



## Biodegradability of Surfactants

### Definition and measuring methods

For the biodegradation of laundry detergents and cleaning agents, one differentiates between primary and secondary degradation:

**Primary degradation:** The surfactant loses its surface-active properties, i.e. the surface tension of the water no longer is affected by the surfactant; this is important for aquatic organisms.

**Secondary or ultimate degradation:** The surfactant is completely biodegraded into  $\text{CO}_2$ , water, minerals, and biomass (during biodegradation of e.g. laundry detergents the number of micro-organisms feeding on the laundry detergent increases).

Secondary degradation distinguishes between:

**Aerobic degradation** (corresponds to degradation in sewage works)

**Anaerobic degradation** (corresponds to direct degradation in soil)

Surfactant	aerobic degradation	anaerobic degradation
Sugar surfactant (APG)	x	x
Fatty alcohol sulfates (FAS)	x	x
Plant-derived oil soaps	x	x
Linear alkyl benzene sulfonate	x	-
Sulphonic acid	x	-

**Measuring methods for determining the degradation pattern in compliance with OECD** (Organisation for Economic Cooperation and Development):

**OECD 301A-F:** These measuring methods determine the ultimate degradation of surfactants. They either measure the dissolved carbon, the used-up oxygen in the liquid, or the  $\text{CO}_2$  which is being released. If the results fulfil the legal requirements, the substance is considered „readily biodegradable“; i.e. easily and completely biodegradable.

**Example:** According to OECD 301B, the laundry detergent to be tested is used as sole carbon nutrient for the microorganisms. The biodegradation is being determined by measuring the carbon released as  $\text{CO}_2$ . If 60 % of the total organic carbon content in the laundry detergent is released after 28 days as  $\text{CO}_2$ , the complete biodegradability is guaranteed, and the product considered „readily biodegradable“.

**Sonett Products** are tested in compliance with OECD 301B, and fulfil the criteria of effortless biodegradability: thus after only 10 days, Sonett Laundry Detergent Lavender, Hand Soaps, Clear Rinse, and Toilet Cleaner are decomposed by 64%, 60%, 69% and 73% respectively.

**OECD 302A-C:** These measuring methods are applied when the legal requirements for ultimate degradation of the series OECD 301 are not met. OECD 302 tests the limited biodegradability.

**OECD 303:** In this measuring method only the primary not the ultimate degradation is tested.

# Biodegradability Of Surfactants

**Uri Zoller**



## Biodegradability Of Surfactants:

**Biodegradability of Surfactants** D.R. Karsa, M.R. Porter, 2012-12-06 The awareness and development of biodegradable surfactants pre dates current pressures by the environmental movement by nearly three decades wherein a responsible industry mutually agreed to replace hard non biodegradable components of household detergents by soft biodegradable alternatives without course to legislation The only requirement at that time was for surfactants used in detergents to exhibit a primary biodegradability in excess of 80% this referring to the disappearance or removal from solution of the intact surface active material as detected by specified analytical techniques This proved useful as observed environmental impacts of surfactants e.g visible foam on rivers are associated with the intact molecule Test methods for primary biodegradability were eventually enshrined in EU legislation for nonionic surfactants Directive 821242 EEC amended 73 404IEEC and for anionic surfactants Directive 8212431IEEC amended 73 405IEEC No approved test methods and resultant legislation have been developed for cationic and amphoteric surfactants to date The environmental classification of chemical substances which of course includes surfactants and associated risk assessment utilises a second criterion ready biodegradability This may be assessed by a number of methods which monitor oxygen uptake BOD carbon dioxide production or removal of dissolved organic carbon DOC Some surfactants which comply with the above Detergents Directive are borderline when it comes to ready biodegradability

Biodegradability of Surfactants D. R. Karsa, M. R. Porter, 1994-12-31 Surfactant Biodegradation, Second Edition, Robert Donald Swisher, 1986-10-31 **Handbook of Detergents, Part B** Uri Zoller, 2004-08-30 The second installment of the multivolume Handbook of Detergents deals with the potential environmental impact of detergents as a result of their production formulation usage consumption and disposal This volume forms a comprehensive treatise on the multidimensional issues involved and emphasizes the alignment of scientific knowledge with the relevant contemporary data and methodologies in toxicology ecotoxicology and environmental risk assessment With contributions from over 50 experts worldwide this volume discusses industry procedures involving surfactant and detergent treatments and explores global concerns centering on recent legislative and regulatory developments

Novel Surfactants Krister Holmberg, 2003-07-03 Extensively revised and expanded this timely reference discusses the synthesis properties and potential applications of popular and emerging surfactant compounds and systems This reference reflects current research trends in green surfactants the production of surfactants using biotechnological methods and surfactants based on natural building

Surfactant Biodegradation Robert Donald Swisher, 1970 *Surfactants Europa* Gordon L Hollis, 2007-10-31 *Surfactants Europa* 3rd Edition provides easy access to current product information on surface active agents surfactants manufactured and sold in Europe It contains valuable data on approximately 9 000 trade names from more than 80 suppliers including chemical description and composition general property application and manufacturer information The directory contains company and trade name indexes with page references and provides a very useful listing of companies with full

contact details including European divisions and agents The products listed in the directory find applications in a wide variety of branches of the chemical manufacturing industry including detergent and cleaning products agrochemicals construction cosmetics food oil paint paper pharmaceuticals plastics and textiles The directory is edited by Dr Gordon Hollis an established consultant in the surfactants field and author of four respected surfactants directories *Surfactants Europa* 3rd Edition will be an essential reference directory for research and development personnel and laboratory staff in general It will also be useful for technical departments and purchasing sales departments not only in the detergent industry but in many industries where surfactants are used      **Environmental and Human Safety of Major Surfactants** Sylvia S.

Talmage,2020-04-08 The book summarizes and reviews the environmental and human safety of two classes of nonionic surfactants alcohol ethoxylates AE and alkylphenol ethoxylates APE This unique resource contains critical data from published sources as well as from unpublished studies submitted by Soap and Detergent Association member companies It reviews information on product chemistry and analysis biodegradation environmental levels including fate and distribution aquatic toxicity and human safety Recently developed analytical techniques for the extraction separation detection and measurement of nonionic surfactants and their metabolites in environmental samples are described Results of biodegradation studies performed with a variety of test systems are tabulated as are results of field studies at wastewater treatment plants Reported comparisons of environmental levels with results of acute and chronic aquatic toxicity tests are provided The information on the toxicity and irritation potential of AE and APE surfactants includes data from in vitro mammalian and human studies      *Encyclopedia of Surface and Colloid Science* - Arthur T. Hubbard,2002-07-18 This comprehensive reference collects fundamental theories and recent research from a wide range of fields including biology biochemistry physics applied mathematics and computer materials surface and colloid science providing key references tools and analytical techniques for practical applications in industrial agricultural and forensic processes as well as in the production of natural and synthetic compounds such as foods minerals paints proteins pharmaceuticals polymers and soaps

Chemistry and Technology of Surfactants Richard J. Farn,2008-04-15 Surfactants are used throughout industry as components in a huge range of formulated products or as effect chemicals in the production or processing of other materials A detailed understanding of the basis of their activity is required by all those who use surfactants yet the new graduate or postgraduate chemist or chemical engineer will generally have little or no experience of how and why surfactants work *Chemistry Technology of Surfactants* is aimed at new graduate or postgraduate level chemists and chemical engineers at the beginning their industrial careers and those in later life who become involved with surfactants for the first time The book is a straightforward and practical survey of the chemistry of surfactants and their uses providing a basic introduction to surfactant theory information on the various types of surfactant and some application details This will allow readers to build on their scientific education the concepts and principles on which the successful use of surfactants across a wide range of

industries is based **Handbook of Biodegradable Materials** Gomaa A. M. Ali, Abdel Salam H. Makhoul, 2023-02-20 This Handbook discusses the recent advances in biodegradation technologies and highlights emerging sustainable materials including environmentally friendly nano based materials for replacing plastics It is useful to scientists engineers biologists medical doctors and provides alternative eco friendly materials to replace the currently used ones with harmful impact on the environment and life The chapters present different types of alternative materials in diverse areas such as food packaging materials materials for construction and agricultural materials The principles and types of biodegradation technologies are described in depth **Biodegradability of Surfactants** B. Ziolkowsky, 1990 *Risk Assessment and Risk Management* R E Hester, R M Harrison, 2007-10-31 Risk assessment is considered by many analysts to be an objective scientific tool It is considered to be variously influenced by broader issues which in turn have important practical implications both for risk assessors and decision makers Risk Assessment and Risk Management examines a range of practical applications of risk assessment methods and risk management procedures in the broad context of environmental science and technology Written by acknowledged experts in the field the articles cover a variety of areas with reference to subjects as diverse as BSE the use of risk assessment in government using computer modelling as an aid to risk assessment in the case of accidental contamination of rivers and estuaries quantitative cancer risk assessment related to carcinogens in the environment landfilling of household wastes environmental risk assessment and management of chemicals and aquatic risk assessment and management of pesticides This book provides a detailed and wide ranging review of the many aspects of risk assessment and risk management which have excited so much debate and controversy in recent times It will be essential reading for all those involved in the assessment and management of risk particularly in the context of environmental science

**Encyclopedia of Surface and Colloid Science** P. Somasundaran, 2006 **Handbook of Detergents, Part B** Uri Zoller, 2004-08-30 The second installment of the multivolume Handbook of Detergents deals with the potential environmental impact of detergents as a result of their production formulation usage consumption and disposal This volume forms a comprehensive treatise on the multidimensional issues involved and emphasizes the alignment of scientific knowledge with the relevant contemporary data and methodologies in toxicology ecotoxicology and environmental risk assessment With contributions from over 50 experts worldwide this volume discusses industry procedures involving surfactant and detergent treatments and explores global concerns centering on recent legislative and regulatory developments **Surfactants and Interfacial Phenomena** Milton J. Rosen, Joy T. Kunjappu, 2012-01-20 Now in its fourth edition Surfactants and Interfacial Phenomena explains why and how surfactants operate in interfacial processes such as foaming wetting emulsion formation and detergency and shows the correlations between a surfactant's chemical structure and its action Updated and revised to include more modern information along with additional three chapters on Surfactants in Biology and Biotechnology Nanotechnology and Surfactants and Molecular Modeling with Surfactant Systems this is the premier text on the properties

and applications of surfactants This book provides an easy to read user friendly resource for industrial chemists and a text for classroom use and is an unparalleled tool for understanding and applying the latest information on surfactants Problems are included at the end of each chapter to enhance the reader's understanding along with many tables of data that are not compiled elsewhere Only the minimum mathematics is used in the explanation of topics to make it easy to understand and very user friendly

*Handbook of Detergents - 6 Volume Set* Uri Zoller, 2008-11-23 With contributions from experts and pioneers this set provides readers with the tools they need to answer the need for sustainable development faced by the industry The six volumes constitute a shift from the traditional mostly theoretical focus of most resources to the practical application of advances in research and development With con

Surfactant Science and Technology Drew Myers, 2005-10-28 A general introduction to surfactants surface activity and surfactant applications Important advances in the tools available for studying the activity of surfactants has significantly increased scientific understanding of interfaces at the molecular level However there is still much to be learned In this Third Edition of the successful classic author and expert Drew Myers combines the latest information available in the field of surfactants with his original accessible text on the subject Now fully updated to reflect recent developments in working with surfactants in both model and practical systems the Third Edition of *Surfactant Science and Technology* provides a solid introduction to the field of surfactant science Written especially for beginners and nonspecialists who would like a practical but not necessarily comprehensive knowledge of the field this clear cogent text conveys the most fundamental and useful concepts of surfactant action and application New chapters bring readers up to date on current biological and medical applications of surfactants as well as applications in food science cosmetics and other areas In addition to new chapters *Surfactant Science and Technology* includes illustrative problems at the end of each chapter These problems explain concepts discussed and stimulate imaginative solutions on the part of the reader A helpful bibliography of supplementary resources for readers who desire more detail has also been included *Surfactant Science and Technology* Third Edition is an invaluable resource for surface and polymer chemists chemical and industrial engineers and a wide range of chemistry students

**Surface Chemistry of Surfactants and Polymers** Bengt Kronberg, Krister Holmberg, Bjorn Lindman, 2014-12-31 This book gives the reader an introduction to the field of surfactants in solution as well as polymers in solution Starting with an introduction to surfactants the book then discusses their environmental and health aspects Chapter 3 looks at fundamental forces in surface and colloid chemistry Chapter 4 covers self assembly and 5 phase diagrams Chapter 6 reviews advanced self assembly while chapter 7 looks at complex behaviour Chapters 8 to 10 cover polymer adsorption at solid surfaces polymers in solution and surface active polymers respectively Chapters 11 and 12 discuss adsorption and surface and interfacial tension while Chapters 13 16 deal with mixed surfactant systems Chapter 17 18 and 19 address microemulsions colloidal stability and the rheology of polymer and surfactant solutions Wetting and wetting agents hydrophobization and hydrophobizing agents solid dispersions

surfactant assemblies foaming emulsions and emulsifiers and microemulsions for soil and oil removal complete the coverage in chapters 20-25      *Biodegradation* Rolando Chamy, 2013-06-14 This book contains a collection of different biodegradation research activities where biological processes take place The book has two main sections A Polymers and Surfactants Biodegradation and B Biodegradation Microbial Behaviour

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