APISARA

Understanding and controlling water in soapmaking

Lye-solution concentration, water-to-lye ratio, process effects and calculation methods

Purpose of this guide

Understand what water actually does in soap, choose a consistent and reproducible amount, and avoid errors caused by the imprecise idea of a “water discount”. This guide focuses mainly on cold-process NaOH soapmaking.

Audience: beginners, artisans, professionals, trainers and self-learners.

Level: progressive reading: essential principles, calculations, then technical detail.

Key points from the start

- The amount of NaOH is determined by the fats, their saponification values and the chosen superfat. Water does not correct an incorrect lye calculation.
- To compare formulas, it is more rigorous to express water relative to lye, as solution concentration or a water-to-lye ratio.
- A 33.3% NaOH solution contains approximately 1 part NaOH to 2 parts water.
- Less water does not automatically mean a “better soap” or “more complete saponification”. It mainly changes processing, workability and initial water content.

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1. The role of water: a processing aid

In cold-process soapmaking, water is primarily used to dissolve sodium hydroxide (NaOH) and enable it to come into homogeneous contact with triglycerides. It therefore facilitates the reaction, but it is not consumed stoichiometrically in the same way as the saponification reactants.

After manufacture, part of this water gradually leaves the soap by evaporation during drying and cure. This is why saponification and curing must not be confused: most of the chemical reaction may be complete long before the soap has reached a stable mass, hardness and in-use behaviour.

> **Professional point** Water is a formulation and process parameter. It should be documented alongside temperature, mixing method, additives and moulding procedure.

2. Three ways of expressing the amount of water

Recipes and calculators do not always use the same convention. This can cause errors when a formula is copied without checking the calculation method.

2.1 NaOH solution concentration

This is the mass fraction of NaOH in the NaOH + water mixture:

Concentration (%) = NaOH / (NaOH + water) × 100

Example: 100 g NaOH + 200 g water gives 300 g solution. The concentration is 100 / 300 × 100 = 33.3%.

2.2 Water-to-NaOH ratio

This indicates how many grams of water are used for 1 g of NaOH.

Water/NaOH ratio = mass of water / mass of NaOH

Thus, a 2:1 ratio means 2 g water for 1 g NaOH. It corresponds to a concentration of 33.3%.

2.3 Water as a percentage of oils

This convention is still found in many recipes. It is simple, but less robust for comparing formulas: two oil blends of the same mass may require different amounts of NaOH. The same water percentage relative to oils can therefore produce different solution concentrations.

> **Apisara recommendation** For formulation, production records and teaching, prefer NaOH solution concentration or the water-to-NaOH ratio. They directly describe the alkaline solution actually used.

3. Practical conversion table

NaOH concentration	Water in solution	Water : NaOH ratio	Water per 100 g NaOH
25%	75%	3.00 : 1	300 g
28%	72%	2.57 : 1	257 g
30%	70%	2.33 : 1	233 g
33.3%	66.7%	2.00 : 1	200 g
35%	65%	1.86 : 1	186 g
38%	62%	1.63 : 1	163 g
40%	60%	1.50 : 1	150 g
50%	50%	1.00 : 1	100 g

A 50% solution contains equal masses of NaOH and water. It represents a high practical concentration for aqueous NaOH solutions in artisan soapmaking and requires advanced control, particularly because crystallisation/precipitation may become an issue under unfavourable temperature conditions.

4. Calculating water from a chosen concentration

Once the NaOH amount has been calculated correctly, the mass of water can be obtained directly:

Water = NaOH × (100 - concentration %) / concentration %

Example. A formula requires 135 g NaOH and a 33.3% solution is selected.

Water ≈ 135 × (100 - 33.3) / 33.3 ≈ 270 g.

This gives the familiar 2:1 ratio: 135 g NaOH × 2 = 270 g water.

5. What does concentration change?

Concentration affects several process characteristics. The effects below are tendencies, not isolated laws: fatty-acid composition, temperature, fragrance, additives, mechanical mixing, batch size and mould geometry can strongly alter the result.

Parameter	More water / more dilute solution	Less water / more concentrated solution
Initial fluidity	Often lasts longer	May decrease more quickly
Trace	Often delayed	Often accelerated
Unmoulding	Soap often softer initially	Soap often firmer sooner
Evaporation required	More	Less
Swirl work	May provide more working time	May reduce available working time
Risk of separation	May increase in some very slow formulas	May be reduced in some formulas
Process tolerance	Often comfortable for some techniques	High concentrations require greater control

Beware of a common misconception “Less water = cure completed faster” is an oversimplification. A lower-water formula starts with less water to lose and may become firm sooner, but curing also involves physical and structural changes in the soap. A sale or use date should not be determined from solution concentration alone.

6. Which concentration should you choose?

There is no single universally optimal concentration. The Handcrafted Soap and Cosmetic Guild presents 33% as a useful starting point for beginners and describes 25% as a more dilute solution that can provide more working time, while 50% is an advanced technique.

For progressive learning, a range of about 30–33% is generally easy to understand and reproduce. The formulator can then adjust through documented trials without changing several variables at once.

Trial method To study the effect of water, keep exactly the same formula, superfat, temperatures, fragrance and procedure. Change only the solution concentration. Record: time to emulsion, trace, maximum temperature, unmoulding, mass loss and cutting behaviour.

7. The term “water discount”: useful but ambiguous

Saying that a recipe has a “water discount” assumes a reference amount of water. That reference varies among books, calculators and working practices. A 20% discount therefore has no precise meaning unless the starting amount is known.

In a technical document, writing “33.3% NaOH solution” is much more precise than “20% water discount”.

8. Replacing part of the water with another liquid

Milks, juices, infusions, purées and other aqueous ingredients also introduce water into the formula. The formulator must therefore consider the total amount of aqueous liquid, not only the water used to dissolve the lye.

A common strategy is to dissolve NaOH first in a sufficient quantity of water, then add the complementary liquid separately. This can make thermal control easier with liquids containing sugars, proteins or other heat-sensitive materials.

Safety Never arbitrarily reduce the water needed to dissolve NaOH. Highly concentrated solutions require a controlled procedure. Always add NaOH gradually to water — never water onto NaOH — using suitable personal protective equipment, a compatible container and appropriate ventilation.

9. Water, temperature and gel phase

The amount of water influences thermal behaviour, but never acts alone. Starting temperature, batch size, mould insulation, sugars, some fragrances and lipid composition also play a role.

A more dilute solution can prolong some thermal stages of the process. A highly concentrated formula may instead thicken quickly and reduce working time. Gel-phase control should therefore be based on observation of the entire process, not on a single number.

10. Situations where adjusting water may be useful

- Very slow-tracing formula: a slightly higher concentration may sometimes improve process control.
- Complex decorative work: a more moderate concentration may provide additional working time, subject to other trace factors.
- Individual moulds: a lower-water soap may become firm sooner and facilitate unmoulding.
- Adding an aqueous liquid: include that liquid in the total water balance.
- Repeated production: setting and documenting a standard concentration improves batch-to-batch reproducibility.

11. Common errors

- Confusing NaOH concentration with water as a percentage of oils.
- Copying “33%” from a recipe without checking what that figure means in the calculator.
- Changing water, fragrance, temperature and formula at the same time, then attributing the outcome to water alone.
- Forgetting the water contained in milk, purée or another aqueous addition.
- Believing that a strong water discount can compensate for an incorrect NaOH calculation.
- Using an extremely concentrated solution without understanding dissolution and temperature constraints.

12. Calculation sheet — complete example

Given: calculation of the oils and superfat results in 142 g NaOH.

Selected concentration	Water calculation	Water	Total solution
30%	142 × 70 / 30	331.3 g	473.3 g
33.3%	142 × 66.7 / 33.3	≈ 284.4 g	≈ 426.4 g
35%	142 × 65 / 35	263.7 g	405.7 g
40%	142 × 60 / 40	213.0 g	355.0 g

All four variants contain exactly the same amount of NaOH. Only the amount of water changes. The theoretical superfat therefore does not change merely because the water amount is altered.

13. Pre-production check

- Is the mass of every oil correct and expressed in a single unit?
- Has the NaOH been recalculated using appropriate saponification values and the desired superfat?
- Does the calculator express water as concentration, water/NaOH ratio or % of oils?
- Have all added aqueous liquids been included?
- Is the selected concentration appropriate for the operator’s experience and intended technique?
- Are NaOH safety procedures, PPE, container and ventilation ready?
- Will batch parameters be recorded in the manufacturing log?

14. Going further: monitoring mass loss

A simple way to understand drying dynamics is to weigh a reference bar at regular intervals. Mass loss mainly reflects evaporation of water and any volatile compounds. It is not, however, analytical proof of complete saponification or product compliance.

Mass loss (%) = (initial mass - measured mass) / initial mass × 100

For useful comparisons, use bars of similar dimensions stored under the same temperature, humidity and air-circulation conditions.

15. Summary

Six essential ideas

1. Water is primarily a dissolution and processing aid.
2. Solution concentration directly relates NaOH and water.
3. 33.3% corresponds approximately to a 2:1 water/NaOH ratio.
4. A higher concentration means less water, not more NaOH.
5. Effects on trace, unmoulding and cure must be assessed alongside other process variables.
6. In production, using and documenting one calculation convention greatly improves reproducibility.

Technical references

- Handcrafted Soap and Cosmetic Guild, The Water Discount — experimental work on soaps made with different NaOH concentrations.
- Handcrafted Soap and Cosmetic Guild, How to Make Cold Process Soap — educational guidance on calculating and preparing NaOH solution.
- Jennifer Hofmann / HSCG, Demystifying Soapy Math — definitions and solution-concentration calculations.

Apisara resources

In addition to the saponification calculator, find Apisara technical guides and reference sheets at apisara.org. Complementary articles are also published on Substack and Facebook.

> **Disclaimer** This guide is an educational resource. It does not replace laboratory analysis, a Safety Data Sheet (SDS), supplier specifications, a cosmetic safety assessment, or the regulatory requirements applicable to the product and country concerned.

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