APISARA

LYE AND

SAPONIFICATION

Understanding the calculations for safer formulation

Technical and educational guide SAP • NaOH • KOH • superfat • lye concentration

Purpose

Understand what a soap calculator actually calculates, learn to check a simple calculation, distinguish SAP, superfat and lye concentration, and avoid dangerous unit or handling errors.

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Eric Bertrand for Apisara Version 1.0 - 16 September 2026

Safety first

Sodium hydroxide (NaOH, caustic soda/lye) is corrosive. It can cause severe skin burns and serious eye damage. Soapmaking therefore requires an organised workspace, appropriate protective equipment and careful reading of the safety data sheet for the product being used.

Basic rule

Wear suitable eye protection, compatible gloves and covering clothing; work in an appropriate, ventilated area; keep children, animals, food and drinks away from the work zone. Ensure immediate access to water for emergency rinsing.

In case of contact

First-aid measures must follow the product safety data sheet. NIOSH references include immediate flushing with water after eye or skin contact and appropriate medical attention depending on the exposure.

This guide explains calculations. It does not replace practical training in handling corrosive substances or the safety data sheet for your lye.

Contents

1. What « saponification » means
2. Saponification value (SAP)
3. Converting KOH SAP to NaOH
4. Manual calculation step by step
5. Understanding superfat
6. Water, ratio and lye concentration
7. Actual lye purity
8. What a calculator calculates
9. What a calculator cannot know
10. Common errors
11. Pre-batch checklist
12. References

1. What « saponification » means

Saponification is the alkaline hydrolysis of triglycerides found in oils and fats. With sodium hydroxide (NaOH), it mainly produces sodium salts of fatty acids — soap — and glycerol.

Simplified equation

Triglyceride + NaOH → glycerol + sodium soaps

The amount of NaOH required depends on the composition of the fat. This is precisely what the saponification value expresses.

A recipe containing several oils therefore requires calculating the alkali requirement for each one and then adding those requirements together.

2. Saponification value (SAP)

In analytical oil chemistry, the saponification value is conventionally expressed as the milligrams of KOH required to saponify 1 gram of fat. Codex Alimentarius uses this convention, in mg KOH/g of oil.

Example: a saponification value of 190 mg KOH/g means that approximately 190 mg of KOH are required, under the analytical method, per gram of that fat.

Watch the terminology

In craft soapmaking, some databases directly display a « NaOH SAP » in grams of NaOH per gram of oil. This is not the same unit as the analytical SAP in mg KOH/g. Always check the unit before calculating.

Natural oils are not chemically identical from one batch to another. Codex therefore publishes ranges of saponification values for named oils. A calculator value is a working value, not an individual analysis of your batch.

3. Converting KOH SAP to NaOH

The conversion is based on the molar masses of KOH and NaOH. For the same amount of substance, less mass of NaOH is required than KOH.

Practical conversion

NaOH SAP ≈ KOH SAP × 40.00 / 56.11

This gives a factor of about 0.713.

If SAP is given in mg KOH/g, the result is in mg NaOH/g. Divide by 1000 to express it as g NaOH/g.

Educational example: for 190 mg KOH/g: 190 × 0.713 ≈ 135.5 mg NaOH/g = 0.1355 g NaOH per gram of oil.

Professional point

Never mix a KOH SAP value and a NaOH SAP value without checking the unit. Confusing conventions can create a major error in the alkali quantity.

4. Manual calculation step by step

The following deliberately simple example uses educational NaOH SAP values. They demonstrate the method and must not replace the database selected for an actual batch.

Oil	Mass	Example NaOH SAP	Theoretical NaOH
Olive	500 g	0.134	67.0 g
Coconut	300 g	0.183	54.9 g
Castor	200 g	0.128	25.6 g
TOTAL	1,000 g	—	147.5 g

Calculation: 500 × 0.134 = 67.0 g; 300 × 0.183 = 54.9 g; 200 × 0.128 = 25.6 g. Total theoretical requirement: 147.5 g NaOH, before any lye discount.

Useful check

The sum of the oil masses must match the intended total. Then check each multiplication separately. A calculator cannot protect you from entering the same oil twice, omitting a line or using the wrong unit.

5. Understanding superfat

In soapmaking, « superfat » is often achieved through a reduction of the theoretical lye amount. With a 5% lye discount, 95% of the theoretical amount is used.

In our example: 147.5 × 0.95 = approximately 140.1 g NaOH.

Formula

NaOH to weigh = theoretical NaOH × (1 − discount rate)

Example at 8%: multiply by 0.92.

It is important to understand that « 5% superfat » does not necessarily mean that exactly 5% of one chosen oil remains intact and identifiable in the finished soap. In a conventional formulation, the term mainly describes an alkali-calculation strategy.

A lye discount must not be used to hide an imprecise calculation, an unsuitable scale or uncertain SAP data.

6. Water, ratio and lye concentration

The water quantity is not determined by SAP. Together with the alkali, it defines the lye-solution concentration. Two recipes can use exactly the same amount of NaOH but different quantities of water.

Lye concentration

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

Example: 140 g NaOH + 280 g water gives: 140 / (140 + 280) × 100 = 33.3%. The water:lye ratio is 2:1.

With 140 g NaOH and 210 g water, concentration becomes 40%. The NaOH quantity has not changed; the water quantity — and therefore process behaviour — has.

Do not confuse

Superfat/lye discount changes the alkali amount relative to the theoretical requirement. Lye concentration changes the water-to-alkali proportion. These are different settings.

7. Actual lye purity

A theoretical calculation assumes a certain amount of active NaOH. Sodium hydroxide is hygroscopic and can absorb moisture and carbon dioxide; commercial products may also be sold with a specified purity.

For rigorous work, use an appropriate product, store it correctly and consult its technical specification and SDS. If a calculator allows purity to be entered, do not use an arbitrary figure: use the supplier's actual specification.

Remember

Calculation accuracy cannot exceed the quality of the input data: actual mass, SAP used, alkali purity and correct identification of the raw material.

8. What a calculator calculates

- The theoretical alkali requirement from oils and SAP values.
- The lye discount corresponding to the chosen superfat.
- The water quantity according to the selected calculation method.
- Lye concentration or water:lye ratio.
- Depending on the tool: fatty-acid profiles, indicative properties, costs or other information. A calculator is particularly useful for avoiding repetitive arithmetic and documenting a formula. It should nevertheless make its units, assumptions and reference values visible.

9. What a calculator cannot know

- Whether you selected the correct oil in the database.
- Whether the material received actually matches its label.
- The exact SAP value of your batch without analytical data.
- Whether your scale is accurate or you misweighed an ingredient.
- Whether you confused grams and ounces, NaOH and KOH, or concentration and ratio.
- Whether your handling practices are safe.
- Whether the finished soap meets all regulatory, sensory and stability requirements.

Principle

A reliable calculator reduces arithmetic error. It does not remove the need for understanding, verification and traceability.

10. Common errors

- 1. Using a SAP value without checking whether it refers to KOH or NaOH.
- 2. Confusing mg KOH/g with g NaOH/g.
- 3. Changing an oil without recalculating the entire formula.
- 4. Trying to change superfat by changing only the water.
- 5. Confusing water:lye ratio with lye concentration.
- 6. Weighing alkali on a scale that is not sufficiently precise.
- 7. Using a product whose purity or identity is unknown.

- 8. Copying a recipe without recalculating it.
- 9. Assuming a generic SAP is the exact analysis of your batch.
- 10. Trusting the numerical result without rereading the entered data.

11. Pre-batch checklist

- ☐ All oils are correctly identified and weighed.
- ☐ Units are consistent.
- ☐ The correct alkali is selected: NaOH or KOH.
- ☐ SAP values come from a known, consistent source.
- ☐ The lye discount/superfat is the intended value.
- ☐ Lye concentration or water:lye ratio has been reread.
- ☐ Alkali purity has been considered when necessary.
- ☐ The calculation has been checked a second time.
- ☐ Protective equipment is ready and in good condition.
- ☐ The work area is organised; SDS and access to water are available.
- ☐ The batch will be identified and actual weighed quantities recorded.

Apisara method

Calculate → understand → verify → make → document → observe.

Safety comes as much from the working method as from the number displayed by a calculator.

12. References

Codex Alimentarius FAO/WHO — standards for oils and fats. Codex methods express saponification value in mg KOH/g of oil and publish characteristic ranges for many oils.

NIOSH / CDC — Sodium Hydroxide — information on hazards, exposure routes, protection and first aid relating to sodium hydroxide.

European Chemicals Agency (ECHA) — regulatory substance information for sodium hydroxide, CAS 1310-73-2.

Document limitation

This guide is educational. It does not replace the safety data sheet for the product used, training in handling corrosive substances, supplier specifications or the regulatory obligations applicable to your activity.

Apisara links

apisara.org - Apisara website and resources

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