



Overview

ABOUT NatSurFact

NatSurFact is a novel sulfate- and phosphate-free line of biosurfactants that outperforms conventional, petroleum-based surfactants in a variety of commercial applications. Based on biosynthesized rhamnolipids, NatSurFact is all-natural and biodegradable, with low eco-toxicity and irritation. It also has Critical Micelle Concentrations (CMCs) orders of magnitude lower than industry-standard ingredients, so it is a more cost-effective ingredient for industries ranging from personal care and household cleaners to agriculture and manufacturing.

ENHANCING CONSUMER SATISFACTION AND CORPORATE SUSTAINABILITY

“Rhamnolipids are readily biodegradable and have no adverse effects on humans or the environment.”
- US EPA

Surfactants containing synthetic phosphates and sulfates have been essential for personal care and cleaning products. However, phosphate-containing surfactants cause environmental problems after they have been rinsed down the drain. Consumers are also wary of using products with sulfate-containing surfactants because of their perceived harshness.

INCI name:
“RHAMNOLIPIDS”

SO WHY NatSurFact?

- Use natural, biodegradable, and low eco-toxicity materials in place of synthetic materials
- Use materials that are more active and cost-effective, so that less material is required
- Create products that are phosphate-, sulfate- and fluorine-free
- Reduce pollution

The Molecular Structure of Rhamnolipids

Rhamnolipids are a sub-class of the larger biosurfactant family. They are naturally produced by microbes, including bacteria and yeast. Biosurfactants can be generally described as possessing a polar head group consisting of either polysaccharide or peptide residues and a hydrophobic, fatty acid-based tail group, and derived from a bio process.

Like all surfactants, these molecules are amphiphilic, having a water-soluble portion and a lipid/oil-soluble portion. Rhamnolipids consist of either one rhamnose sugar (mono-rhamnolipid) or two rhamnose sugars (di-rhamnolipid) covalently linked to two fatty acids, typically 3-hydroxydecanoic acid. They are composed of only carbon, hydrogen, and oxygen.

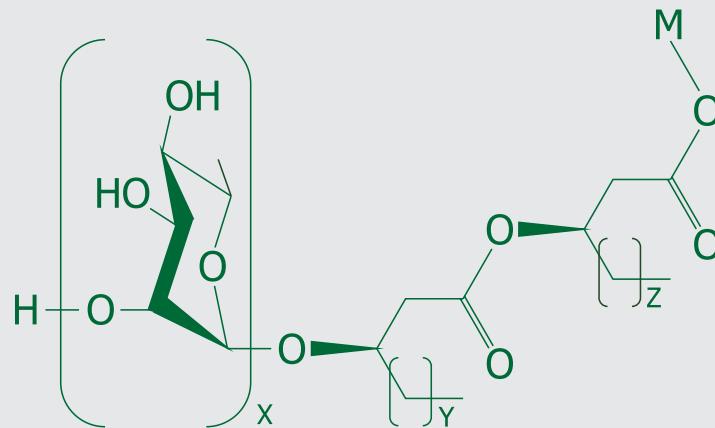


FIGURE 1:
General molecular structure
of rhamnolipids

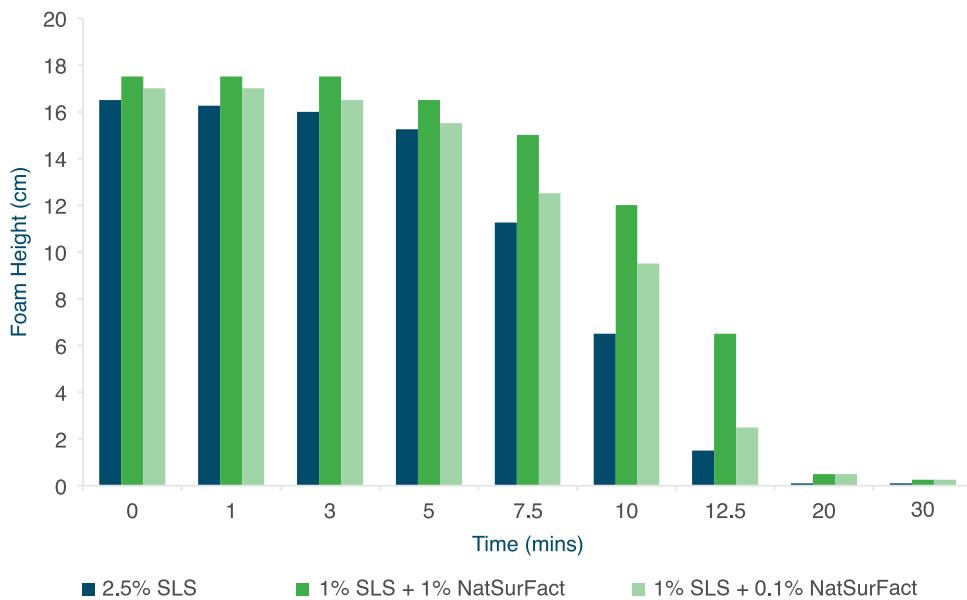
UNIQUE PROPERTIES OF RHAMNOLIPIDS

Logos Technologies developed NatSurFact based on rhamnolipids, a class of microbially produced glycolipids. Rhamnolipids demonstrate several unique properties that make them commercially attractive to the personal care and household cleaner industries. They exhibit orders of magnitude lower Critical Micelle Concentrations (CMCs) than industry standard ingredients. Only milligrams per liter are necessary to make the water “soapy.”

NatSurFact DIFFERENTIATORS

NatSurFact forms a dense, stable foam with better longevity than industry-standard sodium lauryl sulfate (SLS) even at lower concentrations, as shown in Figure 2. This means that small amounts of NatSurFact can be added to existing surfactant systems, producing systems with equal or greater detergent power. NatSurFact also acts as a foam booster for SLS, reducing product cost and environmental damage by releasing far fewer ingredients into the environment during rinse cycles.

FIGURE 2:
NatSurFact produces more stable foam at lower concentrations than SLS, and acts as a foam booster for SLS at very low concentrations.
(Results from extended ASTM D1173 protocol)



NatSurFact VALUE ACROSS MANY INDUSTRIES

Rhamnolipids can be used to replace conventional surfactants, many of which are petroleum derived, in a wide variety of processes, products, and industries beyond the personal care and cleaning industries. For example, rhamnolipid-based NatSurFact also has applications in:

- Agriculture, as adjuvants with reported fungicidal properties
- Food and dairy, as emulsifying and thickening agents
- Pharmaceuticals, as delivery agents or potential actives
- Water Treatment to lower BOD expenses
- Manufacturing, as mold release agents
- Bioremediation of oil and heavy metals

These and other industries are eyeing NatSurFact for many of the same reasons that it has attracted the attention of the personal care and cleaning industries. NatSurFact is an all-natural, biodegradable product, with low eco-toxicity and irritation, and free of sulfates and phosphates, so it offers an environmentally safe as well as cost-effective alternative to conventional surfactants.

NatSurFact GRADES AVAILABLE

Logos has invented an end-to-end process that uses vegetable oil as the input, ferments it into rhamnolipids, and then isolates and concentrates the rhamnolipids. We have several issued and pending patents on both the fermentation and the “downstream” parts of the process. Our approach cost-effectively results in several grades of material that meet a variety of different needs.

- **LCBS** is a dry powder with 90% rhamnolipids (RL) in the sodium salt form. This grade is most commonly used for dry formulations or where high-active is desired.
- **CCB** is an aqueous solution containing 50% rhamnolipid in the sodium salt form. This grade is commonly used when the formulator prefers to work with a liquid ingredient while still maintaining high rhamnolipid concentration.
- **HCCB** is our most popular product. It is 45% rhamnolipid in an aqueous solution as the sodium salt form. The color and odor have been reduced to produce a honey-colored liquid.
- **ACCB** is a suspension of the acid form of rhamnolipids in water at pH 2.1. The concentration of rhamnolipids in this grade is 50%, and it is useful for applications where the acid form of the molecule, instead of the salt form, is necessary.
- **CB** is a 5% rhamnolipid solution of the sodium salt in water. This grade can be taken advantage of when the rhamnolipid use level is low.
- **AX** is a concentrated version, 85% rhamnolipid, of the acid form of the molecule, where all of the water has been eliminated. It can be implemented when working in non-aqueous formulations, where the acid form of rhamnolipids is desired.
- **CPS** grades are chromatographically purified. Pure mono-rhamnolipid, pure di-rhamnolipid, or a mixture of the two are available. They are available for situations where zero contaminants are required for testing or regulatory reasons.



HCCB



CCB

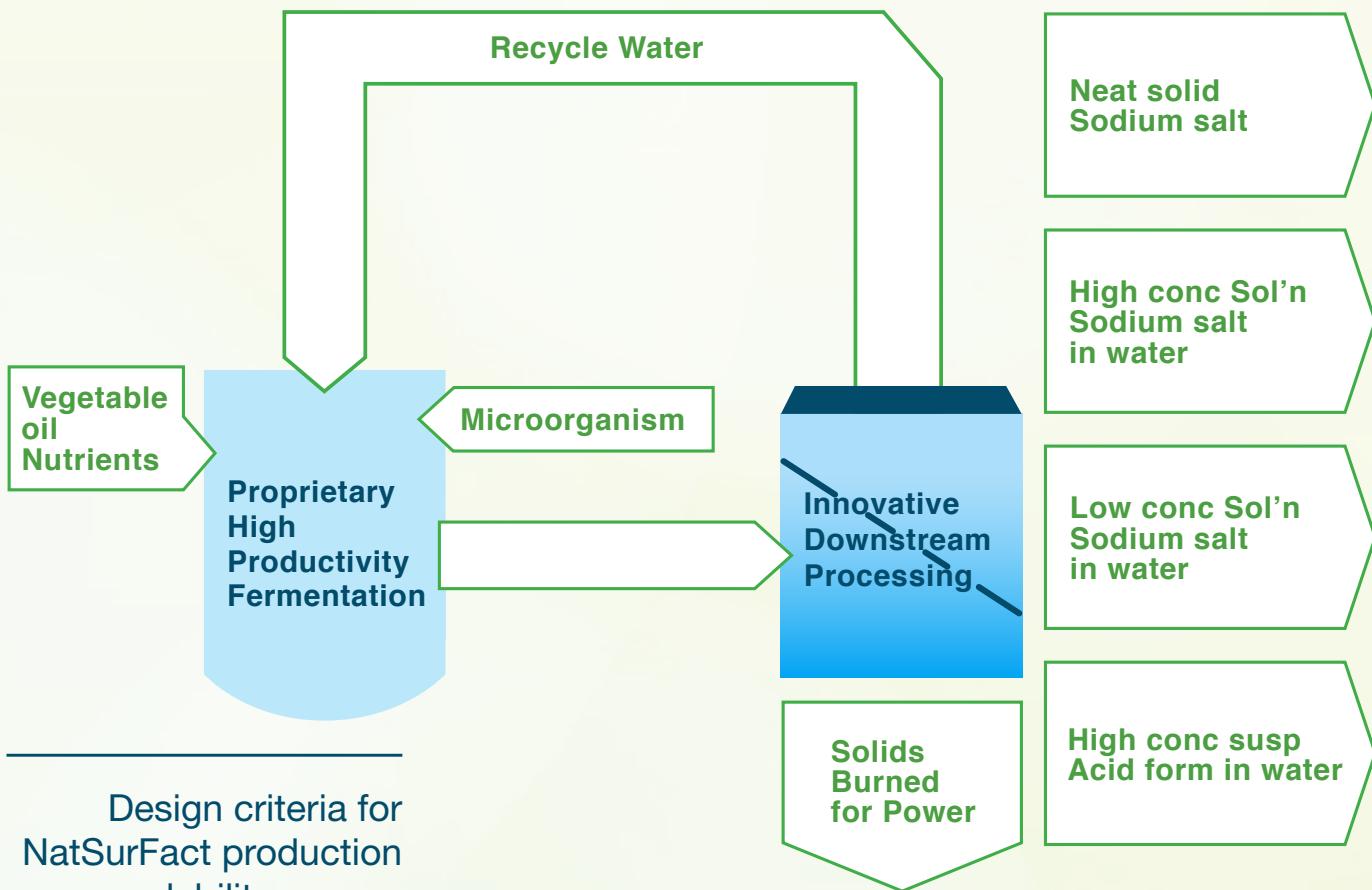


LCBS

Grade	Description
LCBS	90% RL neat powder sodium salt
CCB	50% RL aqueous sodium salt form
HCCB	45% RL aqueous sodium salt form
ACCB	50% RL aqueous acid form
CB	5% RL aqueous sodium salt form
AX	85% RL solid acid form
CPS	Chromatographically pure rhamnolipids

NatSurFact Differentiators

Our process starts with water, renewable vegetable oil, naturally occurring bacteria, and a special mix of nutrients that make the bacteria produce a high titer (i.e., concentration) of rhamnolipids quickly. When the natural fermentation is complete, we remove the bacteria and, voila, NatSurFact CB grade is made! CB is a 5% solution of the sodium salt of rhamnolipids in water at neutral pH.



Design criteria for NatSurFact production were scalability, energy and resource efficiency, and cost-effectiveness.

If a higher concentration is desired, we have clever downstream processing approaches to remove water without any solvents or heat. In fact, it was so clever we have a granted patent, US 9,884,883, with additional patent applications submitted. This results in our more concentrated liquid grades, which are around 50% rhamnolipids: HCCB, CCB, ACCB. And, if a water free grade is desired, we can dry it all the way to LCBS, a powder of the sodium salt of rhamnolipids.

How NatSurFact Compares

	Surfactant type	Readily Biodegradable	Foaming Cleaning Power	Mildness to Us Humans	Relative Aquatic Toxicity	Renewable Production Process	Found in Nature
NatSurFact Rhamnolipid-based BioSurfactant	Anionic						
LAS, SLS, SLES Linear alkylbenzene Sulfonates, Sodium Lauryl Sulfate, Sodium Lauryl Ether Sulfates	Anionic						
Glucosides Alkyl glucoside, coco glucoside, alkyl polyglucosides (APG's)	Non-ionic						
Taurates	Anionic						
Sulfosuccinates	Anionic						
Ethoxylated alcohols	Non-ionic						

1. Low foaming, however good cleansing
2. Some parts of the molecule can be renewably sourced
3. All parts of the molecule can be renewably sourced

NatSurFact is a new biosurfactant ingredient with novel properties, compared to conventional high volume petroleum derived surfactants. NatSurFact is high foaming and a strong cleanser, it is mild with low aquatic toxicity, it is produced in a renewable production process, and it is a natural product. This sets it apart from other surfactants, as demonstrated in the table.

Consumers are demanding more environmentally friendliness and transparency from the products they use today. NatSurFact is a perfect ingredient to meet these demands.



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