APISARA

UNDERSTANDING AND MASTERING SUPERFATTING IN SOAPMAKING

Lye discount, residual lipids, calculations, stability and formulation choices

PURPOSE OF THIS GUIDE

Understand what “superfatting” actually means, calculate a lye discount correctly, avoid misleading interpretations, and choose a level that fits the formula, process and intended use.

Audience: beginners, artisans, formulators, trainers and professionals wishing to strengthen their technical foundations.

Reading level: the main explanations require no chemistry training. “Further detail” boxes provide useful professional formulation nuances.

Key points from the outset

• Superfat is not a magical oil added to soap: in practical terms it is the lipid fraction not converted into soap, or the margin created by using less alkali than the theoretical amount.

• A 5% lye discount means using 95% of the theoretical NaOH amount calculated for the formula.

• Adding an oil at trace generally does not guarantee that this specific oil will remain intact in the finished soap.

• More superfat is not automatically better: too much can affect lather, hardness, stability and shelf life.

• Superfatting must never be used to correct a calculation error. Safety depends on correct formulation, identified raw materials and accurate weighing.

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1. What is superfat?

During saponification, triglycerides in oils and fats react with an alkali. With sodium hydroxide (NaOH), the main products are sodium salts of fatty acids - soap - and glycerol. In handmade soap, the reaction and final composition are more complex than an ideal equation: oils are mixtures, their saponification values vary, and some fractions are unsaponifiable.

In craft formulation, superfat commonly refers to the lipid margin obtained by providing less alkali than would theoretically be required to saponify 100% of the fats. This practice is also called a lye discount.

TERMINOLOGY

“5% superfat” is often used as shorthand for “5% lye discount”. This is convenient, but the expressions are not chemically identical. For professional batch records it is clearer to state the method explicitly: “NaOH discount: 5%” and, where relevant, “oil added: X g”.

2. Two common ways to create a lipid margin

The first method is to reduce the alkali amount. The second is to provide or add more fat than the available alkali can theoretically saponify. In both cases, the aim is a formula without caustic excess and with a non-saponified lipid fraction.

Method	Principle	Advantage	Point to watch
Lye discount	Calculate theoretical lye, then apply a discount, for example 5%.	Simple, reproducible and directly handled by a soap calculator.	The value depends on the SAP values used and raw-material accuracy.
Additional oil	Add fats beyond the theoretical saponification capacity of the available alkali.	Can be useful for process design or a late addition.	Does not prove that this particular oil will be the only one remaining unsaponified.

3. Calculating a lye discount

The correct approach always starts with the theoretical NaOH required by the formula, calculated from the mass and saponification value of each oil.

FORMULA

Adjusted NaOH = theoretical NaOH × (1 - lye discount) For 5%: multiply theoretical NaOH by 0.95. For 8%: multiply by 0.92.

Example: a 1,000 g oil formula theoretically requires 140 g NaOH. With a 5% lye discount: 140 × 0.95 = 133 g NaOH. The reduction is therefore 7 g NaOH.

CAUTION

Never remove “a few grams” of lye arbitrarily. The percentage must be applied to the theoretical amount calculated for the actual recipe.

4. Why SAP values matter

The saponification value expresses the amount of alkali required to saponify a given mass of fat. Tables may provide a KOH value or a value converted for NaOH, so you must know which unit your calculator or table uses.

A natural oil is not a perfectly constant reagent: variety, origin, refining, season, storage and fatty-acid composition can affect its actual value. A lye discount therefore also provides a practical margin for this variability - but it does not replace correct raw-material identification or reliable weighing.

FURTHER DETAIL

A laboratory SAP value is a measurement on a sample; a database value is a reference value. In professional production, batch traceability and supplier specifications are more meaningful than artificial precision to several decimal places.

5. Does oil added at trace remain intact?

Generally, this cannot be assumed. In cold-process soapmaking, trace mainly indicates that the emulsion has become structured enough to thicken; it does not mean all the lye has already been consumed. Saponification continues after pouring.

If a so-called “precious” oil is added at trace, its triglycerides are still in contact with alkali and can participate in the reactions. The finished soap may contain a mixture of residual triglycerides, free fatty acids, mono- and diglycerides, unsaponifiables and other lipophilic compounds. It is therefore more rigorous to say oil added at trace than to claim that this oil alone constitutes the “final superfat”.

A COMMON MISCONCEPTION

“I add 5% jojoba oil at trace, therefore my finished soap contains exactly 5% unsaponified jojoba.” Conclusion: the process alone does not demonstrate this. Determining the precise residual lipid composition would require appropriate analysis.

6. Superfat and soap properties

Parameter	Possible effect of higher superfat	Nuance
Perceived mildness	May reduce the feeling of lipid removal for some users.	Tolerance also depends on fatty-acid profile, use and individual skin.
Lather	May reduce lather volume or persistence when the level becomes high.	The effect depends strongly on the formula.
Hardness / durability	May make some soaps softer or more prone to softening during use.	Saturated fatty acids, water and process also matter.
Stability	More residual lipids may provide more substrate for oxidation.	Risk depends mainly on oil type, freshness and storage.
Cleansing	A strongly cleansing formula may feel less harsh with a lipid margin, but superfat does not change its underlying fatty-acid profile.	Formulate the soap for its intended use first.

7. What percentage should you choose?

There is no universal percentage. The choice depends on formula, process, intended use, raw-material quality and stability objectives. The values below are formulation reference points, not standards or safety guarantees.

Lye discount	Practical interpretation	What to assess first
0-2%	Small margin; requires excellent control of calculations and raw materials.	Weighing accuracy, SAP values, alkali purity and intended use.
3-5%	A range commonly used for many handmade toilet soaps.	Fatty-acid profile, user feel and stability.
6-8%	A more pronounced lipid margin.	Lather, hardness, rancidity, curing and storage conditions.
> 8%	A specific choice to validate by testing; not automatically milder or better.	Stability, weeping, lather, texture and shelf life.

SPECIAL CASE: VERY HIGH-COCONUT-OIL SOAPS

Formulas very rich in lauric and myristic acids are sometimes paired with a substantially higher lye discount to modify the feel in use. This is not a rule that can be transferred to other formulas: the entire fatty-acid profile must be considered.

8. Superfat, pH and free alkali: three different concepts

Properly made soap is naturally alkaline. pH alone cannot be used to calculate superfat, and a high superfat is not a reliable way to “lower the pH” to a chosen value. Likewise, pH measurement alone does not precisely quantify any free caustic alkali.

For quality control, distinguish pH, which describes acidity or alkalinity of a solution under defined measurement conditions; free alkali, meaning unconsumed caustic material; and the unsaponified lipid fraction, which requires other analytical approaches.

REMEMBER

A soap is not demonstrated safe merely because a test strip shows a “good pH”. Safety begins with calculation, procedure, traceability and, where required, appropriate analytical controls.

9. Superfat and oxidation

Residual lipids can oxidise. Oils rich in polyunsaturated fatty acids are generally more oxidation-sensitive than fats rich in saturated or monounsaturated fatty acids. High superfat, already oxidised oils, heat, light, oxygen or certain metal contaminants can reduce stability.

An antioxidant may slow some oxidation reactions; it does not turn degraded oil back into fresh oil and must not be confused with an antimicrobial preservative.

10. Cold process and hot process: what changes?

Cold process (CP). After trace and pouring, the reaction continues. A late oil addition is therefore not automatically “protected” from saponification.

Hot process (HP). When saponification has progressed sufficiently before a final lipid addition, it may be more plausible that a larger proportion of that addition remains unsaponified. The actual result still depends on reaction progress, residual alkali, homogeneity and process conditions. Without analysis, absolute claims should be avoided.

11. Complete calculation example

Suppose the oils in a formula total 1,000 g. After calculating each fat individually, the total theoretical requirement is 142.6 g NaOH.

Step	Calculation	Result
1. Theoretical requirement	Sum of the NaOH requirements of each oil	142.6 g
2. Chosen discount	5%	0.05
3. Fraction of NaOH used	1 - 0.05	0.95
4. NaOH to weigh	142.6 × 0.95	135.47 g
5. Working rounding	According to scale resolution and weighing procedure	135.5 g if the scale is suitable

The batch record should document at least: oil identity and batch, actual weighed masses, SAP value or source, lye purity/specification, discount applied, water amount, temperature/process, additives, date, observations and quality-control results.

12. Common mistakes

- Confusing a 5% lye discount with “adding 5% oil”. The two expressions do not describe exactly the same calculation.
- Calculating lye from total soap-batter weight. It must be calculated from each saponifiable fat.
- Using a KOH SAP value as though it were a NaOH SAP value.
- Assuming that oil added at trace will remain entirely intact.
- Greatly increasing superfat to compensate for an overly cleansing formula. It is better to review the fatty-acid profile.
- Using pH as a measure of superfat percentage.
- Ignoring oxidative stability. More is not always better.
- Ignoring actual alkali purity. A hygroscopic or carbonated raw material may not correspond to 100% active NaOH.

13. Formulator's checklist

Before making	During making	After making
Identify every oil and its batch precisely.	Weigh; do not measure by volume.	Record curing observations.
Check SAP values and units.	Follow lye safety procedures.	Assess hardness, lather, odour, appearance and durability.
State the lye discount explicitly.	Record late additions separately.	Monitor for signs of oxidation.
Check alkali purity/specification.	Do not interpret trace as the end of the reaction.	Retain a reference sample where appropriate.

Before making	During making	After making
Assess the formula's oxidation sensitivity.	Record process deviations.	For commercial products: apply relevant regulatory and safety-assessment requirements.

14. Eight essential ideas

- Superfat is a formulation concept, not by itself a mark of quality.
- The lye discount must be calculated from the actual theoretical requirement of the formula.
- A stated percentage is meaningful only when the method used to obtain it is clear.
- In cold process, an oil added at trace is not necessarily the only residual oil.
- The appropriate level depends on the fatty-acid profile, process and intended use.
- Very high superfat can impair lather, durability or stability.
- pH, free alkali and residual lipid fraction are different parameters.
- For professional work, calculation, traceability, raw-material specifications and appropriate controls take precedence over empirical recipes.

15. Apisara resources

In addition to the Apisara saponification calculator, free technical guides, reference sheets and educational resources are available at apisara.org. Complementary articles are also published on Substack and Facebook. The Apisara website acts as the central access point if platform addresses change.

References and verification leads

- Félix, S. et al. (2018). The Effects of Cold Saponification on the Unsaponified Fatty Acid Composition and Sensory Perception of Commercial Natural Herbal Soaps. Molecules, 23, 2356. DOI: 10.3390/molecules23092356.
- Samorì, C. et al. (2017). Soap production: A green prospective. Waste Management, 66, 190-195.

- For raw materials, give priority to supplier specifications, the alkali Safety Data Sheet and, in professional settings, the analytical methods and regulatory requirements applicable to the product and jurisdiction.

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 obligations applicable to the product and country concerned.

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