CHAPTER IV

Materials
In General Use in R.N. Laundries

1. In order to obtain good results it is important that the operator be familiar with the materials used in the washing process and the reasons for their use. The principal materials used are:

(*a*) Water:
  (i) Soft and hard fresh water.
  (ii) Sea water.
(*b*) Soaps and detergents.
(*c*) Alkalis.
(*d*) Acids.
(*e*) Bleach.

WATER

2. Fresh water can be described as either soft or hard, depending upon its freedom or otherwise from substances held in solution.

3. Soft water

A good example of soft fresh water is rain water. As the rain soaks into the earth, however, it absorbs and holds in solution numerous substances which vary with the geological structure in different parts of the country—limestone, chalk, etc. The amount of the substances held in solution, determines the degree of hardness of the water.

4. Hard water

Water hardness is of two kinds, temporary and permanent, both kinds usually being present in any given sample. The types of hardness depend upon the nature of the substances held in solution.

(*a*) TEMPORARY HARDNESS is usually due to the presence of calcium bicarbonate, *i.e.*, calcium carbonate (chalk) combined with carbonic acid and thus held in solution. This type of hardness can be removed by boiling; the heat decomposes the carbonic acid, the carbon dioxide gas is expelled and the calcium carbonate precipitated as a white chalk sludge. Temporary hardness can also be removed very efficiently by the use of lime. (The Lime Process.)

(*b*) PERMANENT HARDNESS is due to the presence of calcium or magnesium compounds other than the bicarbonate, such as calcium sulphate or chloride. These substances do not respond either to boiling or treatment with lime, but require sodium carbonate for their removal. (The " Soda " Process).

5. Water softening

Hard waters cause considerable waste of soap and also rinse badly. Hardness in water is remedied commercially by means of water-softening plants using either the " Lime-Soda " or the Base Exchange " Zeolite " methods.

When required for laundry purposes, water having a hardness index greater than 6° should be softened if possible. It is therefore necessary to be able to measure readily the hardness of water in the first instant, and the apparatus for doing so is the " Water Hardness Testing Equipment Pattern 2542."

6. Water supplies

(*a*) SHORE ESTABLISHMENTS are supplied from local sources and if required for laundry purposes, hard water must be softened by one of the above methods.

(*b*) H.M. SHIPS. The water supply for laundry purposes may be from:

(i) *The ship's distilling plant.* Distilled water should be of zero hardness, and is ideal for laundry purposes.

(ii) *Shore fresh water.* This will normally be untreated and of the hardness of the local supply. As ships have no water-softening plant, allowance must be made in the washing processs if the water is hard by the use of increased amount of detergent and alkali.

(iii) *Sea water.* With a view to effecting the conservation of fresh water, trials were conducted over a period of 12 months using a sea-water washing process, but, following a detailed analysis of the results achieved, the process was not recommended for general use. Reasons against the use of sea water include:

Unsuitability for use in harbour, due to the risk of contamination.

The high potential risk of corrosion in washing machines.

SOAPS

7. With a few exceptions the soaps used for laundry purposes are manufactured from fatty acids and soda. The fatty acids provide the detergent properties of the soap, and according to the fatty acid used, some soaps produce a greater lathering effect and some are more soluble in water than others.

The " titre " of a fatty acid is its solidifying point and, when related to soaps, it gives the temperature above which the fatty acid content is liquid. The titre value therefore gives a useful indication of the suitability of the soap for a particular process.

As a general rule low titre soaps are oil soaps; true oil soaps have a titre value of less than 25°C. (77°F.). These wash well at low temperatures and rinse easily and are therefore most suitable for use with silks, woollens and other delicate fabrics.

For a normal white work requiring high temperature washing, high titre soaps are more efficient. High titre soaps 30°C. (86°F.) to 35°C. (95°F.) are usually hard soaps; they wash well at high temperatures but require hot water for easy rinsing.

The high titre soaps are suitable for washing through a wide range of temperature and are therefore of greater general value under normal conditions than low titre soap. High titre soap, usually in hard bar form, is in general use at present in H.M. ships; and a partial substitute known as " Teepol " or a Detergent Solution Patt. 862, which is a by-product of petroleum, is also used when making up the stock solution.

8. Action of soaps

The soap solution added to the machine gives the mixture a much greater power of penetration, and the particles of dirt in the fabric are thus more readily loosened and held in suspension.

9. Stock solutions

Soap should be added to the washing machine in liquid form. The necessary stock solution can be prepared in the steam-heated soap and soda boiler, usually of either 25 or 50 gallons capacity, provided for this purpose. A typical stock solution tank (soap and soda boiler) is illustrated in Fig. 29.

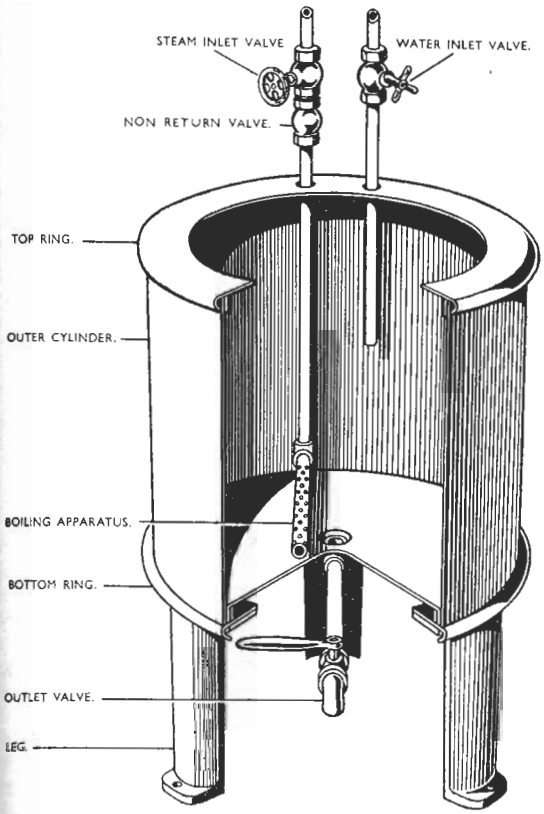

Fig. 29.—Arrangement of soap and soda boiler.

10. Preparation of stock solutions

(*a*) BAR SOAP AND TEEPOL

Material required:

30 lb. of bar soap.

10 lb. of " Teepol " (this is in liquid form and 1 gallon weighs 12 lb.).

Method:

(1) Half fill the soap tank with water.
(2) Add the soap, cut into small pieces.
(3) Turn on the steam and heat the water until all the soap is dissolved.
(4) Turn off the steam.
(5) Add the " Teepol."
(6) Fill the tank to the 40-gallon level.
(7) Mix thoroughly.

(*b*) DETERGENT SOLUTION PATT. 862

It is probable that in future, supplies of detergent solution will not be restricted to the proprietary brand known as Teepol. Detergent solutions will be purchased in bulk to a general specification T.S. 195B and may be Teepol or any other equivalent product. The Admiralty Patt. No. 862 is, however, being retained for this classification.

(*c*) STRENGTH OF STOCK SOLUTIONS

(*a*) The strength of the stock solution can be varied to suit individual requirements, but should always be of a known value. The solutions described have a strength of 1 lb. soap in 1 gallon of water, and are suitable for all general work. Smaller quantities of the solution can be made by using proportionately smaller weights of detergents.

(*b*) Soap may be supplied in powder, flake or bar form. In whatever form it is supplied, a percentage of water exists, thus leaving something less than 100 per cent. of pure soap. As a rough guide, the soap content of average commercial soaps is as follows:—

A very dry powder	..	95 per cent. soap.
An average flake soap	..	90 per cent. soap.
Good quality bar	..	75 per cent. soap.
A moist bar ..	..	70 per cent. soap.

ALKALIS

11. Alkalis increase the detergent power of the soap and protect it against the acid conditions arising from the materials being washed. The soiling in clothes is usually acid in nature, and because soap will not emulsify even in slightly acid conditions, it is necessary to introduce an alkali to neutralise the acid and, in fact, to render the washing water slightly alkaline.

Alkalis neutralize acids, and the alkalinity of a solution is tested by its effect on certain indicators such as litmus or methyl orange. If red litmus turns blue the solution is alkaline. An alkaline solution has a characteristic soapiness to the touch.

12. Measurement of alkali strength

The mixture of an alkali and an acid solution in the correct proportions results in the formation of a " neutral," which has neither acid nor alkaline properties. Such a compound is called a salt.

The alkalinity or acidity of any solution can be estimated and is known as its *p*H value.

Neutral solutions have a *p*H value of 7.

Acid solutions have a *p*H value less than 7.

Alkaline solutions have a *p*H value more than 7, the maximum being 14.

The extent by which the *p*H value of a solution exceeds 7 gives an indication of its alkaline strength.

The following list shows the approximate values of the most common alkalis when dissolved in water to give a concentration of the same order as that usually attained in laundry wash liquors.

	pH value
Sodium hydroxide (caustic soda) ..	12·7
Sodium carbonate (soda ash) ..	11·10
Tetra sodium pyrophosphate ..	10·2
Borax	9·15
Sodium bicarbonate	8·4

Alkalis most generally used commercially give solutions which have *p*H values between 8·0-11·5. Alkalis which give solutions of over 11·5 are considered too strong to be used with safety in normal washing processes and their use is only justified in the case of heavily soiled materials such as greasy overalls, etc.

13. Alkalis used in H.M. ships

The alkali now generally used is soda ash. This should be added to the machine from a stock solution made up in the strength of 1 lb. of soda ash per 1 gallon of water.

Where stock tanks are not available, the stock solution should be prepared in buckets and quantities added as specified in the washing formulae.

ACIDS

14. Acids are substances which have for the most part reverse properties to those of alkali turning, for example, blue litmus red. Widespread use is made of acids in the commercial laundry industry for various " spotting " and stain removal processes, for brightening colours and for the removal of lime soap deposits from fabrics and washing machines, etc. Infinite care must be exercised at all stages when using acids in any form because of their corrosive effect on fabric and metal. The use of acids in H.M. ships' laundries is at present confined to two main requirements; the internal cleaning of washing machines and the removal of rust stains from white uniform, but an increased application will be introduced in due course.

15. Glacial acetic acid

Its primary use is for removing the lime soap deposits from the internal surfaces of the washing machine (see Chapter 3, para. 6). It is purchased as a concentrate in liquid form and should be diluted with distilled water in the proportions of 3 of water to 1 of acid before use.

16. Oxalic acid

Used for removing rust stains from white uniforms and other white cotton goods, oxalic acid is purchased in crystal form and should be diluted to a 1 per cent. solution before use. A suitable solution can be prepared by dissolving ½ oz. of oxalic acid crystals in 2½ pints of distilled water.

PROCEDURE FOR USING OXALIC ACID

Prepare a 1 per cent. solution in a non-metallic container and raise the temperature of the solution to 100° F. Immerse the rust-stained garment in the solution for a period of 10 to 15 minutes. Remove the garment and thoroughly rinse it.

Notes.—The temperature of 100° F. must not be exceeded—any higher temperature will cause weakening of the fibre resulting in eventual rupture.

Before treating articles, all metal buckles and buttons must be removed.

Oxalic acid must not be used on woollen or silk articles.

BLEACH AND BLEACHING

17. The normal methods of washing, using soap and alkalis only, are effective in removing the ordinary soiling matters. It is frequently found, however, that, as a result of the conditions to which fabrics have been exposed during use, they become discoloured or stained by substances which cannot be removed by the normal washing process alone. It is then necessary to employ bleaching agents which, by their oxidizing or reducing action, remove the staining substances. Furthermore, white goods which have been in use for some time, and which have been subjected to repeated washing operations, tend to develop a faint yellow tint. This slight discolouration should also be removed by bleaching treatment.

18. Sodium hypochlorite bleaches (*chlorine bleaches*)

The sodium hypochlorite breaks down chemically into sodium chloride (common salt) and nascent oxygen. The nascent oxygen, which is unstable, combines with the colouring matter forming colourless oxides. Hence the article is bleached.

Sodium hypochlorite is a liquid, and is not carried in H.M. ships because of the difficulties of storing liquid bleaches. If stored in metal containers the bleach decomposes and corrision of the containers takes place.

19. Bleaching powder (*chloride of lime*)

As liquid bleach cannot readily be carried in bulk, arrangements are made for the manufacture of liquid bleach from bleaching powder (chloride of lime). The powder contains about 35 per cent. of available chlorine and can be easily stored.

Bleaching powder is a hypochlorite bleach, but because of its lime content it should not be used in conjunction with soap, and therefore must not be added to the machine direct. Sodium hypochlorite bleach liquor can be prepared from the powder by the addition of a suitable alkali (soda ash); the lime content of the powder becomes precipitated in the form of chalk.

20. Preparation of stock solution

Because of its loss of strength if stored for any length of time and the difficulty in storing it, stock solutions of bleach should be made as required.

(1) Cream 1 lb. of fresh bleaching powder with 1 gallon of cold fresh water.

(2) Completely dissolve 1 lb. of soda ash in 1 gallon of cold water and add this to the bleach powder solution previously mixed.

(3) Make up to 8 gallons, *i.e.*, add a further 6 gallons, with cold water and stir well.

(4) Allow the precipitated chalk to settle, then decant or filter the clear resultant bleach liquid into a non-metallic container.

21. Quantity

(*a*) The above stock solution contains about 40 grains of available chlorine per pint. The permissible concentration of bleach added to the machine must never exceed 5 grains per gallon of wash liquor.

Bleach is normally added during the second wash. Table 7 gives details of the volumetric capacity of various types and sizes of machine corresponding to the dip in inches.

Assume a 30 cu. ft. machine and that bleach is to be added at a 3-in. dip.

Volume of water corresponding to a 3-in. dip = 58 gallons.

Total amount of bleach required = $58 \times 5 = 290$ grains.

Number of pints of bleach stock solution to be added assuming a concentration of 40 grains per pint = $\frac{290}{40} = 7\frac{1}{4}$ pints.

(*b*) The correct quantities of bleach can also be calculated by allowing 3 grains of available chlorine per 1 lb. of work provided the machines are loaded at the rate of $3\frac{1}{2}$ lb. per cu. ft. and the bleach is added to the wash (temperature 140° F.).

22. Method

The following rules must be strictly adhered to when using bleach in order to avoid damage to the fabrics being washed:

(*a*) Never bleach at a temperature higher than 140° F.

(*b*) Never use a bleach of unknown strength.

(*c*) Never add strong bleach direct to the machine.

(*d*) Always measure out bleach; quantities should not be guessed.

(*e*) Always pour bleach into the machine slowly with the cage revolving downwards.

(*f*) The quantity of bleach added to a machine must never exceed 5 grains per gallon of wash liquor, *i.e.*, 1 pint of stock solution to 8 gallons of wash liquor.

(*g*) Bleach liquor should be used only for bleached cotton or linen goods and then subject only to these having been stained, *e.g.*, tablecloths stained with tea, coffee, etc.

(*h*) Indiscriminate use of bleach liquor rapidly damages and rots the fabrics and bleach MUST NOT be used when washing dyed articles or articles containing wool.

23. When to use bleach

The production of good quality white work by means of the normal washing processes and without the use of bleach should always be aimed at. *Bleach should be used as the exception and not as the rule in the washing process.* Rigid control of the bleaching agent at all times is important, as incorrect use or the use of too strong a concentration may cause irreparable damage to the fabric. The wash is the safest stage at which to do the bleaching, as excess bleaching agent may possibly then be removed during subsequent washing and rinsing processes. For this reason revised Admiralty washing formulae direct that the bleach be added at the first wash.

STARCHES AND STARCHING

24. White suits, shirts, collars and table-linen are starched before pressing. The process enables a high standard of finish to be imparted and the slight stiffening of the fabric assists in maintaining the correct shape of the garments for a longer period. Loose dirt cannot adhere so easily to the polished surface produced by starching, hence work so processed keeps clean for a longer period.

25. Types of starch

Starch is present in practically all plant life, but is especially abundant in cereals (rice, wheat, corn etc.) Wheat and rice starches, because of their fine grain, penetrate fabric more thoroughly and promote a smooth flexible finish, but the coarser corn starches tend to produce a stiff brittle finish. Corn and wheat can be combined with other ingredients, *e.g.*, talcum and borax, to produce a general purpose starch which combines the flexibility of the wheat with the stiffness of the corn starches. A combination starch known as National Blended Starch (N.B.S.) having a rice base has been extensively used in H.M. ships and establishments. (*see* para. 28). N.B.S. can be used cooked or raw, and is classified as a semi-thick boiling starch.

26. Density

To obtain a constant standard in starch work it is essential that the stock solution be made up to a predetermined density. A Twaddell hydrometer, graduated from 0 to 12 and designed to indicate the correct density at a temperature of 60° F., is used for this purpose. The starch should be made up to give a Twaddell reading of 5 to 7.

27. Method of application

There are three main operations, each requiring a separate process, namely:

(*a*) STARCHING OF WHITE SHIRTS, TABLE-LINEN, BED-LINEN

Starching is done during the washing process as follows:

(1) Cream 1 lb. N.B.S. in 2 gall. water

(2) Reduce the dip in the washing machine after the last rinse to 3-in.

(3) Add creamed starch as mixed and allow to run for 10 minutes.

(*b*) COLLAR STARCHING

This is normally undertaken in the machine provided for the purpose (see Chapter IX).

(*c*) STARCHING OF DRESS-SHIRT CUFFS AND FRONTS; STIFF CUFFS ON HOSPITAL UNIFORMS.

28. Starch stock solutions

(*a*) COLLARS

A 15 gallon capacity steam heated starch cooker is provided in large ships to facilitate the preparation of the starch stock solution.

(1) Cream 1 lb. of N.B.S.

(2) Dilute to 2 gallons.

(3) Bring slowly to the boil and maintain at the boil for 15 minutes.

(4) Allow to cool to 120°F.

(5) Thoroughly stir in 5 lb. of N.B.S. previously creamed in cold water.

(6) Prepare 3 oz. of wax with about 1½ oz. of white soap, ⅓ pint of glycerine, and a small measure of blue.

(7) Pour this mixture into a bucket with about 2 gallons of water and slowly boil until the mixture has completely emulsified.

(8) Add the mixture to the stock solution.

(9) Add cold water until a Twaddell reading of 5-7 is obtained.

(10) Allow the solution to stand for not less than 72 hours. (Very important).

(11) Before using starch solution, stir well, strain through muslin, and check density.

N.B.—Distilled water of zero hardness should be used wherever possible. The general finish and appearance of starched collars can be varied by the addition of borax, wax, glycerine and Teepol to the basic rice or National Blended Starch.

(i) *Borax.*—Introduction of borax into the starch stock solution allows a higher finishing temperature to be used and collars so processed are less affected by atmospheric conditions. Collars with a pure starch film are apt to become limp particularly in a humid atmosphere and the addition of borax reduces this tendency.

The amount of borax added should not exceed 1 to 2 oz. per 1 lb. of starch. If larger amounts are used, excessive brittleness results thus rendering the material fibres more liable to damage.

(ii) *Wax.*—Is added to the stock solution to give the articles a high glossy finish.

Several types of wax can be used for this purpose but Japan wax is the most suitable. This wax is readily soluble in water and can therefore be completely removed from the soiled article during the washing process.

If the wax available does not emulsify easily, a small quantity of white soap (1 oz. of soap to 2 oz. of wax) should be added to the stock solution.

(iii) *Glycerine.*—When wax is used in the starch solution glycerine may also be added. The glycerine assists the wax by enabling a smoother finish to be imparted and in addition promotes flexibility.

Glycerine should be added in the proportion of ⅓ pint of glycerine to 8 gall. of stock solution.

(iv) *Teepol.*—Is used in the stock solution to assist in obtaining the maximum penetration of the starch into the material.

The quantity used should not exceed ¼ pint per 8 gallons of total stock solution. Teepol is not essential; any detergent solution pattn. 862 may be used.

(*b*) DRESS SHIRT CUFFS AND FRONTS

As for collars, except that borax should be omitted and the glycerine content slightly increased to give flexibility without cracking.

29. Cold Starch method

Proprietary brands of high-grade starch which enable a stock starch solution to be prepared direct by the addition of warm and cold water only are now available. The additional initial cost is more than offset by the simplicity of preparation as compared with the methods detailed in the previous paragraphs. The need for the separate addition of wax, borax, glycerine etc. is completely eliminated as all the ingredients necessary to produce high quality starched work, *i.e.*, stiff collars and dress shirt fronts and cuffs, are incorporated in the starch manufacture. The need for boiling, settling and straining the stock solution is also dispensed with.

A satisfactory stock solution using high-grade starch can be prepared for collar and dress shirt work as follows:

Cream 3 lbs. of starch in about ¼ of a bucket of warm water.

Add cold water until a Twaddell reading of 6 to 7 is obtained.

This solution can be used in the starching machine direct for collar work and in a suitable bowl for the starching of dress shirt fronts and cuffs.

Smaller quantities can be prepared as required, the only important factor being that the resultant stock solution should have a Twaddell reading of 6 to 7.