PRACTICAL ACTION
Technology challenging poverty

SOAPMAKING

Introduction

Making simple plain soap is relatively easy and involves basic equipment. However, there are certain hazards to workers when making soap which any potential producer must be aware of. This Technical Brief describes the procedures needed to make a variety of simple soaps and includes a number of recipes for different types of soap.

Figure 1: Bina Baroi with some of her finished products after soap-making training from Practical Action Bangladesh. Photo credit: Zul / Practical Action

Ingredients

There are three main ingredients in plain soap - oil or fat (oil is simply liquid fat), lye (or alkali) and water. Other ingredients may be added to give the soap a pleasant odour or colour, or to improve its skin-softening qualities. Almost any fat or non-toxic oil is suitable for soap manufacture. Common types include animal fat, avocado oil and sunflower oil. Lyes can either be bought as potassium hydroxide (caustic potash) or from sodium hydroxide (caustic soda), or if they are not available, made from ashes. Some soaps are better made using soft water, and for these it is necessary to either use rainwater or add borax to tap water. Each of the above chemicals is usually available from pharmacies in larger towns.

Caution !

Lye is extremely caustic. It causes **burns** if splashed on the skin and can cause **blindness** if splashed into the eye. If drunk, they can be fatal. Care is needed when handling lye and 'green' (uncured) soap. Details of the precautions that should be taken are given below.

Because of these dangers**, keep small children away** from the processing room while soap is being made.

How to make lye from ashes

Fit a tap near to the bottom of a large (e.g. 250 litre) container, barrel or tub. Do not use aluminium because the lye will corrode it and the soap will be contaminated. Make a filter inside, around the tap hole, using several bricks or stones covered with straw. Fill the tub with ashes and pour boiling water over them until water begins to run from the tap. Then shut the tap and let the ashes soak. The ashes will settle to less than one quarter of their original volume, and as they settle, add more ashes until the tub is full again. Ashes from any burned plant material are suitable, but those from banana leaf/stem make the strongest lye, and those from apple wood make the whitest soap.

technical brief

Practical Action, The Schumacher Centre, Bourton on Dunsmore, Rugby, Warwickshire, CV23 9QZ, UK
T +44 (0)1926 634400 | **F** +44 (0)1926 634401 | **E** infoserv@practicalaction.org.uk | **W** www.practicalaction.org

If a big barrel is not available, or smaller amounts of soap are to be made, a porcelain bowl or plastic bucket can be used. Fill the bucket with ashes and add boiling water, stirring to wet the ashes. Add more ashes to fill the bucket to the top, add more water and stir again. Let the ashes stand for 12 - 24 hours, or until the liquid is clear, then carefully pour off the clear lye.

The longer the water stands before being drawn off, the stronger the lye will be. Usually a few hours will be enough. Lye that is able to cause a fresh egg to float can be used as a standard strength for soap-making. The strength of the lye does not need to always be the same, because it combines with the fat in a fixed proportion. If weak lye is used, more lye can be added during the process until all the fat is made into soap (saponified).

How to make potash

Potash is made by boiling down the lye water in a heavy iron kettle. After the water is driven off, a dark, dry residue remains which is known as known as 'black salts'. This is then heated until it melts and the black impurities are burned away to leave a greyish-white substance. This is potash. It can be stored for future soapmaking in a moisture-proof pot to prevent it absorbing water from the air.

How to make soda lye and caustic soda

Mix 1 part quicklime with 3 parts water to make a liquid that has the consistency of cream. Dissolve 3 parts sal soda in 5 parts boiling water, and add the lime cream, stirring vigorously. Allow the mixture to boil until the ingredients are thoroughly mixed. Then allow it to cool and settle, and pour off the lye. Discard the dregs in the bottom. Caustic soda is produced by boiling down the lye until the water is evaporated and a dry, white residue is left in the kettle. Most commercial lye is caustic soda, and it can be bought and substituted for homemade lye to save time. Lye is supplied in tins and the lid should be kept tightly fitted to stop the lye absorbing water from the air and forming a solid lump.

Care with lye, potash and caustic soda

You should always take precautions when handling these materials as they are **dangerous**. Be especially careful when adding them to cold water, when stirring lye water, and when pouring the liquid soap into moulds**.** Lye produces harmful fumes, so stand back and avert your head while the lye is dissolving. **Do not breathe lye fumes**. **Use rubber gloves** and **plastic safety goggles**. You should also **wear an apron or overalls** to protect your clothes. If lye splashes onto the skin or into your eyes, wash it off immediately with plenty of cold water.

When lye is added to water the chemical reaction quickly heats the water**. Never add lye to hot water** because it can boil over and scald your skin. **Never add water to lye** because it could react violently and splash over you. Always add the lye to the water in **small quantities** at a time.

How to prepare tallow

Cut up beef suet (fat), mutton fat or pork scraps and heat them over a low heat. Strain the melted fat through a coarse cloth, and squeeze as much fat as possible out of the scraps. Clean the melted fat by boiling it in water. Use twice as much water as fat, add a tablespoon of salt per 5 kg fat, and boil for ten minutes, stirring thoroughly all the time. Allow it to cool and form a hard cake of fat on top of the water. Lift off the cake of fat and scrape the underside clean. This is then ready to store or use in a soap recipe.

How to prepare oil

Vegetable oils can be extracted from oilseeds, nuts or some types of fruit (see the separate Technical Brief on 'Oil Extraction'). Oil can be used alone or mixed with fat or other types of oil. Note: solid fats and 'saturated' oils (coconut, oil palm, palm kernel) are more suitable for soap making. 'Unsaturated' oils (e.g. safflower, sunflower) may produce soap that is too soft if used alone (see Table 2) and are not recommended.

Soap making

There are two types of soap: soft soap and hard soap. Soft soap can be made using either a cold process or a hot process, but hard soap can only be made using a hot process. To make

any soap it is necessary to dilute the lye, mix it with the fat or oil, and stir the mixture until saponification takes place. In the processes described below, the word 'fat' is used to mean either fat or oil. The cold process may require several days or even months, depending upon the strength and purity of the ingredients, whereas the hot process takes place within a few minutes to a few hours.

Dispose of soap-making wastes carefully outside the house. ***Do not put them in the drain.***

Fats	Oils
Goat fat	Canola
Lanolin	Coconut
Lard	Cottonseed
Mutton fat	Palm
Pork fat	Palm kernel
Suet	Soybean
Tallow	

Table 1: Types of fats and oils used in soapmaking

Soft soap

Cold process

A simple recipe for soft soap uses 12 kg of fat, 9 kg of potash and 26 litres of water. Dissolve the potash in the water and add it to the fat in a wooden tub or barrel. For the next 3 days, stir it vigorously for about 3 minutes several times a day, using a long wooden stick or paddle. Keep the paddle in the mixture to prevent anyone accidentally touching it and being burned. In a month or so the soap is free from lumps and has a uniform jelly-like consistency. When stirred it has a silky lustre and trails off the paddle in slender threads. Then the soap is ready to use and should be kept in a covered container.

Boiling process

Soft soap is also made by boiling diluted lye with fat until saponification takes place. Using the same amounts as above, put the fat into a soap kettle, add sufficient lye to melt the fat and heat it without burning. The froth that forms as the mixture cooks is caused by excess water, and the soap must be heated until the excess water evaporates. Continue to heat and add more lye until all the fat is saponified. Beat the froth with the paddle and when it ceases to rise, the soap falls lower in the kettle and takes on a darker colour. White bubbles appear on the surface, making a peculiar sound (the soap is said to be 'talking'). The thick liquid then becomes turbid and falls from the paddle with a shining lustre. Further lye should then be added at regular intervals until the liquid becomes a uniformly clear slime. The soap is fully saponified when it is thick and creamy, with a slightly slimy texture. After cooling, it does not harden and is ready to use.

To test whether the soap is properly made, put a few drops from the middle of the kettle onto a plate to cool. If it remains clear when cool it is ready. However, if there is not enough lye the drop of soap is weak and grey. If the deficiency is not so great, there may be a grey margin around the outside of the drop. If too much lye has been added, a grey skin will spread over the whole drop. It will not be sticky, but can be slid along the plate while wet. In this case the soap is overdone and more fat must be added.

Hard soap

The method for making hard soap is similar to that for making soft soap by the boiling process, but with additional steps to separate water, glycerine, excess alkali and other impurities from the soap. The method requires three kettles: two small kettles to hold the lye and the fat, and one large enough to contain both ingredients without boiling over.

Put the clean fat in a small kettle with enough water or weak lye to prevent burning, and raise the temperature to boiling. Put the diluted lye in the other small kettle and heat it to boiling. Heat the large kettle, and ladle in about one quarter of the melted fat. Add an equal amount of the hot lye, stirring the mixture constantly. Continue this way, with one person ladling and another stirring, until about two-thirds of the fat and lye have been thoroughly mixed together.

At this stage the mixture should be uniform with the consistency of cream. A few drops cooled on a glass plate should show neither separate globules of oil or water droplets. Continue boiling and add the remainder of the fat and lye alternately, taking care that there is no excess lye at the end of the process. Boiled hard soaps have saponified when the mixture is thick and ropy and slides off the paddle.

Up to this point, the process is similar to boiling soft soap, but the important difference in making hard soap is the addition of salt at this point. This is the means by which the creamy emulsion of oils and lye is broken up. The salt has a stronger affinity for water than it has for soap, and it therefore takes the water and causes the soap to separate. The soap then rises to the surface of the lye in granules and looks like milk curd. The spent lye contains glycerine, salt and other impurities, but no fat or alkali. Pour the honey-thick mixture into soap moulds or shallow wooden boxes, over which loose pieces of cloth have been placed to stop the soap from sticking. Alternatively, the soap may be poured into a tub which has been soaked overnight in water, to cool and solidify. Do not use an aluminium container because the soap will corrode it. Cover the moulds or tub with sacks to keep the heat in, and let it set for 2 - 3 days.

When cold the soap may be cut into smaller bars with a smooth, hard cord or a fine wire. It is possible to use a knife, but care is needed because it chips the soap. Stack the bars loosely on slatted wooden shelves in a cool, dry place and leave them for at least 3 weeks to season and become thoroughly dry and hard.

Be careful! *Uncured or 'green' soap is caustic since the lye has not reacted fully with the fat and neutralised it. This is known as the curing process.* ***Wear rubber gloves*** *when handling the hardened soap until it has been cured for a few weeks.*

Difficulties involved with the soapmaking process

Problems that can occur in soapmaking and their possible causes are described in Table 2 :

Problem	Possible causes
Soap will not thicken quickly enough	Not enough lye, too much water, temperature too low, not stirred enough or too slowly, too much unsaturated oil (e.g. sunflower or safflower).
Mixture curdles while stirring	Fat and/or lye at too high temperature, not stirred enough or too slowly.
Mixture sets too quickly, while in the kettle	Fat and lye temperatures too high.
Mixture is grainy	Fat and lye temperature too hot or too cold, not stirred enough or too slowly.
Layer of oil forms on soap as it cools	Too much fat in recipe or not enough lye.
Clear liquid in soap when it is cut	Too much lye in recipe, not stirred enough or too slowly.
Soft spongy soap	Not enough lye, too much water, or too much unsaturated oil
Hard brittle soap	Too much lye
Soap smells rancid	Poor quality fat, too much fat or not enough lye.
Air bubbles in soap	Stirred too long
Mottled soap	Not stirred enough or too slowly or temperature fluctuations during curing.
Soap separates in mould, greasy surface layer on soap	Not enough lye, not boiled for long enough, not stirred enough or too slowly
White powder on cured soap	Hard water, lye not dissolved properly, reaction with air.
Warped bars	Drying conditions variable.

To improve hard soap

Better-quality soap may be made by re-melting the product of the first boiling and adding more fats or oils and lye as needed, then boil the whole until saponification is complete. The time required for this final step will depend on the strength of the lye, but 2 - 4 hours' boiling is usually necessary. If pure grained fat and good quality white lye are used, the resulting product will be a pure, hard white soap that is suitable for all household purposes. Dyes, essences or essential oils can be added to the soap at the end of the boiling to colour it or to mask the 'fatty lye' smell and give a pleasant odour.

Hard soap recipes

The simplest and cheapest type of soap is plain laundry soap, but a few inexpensive ingredients can be used to soften the water or to perfume the product and create fine toilet soaps too. The following recipes are a few examples of easily made soaps. There are many more recipes in the information sources given at the end of this Technical Brief.

Simple kitchen soap

Dissolve 1 can of commercial lye in 5 cups cold water and allow it to cool. Meanwhile mix 2 tablespoons each of powdered borax and liquid ammonia in ½ cup water. Melt 3 kg fat, strain it and allow it to cool to body temperature. Pour the warm fat into the lye water and while beating the mixture, gradually add the borax and ammonia mixture. Stir for about 10 - 15 minutes until an emulsion is formed, and pour the mixture into a mould to cool.

Boiled hard white soap

Dissolve 0.5 kg potash lye in 5 litres of cold water. Let mixture stand overnight, then pour the clear liquid into a second 5 litres of hot water and bring it to a boil. Pour in 2 kg of hot melted fat in a thin stream, stirring constantly until an emulsion is formed. Simmer for 4 - 6 hours with regular stirring, and then add 5 litres of hot water in which 1 cup of salt is dissolved. Test to ensure that the mixture is saponified by lifting it on a cold knife blade, to ensure that it is ropey and clear.

Labour-saving soap

Dissolve 0.5 kg soda lye and 1 kg yellow bar soap cut into thin slices in 12 litres of water. Boil for 2 hours and then strain. Clothes soaked overnight in a solution of this soap need no rubbing. Merely rinse them out and they will be clean and white.

English bar soap

Use 5 litres of soft water, 0.5 kg of ground (or agricultural) lime, 1.75 kg soda lye, 30g borax, 1 kg tallow, 0.7 kg pulverised rosin and 14g beeswax. First bring the water to a boil, and then gradually add the lime and soda, stirring vigorously. Add the borax, boil and stir until it is dissolved. Pour in the melted tallow in a thin stream, stirring constantly. Add the rosin and beeswax, and boil and stir until it thickens. Cool in moulds.

Transparent soap

Any good quality white soap may be made transparent by reducing it to shavings, adding one part alcohol to 2 parts soap, and leaving the mixture in a warm place until the soap is dissolved. It may be perfumed as desired.

Bouquet soap

Shave 14 kg tallow soap and melt it in 2 cups water. When it is cool, add 14g essence of bergamot, 30g each of oils of cloves, sassafras and thyme. Pour it into moulds.

Cinnamon soap

Shave 23 kg tallow soap and melt it over a low heat in 1.2 litres water. Cool and add 200g oil of cinnamon and 30g each of essences of sassafras and bergamot. Mix and add 0.5 kg finely powdered yellow ochre. Mix well and pour into moulds.

technical brief

Citron soap

Mix 180g shaved soap with 300g attar of citron, 15g lemon oil, 120g attar of bergamot and 60g attar of lemon.
Medicated soaps

Camphor soap

Dissolve 0.5 kg hard white soap in 1 cup boiling water. Continue boiling over a low heat until the soap is the consistency of butter. Add 180g olive oil, mixed with 30g camphorated oil. Remove it from the heat and beat until an emulsion forms. This soap can be used to clean cuts and scratches.

Sulphur soap

Shave 60g soft soap and add 8g Flowers of Sulphur. Perfume and colour may be added as desired. Mix the ingredients thoroughly in earthenware bowl.

Iodine soap

Dissolve 0.5 kg white, finely shaved soap in 90g distilled water or rose water. Add 30g tincture of iodine. Put in double boiler, melt and mix by stirring.

Glossary

Lye, Lye water, potash lye - interchangeable terms for alkali made from wood ashes soaked in water

Potash (caustic potash) - lye water evaporated to a powder.

Lime (or stone lime) - ground or agricultural limestone.

Quicklime - lime that has been baked.

Soda lye - quicklime slaked in water and heated with soda.

Soda - hydrated sodium carbonate.

Caustic soda - soda lye evaporated to a powder.

Commercial lye - usually caustic soda and is the equivalent of 'lye' in most recipes.

Equipment list

The following equipment is needed to make soap:
1. a large iron soap kettle for making soap in commercial quantities.
2. a long-handled wooden ladle to stir the soap.
3. a kitchen grater or a meat grinder to make soap flakes for laundry use or to grind soap for some recipes.
4. flat wooden boxes, moulds or tubes, cut plastic bottles or plastic tubs, to mould the soap.
5. pieces of cloth to stop the soap sticking to the wooden moulds.
6. a plate on which to cool and test a few drops of the liquid soap.

Web resources

Soap-making: A short guide to the technical constraints. M. L. Allen, University of Auckland, New Zealand.
Create a Basic Soap Recipe Starting From Scratch by David Fisher
Homemade Soap Recipes
Soap Production – Technologies Series Guide No 3, Centre for the Development of Enterprise, Brussels, 1994. Free download available at:
Home Soap Making
Soap-Making Technology

technical brief

Further information

The following publications describe soapmaking in more detail:

- *Small-scale Soapmaking: A handbook*, by Peter Donker, Practical Action Publishing/TCC, 1993.
- *Case Study No 3: Soap Pilot Plant*, Technology Consultancy Centre, Kumasi, Ghana, 1983.
- *Soap*, Ann Bramson, Workman Publishing Co, 1975
- *The Art of Soap Making*, Merilyn Mohr, Camden House Publishing, 1979
- *Making Soaps and Candles*, Phyllis Hobson, Storey Communications Inc., 1973

This technical brief was last updated by Tony Swetman for Practical Action in November 2008.

Practical Action
The Schumacher Centre
Bourton-on-Dunsmore
Rugby, Warwickshire, CV23 9QZ
United Kingdom
Tel: +44 (0)1926 634400
Fax: +44 (0)1926 634401
E-mail: inforserv@practicalaction.org.uk
Website: http://practicalaction.org/practicalanswers/

Practical Action is a development charity with a difference. We know the simplest ideas can have the most profound, life-changing effect on poor people across the world. For over 40 years, we have been working closely with some of the world's poorest people - using simple technology to fight poverty and transform their lives for the better. We currently work in 15 countries in Africa, South Asia and Latin America.

technical brief