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International Association for Soaps,  
Detergents and Maintenance Products

# Detergents Regulation: Fact sheet on aerobic biodegradation of surfactants

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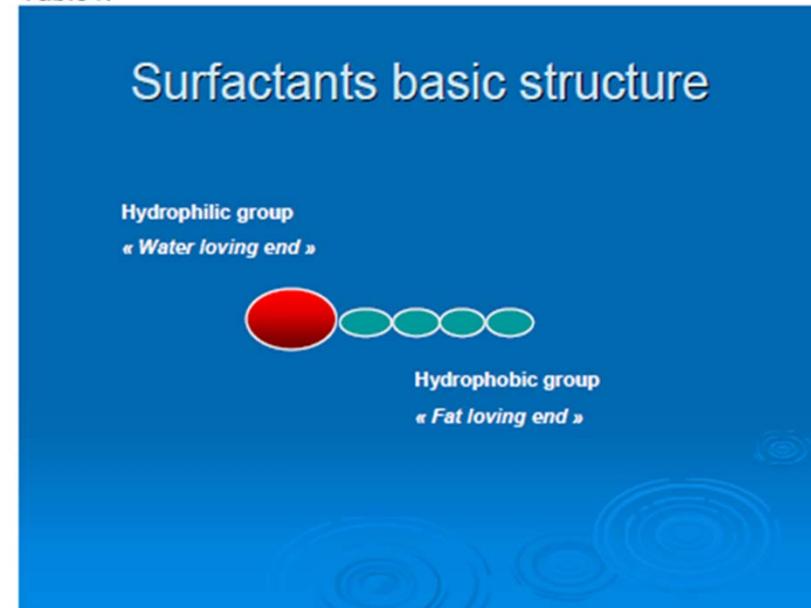
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# 1) Role of surfactants in detergents

Surfactants, or surface-active agents, are an **essential component of detergents**. They are substances that, when dissolved in water, give a product the ability to remove dirt from surfaces such as textiles and keep it in suspension.

The characteristic property of surfactants is that **they detach poorly water-soluble types of soiling (e.g. fat) from the surface**. They are able to do so because each surfactant molecule has a “water-loving” (hydrophilic) head that is attracted to water molecules AND a “water-hating” (hydrophobic) and “fat-loving” (lipophilic) tail that repels water and simultaneously attaches itself to oil and grease in dirt.

Table1:



These opposing forces loosen the dirt and suspend it in the water. The mechanical action further helps pull the dirt free.

## 2) Classes of Surfactants:



Surfactants can be classified in different groups :

- **anionic,**
- **non-ionic,**
- **cationic**
- **or amphoteric**

... depending on the electrostatic charge of their water-loving end (“positive or negative“-see Table 4).

The first two groups are the most common and account for over 80% of the total usage in detergents. Cationic surfactants are used mainly in fabric conditioners to give a pleasant soft feel to the fabric.

Amphoteric surfactants are used mainly for their skin mildness properties.



Table 4:

## Classes of surfactants

| <i>Class of surfactants</i> | <i>Charge of the waterloving part</i> | <i>Scheme</i>   | <i>Examples of use (characteristics)</i>   |
|-----------------------------|---------------------------------------|---|--|
| Nonionic                    | Uncharged                             |    | Heavy duty detergents for textiles;<br>automatic dish-washing detergents (low foaming) |
| Anionic                     | Negative                              |    | Heavy duty detergents for textiles;<br>all purpose cleaners                            |
| Amphoteric                  | Positive and negative                 |  | Hand-dishwashing products (skin friendliness)  |
| Cationic                    | Positive                              |  | Fabric conditioners  |



# Surfactants can work in different ways:



Table 2:

| Roll-up mechanism   | Emulsification  |
|---|---|
| <p>The surfactant lowers the oil/solution and surface/solution interfacial tensions and in this way lifts the stain off the surface (e.g. cotton fabric).</p> | <p>The surfactant lowers the oil-solution interfacial tension and makes easy emulsification of the oily soils possible.</p> |
| <p style="text-align: center;"><b>Roll-up</b></p>   | <p style="text-align: center;"><b>Emulsification</b></p>  |

A third mechanism is **solubilization**. Through interaction with a surfactant in water, a substance spontaneously dissolves to form a temporarily stable mixture.



### 3) What does biodegradation of surfactants mean?

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**Biodegradation is the process by which micro-organisms break down organic materials into smaller, simpler fragments.** Bacteria and fungi are the organisms most frequently associated with biodegradation. The organic matter serves also as “food” to the bacteria providing them with energy and building blocks from which to make more bacteria.

When biodegradation is complete, the end products are mostly carbon dioxide and water. We refer to an organic substance as biodegradable when it is a good growth and energy substrate for commonly found micro-organisms in nature.

When biodegradation is incomplete, by-products are formed that will accumulate in the environment or will degrade further through other mechanisms.

Surfactants used in detergents normally end up in the waste-water that eventually enters a sewage treatment plant with the dirt they have removed. At this stage, the surfactants are biodegraded under aerobic conditions. In this process, the bacteria in sewage treatment plants increase in number; this means that “biomass” is formed.

*(cont'd)*

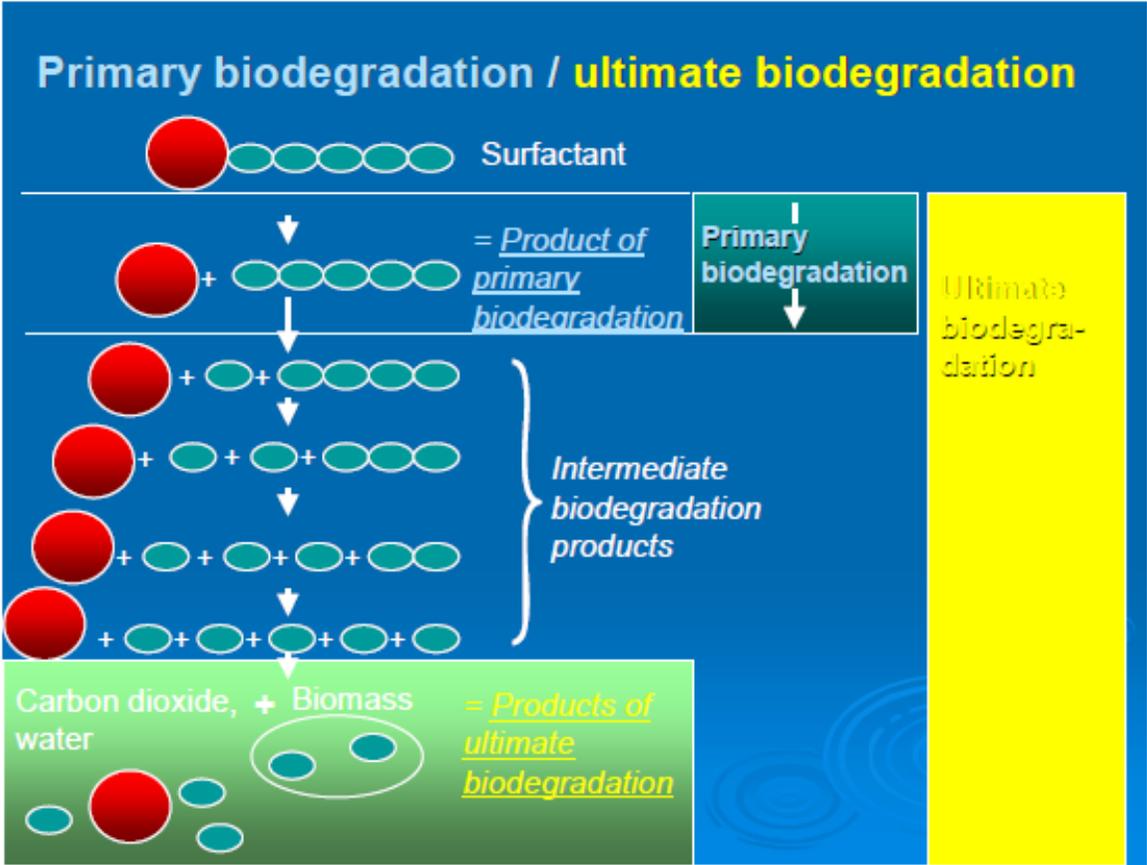
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In biodegradation of organics, there is a differentiation between primary biodegradation and ultimate biodegradation.

For surfactants, **primary biodegradation** is the first and the most important step. This is when surfactants lose their characteristic property to influence surface tension and hence detach dirt and, at the same time, most of their hazardousness for water organisms.

The subsequent **ultimate biodegradation** of surfactants takes place in several steps until only water and carbon dioxide are left.

Table 3:



- Simplified depiction: Difference between primary and ultimate biodegradation -



## 4) Detergent Regulation (2005) and Biodegradation of surfactants



With the entry into force of the Detergents Regulation on 8 October 2005, all surfactants used for domestic detergents **have to be ultimately biodegradable**.

However, since the late 70's, anionic and nonionic surfactants had to prove their primary biodegradation and over the years the large majority of all surfactants used in detergents – including also cationic and amphoteric surfactants - had been fulfilling even more stringent requirements regarding their ultimate degradation.

Since October 2005, the proof of ultimate biodegradation is obligatory EU-wide for all groups of surfactants used in domestic detergents.

Detergents used in the Industrial & Institutional (I&I) may continue to use some surfactants which are primarily but not ultimately biodegradable only for very special purposes and after having obtained a derogation based on risk assessment and benefits evaluations.





## For more info, please contact:

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