the proper dressing material must depend primarily on the type of fabric to be treated. Some fabrics absorb the dressing more readily than others and, therefore, require less of the stiffening material to achieve the desired finish. Various starches have practically the same composition, but differ greatly in the size and character of their grains, which directly affects their ability to penetrate fabrics. Because of its very small swollen granules, rice starch will penetrate most fabrics thoroughly. Common practice, however, is to use a "thin boiling" mixture of corn and wheat starch for ordinary cotton materials. The liquid starches are aqueous solutions of starch to which a preservative and sometimes bluing have been added. Gum arabic or wax (usually paraffin) is sometimes added to starch to improve the gloss of the finished product. Gelatin, gum arabic, gum tragacanth, and glue are used as dressings for silks, woolsens, and finer cotton materials. Because the latter are transparent, they are desirable for the dressing of colored fabrics.

9. Specifications

The following printed Federal Specifications cover products used for cleaning. These specifications are used for Federal Government procurement.

Title	Specification Symbol	Price
Bleach, calcium hypochlorite	O-C-114a	10 cents
Bleach, sodium hypochlorite	O-S-602	5 cents
Bluing, laundry	O-B-491b	10 cents
Cleaning compound, synthetic detergent, non-abrasive, all purpose	P-C-431a	10 cents
Cleaning compound, alkali type	P-C-436a	5 cents

Title	Specification Symbol	Price
Scouring compound for floors	P-S-311	5 cents
Soap, built, high-titer, powdered	P-S-563	5 cents
Soap, chip	P-S-566b	5 cents
Soap, grit cake	P-S-571b	5 cents
Soap, laundry, bar	P-S-591e	5 cents
Soap, laundry(powdered)	P-S-596c	5 cents
Soap, liquid and paste	P-S-598b	5 cents
Soap, potash-linseed oil	P-S-603b	5 cents
Soap, powder	P-S-606a	5 cents
Soap, toilet(cake,milled)	P-S-621c	5 cents
Soap, toilet(floating,white)	P-S-616b	5 cents
Soap, toilet, liquid, and paste	P-S-624b	10 cents
Soap, powdered, for use in dispensers	P-S-626e	10 cents
Sodium carbonate- bicarbonate mixture	P-S-641d	10 cents
Sodium orthosilicate	P-S-651a	10 cents
Starch, laundry	JJJ-S-701a	5 cents

Copies of these specifications can be obtained at the prices indicated (stamps not accepted) from the Business Service Center, General Services Administration, Washington 25, D. C.

10. References

- Bennett, H. : The Chemical Formulary, Chemical Publishing Co., Inc., Brooklyn, N. Y. (1951)
- Hiscox, G. D. : Henley's Twentieth Century Book of Recipes, Formulas, and Processes. Norman W. Henley Publishing Co., New York, N. Y. (1944)
(Revised and enlarged by Prof. T. O'Connor Sloane)
- Martin, G. : The Modern Soap and Detergent Industry, 1950-1, London Technical Press (1951)
- Schwartz - Perry : Surface Active Agents and Detergents, MacNair-Dorland Co., 254 W. 31st St., New York 1, N. Y. (1958)
- Thomssen, E. G. and McCutcheon, J. W. : Soaps and Detergents, MacNair-Dorland Co., New York, N. Y. (1949)
- Technical Journals : Soap and Chemical Specialties, MacNair-Dorland Co., Inc., 254 W. 31st St., New York 1, N. Y.
- The Journal of the American Oil Chemists' Society,
35 E. Wacker Drive, Chicago 1, Illinois

Supersedes LC868 dated 7/22/47
Prepared by: AMM/RYC
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FORMULAS FOR DETERGENTS AND RELATED PRODUCTS

Formulas and directions for making detergents and related products may be found in the following reference books:

- Bennett, H. : The Chemical Formulary, Chemical Publishing Co., Inc., Brooklyn, N. Y. (1951)
- Bennett, H. : Commercial Waxes, Chemical Publishing Co., Inc., Brooklyn, N. Y. (1956)
- Hiscox, G. D. : Henley's Twentieth Century Book of Recipes, Formulas, and Processes. Norman W. Henley Publishing Co., New York, N. Y. (1944)
(Revised and enlarged by Prof. T. O'Connor Sloane)
- John, W. D. : Modern Polishes and Specialties, Chemical Publishing Co., Inc., Brooklyn, N. Y. (1947)
- Martin, G. : The Modern Soap and Detergent Industry, 1950-1, London Technical Press (1951)
- McCutcheon, J. W. : Synthetic Detergents, MacNair-Dorland, New York, N. Y. (1950)
- Thomssen, E. G. and McCutcheon, J. W. : Soaps and Detergents, MacNair-Dorland Co., New York, N. Y. (1949)
- Warth, Albin H. : The Chemistry and Technology of Waxes. Reinhold Publishing Corp., New York, N. Y. (1956)

The above books are available in many public libraries.

August, 1958

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