APISARA

KETTLE SOAPMAKING

Method, operation and process control

PURPOSE OF THIS GUIDE

To understand what kettle soapmaking actually covers, distinguish its main variants, and control formulation, vessel loading, heating, agitation, water, alkali, cooking, quality checks and end-of-process operations.

Audience: artisans, professionals, trainers and anyone seeking to understand the transition from small-batch production to a heated-vessel process.

SAFETY WARNING

> Concentrated alkalis are corrosive, and hot soap masses can cause both thermal and chemical burns. This guide does not replace an SDS, a risk assessment, equipment-manufacturer instructions, laboratory analysis or applicable regulatory requirements.

Contents

1. Defining kettle soapmaking
2. Main process families
3. Formulation and material balance
4. Vessel, heating and agitation
5. Organisation and safety
6. Step-by-step operation
7. Water, alkali and consistency
8. Monitoring saponification
9. End of cooking and finishing
10. Quality controls
11. Defects and diagnosis
12. Scale-up
13. Cleaning and traceability
14. Practical batch sheet

1. Defining kettle soapmaking

In artisanal usage, kettle soapmaking generally means production carried out in a heated, agitated vessel. Historically and industrially, the term can also cover more complex processes involving prolonged boiling, salting-out, phase separation, washing or successive adjustments.

Kettle soapmaking should therefore not automatically be treated as hot process soapmaking in a larger pot. Increasing batch size substantially changes heat transfer, mixing, thermal inertia and risk.

KEY POINT

“Kettle” mainly describes equipment and a way of operating the process. The actual variant must be specified: full-boiled or mass cooking, salting-out process, potassium soap, a specific traditional process, etc.

2. Main process families

Family	Principle	Distinctive feature
Mass cooking	Fats and alkali are saponified in a heated vessel.	Glycerol generally remains in the soap mass.
With salting-out	An electrolyte, traditionally salt, promotes separation between soap and an aqueous phase.	Allows separation or washing; requires specific control.
Potassium soap	KOH is used mainly or partly.	More soluble, paste-like or liquid product depending on formulation.
Traditional process	Sequences specific to a tradition, raw material or equipment.	Cannot be reduced to one universal recipe.

3. Formulation and material balance

The formula must be complete before charging the vessel. A kettle cannot correct a calculation error.

- mass and lot number of each fat or oil;
- saponification values and their source;
- alkali type: NaOH, KOH or a calculated combination;
- theoretical alkali requirement and superfat strategy;
- total water and alkali-solution concentration;
- additives, electrolytes, fragrances and colourants;
- total charge mass and required free vessel volume.

PROCESSES WITH PHASE SEPARATION

When salting-out, washing or phase separation is used, superfat and yield must be considered in relation to the actual process: some constituents may move into another phase or be removed.

4. Vessel, heating and agitation

Element	Practical requirement
Vessel	Material compatible with alkalis, temperature and cleaning; suitable geometry.
Working volume	Leave sufficient headspace for expansion, foam and agitation; nominal volume is not the working capacity.
Heating	Controllable and sufficiently uniform; avoid hot spots.
Agitation	Must move the entire mass, including near the bottom and walls, without hazardous splashing.
Temperature	Representative measurement; multiple points may be needed at larger scale.
Discharge	Safe despite viscosity and temperature; compatible valve and piping.

Insufficient agitation creates composition and temperature gradients. Excessive agitation may entrain air, cause splashing or overload the equipment.

5. Organisation and safety

- PPE appropriate to chemical and thermal hazards;
- ventilation and a safe procedure for preparing/transferring alkali solutions;
- immediate access to emergency stops and controls;
- prevention of slips and splashes around the vessel;
- appropriate handling methods for heavy containers and hot materials;
- written procedure for loss of agitation, heating failure, leaks or overflow.

ADDING WATER TO A HOT SOAP MASS

Poorly controlled water addition can cause local flashing, boiling and splashing. Any correction must be calculated, covered by the procedure and introduced progressively under controlled conditions.

6. Step-by-step operation

1 - Check the batch record

Confirm formula, raw materials, quantities, cleanliness, usable capacity and safety devices.

2 - Charge the fats

Load in the defined order, melt without overheating and homogenise.

3 - Prepare the alkali

Use a solution of known concentration, clearly identified and recorded.

4 - Start appropriate agitation

Confirm that circulation involves the whole mass.

5 - Add the alkali

Introduce in a controlled manner to avoid highly alkaline local zones or an excessively vigorous reaction.

6 - Control heating

Adjust heat input to the formula and vessel heat-transfer capacity; hotter is not necessarily better.

7 - Monitor the mass

Record temperature, viscosity, homogeneity, time and significant events.

8 - Correct only after diagnosis

Water, electrolyte or other corrections must be calculated and documented.

9 - Determine the end of saponification

Use defined process criteria and appropriate controls, not a single visual appearance.

10 - Carry out finishing operations

Depending on the process: adjustment, addition, salting-out, separation, dilution, cooling or transfer.

11 - Control and release

Sample appropriately, perform defined checks, record yield and make the batch disposition decision.

7. Water, alkali and consistency

Water dissolves the alkali, enables reactant mobility, contributes to heat transfer and affects consistency. During prolonged cooking, water evaporates, so system concentration changes throughout the process.

Observation	Common mistake	Reasoned response
Very thick paste	Immediately add a large amount of water.	Check temperature, water loss, agitation and reaction stage first.
Very fluid mass	Automatically conclude that cooking is insufficient.	Check formula, water, temperature and analytical/process controls.
Suspected alkali shortage	Add lye by eye.	Recalculate the material balance and test before any addition.
High evaporation	Fail to quantify it.	Monitor mass/yield or another validated indicator.

8. Monitoring saponification

At larger scale, the surface is not necessarily representative of the bottom of the vessel. Sampling must therefore be designed for the process.

Useful indicators may include time/temperature history, homogeneity, pH measured by a defined method, free alkali or alkalinity, free fatty acids, water/volatile matter and other appropriate analyses.

pH IS NOT ENOUGH

Traditional soap is normally alkaline. pH alone, especially without a standardised sampling and dilution method, does not demonstrate that free alkali is acceptable.

9. End of cooking and finishing

The end of cooking must correspond to a defined process criterion; it does not necessarily mean that the product is finished.

- controlled adjustment of water content;
- addition of heat-sensitive ingredients at a compatible temperature;
- salting-out with an electrolyte according to a validated process;
- settling or phase separation;
- washing or further boiling in some processes;
- transfer to moulds, frames, cooling vessels or finishing equipment.

SALTING-OUT

Salt can reduce the solubility of some soaps and promote phase separation, but the result depends on soap composition, water, electrolyte concentration and temperature. This operation should not be improvised.

10. Quality controls

Control	Purpose
Raw materials and lots	Traceability and understanding variation.
Weighing balance	Detect critical errors.
Time / temperatures	Compare batches and process deviations.
Homogeneity	Identify oily, alkaline, dry or poorly mixed zones.
Free alkali / alkalinity	Assess possible excess alkali using an appropriate method.
Water / volatile matter	Control consistency, yield and drying.
Mass / yield	Establish material balance and detect abnormal losses.
Appearance / odour / colour	Detect overheating, contamination, oxidation or addition problems.

11. Defects and diagnosis

Defect	Possible causes	Check / correct
Oily zones	Insufficient mixing, alkali error, poor homogenisation.	Sample several areas; review weighing and agitation; quarantine if uncertain.
Scorched material at bottom	Hot spot, insufficient agitation, excessive heating.	Reduce/stop heating; inspect vessel bottom and heating system.
Mass too compact	Evaporation, formulation, temperature or agitation.	Establish the water balance before correction.
Overflow	Vessel too full, heating too fast, foaming additive.	Reduce energy and secure the area; increase headspace next time.
Final heterogeneity	Insufficient mixing, late addition or unsuitable temperature.	Review sequence and homogenisation time.
High free alkali	Calculation/weighing error, incomplete reaction or heterogeneity.	Quarantine; review batch record and analysis; do not release until resolved.

Defect	Possible causes	Check / correct
Abnormal yield	Evaporation, transfer losses, phase separation or weighing error.	Perform a complete material balance.

Method: defect → hypotheses → measurements → probable cause → documented action. The larger the batch, the less acceptable empirical corrections become.

12. Scale-up

Multiplying a recipe by ten does not automatically reproduce the same process. Surface-to-volume ratio, thermal inertia, mixing time and required agitation power all change.

Variable	Small batch	Larger vessel
Thermal inertia	Heats and cools quickly.	Responds more slowly to adjustments.
Homogenisation	Relatively easy.	Strongly dependent on vessel geometry and agitator.
Evaporation	High relative surface area.	Different behaviour that must be revalidated.
Sampling	Simple.	Several sampling points may be required.
Error	Limited consequence.	Greater human, equipment and economic risk.

> SCALE-UP RULE Validate progressively: pilot → intermediate → target size. At each stage, document temperature, time, agitation, evaporation, yield and controls.

13. Cleaning and traceability

Cleaning must be built into the process. Residue under a blade, in a valve or pipe can contaminate the next batch or impair operation.

The batch record should include at least:

- formula/version, operator, date and equipment;
- actual raw-material lots and quantities;
- alkali concentration and quantity;
- key times and temperatures;
- agitation settings or description;
- justified additions and corrections;
- control results;
- final mass, yield, losses and batch-release decision.

14. Practical batch sheet

Stage	Validation
Before	Clean vessel; adequate capacity; approved formula; materials and PPE available.
Charging	Defined order followed; masses recorded; fat phase homogeneous.
Alkali	Concentration and mass verified; safe transfer.
Reaction	Agitation and heating controlled; observations recorded.
Corrections	Only calculated, justified and recorded.
End of cooking	Defined criteria reached; representative sampling.
Finishing	Additions / separation / transfer according to procedure.
Control	Results meet applicable criteria.
Balance	Yield, losses and deviations recorded.
Release	Batch identified, traceable and authorised before use or sale.

10 key points

- Kettle soapmaking is not one universal recipe: define the process.
- A large vessel changes heat transfer, mixing and risk.
- Formula and material balance come before charging.
- Maintain adequate free vessel volume.
- Agitation must homogenise the whole mass.
- Do not correct water or alkali blindly.
- Visual appearance alone does not define the end of reaction.
- Salting-out and washing are distinct technical operations.
- Scale-up must be progressive and documented.
- Professional control depends on procedures, measurements, traceability and release criteria.

Apisara resources

In addition to the saponification calculator, the technical guides and fact sheets available on apisara.org form a free knowledge base for hobbyists, artisans, professionals and trainers. Articles published on Substack and Facebook complement these resources.

apisara.org - Apisara website and resources Substack - in-depth articles and technical guides Facebook - educational publications and Apisara news

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