Reprinted — February, 1968.

COCONUT RESEARCH INSTITUTE

LEAFLET No. 10

SOAP-MAKING BY THE COLD PROCESS

The making of soap as a cottage industry is best carried out by the 'Cold Process', since this is essentially very simple and does not require elaborate and expensive plant. It is fortunate, moreover, that coconut oil, which is the raw material most readily available locally, is the fat most suitable for the 'Cold Process', some other fats being difficult to work without boiling.

1. THE SOAP MAKING PROCESS

(*a*) **Raw Materials:**— The essential ingredients for making soap are fat (or fatty oil), caustic soda and water. The commonest fatty oil in Ceylon is coconut oil, and reasonably good soap can be made using this alone. Improved soap can however be made by using mixtures of coconut oil with certain proportions of tallow, Mee oil, etc. and/or rosin.

Caustic soda can be obtained in drums of 1 cwt., 3 cwt. or 5 cwt. If it is not desired to handle so large a quantity at first there are retail dealers in many districts.

(*b*) **The Process:**— The formation of soap from a fat or oil and caustic soda is known as 'saponification' and this term should be noted, as it is commonly used in connection with soap work. All fats and fatty oils undergo the process of saponification with caustic soda, though some require boiling. Coconut oil is

readily saponified by stirring in the cold with a strong solution or 'lye' of caustic soda, and this is the basis of the 'Cold Process'. In saponification, besides soap there is also formed glycerine, so that the process of saponification can be represented by the equation:—

Fat (or fatty oil) + caustic soda = soap + glycerine.

In large scale soap manufacture by the 'Boiling Process' the soap is separated from the glycerine by addition of salt, which causes the soap to rise to the surface whilst the 'spent lye' with the glycerine remains at the bottom. In the 'Cold Process' no attempt is made to separate glycerine ,which remains in the finished soap, and since it is good for the skin is quite a useful constituent.

It will be obvious that since all the materials used remain in the finished soap in one form or another, the quality of the soap depends on the raw materials. Coconut oil should be of good quality; chekku oil should be filtered if necessary from pieces of poonac, etc. and (for reasons given below) the oil should not contain more than 2 per cent. free fatty acid. Freshly made mill oil is usually satisfactory.

Caustic soda:— as supplied is of a high grade of purity. It should be pointed out that this material is a *very caustic* substance, which must not be allowed to come into contact with the skin. For the same reason, it is most undesirable to have any unchanged caustic soda in the finished soap, which would be detrimental to clothes washed with it, and very irritating to the skin. Caustic soda must be kept *in closed tins* and stored in a dry place; other-wise it deteriorates, getting wet and being converted gradually into ordinary washing soda, which will not saponify oils in the cold process.

(*c*) **Equipment Required:—** The cold process, as mentioned, requires very simple equipment:

(i) A vessel for mixing the caustic soda lye.

(ii) A vessel (called the soap pan) for stirring the oil and lye together.

(iii) A frame or box for cooling the saop.

It is also useful to have a scale for weighing the oil and caustic soda, though it is sufficient for the oil to measure it, and in making up the lye to check its strength by a hydrometer.

An enamel jug will serve on a small scale for mixing caustic soda and water. Aluminium vessels must not be used.

With regard to the main soap pan, the size of this will of course depend on the intended scale of operations; on the smallest-scale even the homely kerosene tin may be used. On a semi--commercial scale cast iron pans are used, for example a pan 31 inches across and 2 feet deep will hold about 500 lb. of raw materials.

Cooling frames may be of wood or iron; for small scale operations wooden frames are probably best. They are made with removable sides, so that the cold slab of soap can easily be removed at the end of the operation. For small scale trials, a stout wooden box with removable sides is easily made, say 12"x14"x8" deep which would hold up to 50 lb. of soap.

Additional equipment can be added as required such as a device for cutting the soap into bars, and a stamping machine.

2. SOAP FORMULAE AND WORKING DETAILS

(*a*) Soap made from coconut oil alone lathers freely, so much so that it can be used with sea-water. So called 'Marine Soaps' are made from coconut oil for this reason. The lather is not a lasting one and coconut oil soaps have the disadvantage of wasting away quickly and so are not economical in use.

Harder fats such as tallow, Mee oil, etc., correct this, so that whilst it is essential that a large proportion of the fat charge should be coconut oil (for ease of working the cold process), a moderate percentage of hard fat is useful.

A certain proportion of rosin is often used. Although this is not a fat it does form a sort of soap with caustic soda. Its use in moderate amount improves the odour of the soap and to some extent checks any tendency to rancidity. It is less frequently used in 'cold process' soaps than in boiled soaps as certain precautions have to be observed. These are noted below.

Caustic lye:— The lye used for the saponification in the cold process is a strong one, usually over 30 per cent. by weight. The following formulae are based on a 38° Beaume lye, except when stated.

Study of this question is complicated by the fact that at least three scales are in use for measuring the density of lye, *viz.* Twaddell's (mostly in England) and Beaume's (mostly continental) and the ordinary scientific scale of densities, which should be preferred.

The following table shows the comparison of the various scales with the corresponding lye strengths:—

TABLE I

Density	*Degrees Twaddell*	*Degrees Beaume*	*lb. caustic soda per 100 lb. Solution*	*lb. per 100 gallons*
1.20	40	24	18.2	218½
1.22	44	26	20.2	246
1.24	48	27.9	22.1	274
1.26	52	29.7	24.0	303
1.28	56	31.5	28.8	330
1.30	60	33.3	27.5	358
1.32	64	35	29.2	386
1.34	68	36.6	30.8	414
1.36	72	38.2	32.5	442
1.38	76	39.8	34.1	470
1.40	80	41.2	35.6	498½

The table will be found useful since it covers most of the strengths used in 'Cold Process' soap-making, and it has been calculated for use at tropical temperatures of about 80° F. Any hydrometer can thus be used.

A 38° Beaume lye (or a 71.15° Twaddell) has a density of 1.358 approximately and contains 32.3 lb. of caustic soda in 100 lb. of solution.

To make up this lye 4 lb. 14 oz. of caustic soda are dissolved in a gallon of water (it may be mentioned again that the caustic soda and the lye should not get on the skin. If it does, wash it off with vinegar at once). The solution gets hot and must be allowed to cool before use.

When the solution is cool, its strength should be tested with the hydrometer. It will probably be found a little strong, and a little water must then be added until the hydrometer reads correctly, *i.e.* 1.358, or 38° Beaume or 71.15° Twaddell.

If the solution is not clear it must be allowed to settle and the clear liquor carefully poured off for use. During cooling and settling (if necessary) the solution should be covered away from the air.

(*b*) **Proportions of Fat to Lye:—** Different fats and oils require different amounts of caustic soda for complete saponification. Thus to convert 100 lb. of coconut oil into soap (plus glycerine) 18.3 lb. of caustic soda are required. If less is used, the resulting soap will contain unchanged oil; if more, the soap will contain unchanged caustic soda. The approximate figures for other oils likely to be available locally are:—

Oil (100 *lb.*) *require*	*lb. caustic soda or lb.*	38° *Be lye*
Coconut oil ...	18.2 lb.	56½ lb.
Coconut (Parings) oil ...	17.1 „	53 „
Tallow	13.9 „	43 „
Mee oil	13.8 „	42⅞ „
Groundnut oil ...	13.5 „	41¾ „
Castor oil	13.2 „	41 „
Rosin	12.5 „	38¾ „

From these figures it is easy to calculate by proportions the caustic soda or lye required for any mixture of the above oils fats or rosin

Now in practice it is customary to use up to 5 or 6 per cent, less than the weight of lye actually required according to the theoretical requirements given by the above table. The reason for this is that it is practically impossibly to get absolutely complete 100 per cent. saponification by the cold process and it is better to have a soap with a little unchanged fat in it than run the risk of having unchanged caustic soda. So, using coconut oil alone, for 100 lb. instead of 56½ lb. of 38° Be lye, between 50 and 54 lb. are used.

When starting for the first time without experience to work the cold process it is advisable to use too little caustic soda.

The beginner moreover would be advised to start on a simple coconut oil soap. The saponification in this case goes well at the ordinary tropical temperature of 80 to 90° F. With larger proportions of tallow it is necessary to work with the oil mixture slightly warmed, say 100 to 105° F.

Some suitable formulae:— The following formulae are arranged roughly in order of complexity, starting from a simple coconut oil soap.

(*a*)	Coconut oil ...	100 lb.	
	Caustic lye 38° *Be*	50 ,,	(6 gallons 6½ pints)
	With practice the lye can be increased to 53 lb.		
(*b*)	Coconut oil ...	91 lb.	
	Mee oil ...	9 lb.	
	Caustic lye 38° *Be*	52 ,,	(7 gallons 1½ pints)
	With experience the lye can be increased up to 53 lb.		
(*c*)	Coconut oil ...	80 lb.	
	Mee oil ...	20 ..	
	Caustic lye 38° *Be*	53 ,,	(7 gallons 1½ pints)
	The following formulae give full quantity of lye, for experienced workers.		
(*d*)	Coconut oil ...	75 lb.	
	Castor oil —	15 ,,	
	Groundnut oil ...	10 ,,	
	Caustic lye 38° *Be*	51 ,,	(6 gallons 7½ pints)
(*e*)	Coconut oil ...	60 lb.	
	Mee oil ...	20 ,,	
	Groundnut oil ...	20 ,,	
	Caustic lye 38° *Be*...	50 ,,	(6 gallons 6½ pints)
(*f*)	Coconut oil ...	50 lb.	
	Tallow ...	50 ,,	
	Caustic lye 38° *Be*	49 ,,	(6 gallons 5½ pints)

An example with rosin, which should be tried when practice has been obtained with oils alone:—

(*g*)	Mee oil ...	50 lb.	
	Coconut oil ...	40 ,,	
	Rosin	10 ,,	
	Caustic lye 38° *Be*	47½ ,,	(6½ gallons)

If a balance or scale is not available, it is useful to note that a gallon of coconut oil or groundnut oil weighs 9 lb. 3 oz. and a gallon of castor oil 9 lb. 10 oz. A balance will however be necessary when tallow or rosin is used.

(*c*) **Method of Working:**— The oil charge is placed in the oil pan. When coconut oil alone or coconut with liquid oils such as castor are used melting or heating is not necessary in the low country. Tallow, rosin, and sometimes Mee oil and parings oil require melting until the whole mixture is liquid and homogeneous. (Special care must be exercised with rosin. It should be finally powdered and then warmed with the oil until dissolved). After melting the mixture must be allowed to cool. The saponification must not be started when the oils are still hot. Coconut oil alone is worked quite cold; mixtures (*b*), (*c*) and (*d*) at about 90° F and (*e*) and (f) at 100° F (just warm to the hand). A thermometer is useful but not absolutely necessary.

The cooled lye (prepared as above) is added very gradually to the oil in the pan, and *well stirred in* with a wooden paddle. Good, steady (but not violent) stirring is necessary, the object being to get the lye well in contact with the oil. As mixing proceeds the mixture thickness to the consistency of treacle and stirring is continued until the mixture seems smooth and homogeneous and is firm enough for a mark made on the surface to remain for a short time. This point is better recognized as a result of experience than from any written description. According to the quantity of material worked the mixing and stirring may take from 15 minutes to an hour. Half an hour is usually enough for a small batch of say 20 lb.

At this stage the whole mix is poured off into the frames. Saponification goes on in the frame for a day or more, the temperature rising to about 180° F. It is desirable to conserve the heat developed so as to promote as complete saponification as possible; wooden frames lose heat less quickly than metal and further the frames are covered with planks and sacking.

After two days the process is complete and on the third day the soap can be removed, by taking down the collapsible sides of the frame. (For easy removal it is sometimes the practice to line the frame with paper). It is best to allow the block of soap to stand for a day before cutting into bars. The bars themselves are allowed to dry out further before stamping.

(*a*) **Colouring and Perfuming:**— For perfuming the most easily available material locally is citronella oil and this is satisfactory enough when used with discretion. 12. oz. is sufficient for 100 lb. of soap.

Suitable soap dyes can be purchased in Colombo. It is a common fault with soaps made by small makers that too much colour is used or that it is not evenly mixed. Very small quantities of dyes are required to give a good colour, 1 or 2 oz. being enough for 1,000 lb. of soap. The dye-stuff is prepared by dissolving 1 oz. in 50 oz. of water; 1 oz. of this solution is then enough for 50 lb. of soap.

The dye-stuff solution and the perfume oils are stirred in just before the soap is ready for framing. It is obvious that good mixing is essential.

(*e*) **Points needing attention:**— These notes will be concluded with a further reference to some points needing attention.

(i) All materials must be of good quality. Oils should be clear (filtered if necessary); tallow freshly rendered and melting clear; rosin of a pale colour. Suitable rosin is that known as Grade II. The caustic lye should be of correct strength and clear.

Oils of high acid content produce much trouble in the saponification, causing what is known as 'bunching' *i.e.* the formation of separate grains in the mix which gives a bad uneven appearance to the soap.

(ii) If the saponification is commenced with the oil or lye or both too warm, good mixing is impossible and a layer of oil may even separate on top, and a good soap cannot be obtained.

Wijaya,Printers, Negombo.