SLOVENSKI STANDARD
kSIST-TP FprCEN/TR 17557:2020

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Površinsko aktivne snovi - Površinsko aktivne snovi na biološki osnovi - Pregled površinsko aktivnih snovi na biološki osnovi

Surface active agents - Bio-based surfactants - Overview on bio-based surfactants

Tenside - Biobasierte Tenside - Übersicht über Biobasierte Tenside

Agents de surface - Agents tensioactifs biosourcés - Vue d’ensemble des agents tensioactifs biosourcés

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ICS

English Version

Surface active agents - Bio-based surfactants - Overview on bio-based surfactants

Tenside - Biobasierte Tenside - Übersicht über Biobasierte Tenside

This draft Technical Report is submitted to CEN members for Vote. It has been drawn up by the Technical Committee CEN/TC 276.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

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European foreword

This document (FprCEN/TR 17557:2020) has been prepared by Technical Committee CEN/TC 276 “Surface Active Agent”, the secretariat of which is held by AFNOR.

This document is currently submitted to the Vote on TR.

Introduction

Bio-based raw materials have been used for millennia in the manufacture of surfactants, e.g. the first surfactant used by mankind was already completely bio-based – soap. With the advent of modern surfactants in the early 20th Century, petrochemical-based raw materials also became of interest. They offered the opportunity to tune the surfactant properties, in a broader sense, to their various applications.

The last decades have seen the emergence of new bio-based raw materials for surfactants. Some of the reasons for the increased interest lie in the bio-based products' potential benefits in relation to the depletion of fossil resources and climate change.

Acknowledging the need for common standards for bio-based products, the European Commission issued mandate M/492[1], resulting in a series of standards developed by CEN/TC 411, with a focus on bio-based products other than food, feed and biomass for energy applications.

The standards of CEN/TC 411 "Bio-based products" provide a common basis on the following aspects:

— Common terminology[2]

— Bio-based content determination

— Life Cycle Assessment (LCA)[3]

— Sustainability aspects[4]

— Declaration tools.

It is important to understand what the term "bio-based product" covers and how it is being used. The term "bio-based" means "derived wholly or partly from biomass". It is essential to characterize the amount of biomass contained in the product by, for instance, its (total) bio-based content or bio-based carbon content.

The bio-based content of a product itself does not provide information on its environmental impact or sustainability, which may be assessed through Life Cycle Inventory (LCI), LCA and sustainability criteria. In addition, transparent and unambiguous communication within bio-based value chains is facilitated by a harmonized framework for certification and declaration.

Breaking down the horizontal standards to bio-based products like bio-based surfactants, the European Commission issued mandate M/491, resulting in standards developed by CEN/TC 276. This Technical Specification has been developed with the aim to fulfil part of the Mandate to describe the technical requirements of bio-based surfactants. The criteria for "bio-based surfactants" published in this Technical Specification are complementary to the horizontal standards by CEN/TC 411.

Surfactants are products which have the ability to reduce interfacial/surface tension, wet surfaces, suspend materials or emulsify oils and fats. In Europe, thousands of producers, manufacturers and

1 A Mandate is a standardisation task embedded in European trade laws. M/492 Mandate is addressed to the European Standardisation bodies, CEN, CENELEC and ETSI, for the development of horizontal European Standards for bio-based products. M/491 mandate is addressed to the development of European standards for bio-solvents and bio-surfactants.

2 EN 16575

3 EN 16760

4 EN 16751

nearly every inhabitant in Europe use surfactants every day in consumer or industrial applications. The surfactant-producing industry is composed of mainly multinationals. Downstream users are found in multinationals as well as SME's.

Surfactants may be produced from both fossil and renewable carbon feedstock (Ref. EN 16575:2014 nomenclature). The amount of crude oil used for surfactant production is, however, low with less than 1 % of the total world's crude oil consumption.

Finally, the approach for these Technical Reports/Specifications/Standards intends to strengthen and harmonize the reputation of “bio-based surfactants” and the confidence of the customer in this product group.

1 Scope

The aim of this document is to summarize the actual situation regarding many aspects regarding bio-based surfactants and their relation to any other surfactant regardless of its origin. It will describe existing raw material sources with regard to their current usage in surface active agents, their source identification and conformation, and the options for communication same.

It also includes the current work on surfactants regarding their performances, their sustainability, the LCA approaches and end of life options.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 16575 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1
surfactant
organic substance, possessing surface activity which, dissolved in a liquid, particularly water, lowers the surface or interfacial tension, by preferred adsorption at the liquid/vapour surface, or other interfaces

Note 1 to entry: "substance" as defined in REACH [2]

[SOURCE: ISO 862:1984, surface active agent 1.1 modified]

3.2
bio-based surfactant
surfactant wholly or partly derived from biomass (based on biogenic carbon) produced either by chemical or biotechnological processing

[SOURCE: EN 16575:2019, bio-based surfactant 3.2]

3.3
bio surfactant
surfactant wholly based on biomass (based on biogenic carbon) produced either by chemical or biotechnological processing

[SOURCE: EN 16575:2019, bio-surfactant 3.3]

3.4
degradation
transformation of a compound into smaller component parts due to the physico-chemical environment. This may occur due to abiotic processes such as oxidation and UV adsorption

[SOURCE: EN 16575:2019, degradation 3.4]

3.5
biodegradation
transformation of a compound into smaller component parts due to biological processes,

[SOURCE: EN 16575:2019, biodegradation 3.5]

3.6
ultimate biodegradation
breakdown of organic matter by micro-organisms in the presence of oxygen to carbon dioxide, water and mineral salts of any other elements present (mineralisation) or in absence of oxygen to carbon dioxide, methane and mineral salts, and in both cases the production of new biomass

[SOURCE: EN 16575:2019, ultimate biodegradation 3.6]

4 Market situation and penetration of bio-based surfactants in Europe

Surfactants consist of at least one hydrophobic and one hydrophilic part. The source of these parts can be either fossil-based or bio-based (renewable).

Traditionally, triglycerides from various oil plants are used as renewable sources for the hydrophobic part. Suitable plants are e.g. oil palms, coconut palms, sunflowers, rapeseeds, or soy beans. The oils taken from these plants are further chemically processed to get fatty acids by saponification or to get fatty alcohols by methanolysis of the triglycerides and consecutive hydrogenation of the fatty methylester.

If fossil resources are used for the hydrophobic part, there is a multitude of pathways to process either crude oil or natural gas to build the hydrophobic building block. This includes e.g. Fischer-Tropsch synthesis, oxo process, olefin oligomerisation, or Friedel-Crafts alkylation.

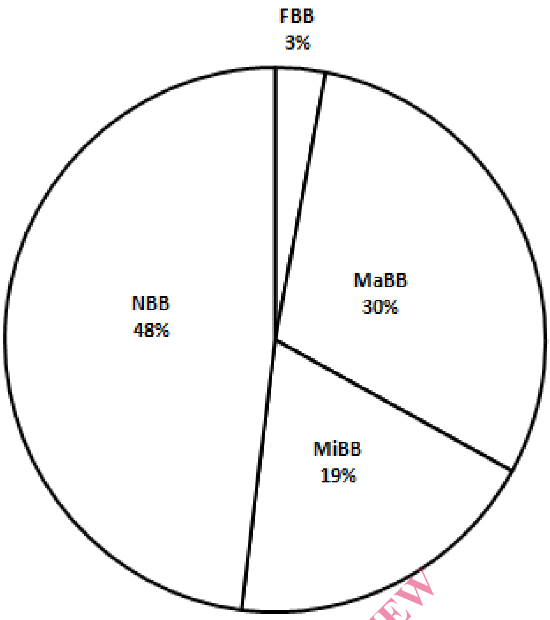
Generally, the carbon number of the hydrophobic part of a surfactant ranges from 4 to 24 carbon atoms, whereas the majority has a carbon number between 10 and 15 carbon atoms.

Also the hydrophilic part may be derived from different sources either organic from renewable or fossil sources or inorganic from minerals. Table 1 gives a non-exhaustive summary.

Table 1 — Hydrophilic components of surfactants and their origin

Hydrophilic source	Type of material
Renewable	Sugar, starch
Fossil	EO, chloroacetic acid
Inorganic	Sulfate, sulfonate, phosphate

The production of surfactants is carried out by multinational companies as well as SME's. Figure 1 shows the use of bio-based and non bio-based surfactants in EU (+ Norway, Iceland, and Switzerland) in 2015. The split is close to be equal between them. Partitioning the bio-based part further into minority bio-based surfactants (5 % < bio-based carbon content ≤ 50 %), majority bio-based surfactants (50 % < bio-based carbon content < 95 %), and fully bio-based surfactants (bio-based carbon content ≥ 95 %) show further details of the use of the different types of surfactants.



Key

FBB	Fully Bio-Based (3 %)
MaBB	Majority Bio-Based (30 %)
MiBB	Minority Bio-Based (19 %)
NBB	Non Bio-Based (48 %)

Figure 1 —Proportion of bio-based and non-bio-based surfactants used in the European Union + Norway, Switzerland, and Iceland in 2015 (Source: CESIO 2016)

5 Description of differences between bio-based and non-bio-based surfactant

5.1 Impact on biodegradability/aquatic toxicity

Surface active agents are generally discharged via treated and untreated wastewater into the environment. Consequently, ultimate biodegradability (mineralisation) is often required for such substances. There are numerous test methods to measure biodegradability which may be used [2].

Common criteria for biodegradability is in most cases the ultimate biodegradation within 28 days and a pass level of 60 % of either the theoretical consumption of oxygen or the theoretical evolution of carbon dioxide.

If these ultimate degradation methods cannot be measured because of the physical characteristics of the surfactant other methods [3] determining the elimination can be used. Please note that the high initial test concentration may be inhibitory because of toxic effects of the test substance to microorganisms.

In general, structural properties and molecular weight of any substance are decisive for their biodegradation. This is independent from the origin of the used raw materials as is shown in Table 2 where some examples are given using the methods described in [2] or [3]. Completely fossil-based surfactants like linear alkylbenzene sulfonates LAS are biodegradable and on the other hand majority bio-based surfactants like cetyltrimethylammonium bromide CTAB are not biodegradable.