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► **B** REGULATION (EC) No 648/2004 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL  
of 31 March 2004  
on detergents  
(Text with EEA relevance)  
(OJ L 104, 8.4.2004, p. 1)

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► <b><u>M1</u></b>	Commission Regulation (EC) No 907/2006 of 20 June 2006	L 168	5	21.6.2006
► <b><u>M2</u></b>	Regulation (EC) No 1336/2008 of the European Parliament and of the Council of 16 December 2008	L 354	60	31.12.2008
► <b><u>M3</u></b>	Regulation (EC) No 219/2009 of the European Parliament and of the Council of 11 March 2009	L 87	109	31.3.2009
► <b><u>M4</u></b>	Commission Regulation (EC) No 551/2009 of 25 June 2009	L 164	3	26.6.2009
► <b><u>M5</u></b>	Regulation (EU) No 259/2012 of the European Parliament and of the Council of 14 March 2012	L 94	16	30.3.2012



**REGULATION (EC) No 648/2004 OF THE EUROPEAN  
PARLIAMENT AND OF THE COUNCIL**

**of 31 March 2004**

**on detergents**

**(Text with EEA relevance)**

THE EUROPEAN PARLIAMENT AND THE COUNCIL OF THE  
EUROPEAN UNION,

Having regard to the Treaty establishing the European Community, and  
in particular Article 95 thereof,

Having regard to the proposal from the Commission,

Having regard to the Opinion of the European Economic and Social  
Committee <sup>(1)</sup>,

Acting in accordance with the procedure laid down in Article 251 of the  
Treaty <sup>(2)</sup>,

Whereas:

- (1) Council Directives 73/404/EEC of 22 November 1973 on the approximation of the laws of the Member States relating to detergents <sup>(3)</sup>, 73/405/EEC of 22 November 1973 on the approximation of the laws of the Member States relating to methods of testing the biodegradability of anionic surfactants <sup>(4)</sup>, 82/242/EEC of 31 March 1982 on the approximation of the laws of the Member States relating to methods of testing the biodegradability of non-ionic surfactants <sup>(5)</sup>, 82/243/EEC of 31 March 1982 amending Directive 73/405/EEC on the approximation of the laws of the Member States relating to methods of testing the biodegradability of anionic surfactants <sup>(6)</sup> and 86/94/EEC of 10 March 1986 amending for the second time Directive 73/404/EEC on the approximation of the laws of the Member States relating to detergents <sup>(7)</sup>, have been significantly amended on several occasions. It is desirable, for reasons of clarity and rationalisation, that the provisions in question should be recast by bringing them all together in a single text. Commission Recommendation 89/542/EEC of 13 September 1989 <sup>(8)</sup>, as regards labelling provisions concerning detergents and cleaning products, should also be included in the single text.
- (2) Since the objective of this Regulation, to ensure the internal market in detergents, cannot be sufficiently achieved by the Member States, if there is no common technical criteria throughout the Community, and can therefore be better

<sup>(1)</sup> OJ C 95, 23.4.2003, p. 24.

<sup>(2)</sup> Opinion of the European Parliament of 10 April 2003 (not yet published in the Official Journal), Council Common Position of 4 November 2003 (OJ C 305 E, 16.12.2003, p. 11) and Position of the European Parliament of 14 January 2004 (not yet published in the Official Journal). Decision of the Council of 11 March 2004.

<sup>(3)</sup> OJ L 347, 17.12.1973, p. 51. Directive as last amended by Regulation (EC) No 807/2003 (OJ L 122, 16.5.2003, p. 36).

<sup>(4)</sup> OJ L 347, 17.12.1973, p. 53. Directive as amended by Directive 82/243/EEC (OJ L 109, 22.4.1982, p. 11).

<sup>(5)</sup> OJ L 109, 22.4.1982, p. 1.

<sup>(6)</sup> OJ L 109, 22.4.1982, p. 18.

<sup>(7)</sup> OJ L 80, 25.3.1986, p. 51.

<sup>(8)</sup> OJ L 291, 10.10.1989, p. 55.

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achieved at Community level, the Community may adopt measures, in accordance with the principle of subsidiarity as set out in Article 5 of the Treaty. In accordance with the principle of proportionality, as set out in that Article, this Regulation does not go beyond what is necessary in order to achieve that objective. A Regulation is the appropriate legal instrument as it imposes directly on manufacturers precise requirements to be implemented at the same time and in the same manner throughout the Community; in the area of technical legislation, uniformity of application in the Member States is needed, and this can only be guaranteed by a Regulation.

- (3) A new definition for detergents is needed to cover equivalent uses and be in line with developments at Member State level.
- (4) It is necessary to introduce a surfactant definition, which was lacking in the existing legislation.
- (5) It is important to give a clear and precise description of the relevant types of biodegradability.
- (6) Measures concerning detergents should be adopted to ensure the functioning of the internal market and avoid restricting competition in the Community.
- (7) As confirmed by the Commission White Paper on the strategy for a future Chemical Policy, appropriate measures concerning detergents should ensure a high level of environmental protection, especially of the aquatic environment.
- (8) Detergents are already subject to certain Community provisions concerning their manufacture, proper handling, usage and labelling, in particular with reference to Commission Recommendation 89/542/EEC and Commission Recommendation 98/480/EC of 22 July 1998 concerning good environmental practice for household laundry detergents<sup>(1)</sup>; Directive 1999/45/EC of the European Parliament and of the Council of 31 May 1999 concerning the approximation of the laws, regulations and administrative provisions of the Member States relating to the classification, packaging and labelling of dangerous preparations<sup>(2)</sup> applies to detergents.
- (9) Ditallow-dimethyl-ammonium-chloride (DTDMAC) and nonylphenol (including ethoxylates derivatives-APEs) are priority substances undergoing at Community level risk assessment activities, in accordance with Council Regulation (EEC) No 793/93 of 23 March 1993 on the evaluation and control of the risks of existing substances<sup>(3)</sup>, and if necessary

<sup>(1)</sup> OJ L 215, 1.8.1998, p. 73.

<sup>(2)</sup> OJ L 200, 30.7.1999, p. 1. Directive as last amended by Regulation (EC) No 1882/2003 of the European Parliament and of the Council (OJ L 284, 31.10.2003, p. 1).

<sup>(3)</sup> OJ L 84, 5.4.1993, p. 1. Regulation as amended by Regulation (EC) No 1882/2003.

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adequate strategies to limit the risks of exposure to these substances should therefore be recommended and implemented in the framework of other Community provisions.

- (10) The existing legislation on biodegradability of surfactants in detergents only covers primary biodegradability<sup>(1)</sup> and it is only applicable to anionic<sup>(2)</sup> and non-ionic<sup>(3)</sup> surfactants; therefore it should be replaced by new legislation, which lays the main emphasis on ultimate biodegradability and meets the important concerns related to the potential toxicity of persistent metabolites.
- (11) This requires the introduction of a new set of tests based on EN ISO standards and OECD guidelines, which governs the granting of direct permission for placing detergents on the market.
- (12) To provide a high level of protection of the environment, detergents not fulfilling requirements laid down by this Regulation should not be placed on the market.
- (13) On 25 November 1999 the Scientific Committee on Toxicity, Ecotoxicity and the Environment issued an opinion on biodegradability of surfactants in detergents and relevance of test-methods for regulatory control in this area.
- (14) The existing requirements regarding primary biodegradability should be maintained on a second hierarchy level and supplemented by a complementary risk assessment, for those surfactants failing ultimate biodegradability tests; furthermore surfactants failing primary biodegradability tests should not obtain marketing authorisation by way of derogation
- (15) The primary biodegradability requirements should be extended to all surfactants, in particular cationic and amphoteric, whilst allowing the possibility of applying instrumental analyses in those cases in which semi-specific analytical methods are not suitable.
- (16) The determination of biodegradability test-methods and the record-keeping of lists of derogations are technical matters and should be revised taking into account technical and scientific developments as well as regulatory developments.
- (17) Test-methods should produce data that give sufficient assurance of aerobic biodegradability of surfactants in detergents.

<sup>(1)</sup> Directives 73/404/EEC and 86/94/EEC.

<sup>(2)</sup> Directives 73/405/EEC and 82/243/EEC.

<sup>(3)</sup> Directive 82/242/EEC.

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- (18) Methods to test biodegradability of surfactants in detergents may produce variable results. In such cases they should be complemented by additional assessments in order to determine the risks of continued use.
- (19) Provisions should also be laid down regarding the placing on the market in exceptional cases of surfactants in detergents failing ultimate biodegradability tests and this should take place on the basis of all relevant information to ensure environmental protection and on a case by case basis.
- (20) The measures necessary for the implementation of this Regulation should be adopted in accordance with Council Decision 1999/468/EC of 28 June 1999 laying down the procedures for the exercise of implementing powers conferred on the Commission <sup>(1)</sup>.
- (21) It is appropriate to recall that other horizontal legislation is applicable to detergent surfactants, in particular Council Directive 76/769/EEC of 27 July 1976 on the approximation of the laws, regulations and administrative provisions of the Member States relating to restrictions on the marketing and use of certain dangerous substances and preparations <sup>(2)</sup> by which the marketing and use of dangerous substances covered by this Regulation might be banned or restricted, Council Directive 67/548/EEC of 27 June 1967 on the approximation of laws, regulations and administrative provisions relating to the classification, packaging and labelling of dangerous substances <sup>(3)</sup>, Commission Directive 93/67/EEC of 20 July 1993 laying down the principles for assessment of risks to man and the environment of substances notified in accordance with Council Directive 67/548/EEC <sup>(4)</sup>, Regulation (EEC) No 793/93, and Commission Regulation (EC) No 1488/94 of 28 June 1994 laying down the principles for the assessment of risks to man and the environment of existing substances <sup>(5)</sup>; Directive 98/8/EC of the European Parliament and of the Council of 16 February 1998 concerning the placing of biocidal products on the market <sup>(6)</sup>; Directive 2004/10/EC of the European Parliament and of the Council of 11 February 2004 on the harmonisation of laws, regulations and administrative provisions relating to the application of the principles of good laboratory practice and the verification of their application for tests on chemical substances (codified version) <sup>(7)</sup>; Directive 2004/9/EC of the European Parliament and of the Council of 11 February 2004 on the inspection and verification of good laboratory practice (GLP) (codified version) <sup>(8)</sup>; and Council

<sup>(1)</sup> OJ L 184, 17.7.1999, p. 23.

<sup>(2)</sup> OJ L 262, 27.9.1976, p. 201. Directive as last amended by Commission Directive 2004/21/EC (OJ L 57, 25.2.2004, p. 4).

<sup>(3)</sup> OJ L 196, 16.8.1967, p. 1. Directive as last amended by Regulation (EC) No 807/2003.

<sup>(4)</sup> OJ L 227, 8.9.1993, p. 9.

<sup>(5)</sup> OJ L 161, 29.6.1994, p. 3.

<sup>(6)</sup> OJ L 123, 24.4.1998, p. 1. Directive as amended by Regulation (EC) No 1882/2003.

<sup>(7)</sup> OJ L 50, 20.2.2004, p. 44.

<sup>(8)</sup> OJ L 50, 20.2.2004, p. 28.

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Directive 86/609/EEC of 24 November 1986 on the approximation of laws, regulations and administrative provisions of the Member States regarding the protection of animals used for experimental and other scientific purposes <sup>(1)</sup>.

- (22) It should be the responsibility of manufacturers to refrain from marketing detergents not complying with this Regulation and to have at the disposal of the national authorities the technical files for all substances and ►**M2** mixtures ◀ covered by this Regulation; this should also apply to surfactants that have failed to pass the tests mentioned in Annex III.
- (23) Manufacturers should be able to request a derogation from the Commission, which should have the possibility to grant such derogation in accordance with the procedure referred to in Article 12(2).
- (24) Member States' competent authorities should be able to apply control measures to detergents on the market, but should avoid repeating tests made by the competent laboratories.
- (25) The existing labelling provisions for detergents should be continued, including those in Recommendation 89/542/EEC, which are included in this Regulation in order to fulfil the objective of modernising the rules on detergents. Specific labelling is introduced to inform consumers about fragrance substances and preservation agents that are present in detergents. Medical personnel should be able to obtain from the manufacturer upon request a full listing of all ingredients of a detergent to assist them investigate whether a causal link exists between the development of an allergic response and exposure to a particular chemical substance, and Member States should be able to require that such a listing is also made available to a specific public body designated to provide this information to medical personnel.
- (26) All the above points call for new legislation replacing the existing legislation; however, for a certain period, Member States can continue to apply their existing laws.

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- (28) Detergents complying with this Regulation should be allowed to be placed on the market without prejudice to other relevant Community provisions.
- (29) In order to ensure the protection of man and the environment from unforeseen risks of detergents, a safeguard clause is needed.
- (30) The tests specified for the biodegradability of surfactants should be carried out in laboratories meeting an internationally recognised standard, namely EN/ISO/IEC/17025 or the principles of good laboratory practice; it would not be justified to ask for

<sup>(1)</sup> OJ L 358, 18.12.1986, p. 1. Directive as amended by Directive 2003/65/EC of the European Parliament and of the Council (OJ L 230, 16.9.2003, p. 32).

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the application of this latter requirement to existing surfactants to the extent that the available tests on them had been performed before the entering into force of the above standard and still provide a comparable level of scientific quality.

- (31) The issues relating to anaerobic biodegradation, the biodegradation of the main non-surfactant organic detergent ingredients, and phosphate content, which are not dealt with in this Regulation should be examined by the Commission and, where this is justified, a proposal should be presented to the European Parliament and the Council. Pending further harmonisation, the Member States may maintain or lay down national rules concerning the above issues.
- (32) The five Directives and the Commission Recommendation mentioned in recital (1) which are replaced by this Regulation should be repealed,

HAVE ADOPTED THIS REGULATION:

*Article 1*

**Objectives and scope**

1. This Regulation establishes rules designed to achieve the free movement of detergents and surfactants for detergents in the internal market while, at the same time, ensuring a high degree of protection of the environment and human health.

2. For this purpose, this Regulation harmonises the following rules for the placing on the market of detergents and of surfactants for detergents:

- the biodegradability of surfactants in detergents;
- restrictions or bans on surfactants on grounds of biodegradability;

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- the additional labelling of detergents, including fragrance allergens;
- the information that manufacturers must hold at the disposal of the Member States' competent authorities and medical personnel;
- limitations on the content of phosphates and other phosphorus compounds in consumer laundry detergents and consumer automatic dishwasher detergents.

**▼ B***Article 2***Definitions**

For the purpose of this Regulation:

1. ‘Detergent’ means any substance or ►**M2** mixture ◀ containing soaps and/or other surfactants intended for washing and cleaning processes. Detergents may be in any form (liquid, powder, paste, bar, cake, moulded piece, shape, etc.) and marketed for or used in household, or institutional or industrial purposes.

Other products to be considered as detergents are:

- ‘Auxiliary washing ►**M2** mixture ◀’, intended for soaking (pre-washing), rinsing or bleaching clothes, household linen, etc.;
- ‘Laundry fabric-softener’, intended to modify the feel of fabrics in processes which are to complement the washing of fabrics;
- ‘Cleaning ►**M2** mixture ◀’, intended for domestic all purposes cleaners and/or other cleaning of surfaces (e.g.: materials, products, machinery, mechanical appliances, means of transport and associated equipment, instruments, apparatus, etc.);
- ‘Other cleaning and washing ►**M2** mixtures ◀’, intended for any other washing and cleaning processes.

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- 1a. ‘Consumer laundry detergent’ means a detergent for laundry placed on the market for use by non-professionals, including in public laundrettes.
- 1b. ‘Consumer automatic dishwasher detergent’ means a detergent placed on the market for use in automatic dishwashers by non-professionals.

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2. ‘Washing’ means the cleaning of laundry, fabrics, dishes and other hard surfaces.

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3. ‘Cleaning’ means the process by which an undesirable deposit is dislodged from a substrate or from within a substrate and brought into a state of solution or dispersion.

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4. ‘Substance’ means chemical elements and their compounds in the natural state or obtained by any production process, including any additive necessary to preserve the stability of the products and any impurity deriving from the process used, but excluding any solvent which may be separated without affecting the stability of the substance or changing its composition.
5. ‘►**M2** Mixture ◀’ means a mixture or solution composed of two or more substances.

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6. 'Surfactant' means any organic substance and/or ►**M2** mixture ◀ used in detergents, which has surface-active properties and which consists of one or more hydrophilic and one or more hydrophobic groups of such a nature and size that it is capable of reducing the surface tension of water, and of forming spreading or adsorption monolayers at the water-air interface, and of forming emulsions and/or microemulsions and/or micelles, and of adsorption at water-solid interfaces.
7. 'Primary biodegradation' means the structural change (transformation) of a surfactant by micro-organisms resulting in the loss of its surface-active properties due to the degradation of the parent substance and consequential loss of the surface-active property as measured by test methods listed in Annex II.
8. 'Ultimate aerobic biodegradation' means the level of biodegradation achieved when the surfactant is totally used by micro-organisms in the presence of oxygen resulting in its breakdown to carbon dioxide, water and mineral salts of any other elements present (mineralisation), as measured by test methods listed in Annex III, and new microbial cellular constituents (biomass).

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9. 'Placing on the market' means the first making available on the Union market. Import into the Union customs territory shall be deemed to be placing on the market.
- 9a. 'Making available on the market' means any supply for distribution, consumption or use on the Union market in the course of a commercial activity, whether in return for payment or free of charge.

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10. 'Manufacturer' means the natural or legal person responsible for placing a detergent or a surfactant for a detergent on the market; in particular, a producer, an importer, a packager working for his own account, or any person changing the characteristics of a detergent or of a surfactant for a detergent, or creating or changing the labelling thereof, shall be deemed to be a manufacturer. A distributor who does not change the characteristics, labelling or packaging of a detergent, or of a surfactant for a detergent, shall not be deemed to be a manufacturer, except where he acts as an importer.
11. 'Medical personnel' means a registered medical practitioner, or a person working under the direction of a registered medical practitioner, acting to provide patient care, make a diagnosis or administer treatment, and who is bound by professional confidentiality.
12. 'Industrial and institutional detergent' means a detergent for washing and cleaning outside the domestic sphere, carried out by specialised personnel using specific products.



### *Article 3*

#### **The placing on the market**

1. When placed on the market, detergents and surfactants for detergents referred to in Article 1 shall conform with the conditions, characteristics and limits laid down in this Regulation and its Annexes and, where relevant, with Directive 98/8/EC and with any other relevant Community legislation. Surfactants that are also active substances within the meaning of Directive 98/8/EC and that are used as disinfectants are exempt from the provisions of Annexes II, III, IV and VIII of this Regulation provided:

- (a) they are listed in Annex I or IA of Directive 98/8/EC, or
- (b) they are constituents of biocidal products authorised under Article 15(1) or 15(2) of Directive 98/8/EC, or
- (c) they are constituents of biocidal products allowed under the transitional measures or subject to the 10 year work programme provided for in Article 16 of Directive 98/8/EC.

Instead, such surfactants are deemed to be disinfectants and the detergents of which they are ingredients are subject to the labelling provisions for disinfectants of Annex VII A.

2. Manufacturers of detergents and/or of surfactants for detergents shall be established within the Community.

3. Manufacturers shall be responsible for the conformity of detergents and/or of surfactants for detergents with the provisions of this Regulation and its Annexes.

### *Article 4*

#### **Limitations based on the biodegradability of surfactants**

1. Under this Regulation, surfactants and detergents containing surfactants that meet the criteria for ultimate aerobic biodegradation as laid down in Annex III may be placed on the market without further limitations relating to biodegradability.

2. If a detergent contains surfactants for which the level of ultimate aerobic biodegradation is lower than that stipulated in Annex III, manufacturers of industrial or institutional detergents containing surfactants, and/or of surfactants for industrial or institutional detergents, may ask for derogation. Requests for derogation shall be made and decided in accordance with Articles 5, 6 and 9.

3. The level of primary biodegradability shall be measured for all surfactants in detergents failing ultimate aerobic biodegradation tests. Detergent surfactants, for which the level of primary biodegradability is lower than that stipulated in Annex II, shall not be granted derogation.

**▼M5***Article 4a***Limitations on the content of phosphates and of other phosphorus compounds**

Detergents listed in Annex VIa that do not comply with the limitations on the content of phosphates and of other phosphorus compounds laid down in that Annex shall not be placed on the market from the dates set out therein.

**▼B***Article 5***Granting of derogation**

1. The request by a manufacturer for derogation shall be made by sending an application to the competent authority of the Member State concerned, referred to in Article 8(1), and to the Commission, providing evidence relating to the criteria mentioned under Article 6(1). Member States can make the request for derogation dependent upon the payment to the Member State's competent authority of a fee. Such fees, if any, shall be levied in a non-discriminatory way and shall not exceed the cost of processing the application.

2. Applications shall include a technical file supplying all the information and justifications necessary for evaluating the safety aspects related to the specific use of surfactants in detergents failing to comply with the biodegradability limits, as set out in Annex III.

In addition to the results of tests stipulated in Annex III, the technical file shall include information and results of tests, as stipulated in Annexes II and IV.

The tests laid down in Annex IV, point 4 shall be carried out on the basis of a tiered approach. The tiered approach will be defined in a technical guidance document to be adopted in accordance with the procedure referred to in Article 12(2) by 8 April 2007. This guidance document will also specify, where appropriate, those tests for which the principles of good laboratory practice should be applied.

3. The competent authority of the Member State, receiving applications for derogation in accordance with paragraphs 1 and 2, shall examine the requests, evaluate their compliance with the conditions for derogation and inform the Commission about the results within six months of receiving the complete application.

If the competent authority of the Member State deems it necessary for the evaluation of the risk which may be caused by a substance and/or a ►**M2** mixture ◀, it shall, within three months of receiving the application, ask for further information, verification and/or confirmatory tests concerning these substances and/or ►**M2** mixtures ◀ or their transformation products, of which they have been notified or have received information under this Regulation. The time period for the evaluation of the dossier by the competent authority of the Member State will start only after the dossier is completed with the additional information. If the requested information is not provided within 12 months, the application shall be considered incomplete and thus invalid. In such a case Article 6(2) shall not apply.

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If further information on metabolites is sought, stepwise testing strategies should be employed to ensure maximum use of in-vitro and other non-animal test methods.

4. On the basis of, in particular, the evaluation carried out by the Member State, the Commission may grant a derogation in accordance with the procedure referred to in Article 12(2). If necessary, before granting such derogation the Commission shall evaluate further the matters indicated in paragraph 3 of this Article. It shall take its decision within 12 months of receiving the evaluation from the Member State, except in the case of Article 5(4) and (6) of Decision 1999/468/EC where the period shall be 18 months.

5. Such derogations may allow, limit or severely restrict the placing on the market and the use of surfactants as ingredients in detergents, depending on the results of the complementary risk assessment, as defined in Annex IV. They may include a phase-out period for placing on the market and the use of surfactants as ingredients in detergents. The Commission may review a derogation as soon as information comes to light which would justify a significant revision of the technical file that was included in the application for derogation. For this purpose, the manufacturer shall, upon request, supply to the Commission a technical file that has been updated regarding the items mentioned in Annex IV, point 2. On the basis of this updated information, the Commission may decide to prolong, modify or terminate the derogation. Paragraphs 1 to 4 and 6 of this Article and Article 6 shall apply *mutatis mutandis*.

6. The Commission shall publish the list of surfactants that have obtained derogation, with the corresponding conditions or limitations of use, as provided in Annex V.

*Article 6***Conditions for granting a derogation**

1. Where the Commission considers granting a derogation, it shall do so in accordance with the procedure referred to in Article 12(2), and on the basis of the following criteria:

- use in low-dispersive applications, rather than in wide-dispersive applications;
- use in specific industrial and/or institutional applications only;
- the risk to the environment or to health posed by the volume of sales and the pattern of use throughout the Community is small compared to the socio-economic benefits, including food safety and hygiene standards.

2. As long as the Commission has not decided on a request for derogation, the placing on the market and use of the surfactant in question may be maintained, provided the manufacturer can show that the surfactant was already in use on the Community market at the date of entry into force of this Regulation and that the request for derogation was made within two years from that date.

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3. If the Commission refuses to grant a derogation, it shall do so within 12 months of receiving from a Member State the evaluation mentioned in Article 5(3), except in the case of Article 5(4) and (6) of Decision 1999/468/EC where the period shall be 18 months. It may set a transitional period during which the placing on the market and use of the surfactant in question shall be phased out. This transitional period shall not exceed two years from the date of the Commission's decision.

4. The Commission shall publish in Annex VI the list of surfactants that have been identified as not complying with this Regulation.

*Article 7***Testing of surfactants**

All tests referred to in Articles 3 and 4 and in Annexes II, III, IV and VIII shall be conducted in compliance with the standards mentioned in Annex I.1 and in accordance with testing requirements under Article 10(5) of Regulation (EEC) No 793/93. For this purpose, it is sufficient to apply either the EN ISO/IEC standard or the principles of good laboratory practice, except for those tests for which the principles of good laboratory practice have been made mandatory. In cases where surfactants are used in detergents which were placed on the market before the entry into force of the above standard, existing tests that were performed using the best scientific knowledge available, and that were performed to a standard comparable to those of the standards mentioned in Annex I may be accepted on a case-by-case basis. The manufacturer or the Member State may submit to the Commission any case over which there is doubt or dispute. A decision shall then be taken in accordance with the procedure laid down in Article 12(2).

*Article 8***Duties of the Member States**

1. Member States shall appoint the competent authority or authorities responsible for communicating and exchanging information relating to the management of this Regulation and inform the Commission of the full name and address of these authorities.

2. Each Member State shall notify to the other Member States and to the Commission the list of approved laboratories, with their full name and address, that are competent and authorised to carry out the tests required by this Regulation. Member States shall demonstrate the competence of the above laboratories according to the standard EN ISO/IEC 17025 mentioned in Annex I.1. This requirement shall be deemed to be fulfilled if the Member State has verified the compliance of laboratories with the principles of good laboratory practice in accordance with Article 2 of Directive 2004/9/EC.

3. Where the competent authority of a Member State has grounds for believing that an approved laboratory does not possess the competence referred to in paragraph 2, it shall raise the matter in the Committee referred to in Article 12. If the Commission decides that the laboratory

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does not possess the required competence, the name of the approved laboratory shall be removed from the list referred to in paragraph 4. Article 15(2) shall apply, except in the case of laboratories claiming compliance with the requirements of good laboratory practice, for which the non-compliance provisions of Articles 5 and 6 of Directive 2004/9/EC shall apply.

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4. The Commission shall make publicly available the lists of competent authorities, mentioned in paragraph 1, and of approved laboratories, mentioned in paragraph 2.

**▼B***Article 9***Information to be provided by manufacturers**

1. Without prejudice to Article 17 of Directive 1999/45/EC, manufacturers placing on the market the substances and/or ►**M2** mixtures ◀ covered by this Regulation shall hold at the disposal of the competent authorities of the Member States:

- information on one or more results of the tests mentioned in Annex III;
- for those surfactants failing to pass tests mentioned in Annex III, and for which a request for derogation was made as referred to in Article 5:
  - (i) a technical file on results of the tests mentioned in Annex II,
  - (ii) a technical file on results of the tests and information mentioned in Annex IV.

2. Whenever substances and/or ►**M2** mixtures ◀ covered by this Regulation are placed on the market, the manufacturer shall be responsible for the correct performance of the relevant tests mentioned above. He shall also have available documentation on the testing carried out to demonstrate compliance with this Regulation, and to show that he is allowed to benefit from the property rights concerning the test results, other than for those test results already in the public domain.

3. Manufacturers placing on the market the ►**M2** mixtures ◀ covered by this Regulation shall, upon request, make available without delay and free of charge, to any medical personnel, an ingredient datasheet as stipulated in Annex VII C.

This is without prejudice to the right of a Member State to request that such a datasheet be made available to a specific public body to which the Member State has assigned the task of providing this information to medical personnel.

The information contained in the datasheet shall be kept confidential by the specific public body and by the medical personnel, and shall be used only for medical purposes.

*Article 10***Control measures**

1. Member States' competent authorities may apply, as appropriate, all necessary control measures to detergents placed on the market which ensure the compliance of the product with the provisions of this Regulation. The reference method shall be the test and analytical methods referred to in Annex VIII. These control measures shall not oblige

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manufacturers to repeat tests made by laboratories fulfilling the conditions indicated in Article 8(2), or to pay for any repeat or additional test, provided the initial test has shown compliance of detergents, or surfactants used as ingredients in detergents, with this Regulation.

2. In cases of concern that a test carried out in accordance with the methods listed in Annex II, III, IV or VIII has produced false positive results, the Member States' competent authorities shall notify the Commission and the Commission shall, in accordance with the procedure laid down in Article 12(2), verify those results and take the necessary measures.

*Article 11***Labelling**

1. The provisions of this Article are without prejudice to the provisions relating to the classification, packaging and labelling of dangerous substances and ►**M2** mixtures ◀ in Directives 67/548/EEC and 1999/45/EC.

2. The following information must appear in legible, visible and indelible characters on the packaging in which the detergents are put up for sale to the consumer:

- (a) the name and trade name of the product;
- (b) the name or trade name or trademark and full address and telephone number of the party responsible for placing the product on the market;
- (c) the address, email address, where available, and telephone number from which the datasheet referred to in Article 9(3) can be obtained.

The same information must appear on all documents accompanying detergents transported in bulk.

3. The packaging of detergents shall indicate the content, in accordance with the specifications provided for in Annex VII A. It shall also indicate instructions for use and special precautions, if required.

**▼M5**

4. Additionally, the packaging of consumer laundry detergents and consumer automatic dishwasher detergents shall bear the information provided for in section B of Annex VII.

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5. In cases where a Member State has a national requirement to label in the national language(s), the manufacturer and distributor shall comply with that requirement for the information specified in paragraphs 3 and 4.

6. Paragraphs 1 to 5 are without prejudice to existing national rules according to which graphic representations of fruits which may lead the user into error as to the use of liquid products, shall not appear on the packaging in which the detergents are put up for sale to the consumer.

▼ **M3***Article 12***Committee procedure**

1. The Commission shall be assisted by a Committee.
2. Where reference is made to this paragraph, Articles 5 and 7 of Decision 1999/468/EC shall apply, having regard to the provisions of Article 8 thereof.

The period laid down in Article 5(6) of Decision 1999/468/EC shall be set at three months.

▼ **M5***Article 13***Adaptation of Annexes**

1. The Commission shall be empowered to adopt delegated acts in accordance with Article 13a in order to introduce amendments necessary for adapting Annexes I to IV, VII and VIII to scientific and technical progress. The Commission shall, wherever possible, use European standards.
2. The Commission shall be empowered to adopt delegated acts in accordance with Article 13a in order to introduce amendments to the Annexes of this Regulation regarding solvent-based detergents.
3. Where individual risk-based concentration limits for the fragrance allergens are established by the Scientific Committee on Consumer Safety, the Commission shall adopt delegated acts in accordance with Article 13a in order to adapt the limit of 0,01 % set out in section A of Annex VII accordingly.

*Article 13a***Exercise of the delegation**

1. The power to adopt delegated acts is conferred on the Commission subject to the conditions laid down in this Article.
2. The power to adopt delegated acts referred to in Article 13 shall be conferred on the Commission for a period of 5 years from 19 April 2012. By 19 July 2016, the Commission shall draw up a report in respect of the delegation of power. The delegation of power shall be tacitly extended for further periods of 5 years, unless the European Parliament or the Council opposes such extension not later than 3 months before the end of each such period.
3. The delegation of power referred to in Article 13 may be revoked at any time by the European Parliament or by the Council. A decision of revocation shall put an end to the delegation of the power specified in that decision. It shall take effect the day following the publication of the decision in the *Official Journal of the European Union* or at a later date specified therein. It shall not affect the validity of any delegated acts already in force.
4. As soon as it adopts a delegated act, the Commission shall notify it simultaneously to the European Parliament and to the Council.

**▼ M5**

5. A delegated act adopted pursuant to Article 13 shall enter into force only if no objection has been expressed either by the European Parliament or the Council within a period of 2 months of notification of that act to the European Parliament and the Council or if, before the expiry of that period, the European Parliament and the Council have both informed the Commission that they will not object. That period shall be extended by 2 months at the initiative of the European Parliament or the Council.

*Article 14***Free movement clause**

1. Member States shall not prohibit, restrict or impede the making available on the market of detergents, and/or of surfactants for detergents, which comply with the requirements of this Regulation, on grounds that are dealt with in this Regulation.

2. Member States may maintain or lay down national rules concerning restrictions on the content of phosphates and of other phosphorus compounds in detergents for which no restrictions on the content are set out in Annex VIa where justified, in particular, on grounds such as the protection of public health or the environment and where technically and economically feasible alternatives are available.

3. Member States may maintain national rules that were in force on 19 March 2012 concerning restrictions on the content of phosphates and of other phosphorus compounds in detergents for which restrictions set out in Annex VIa have not yet become applicable. Such existing national measures shall be reported to the Commission by 30 September 2012 and may remain in force until the date when the restrictions set out in Annex VIa apply.

4. From 19 March 2012 until 31 December 2016 Member States may adopt national rules that implement the restriction on the content of phosphates and of other phosphorus compounds laid down in the point 2 of Annex VIa, where justified, in particular, on grounds such as the protection of public health or the environment and where technically and economically feasible alternatives are available. Member States shall notify such measures to the Commission in accordance with Directive 98/34/EC of the European Parliament and of the Council of 22 June 1998 laying down a procedure for the provision of information in the field of technical standards and regulations and of rules on Information Society services <sup>(1)</sup>.

5. The Commission shall make publicly available the list of national measures referred to in paragraphs 3 and 4.

**▼ B***Article 15***Safeguard clause****▼ M5**

1. Where a Member State has justifiable grounds for believing that a specific detergent, although complying with the requirements of this Regulation, constitutes a risk to the safety or health of humans or of animals or a risk to the environment, it may take all appropriate

<sup>(1)</sup> OJ L 204, 21.7.1998, p. 37.

**▼M5**

provisional measures, commensurate with the nature of the risk, in order to ensure that the detergent concerned no longer presents that risk, is withdrawn from the market or recalled within a reasonable period or its availability is otherwise restricted.

The Member State shall immediately inform the other Member States and the Commission thereof, giving the reasons for its decision.

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2. After consultation of the Member States, or, if appropriate, of the relevant technical or scientific committee of the Commission, a decision shall be taken on the matter within ninety days in accordance with the procedure referred to in Article 12(2).

**▼M5***Article 16***Report**

1. By 31 December 2014, the Commission shall, taking into account information from Member States on the content of phosphorus in consumer automatic dishwasher detergents placed on the market in their territories and in the light of any existing or new scientific information available to it regarding substances employed in phosphates-containing and alternative formulations, evaluate by way of a thorough assessment whether the restriction set out in point 2 of Annex VIa should be modified. That assessment shall include an analysis of the impact on the environment, industry and consumers of consumer automatic dishwasher detergents with phosphorus levels above and below the limit value set out in Annex VIa, taking into account matters including cost, availability, cleaning efficiency and the impact on waste water treatment. The Commission shall submit that thorough assessment to the European Parliament and to the Council.

2. In addition, if the Commission, on the basis of the thorough assessment referred to in paragraph 1, considers that the restriction of phosphates and other phosphorus compounds used in consumer automatic dishwasher detergents requires revision, it shall, by 1 July 2015, present an appropriate legislative proposal. Any such proposal must be aimed at minimising the negative impact from all consumer automatic dishwasher detergent products on the wider environment, whilst considering any economic costs as identified in that thorough assessment. Unless the European Parliament and the Council, on the basis of such a proposal, decide otherwise by 31 December 2016, the limit value set out in point 2 of Annex VIa shall become the limitation for phosphorus content in consumer automatic dishwasher detergents from the date set out in that point.

**▼B***Article 17***Legislation to be repealed**

1. The following Directives are hereby repealed with effect from 8 October 2005.

— Directive 73/404/EEC;

— Directive 73/405/EEC;

— Directive 82/242/EEC;

**▼ B**

— Directive 82/243/EEC and

— Directive 86/94/EEC.

2. Recommendation 89/542/EEC is hereby repealed with effect from 8 October 2005.

3. References made to the repealed Directives shall be construed as being references to this Regulation.

4. On the day of entry into force of this Regulation, Member States shall repeal their laws, regulations and administrative provisions adopted pursuant to the Directives provided for in paragraph 1 or to the Recommendation referred to in paragraph 2.

**▼ M5***Article 18***Penalties**

Member States shall lay down the rules on penalties applicable to infringements of this Regulation and shall take all measures necessary to ensure that they are implemented. This may also include appropriate measures allowing the competent authorities of the Member States to prevent the making available on the market of detergents or surfactants for detergents that fail to comply with this Regulation. The penalties provided for must be effective, proportionate and dissuasive. Member States shall notify those provisions and any subsequent amendment affecting those provisions to the Commission without delay.

Those rules shall include measures allowing the competent authorities of Member States to detain consignments of detergents that fail to comply with this Regulation.

**▼ B***Article 19***Entry into force**

This Regulation shall enter into force 8 October 2005.

This Regulation shall be binding in its entirety and directly applicable in all Member States.

*ANNEX I***Standards of accreditation, good laboratory practice and animal protection concerning the laboratories that are competent and authorised to provide the necessary service for checking compliance of detergents with the requirements of this Regulation and its Annexes**1. *Standards applicable at the level of the laboratories:*

EN ISO/IEC 17025, General requirements for the competence of testing and calibration laboratories;

Directive 2004/10/EC;

Council Directive 86/609/EEC.

2. *Standards applicable at the level of the accreditation bodies and good laboratory practice monitoring authorities:*

EN 45003, Calibration and testing laboratory accreditation system, general requirements for operation and recognition;

Directive 2004/9/EC.

*ANNEX II***PRIMARY BIODEGRADABILITY TEST METHODS FOR SURFACTANTS IN DETERGENTS**

Primary biodegradability is measured by the determination in biodegraded liquors of the remaining level of parent surfactants. This Annex begins with a list of the test-methods common to all classes of surfactants, and then lists under headings A to D the analytical test procedures specific to each class of surfactant.

The pass criterion for primary biodegradability shall be a level of at least 80 %, as measured according to the test methods below.

The reference method for the laboratory testing of surfactants in this Regulation is based on the Confirmatory test procedure in the OECD method, described in Annex VIII.1. Changes to the Confirmatory test procedure are permissible provided that they comply with EN ISO 11733.

**Test methods**

- (1) The OECD method published in the OECD's technical report of 11 June 1976 on the 'Proposed Method for the Determination of the Biodegradability of Surfactants in Synthetic Detergents'.
- (2) The method in use in France, approved by the 'arrêté du 24 décembre 1987' published in the Journal officiel de la République française of 30 December 1987, p. 15385, and by the standard NF 73-260 of June 1981, published by the Association française de normalisation (AFNOR).
- (3) The method in use in Germany, established by the 'Verordnung über die Abbaubarkeit anionischer und nichtionischer grenzflächenaktiver Stoffe in Wasch- und Reinigungsmitteln' of 30 January 1977, published in the Bundesgesetzblatt of 1977, Part I, p. 244, as set out in the Regulation amending that Regulation of 4 June 1986, published in the Bundesgesetzblatt of 1986, Part I, p. 851.
- (4) The method in use in the United Kingdom called the 'Porous Pot Test' and described in Technical Report No 70 (1978) of the Water Research Centre.
- (5) The 'Confirmatory test procedure' in the OECD method, described in Annex VIII.1 (including possible changes in operating conditions as proposed in EN ISO 11733). This is also the reference method used for the settlement of litigation.

**A. ANALYTICAL METHODS FOR ANIONIC SURFACTANTS**

The determination of anionic surfactants in the tests shall be done by the Methylene Blue Active Substance (MBAS) analysis according to the criteria established in Annex VIII.2. For those anionic surfactants not reacting to the abovementioned MBAS method, or if it seems more appropriate for reasons of efficiency or precision, appropriate specific instrumental analyses such as high performance liquid chromatography (HPLC) or gas chromatography (GC) are to be applied. Samples of the pure surfactant of interest shall be provided by the manufacturer to the competent authorities of the Member States upon request.

**B. ANALYTICAL METHODS FOR NON-IONIC SURFACTANTS**

The determination of non-ionic surfactants in the tests shall be done by the Bismuth Active Substance (BiAS) method, according to the analytical procedure established in Annex VIII.3.

**▼B**

For those non-ionic surfactants not reacting to the abovementioned BiAS method, or if it seems more appropriate for reasons of efficiency or precision, appropriate specific instrumental analyses such as HPLC or GC are to be applied. Samples of the pure surfactant of interest shall be provided by the manufacturer to the competent authorities of the Member States upon request.

**C. ANALYTICAL METHODS FOR CATIONIC SURFACTANTS**

The determination of cationic surfactants in the tests shall be done by the Disulfine Blue Active Substance (DBAS) analysis according to the following DBAS procedures:

The method in use in the Federal Republic of Germany, (1989) DIN 38 409 — Ausgabe: 1989-07.

For those cationic surfactants not reacting to the abovementioned test method, or if it seems more appropriate for reasons of efficiency or precision (this must be justified), appropriate specific instrumental analyses such as HPLC or GC are to be applied. Samples of the pure surfactant of interest shall be provided by the manufacturer to the competent national authorities of the Member States upon request.

**D. ANALYTICAL METHODS FOR AMPHOTERIC SURFACTANTS**

The determination of amphoteric surfactants in the tests shall be done by analysis following the procedures listed below:

**1. If cationics absent:**

The method in use in the Federal Republic of Germany, (1989) DIN 38 409-Teil 20.

**2. Otherwise:**

Orange II method (Boiteux, 1984).

For those amphoteric surfactants not reacting to the abovementioned tests, or if it seems more appropriate for reasons of efficiency or precision (this must be justified), appropriate specific instrumental analyses such as HPLC or GC are to be applied. Samples of the pure surfactant of interest shall be provided by the manufacturer to the competent authorities of the Member States upon request.

**▼ M1***ANNEX III***ULTIMATE BIODEGRADABILITY (MINERALISATION) TEST  
METHODS FOR SURFACTANTS IN DETERGENTS**

- A. The reference method for laboratory testing of surfactant ultimate biodegradability in this Regulation is based on the EN ISO standard 14593: 1999 (CO<sub>2</sub> headspace test).

Surfactants in detergents shall be considered as biodegradable if the level of biodegradability (mineralisation) measured according to one of the following tests <sup>(1)</sup> is at least 60 % within 28 days:

1. EN ISO Standard 14593: 1999 — Water quality — Evaluation of ultimate aerobic biodegradability of organic compounds in aqueous medium — Method by analysis of inorganic carbon in sealed vessels (CO<sub>2</sub> headspace test). Pre-adaptation is not to be used. The 10-day window principle is not applied (reference method).
  2. Directive 67/548/EEC method, Annex V.C.4-C (carbon dioxide (CO<sub>2</sub>) Evolution modified Sturm test): pre-adaptation is not to be used. The 10-day window principle is not applied.
  3. Directive 67/548/EEC method, Annex V.C.4-E (closed Bottle): pre-adaptation is not to be used. The 10-day window principle is not applied.
  4. Directive 67/548/EEC method, Annex V.C.4-D (manometric respirometry): pre-adaptation is not to be used. The 10-day window principle is not applied.
  5. Directive 67/548/EEC method, Annex V.C.4-F (MITI: Ministry of International Trade and Industry, Japan): pre-adaptation is not to be used. The 10-day window principle is not applied.
  6. ISO 10708:1997 — Water quality — Evaluation in an aqueous medium of the ultimate aerobic biodegradability of organic compounds — Determination of biochemical oxygen demand in a two-phase closed bottle test. Pre-adaptation is not to be used. The 10-day window principle is not applied.
- B. Depending on the physical characteristics of the surfactant, one of the methods listed below may be used if appropriately justified <sup>(2)</sup>. It should be noted that the pass criterion of at least 70 % of these methods is to be considered as equivalent to the pass criterion of at least 60 % referred to in methods listed in point A. The adequacy of the choice of the methods listed below shall be decided on a case-by-case confirmation, in accordance with Article 5 of this Regulation.

<sup>(1)</sup> These tests are identified as the most suitable for surfactants.

<sup>(2)</sup> The DOC methods could give results on the removal and not on the ultimate biodegradation. The manometric respirometry and the MITI and two-phase BOD methods would not be appropriate in some cases because the high initial test concentration could be inhibitory.

**▼ M1**

1. Directive 67/548/EEC method, Annex V.C.4-A (dissolved organic carbon DOC die-away): pre-adaptation is not to be used. The 10-day window principle is not applied. The pass criteria for biodegradability measured according to the test shall be at least 70 % within 28 days.
2. Directive 67/548/EEC method, Annex V.C.4-B (modified OECD screening-DOC die-away): pre-adaptation is not to be used. The 10-day window principle is not applied. The pass criteria for biodegradability measured according to the test shall be at least 70 % within 28 days.

*NB:* Those of the abovementioned methods that are taken from Council Directive 67/548/EEC can also be found in the publication 'Classification, Packaging and Labelling of Dangerous Substances in the European Union', Part 2: 'Testing Methods'. European Commission 1997, ISBN 92-828-0076-8.



## ANNEX IV

**COMPLEMENTARY RISK ASSESSMENT FOR SURFACTANTS IN DETERGENTS**

For those surfactants for which an environmental risk assessment is available in the context of Directive 93/67/EEC, or Regulation (EEC) No 793/93 and Regulation (EC) No 1488/94, and Technical Guidance Documents, this risk assessment shall be considered together with the complementary risk assessment run in the scope of this Regulation.

The complementary risk assessment run in the scope of this Regulation, in case it is likely that recalcitrant metabolites are produced, shall be considered in the context of assessments made on the basis of Directive 93/67/EEC or Regulation (EEC) No 793/93. This is to be assessed case by case and in particular on the basis of the results of the tests referred to in part 3.

The study shall cover the aquatic environmental compartment. Additional information relating to specific risk assessment concerns might be required by the Committee referred to in Article 12(2) on a case by case basis. Additional information might include other environmental compartments such as sewage sludge and soil. A tiered approach shall be adopted concerning the information required for the technical file referred to in Articles 5 and 9. The file shall contain at least the information described under points 1, 2 and 3 below.

However, to minimise testing, and especially to avoid unnecessary animal testing, the additional studies listed under point 4.2.2 should be requested only where such information is necessary and proportionate. In case of dispute concerning the extent of additional information required, a Decision may be taken in accordance with the procedure laid down in Article 12(2).

As noted in Article 13, the guidelines included in this Annex for the Decisions on derogation may be adapted as appropriate on the basis of the accumulated experience.

1. *Identity of the surfactant (in accordance with the provisions laid down by Annex VII.A of Directive 67/548/EEC).*

1.1. Name

1.1.1. Names in the IUPAC nomenclature

1.1.2. Other names

1.1.3. CAS number and CAS name (if available)

1.1.4. Einescs<sup>(1)</sup> or Elincs<sup>(2)</sup> numbers (if available)

1.2. Molecular and structural formula

1.3. Composition of the surfactant

2. *Information on the surfactant*

2.1. Quantities of the surfactant used in detergents

2.2. The information on use patterns given in this section shall be sufficient to allow an approximate but realistic estimate of function and environmental exposure to the surfactant as associated with its use in detergents. It shall include the following:

— importance of the application (societal value),

<sup>(1)</sup> European Inventory of Existing Commercial Substances.

<sup>(2)</sup> European List of Notified Chemical Substances.

**▼B**

- use conditions (release scenario),
- use volume,
- availability and suitability of alternatives (performance and economic considerations),
- assessment of relevant environmental information.

3. *Information on the potential recalcitrant metabolites*

Toxicity information on test liquors shall be provided. If no data are available on residue identity, the information referred to in point 4.2.1 may be requested, depending on the potential risk, the importance and the quantity of the surfactant used in detergents. In conflicting cases concerning this information, a Decision may be taken in accordance with the procedure laid down in Article 12(2).

4. *Additional studies*

## 4.1. Biodegradability tests

## 4.1.1. Pre-adapted inoculum

Any of the tests described in Annex III, may be run with pre adapted inoculum in order to provide evidence of the relevance of pre-adaptation for the surfactant.

## 4.1.2. Inherent Biodegradability Tests

At least one of the tests referred to below shall be included:

- method of the Directive 67/548/EEC, Annex V.C.12 (Modified SCAS test),
- method of the Directive 67/548/EEC, Annex V.C.9 (Zahn-Wellens).

Failure to pass the inherent biodegradability test would indicate potential for persistency which may be considered, in general terms, as sufficient to prohibit the placing on the market of such a surfactant except in cases where the criteria set out in Article 6 indicate that there is no justification for refusing a derogation.

## 4.1.3. Activated Sludge Simulation Biodegradability Tests

The following tests referred below shall be included:

- method of the Directive 67/548/EEC, Annex V.C.10 (including possible changes in operating conditions as proposed in EN ISO 11733).

Failure to pass the activated sludge simulation biodegradability test would indicate potential for the release of the metabolites by sewage treatment, which may be considered, in general terms, as evidence of need for a more complete risk assessment.

## 4.2. Toxicity testing of biodegradation test liquors

Toxicity information on test liquors is to be provided on:

## 4.2.1. Chemical and physical information, such as:

- identity of the metabolite (and analytical means by which it was obtained);
- key physical chemical properties (water solubility, Octanol: Water partition coefficient (Log Po/w, etc.).

**▼B**

4.2.2. Effects on organisms. Tests to be conducted in compliance with the principles of good laboratory practice.

Fish: the test recommended is that in Annex V.C.1 of Directive 67/548/EEC

Daphnia: the test recommended is that in Annex V.C.2 of Directive 67/548/EEC

Algae: the test recommended is that in Annex V.C.3 of Directive 67/548/EEC

Bacteria: the test recommended is that in Annex V.C.11 of Directive 67/548/EEC

4.2.3. Degradation

Biotic: the test recommended is that in Annex V.C.5 of Directive 67/548/EEC

Abiotic: the test recommended is that in Annex V.C.7 of Directive 67/548/EEC. The information to be provided will consider as well the potential of metabolites for bio-concentration and their partitioning to the sediment phase.

Moreover, if some metabolites are suspected for endocrine disrupting activity, it is recommended to determine if these have potential to result in adverse effects as soon as validated testing schemes to assess such adverse effects are available.

*N.B.* All the abovementioned tests can also be consulted in the publication Classification, Packaging and Labelling of Dangerous Substances in the European Union; Part 2: 'Testing Methods'. European Commission 1997. ISBN 92-828-0076-8.

▼ **M4***ANNEX V***LIST OF SURFACTANTS THAT HAVE OBTAINED A DEROGATION**

By way of derogation granted in accordance with Articles 4-6 and in accordance with the procedure laid down in Article 12(2), the following detergent surfactants, which pass the tests stipulated in Annex II, but which fail the tests stipulated in Annex III, may be placed on the market and used subject to the limitations mentioned below.

Name in the IUPAC nomenclature	EC Number	CAS number	Limitations
Alcohols, Guerbet, C16-20, ethoxylated, n-butyl ether (7-8EO)	None (polymer)	147993-59-7	May be used for the following industrial applications until 27 June 2019: — bottle washing, — cleaning-in-place, — metal cleaning,

The 'EC number' means the EINECS, ELINCS or NLP number and is the official number of the substance within the European Union.

'EINECS' means the European Inventory of Existing Commercial Chemical Substances. This inventory contains the definitive list of all substances deemed to be on the Community market on 18 September 1981. The EINECS number can be obtained from the European Inventory of Existing Commercial Chemical Substance <sup>(1)</sup>.

'ELINCS' means the European List of Notified Chemical Substances. The ELINCS number can be obtained from the European List of Notified Substances, as amended <sup>(2)</sup>.

'NLP' means No-Longer Polymer. The term polymer is defined in Article 3(5) of Regulation (EC) No 1907/2006 <sup>(3)</sup> of the European Parliament and of the Council. The NLP number can be obtained from the list of 'No-Longer Polymers', as amended <sup>(4)</sup>.

<sup>(1)</sup> OJ C 146 A, 15.6.1990, p. 1.

<sup>(2)</sup> Office for Official Publications of the European Communities, 2006, ISSN 1018-5593 EUR 22543 EN.

<sup>(3)</sup> OJ L 396, 30.12.2006, p. 1, as corrected by OJ L 136, 29.5.2007, p. 3.

<sup>(4)</sup> Office for Official Publications of the European Communities, 2007, ISSN 1018-5593 EUR 20853 EN/3.

**▼M4***ANNEX VI***LIST OF BANNED OR RESTRICTED DETERGENT SURFACTANTS**

The following detergent surfactants have been identified as not complying with the provisions of this Regulation:

Name in the IUPAC nomenclature	EC Number	CAS number	Limitations

The 'EC number' means the EINECS, ELINCS or NLP number and is the official number of the substance within the European Union.

▼ **M5***ANNEX VIa***LIMITATIONS ON THE CONTENT OF PHOSPHATES AND OF OTHER PHOSPHORUS COMPOUNDS**

Detergent	Limitations	Date as of which the limitation applies
1. Consumer laundry detergents	Shall not be placed on the market if the total content of phosphorus is equal to or greater than 0,5 grams in the recommended quantity of the detergent to be used in the main cycle of the washing process for a standard washing machine load as defined in section B of Annex VII for water of hard water hardness — for ‘normally soiled’ fabrics in the case of heavy-duty detergents, — for ‘lightly soiled’ fabrics in the case of detergents for delicate fabrics,	30 June 2013
2. Consumer automatic dishwasher detergents	Shall not be placed on the market if the total content of phosphorus is equal to or greater than 0,3 grams in the standard dosage as defined in section B of Annex VII	1 January 2017

**▼M1***ANNEX VII***LABELLING AND INGREDIENT DATA SHEET****A. Labelling of contents**

The following provisions on labelling shall apply to the packaging of detergents sold to the general public.

The following weight percentage ranges:

- less than 5 %,
- 5 % or over but less than 15 %,
- 15 % or over but less than 30 %,
- 30 % and more,

shall be used to indicate the content of the constituents listed below where they are added in a concentration above 0,2 % by weight:

- phosphates,
- phosphonates,
- anionic surfactants,
- cationic surfactants,
- amphoteric surfactants,
- non-ionic surfactants,
- oxygen-based bleaching agents,
- chlorine-based bleaching agents,
- EDTA and salts thereof,
- NTA (nitrilotriacetic acid) and salts thereof,
- phenols and halogenated phenols,
- paradichlorobenzene,
- aromatic hydrocarbons,
- aliphatic hydrocarbons,
- halogenated hydrocarbons,
- soap,
- zeolites,
- polycarboxylates.

The following classes of constituent, if added, shall be listed irrespective of their concentration:

- enzymes,
- disinfectants,
- optical brighteners,
- perfumes.

If added, preservation agents shall be listed, irrespective of their concentration, using where possible the common nomenclature established under Article 8 of Council Directive 76/768/EEC of 27 July 1976 on the approximation of laws of the Member States relating to cosmetic products <sup>(1)</sup>.

<sup>(1)</sup> OJ L 262, 27.9.1976, p. 169. Directive as last amended by Commission Directive 2005/80/EC (OJ L 303, 22.11.2005, p. 32).

**▼ M1**

If added at concentrations exceeding 0,01 % by weight, the allergenic fragrances that appear on the list of substances in Annex III, Part 1 to Directive 76/768/EEC, as a result of its amendment by Directive 2003/15/EC of the European Parliament and of the Council <sup>(1)</sup> to include the allergenic perfume ingredients from the list first established by the Scientific Committee on Cosmetics and Non-food Products (SCCNFP) in its opinion SCCNFP/0017/98, shall be listed using the nomenclature of that Directive, as shall any other allergenic fragrances that are subsequently added to Annex III, Part 1 to Directive 76/768/EEC by adaptation of that Annex to technical progress.

**▼ M5**

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**▼ M1**

The website address, from which the list of ingredients mentioned in section D of Annex VII can be obtained, shall be given on the packaging.

For detergents intended to be used in the industrial and institutional sector, and not made available to members of the general public, the abovementioned requirements do not have to be fulfilled if the equivalent information is provided by means of technical data sheets, safety data sheets, or in a similar appropriate manner.

**▼ M5****B. Labelling of dosage information**

As prescribed in Article 11(4), the following provisions on labelling shall apply to the packaging of detergents sold to the general public.

*Consumer laundry detergents*

The packaging of detergents sold to the general public intended to be used as laundry detergents shall bear the following information:

- the recommended quantities and/or dosage instructions expressed in millilitres or grams appropriate to a standard washing machine load, for soft, medium and hard water hardness levels and making provision for one or two cycle washing processes,
- for heavy-duty detergents, the number of standard washing machine loads of 'normally soiled' fabrics, and, for detergents for delicate fabrics, the number of standard washing machine loads of 'lightly soiled' fabrics, that can be washed with the contents of the package using water of medium hardness, corresponding to 2,5 millimoles CaCO<sub>3</sub>/l,
- the capacity of any measuring cup, if provided, shall be indicated in millilitres or grams, and markings shall be provided to indicate the dose of detergent appropriate for a standard washing machine load for soft, medium and hard water hardness levels,

The standard washing machine loads are 4,5 kg dry fabric for heavy-duty detergents and 2,5 kg dry fabric for light-duty detergents, in line with the definitions of Commission Decision 1999/476/EC of 10 June 1999 establishing the Ecological Criteria for the award of the Community Eco-label to Laundry Detergents <sup>(2)</sup>. A detergent shall be considered to be a heavy-duty detergent unless the claims of the manufacturer predominantly promotes fabric care, i.e. low temperature wash, delicate fibres and colours.

<sup>(1)</sup> OJ L 66, 11.3.2003, p. 26.

<sup>(2)</sup> OJ L 187, 20.7.1999, p. 52. Decision as amended by Decision 2011/264/EU (OJ L 111, 30.4.2011, p. 34).

**▼ M5***Consumer automatic dishwasher detergents*

The packaging of detergents sold to the general public intended to be used as automatic dishwasher detergents shall bear the following information:

- the standard dosage expressed in grams or ml or number of tablets for the main washing cycle for normally soiled tableware in a fully loaded 12 place settings dishwasher, making provisions, where relevant, for soft, medium, and hard water hardness.

**▼ M1****C. Ingredient data sheet**

The following provisions shall apply to the listing of ingredients on the data sheet referred to in Article 9(3).

The data sheet shall list the name of the detergent and that of the manufacturer.

All ingredients shall be listed; in order of decreasing abundance by weight, and the list shall be sub-divided into the following weight percentage ranges:

- 10 % or more,
- 1 % or over, but less than 10 %,
- 0,1 % or over, but less than 1 %,
- less than 0,1 %.

Impurities shall not be considered to be ingredients.

'Ingredient' means any chemical substance, of synthetic or natural origin, intentionally included in the composition of a detergent. For the purpose of this Annex, a perfume, an essential oil, or a colouring agent shall be considered to be a single ingredient and none of the substances that they contain shall be listed, with the exception of those allergenic fragrance substances that appear on the list of substances in Annex III, Part 1 to Directive 76/768/EEC if the total concentration of the allergenic fragrance substance in the detergent exceeds the limit mentioned in section A.

The common chemical name or IUPAC <sup>(1)</sup> name and, where available, the INCI <sup>(2)</sup> name, the CAS number, and the European Pharmacopoeia name, shall be given for each ingredient.

**D. Publication of the list of ingredients**

Manufacturers shall make available on a website the ingredient data sheet mentioned above except for the following:

- information on weight percentage ranges is not required
- CAS numbers are not required
- the ingredient names shall be given in INCI nomenclature, or where this is not available, the European Pharmacopoeia name, shall be given. If neither name is available, the common chemical name or IUPAC name shall be used instead. For a perfume the word 'parfum' shall be used and for a colouring agent, the word 'colorant'. A perfume, an essential oil, or a colouring agent shall be considered to be a single ingredient and none of the substances that they contain shall be listed, with the exception of those allergenic fragrance substances that appear on the list of substances in Annex III, Part 1 to Directive 76/768/EEC if the total concentration of the allergenic fragrance substance in the detergent exceeds the limit mentioned in section A.

<sup>(1)</sup> International Union of Pure and Applied Chemistry.

<sup>(2)</sup> International Nomenclature Cosmetic Ingredient.

**▼ M1**

Access to the website shall not be subject to any restriction or condition and the content of the website shall be kept up to date. The website shall include a link to the Commission Pharmacos website or to any other suitable website that provides a table of correspondence between INCI names, European Pharmacopoeia names, and CAS numbers.

This obligation shall not apply to industrial or institutional detergents, or to surfactants for industrial or institutional detergents, for which a technical data sheet or safety data sheet is available.



ANNEX VIII

TEST METHODS AND ANALYTICAL METHODS

The following test and analytical methods apply to control procedures for detergents on the market carried out by Member States:

1. **Reference method (confirmatory test)**

1.1. *Definition*

This method describes a laboratory model of the activated sludge + secondary settler which is designed to simulate municipal sewage treatment. The conditions described are those from the Directives that preceded this Regulation. Improved state-of-the-art operating conditions can be applied to this test method as described in EN ISO 11733.

1.2. *Equipment needed for measurement*

The method of measurement employs the small-activated sludge plant shown in Figure 1, and in greater detail in Figure 2. The equipment consists of a sewage vessel A for synthetic sewage, dosing pump B, aeration vessel C, settling vessel D, air-lift pump E to recycle the activated sludge, and vessel F for collecting the treated effluent.

Vessels A and F must be of glass or suitable plastic and hold at least twenty-four litres. Pump B must provide a constant flow of synthetic sewage to the aeration vessel; this vessel, during normal operation, contains three litres of mixed liquor. A sintered aeration cube G is suspended in the vessel C at the apex of the cone. The quantity of air blown through the aerator shall be monitored by means of a flow meter H.

1.3. *Synthetic sewage*

A synthetic sewage is employed for the test. Dissolve in each litre of tap water:

- 160 mg peptone;
- 110 mg meat extract;
- 30 mg urea,  $\text{CO}(\text{NH}_2)_2$ ;
- 7 mg sodium chloride,  $\text{NaCl}$ ;
- 4 mg calcium chloride,  $\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$ ;
- 2 mg magnesium sulphate,  $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$ ;
- 28 mg of di-potassium hydrogen phosphate,  $\text{K}_2\text{HPO}_4$ ;
- and  $10 \pm 1$  mg of the surfactant.

The synthetic sewage is freshly prepared daily.

1.4. *Preparation of samples*

Uncompounded surfactants are examined in the original state. Active content of surfactant samples must be determined in order to prepare the synthetic sewage (1.3).

1.5. *Operation of equipment*

Initially, fill aeration vessel C and settling vessel D with synthetic sewage. The height of the vessel D should be so fixed that the volume contained in the aeration vessel C is three litres. Inoculation is made by introducing 3 ml of a secondary effluent of good quality, freshly collected from a treatment plant dealing with a predominantly domestic

**▼ B**

sewage. The effluent must be kept under aerobic conditions in the period between sampling and application. Then set the aerator G, air-lift E and dosing device B in operation. The synthetic sewage must pass through the aeration vessel C at a rate of one litre per hour; this gives a mean retention time of three hours.

The rate of aeration should be so regulated that the contents of vessel C are kept constantly in suspension and the dissolved oxygen content is at least 2 mg/l. Foaming must be prevented by appropriate means. Anti-foaming agents that inhibit the activated sludge or contain surfactants must not be used. The air-lift pump E must be set so that the activated sludge from the settling vessel is continually and regularly recycled to aeration vessel C. Sludge which has accumulated around the top of the aeration vessel C, in the base of the settling vessel D, or in the circulation circuit must be returned to the circulation at least once each day by brushing or some other appropriate means. When the sludge fails to settle, its settleability may be increased by the addition of 2 ml portions of a 5 % solution of ferric chloride, repeated as necessary.

The effluent from the settling vessel D is accumulated in vessel F for twenty-four hours, following which a sample is taken after thorough mixing. Vessel F must then be carefully cleaned.

#### 1.6. *Checking measuring equipment*

The surfactant content (in mg/l) of the synthetic sewage is determined immediately before use.

The surfactant content (in mg/l) of the effluent collected over twenty-four hours in vessel F should be determined analytically by the same method, immediately after collection: otherwise the samples must be preserved, preferably by freezing. The concentrations must be determined to the nearest 0,1 mg/l surfactant

As a check on the efficiency of the process, the chemical oxygen demand (COD) or the dissolved organic carbon (DOC) of the glass fibre filtered effluent accumulated in vessel F and of the filtered synthetic sewage in vessel A is measured at least twice per week.

The reduction in COD or DOC should level off when a roughly regular daily surfactant degradation is obtained at the end of the running-in period shown in Figure 3.

The content of dry matter in the activated sludge contained in the aeration vessel should be determined twice a week in g/l. If it is more than 2,5 g/l, the excess activated sludge must be discarded.

The degradation test is performed at room temperature; this should be steady and kept between 19-24 ° C.

#### 1.7. *Calculation of biodegradability*

The percentage degradation of surfactant must be calculated every day on the basis of the surfactant content in mg/l of the synthetic sewage and of the corresponding effluent accumulated in vessel F.

The degradability values thus obtained should be presented graphically as in Figure 3.

**▼B**

The degradability of the surfactant should be calculated as the arithmetic mean of the values obtained over the twenty-one days that follow the running-in and acclimatisation period, during which degradation has been regular and the operation of the plant trouble-free. In any event the duration of the running-in period should not exceed six weeks.

The daily degradation values are calculated to the nearest 0,1 % but the final result is given to the nearest whole number.

In some cases it may be permissible to reduce the frequency of sampling but at least fourteen results collected over the twenty-one days which follow the running-in period should be used in calculating the average.

## 2. Determination of anionic surfactants in biodegradability tests

### 2.1. Principle

The method is based on the fact that the cationic dye methylene blue forms blue salts with anionic surfactants (MBAS), which can be extracted with chloroform. To eliminate interference, the extraction is first effected from alkaline solution and the extract is then shaken with acidic methylene blue solution. The absorbency of the separated organic phase is measured photometrically at the wavelength of maximum absorption of 650 nm.

### 2.2. Reagents and equipment

#### 2.2.1. Buffer solution pH 10

Dissolve 24 g sodium bicarbonate, NaHCO<sub>3</sub> AR, and 27 g anhydrous sodium carbonate (Na<sub>2</sub>CO<sub>3</sub>) AR in deionised water and dilute to 1 000 ml.

#### 2.2.2. Neutral methylene blue solution

Dissolve 0,35 g methylene blue AR in deionised water and dilute to 1 000 ml. Prepare the solution at least twenty-four hours before use. The absorbency of the blank chloroform phase, measured against chloroform must not exceed 0,015 per 1 cm of layer thickness at 650 nm.

#### 2.2.3. Acidic methylene blue solution

Dissolve 0,35 g methylene blue AR in 500 ml deionised water and mix with 6,5 ml H<sub>2</sub>SO<sub>4</sub> (d = 1,84 g/ml). Dilute to 1 000 ml with deionised water. Prepare the solution at least twenty-four hours before use. The absorbency of the blank chloroform phase, measured against chloroform must not exceed 0,015 per 1 cm of layer thickness at 650 nm.

#### 2.2.4. Chloroform (trichloromethane) AR freshly distilled

#### 2.2.5. Dodecyl benzene sulphonic acid methyl ester

#### 2.2.6. Ethanolic potassium hydroxide solution, KOH 0,1 M

#### 2.2.7. Ethanol pure, C<sub>2</sub>H<sub>5</sub>OH

#### 2.2.8. sulphuric acid, H<sub>2</sub>SO<sub>4</sub> 0,5 M

#### 2.2.9. Phenolphthalein solution

Dissolve 1 g phenolphthalein in 50 ml ethanol and add 50 ml deionised water while stirring continuously. Filter off any precipitate obtained.

#### 2.2.10. Methanolic hydrochloric acid: 250 ml hydrochloric acid AR and 750 ml methanol

#### 2.2.11. Separating funnel, 250 ml

**▼B**

- 2.2.12. Graduated flask, 50 ml
- 2.2.13. Graduated flask, 500 ml
- 2.2.14. Graduated flask, 1 000 ml
- 2.2.15. Round-bottomed flask with ground glass stopper and reflux condenser, 250 ml; boiling granules
- 2.2.16. pH meter
- 2.2.17. Photometer for measurements at 650 nm, with 1 to 5 cm cells
- 2.2.18. Qualitative grade filter paper

**2.3. Procedure**

The samples for analysis must not be taken through a layer of foam.

After thorough cleaning with water, the equipment used for the analysis must be thoroughly rinsed with methanolic hydrochloric acid (2.2.10) and then with deionised water before using.

Filter the activated sludge plant influent and effluent to be examined immediately on sampling. Discard the first 100 ml of the filtrates.

Place a measured volume of the sample, neutralised if necessary, into a 250 ml separating funnel (2.2.11). The volume of sample should contain between 20 and 150 g of MBAS. At the lower MBAS content, up to 100 ml of sample may be used. When using less than 100 ml, dilute to 100 ml with deionised water. Add to the sample 10 ml of buffer solution (2.2.1), 5 ml of neutral methylene blue solution (2.2.2) and 15 ml of chloroform (2.2.4). Shake the mixture uniformly and not too vigorously for one minute. After phase separation, run the chloroform layer into a second separating funnel, containing 110 ml of deionised water and 5 ml of acidic methylene blue solution (2.2.3). Shake the mixture for one minute. Pass the chloroform layer through a cotton-wool filter previously cleaned and wetted with chloroform into a graduated flask (2.2.12).

Extract the alkaline and acid solutions three times, using 10 ml of chloroform for the second and third extractions. Filter the combined chloroform extracts through the same cotton wool filter and dilute to the mark in the 50 ml flask (2.2.12) with chloroform used for rewashing the cotton wool. Measure the absorbency of the chloroform solution with a photometer at 650 nm in 1 to 5 cm cells against chloroform. Run a blank determination through the whole procedure.

**2.4. Calibration curve**

Prepare a calibration solution from the standard substance dodecylbenzene sulphonic acid methyl ester (tetrapropylene type mol. wt. 340) after saponification into the potassium salt. The MBAS is calculated as sodium dodecyl benzene sulphonate (mol. wt. 348).

From a weighing pipette, weigh 400 to 450 mg of dodecyl-benzene-sulphonic-acid-methyl-ester (2.2.5) to the nearest 0,1 mg in a round-bottomed flask and add 50 ml of ethanolic potassium hydroxide solution (2.2.6) and some boiling granules. After mounting the reflux condenser, boil for one hour. After cooling, wash the condenser and ground glass joint with about 30 ml of ethanol, and add these washings to the contents of the flask. Titrate the solution with sulphuric acid against phenolphthalein until it becomes colourless. Transfer this solution to a 1 000 ml graduated flask (2.2.14), dilute to the mark with deionised water and mix.

**▼ B**

Part of this surfactant stock solution is then further diluted. Withdraw 25 ml, transfer to a 500 ml graduated flask (2.2.13), dilute to the mark with deionised water and mix.

This standard solution contains:

$$\frac{E \times 1,023 \text{ mg MBAS per ml}}{20\,000}$$

where E is the sample weight in mg.

To establish the calibration curve, withdraw 1, 2, 4, 6, 8 ml portions of the standard solution and dilute each to 100 ml with deionised water. Then proceed as stated under item 2.3 including a blank determination.

### 2.5. *Calculation of results*

The amount of anionic surfactant (MBAS) in the sample is read from the calibration curve (2.4). The MBAS content of the sample is given by:

$$\frac{\text{mg MBAS} \times 1\,000}{V} = \text{MBAS mg/l}$$

where: V = ml volume of the sample used.

Express the results as sodium dodecylbenzene sulphonate (MW 348).

### 2.6. *Expression of results*

Express the results as MBAS mg/l to the nearest 0,1.

## 3. **Determination of non-ionic surfactants in biodegradation test liquors**

### 3.1. *Principle*

Surface active agents are concentrated and isolated by gas stripping. In the sample used, the quantity of non-ionic surfactant should be in the range 250-800 g.

The stripped surfactant is dissolved in ethyl acetate.

After phase separation and evaporation of the solvent, the non-ionic surfactant is precipitated in aqueous solution with modified Dragendorff reagent ( $\text{KBiI}_4 + \text{BaCl}_2 + \text{glacial acetic acid}$ ).

The precipitate is filtered, washed with glacial acetic acid and dissolved in ammonium tartrate solution. The bismuth in the solution is titrated potentiometrically with pyrrolidinedithiocarbamate solution at pH 4-5 using a bright platinum indicator electrode and a calomel or silver/silver chloride reference electrode. The method is applicable to non-ionic surfactants containing 6-30 alkylene oxide groups.

The titration result is multiplied by the empirical factor of 54 for conversion to the reference substance nonylphenol condensed with 10 mols ethylene oxide (NP 10).

### 3.2. *Reagents and Equipment*

Reagents are to be made up in deionised water.

3.2.1. Pure ethyl acetate, freshly distilled.

3.2.2. Sodium bicarbonate,  $\text{NaHCO}_3$  AR.

3.2.3. Dilute hydrochloric acid [20 ml concentrated acid (HCl) diluted to 1 000 ml with water]

3.2.4. Methanol AR, freshly distilled, stored in a glass bottle.

3.2.5. Bromocresol purple, 0,1 g in 100 ml methanol.

**▼B**

3.2.6. Precipitating agent: the precipitating agent is a mixture of two volumes of solution A and one volume of solution B. The mixture is stored in a brown bottle and can be used for up to one week after mixing.

3.2.6.1. Solution A

Dissolve 1,7 g bismuth nitrate,  $\text{BiONO}_3 \cdot \text{H}_2\text{O}$  AR, in 20 ml glacial acetic acid, and make up to 100 ml with water. Then dissolve 65 g potassium iodide AR in 200 ml water. Mix these two solutions in a 1 000 ml measuring flask, add 200 ml glacial acetic acid (3.2.7) and make up to 1 000 ml with water.

3.2.6.2. Solution B

Dissolve 290 g barium chloride,  $\text{BaCl}_2 \cdot 2\text{H}_2\text{O}$  AR, in 1 000 ml of water.

3.2.7. Glacial acetic acid 99-100 % (lower concentrations are unsuitable).

3.2.8. Ammonium tartrate solution: mix 12,4 g tartaric acid AR and 12,4 ml of ammonia solution AR ( $d = 0,910 \text{ g/ml}$ ) and make up to 1 000 ml with water (or use the equivalent amount of ammonium tartrate AR).

3.2.9. Dilute ammonia solution: 40 ml ammonia solution AR ( $d = 0,910 \text{ g/ml}$ ) diluted to 1 000 ml with water.

3.2.10. Standard acetate buffer: dissolve 40 g solid sodium hydroxide AR, in 500 ml water in a beaker and allow to cool. Add 120 ml glacial acetic acid (3.2.7). Mix thoroughly, cool and transfer to a 1 000 ml volumetric flask. Make up to the mark with water.

3.2.11. Pyrrolidinedithiocarbamate solution (known as 'carbate solution'): dissolve 103 mg sodium pyrrolidinedithiocarbamate,  $\text{C}_5\text{H}_8\text{NNaS}_2 \cdot 2\text{H}_2\text{O}$ , in about 500 ml water, add 10 ml of n-amyl alcohol AR and 0,5 g  $\text{NaHCO}_3$  AR, and make up to 1 000 ml with water.

3.2.12. Copper sulphate solution (for standardisation of 3.2.11).

STOCK SOLUTION

Mix 1,249 g copper sulphate,  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$  AR, with 50 ml 0,5 M sulphuric acid and make up to 1 000 ml with water.

STANDARDSOLUTION

Mix 50 ml stock solution with 10 ml 0,5 M  $\text{H}_2\text{SO}_4$  and make up to 1 000 ml with water.

3.2.13. Sodium chloride AR.

3.2.14. Gas-stripping apparatus (see Figure 5).

The diameter of the sintered disc must be the same as the internal diameter of the cylinder.

3.2.15. Separating funnel, 250 ml.

3.2.16. Magnetic stirrer with magnet 25-30 mm.

3.2.17. Gooch crucible, diameter of the perforated base = 25 mm, Type G4.

3.2.18. Circular glass-fibre filter papers, 27 mm diameter with fibre diameter 0,3-1,5  $\mu\text{m}$ .

3.2.19. Two filter flasks with adapters and rubber collars, 500 and 250 ml respectively.

3.2.20. Recording potentiometer fitted with a bright platinum indicator electrode and a calomel or silver/silver chloride reference electrode with a 250 mV range, with automatic burette of 20-25 ml capacity, or alternative manual equipment.

**▼B**3.3. *Method*

## 3.3.1. Concentration and separation of the surfactant

Filter the aqueous sample through a qualitative filter paper. Discard the first 100 ml of the filtrate.

Into the stripping apparatus, previously rinsed with ethyl acetate, place a measured quantity of the sample, such that it contains between 250-800 g non-ionic surfactant.

To improve the separation add 100 g sodium chloride and 5 g sodium bicarbonate.

If the volume of the sample exceeds 500 ml, add these salts to the stripping apparatus in solid form, and dissolve by passing nitrogen or air through.

If a smaller-sized sample is used, dissolve the salts in 400 ml water and then add to the stripping apparatus.

Add water to bring the level to the upper stopcock.

Cautiously add 100 ml ethyl acetate on top of the water.

Fill the wash-bottle in the gas-line (nitrogen or air) two-thirds full with ethyl acetate.

Pass a gas stream of 30-60 l/h through the apparatus; the use of a flowmeter is recommended. The rate of aeration must be increased gradually at the beginning. The gas rate must be so adjusted that the phases remain noticeably separate to minimise the mixing of the phases and the solution of the ethyl acetate in the water. Stop the gas flow after five minutes.

If there is a reduction of more than 20 % in the volume of the organic phase through solution in water, the sublation must be repeated paying special attention to the rate of gas flow.

Run off the organic phase into a separating funnel. Return any water in the separating funnel from the aqueous phase — it should only be a few ml — to the stripping apparatus. Filter the ethyl acetate phase through a dry qualitative filter paper into a 250 ml beaker.

Put a further 100 ml ethyl acetate into the stripping apparatus and again pass nitrogen or air through for five minutes. Draw off the organic phase into the separating funnel used for the first separation, reject the aqueous phase and run the organic phase through the same filter as the first ethyl acetate portion. Rinse both the separating funnel and the filter with about 20 ml ethyl acetate.

Evaporate the ethyl acetate extract to dryness using a water-bath (fume cupboard). Direct a gentle stream of air over the surface of the solution to accelerate the evaporation.

## 3.3.2. Precipitation and filtration

Dissolve the dry residue from 3.3.1 in 5 ml methanol, add 40 ml water and 0,5 ml dilute HCl (3.2.3) and stir the mixture with a magnetic stirrer.

To this solution add 30 ml of precipitating agent (3.2.6) from a measuring cylinder. The precipitate forms after repeated stirring. After stirring for ten minutes leave the mixture to stand for at least five minutes.

Filter the mixture through a Gooch crucible, the base of which is covered with a glass-fibre filter paper. First wash the filter under suction with about 2 ml glacial acetic acid. Then thoroughly wash the beaker, magnet, and crucible with glacial acetic acid, of which about 40-50 ml is necessary. It is not necessary to quantitatively transfer the precipitate adhering to the sides of the beaker, to the filter, because the solution of the precipitate for the titration is returned to the precipitating beaker, and the remaining precipitate will then be dissolved.

**▼B**

## 3.3.3. Dissolution of the precipitate

Dissolve the precipitate in the filter crucible by the addition of hot ammonium tartrate solution (about 80 ° C) (3.2.8) in three portions of 10 ml each. Allow each portion to stand in the crucible for some minutes before being sucked through the filter into the flask.

Put the contents of the filter flask into the beaker used for the precipitation. Rinse the sides of the beaker with a further 20 ml of tartrate solution to dissolve the rest of the precipitate.

Carefully wash the crucible, adapter and filter flask with 150-200 ml water, and return the rinsing water to the beaker used for the precipitation.

## 3.3.4. The titration

Stir the solution using a magnetic stirrer (3.2.16), add a few drops of bromocresol purple (3.2.5) and add the dilute ammonia solution (3.2.9) until the colour turns violet (the solution is initially weakly acid from the residue of acetic acid used for rinsing).

Then add 10 ml standard acetate buffer (3.2.10), immerse the electrodes in the solution, and titrate potentiometrically with standard 'carbate solution' (3.2.11), the burette tip being immersed in the solution.

The titration rate should not exceed 2 ml/min.

The endpoint is the intersection of the tangents to the two branches of the potential curve.

It will be observed occasionally that the inflection in the potential curve becomes flattened; this can be eliminated by carefully cleaning the platinum electrode (by polishing with emery paper).

## 3.3.5. Blank determinations

At the same time run a blank determination through the whole procedure with 5 ml methanol and 40 ml water, according to the instructions in 3.3.2. The blank titration should be below 1 ml, otherwise the purity of the reagents (3.2.3, 3.2.7, 3.2.8, 3.2.9, 3.2.10) is suspect, especially their content of heavy metals, and they must be replaced. The blank must be taken into account in the calculation of the results.

## 3.3.6. Control of the factor of the 'carbate solution'

Determine the factor for the carbate solution on the day of use. To do this, titrate 10 ml of the copper sulphate solution (3.2.12) with 'carbate solution' after the addition of 100 ml water and 10 ml standard acetate buffer (3.2.10). If the amount used is  $a$  ml, the factor  $f$  is:

$$f = \frac{10}{a}$$

and all the results of the titration are multiplied by this factor.

3.4. *Calculation of results*

Every non-ionic surfactant has its own factor, depending on its composition, particularly on the length of the alkene oxide chain. The concentration of non-ionic surfactant is expressed in relation to a standard substance — a nonyl phenol with ten ethylene oxide units (NP 10) — for which the conversion factor is 0,054.

**▼B**

Using this factor the amount of surfactant present in the sample is found expressed as mg of NP 10 equivalent, as follows:

$$(b - c) \times f \times 0,054 = \text{mg non-ionic surfactant as NP 10}$$

where:

b = volume of 'carbate solution' used by the sample (ml),

c = volume of 'carbate solution' used by the blank (ml),

f = factor of the 'carbate solution'.

### 3.5. *Expression of results*

Express the results in mg/l as NP 10 to the nearest 0,1.

## 4. **Preliminary treatment of anionic surfactants to be tested**

### 4.1. *Preliminary notes*

#### 4.1.1. Treatment of samples

The treatment of anionic surface-active agents and formulated detergents prior to the determination of primary biodegradability in the confirmatory test is:

Products	Treatment
Anionic surfactants	None
Formulated detergents	Alcoholic extraction followed by separation of the anionic surfactants by ion exchange

The purpose of the alcoholic extraction is to eliminate the insoluble and inorganic ingredients of the commercial product, which in some circumstances might upset the biodegradability test.

#### 4.1.2. Ion-exchange procedure

Isolation and separation of anionic surface active agents from soap, non-ionic and cationic surfactants are required for correct biodegradability tests.

This is achieved by an ion-exchange technique using a macro-porous exchange resin and suitable eluants for fractional elution. Thus soap, anionic and non-ionic surfactants may be isolated in one procedure.

#### 4.1.3. Analytical control

After homogenising, the concentration of anionic surfactants in the synthetic detergent is determined according to the MBAS analytical procedure. The soap content is determined by a suitable analytical method.

This analysis of the products is necessary to calculate the quantities required for preparing fractions for the biodegradability test.

Quantitative extraction is not necessary; however, at least 80 % of the anionic surfactants should be extracted. Usually, 90 % or more is obtained.

**▼ B**4.2. *Principle*

From a homogeneous sample (powders, dried pastes and dried liquids) an ethanol extract is obtained which contains the surfactants, soap and other alcohol-soluble constituents of the synthetic detergent sample.

The ethanol extract is evaporated to dryness, dissolved in an isopropanol/water mixture and the solution obtained is passed through a strongly acidic cation exchange/macro-porous anion exchange combination heated to 50 ° C. This temperature is necessary to prevent the precipitation of any fatty acids which may be present in acidic media.

Any non-ionic surfactants remain in the effluent.

Soap fatty acids are separated by extraction with ethanol containing CO<sub>2</sub>. The anionic surfactants are then obtained as ammonium salts, by elution with an aqueous isopropanolic solution of ammonium bicarbonate. These ammonium salts are used for the degradation test.

Cationic surfactants that might upset the biodegradability test and the analytical procedure are eliminated by the cation exchanger placed above the anion exchanger.

4.3. *Chemicals and equipment*

## 4.3.1. Deionised water

4.3.2. Ethanol, 95 % (v/v) C<sub>2</sub>H<sub>5</sub>OH (permissible denaturant: methyl ethyl ketone or methanol)

## 4.3.3. Isopropanol/water mixture (50/50 v/v):

— 50 parts by volume isopropanol, CH<sub>3</sub>CHOH.CH<sub>3</sub>, and

— 50 parts by volume water (4.3.1)

4.3.4. Solution of carbon dioxide in ethanol (approximately 0,1 % CO<sub>2</sub>): using a delivery tube with a built-in sinter, pass carbon dioxide, CO<sub>2</sub>, through the ethanol (4.3.2) for ten minutes. Use fresh solutions only4.3.5. Ammonium bicarbonate solution (60/40 v/v): 0,3 mol NH<sub>4</sub>HCO<sub>3</sub> in 1 000 ml of an isopropanol/water mixture consisting of 60 parts by volume isopropanol and 40 parts by volume water (4.3.1)

## 4.3.6. Cation exchanger (KAT), strongly acidic, resistant to alcohol (50-100 mesh)

## 4.3.7. Anion exchanger (AAT), macro-porous, Merck Lewatit MP 7080 (70-150 mesh) or equivalent

## 4.3.8. Hydrochloric acid, 10 % HCl (w/w)

## 4.3.9. 2 000 ml round-bottomed flask with ground glass stopper and reflux condenser

## 4.3.10. 90 mm diameter suction filter (heatable) for filter papers

## 4.3.11. 2 000 ml filter flask

## 4.3.12. Exchange columns with heating jacket and tap: inner tube 60 mm in diameter and 450 mm in height (see Figure 4)

## 4.3.13. Water-bath

## 4.3.14. Vacuum drying oven

## 4.3.15. Thermostat

## 4.3.16. Rotary evaporator

**▼B**4.4. *Preparation of extract and separation of anionic active agents*

## 4.4.1. Preparation of extract

The quantity of surfactants necessary for the biodegradation test is about 50 g MBAS.

Normally, the quantity of product to be extracted will not exceed 1 000 g, but it may be necessary to extract further quantities of sample. For practical reasons, the quantity of product used should in most cases be limited to 5 000 g in preparing extracts for the biodegradation test.

Experience has shown that there are advantages in using a number of small extractions rather than one large extraction. The exchanger quantities specified are designed for a working capacity of 600-700 mmoles of surfactants and soap.

## 4.4.2. Isolation of alcohol-soluble constituents

Add 250 g of the synthetic detergent to be analysed to 1 250 ml ethanol, heat the mixture to boiling point and reflux for one hour with stirring. Pass the hot alcoholic solution through a coarse-pored suction filter heated to 50 ° C and filter rapidly. Wash the flask and suction filter with approximately 200 ml hot ethanol. Collect the filtrate and filter washings in a filter flask.

In the case of pastes or liquid products to be analysed, make sure that not more than 55 g anionic surfactants and 35 g soap are contained in the sample. Evaporate this weighed sample to dryness. Dissolve the residue in 2 000 ml ethanol and proceed as described above. In the case of powders of low apparent density (< 300 g/l) it is recommended to increase the ethanol ratio in the relation 20:1. Evaporate the ethanolic filtrate to dryness, preferably by means of a rotary evaporator. Repeat the operation if a greater quantity of extract is required. Dissolve the residue in 5 000 ml isopropanol/water mixture.

Preparation of ion-exchange columns

## 4.4.3. CATION-EXCHANGE COLUMN

Place 600 ml cation-exchange resin (4.3.6) in a 3 000 ml beaker and cover by adding 2 000 ml hydrochloric acid (4.3.8). Allow to stand for at least two hours, with occasional stirring.

Decant the acid and transfer the resin into the column (4.3.12) by means of deionised water. The column should contain a glass-wool plug.

Wash the column with deionised water at a rate of 10-30 ml/min until the eluate is free of chloride.

Displace the water with 2 000 ml isopropanol/water mixture (4.3.3) at a rate of 10-30 ml/min. The exchange column is now ready for operation.

## ANION-EXCHANGE COLUMN

Place 600 ml anion-exchange resin (4.3.7) in a 3 000 ml beaker and cover by adding 2 000 ml deionised water.

Allow the resin to swell for at least two hours.

Transfer the resin into the column by means of deionised water. The column should contain a glass-wool plug.

**▼ B**

Wash the column with 0,3 M ammonium bicarbonate solution (4.3.5) until free of chloride. This requires about 5 000 ml solution. Wash again with 2 000 ml deionised water. Displace the water with 2 000 ml isopropanol/water mixture (4.3.3) at a rate of 10-30 ml/min. The exchange column is now in the OH-form and ready for operation.

Ion-exchange procedure

- 4.4.4. Connect the exchange columns so that the cation-exchange column is placed on top of the anion-exchange column.

Heat the exchange columns to 50 ° C using thermostatic control.

Heat 5 000 ml of the solution obtained in item 4.4.2 to 60 ° C and pass the solution through the exchanger combination at a rate of 20 ml/min. Wash the columns with 1 000 ml hot isopropanol/water mixture (4.3.3).

To obtain the anionic surface active agents (MBAS), disconnect the KAT column. Using 5 000 ml ethanol/CO<sub>2</sub> solution at 50 ° C (4.3.4), elute the soap fatty acids out of the KAT column. Reject the eluate.

Then elute the MBAS out of the AAT column with 5 000 ml ammonium bicarbonate solution (4.3.5). Evaporate the eluate to dryness using a steam bath or in a rotary evaporator.

The residue contains the MBAS (as ammonium salt) and possible non-surfactant anionics that have no detrimental effect on the biodegradation test. Add deionised water to the residue until a definite volume is obtained and determine the MBAS content in an aliquot. The solution is used as a standard solution of the anionic synthetic detergents for the biodegradation test. The solution should be kept at a temperature below 5 ° C.

Regeneration of ion exchange resins

- 4.4.5. The cation exchanger is rejected after use.

Passing an additional quantity of ammonium bicarbonate solution (4.3.5) down the column at a flow rate of approximately 10 ml/min until the eluate is free from anionic surfactants (methylene blue test) regenerates the anion-exchange resin.

Then pass 2 000 ml isopropanol/water mixture (4.3.3) down the anion exchanger to wash. The anion exchanger is again ready for operation.

Preliminary treatment of non-ionic surfactants to be tested

## 5. Preliminary notes

### 5.1. Treatment of samples

- 5.1.1. The treatment of non-ionic surface-active agents and formulated detergents prior to the determination of primary biodegradability in the confirmatory test is:

The purpose of the alcoholic extraction is to eliminate the insoluble and inorganic ingredients of the commercial product, which in some circumstances might upset the biodegradability test.

Products	Treatment
Non-ionic surfactants	None
Formulated detergents	Alcoholic extraction followed by separation of the non-ionic surfactants by ion exchange

**▼B**

## Ion-exchange procedure

- 5.1.2. Isolation and separation of non-ionic surface active agents from soap, anionic and cationic surfactants are required for correct biodegradability tests.

This is achieved by an ion exchange technique using a macro-porous exchange resin and suitable eluants for fractional elution. Thus soap, anionic and non-ionic surfactants may be isolated in one procedure.

## Analytical control

- 5.1.3. After homogenising, the concentration of anionic and non-ionic surfactants in the detergent is determined according to the MBAS and BiAS analytical procedure. The soap content is determined by a suitable analytical method.

This analysis of the product is necessary to calculate the quantities required preparing fractions for the biodegradability tests.

Quantitative extraction is not necessary; however, at least 80 % of the non-ionic surfactants should be extracted. Usually, 90 % or more is obtained.

## Principle

- 5.2. *From a homogeneous sample (powders, dried paste and dried liquids) an ethanol extract is obtained which contains the surfactants, soap and other alcohol-soluble constituents of the detergent sample.*

The ethanol extract is evaporated to dryness, dissolved in an isopropanol/water mixture and the solution obtained is passed through a strongly acidic cation exchange/macro-porous anion exchange combination heated to 50 ° C. This temperature is necessary to prevent the precipitation of any fatty acids which may be present in acidic media. The non-ionic surfactants are obtained from the effluent by evaporation.

Cationic surfactants, which might upset the degradation test and the analytical procedure, are eliminated by the cation exchanger placed above the anion exchanger.

## Chemicals and equipment

- 5.3. *Deionised water*
- 5.3.1. Ethanol, C<sub>2</sub>H<sub>5</sub>OH 95 % (v/v) (permissible denaturant: methyl-ethyl ketone or methanol)
- 5.3.2. Isopropanol/water mixture (50/50 v/v):
- 5.3.3. 50 parts by volume isopropanol, CH<sub>3</sub>CHOH.CH<sub>3</sub>, and
- 50 parts by volume water (5.3.1)
- Ammonium bicarbonate solution (60/40 v/v):
- 5.3.4. 0,3 mol NH<sub>4</sub>HCO<sub>3</sub> in 1 000 ml of an isopropanol/water mixture consisting of 60 parts by volume isopropanol and 40 parts by volume water (5.3.1)
- Cation exchanger (KAT), strongly acidic, resistant to alcohol (50-100 mesh)
- 5.3.5. Anion exchanger (AAT), macro-porous, Merck Lewatit MP 7080 (70-150 mesh) or equivalent
- 5.3.6. Hydrochloric acid, 10 % HCl w/w
- 5.3.7. 2 000 ml round-bottomed flask with ground glass stopper and reflux condenser

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- 5.3.8. 90 mm diameter suction Filter (heatable) for filter papers
- 5.3.9. 2 000 ml filter flask
- 5.3.10. Exchange columns with heating jacket and tap: inner tube 60 mm in diameter and 450 mm in height (see Figure 4)
- 5.3.11. Water-bath
- 5.3.12. Vacuum drying oven
- 5.3.13. Thermostat
- 5.3.14. Rotary evaporator
- 5.3.15. Preparation of extract and separation of non-ionic active agents

5.4. *Preparation of extract*

- 5.4.1. The quantity of surfactant necessary for the degradation test is about 25 g BiAS.

In preparing extracts for the degradation tests, the quantity of product to be used should be limited to a maximum of 2 000 g. Therefore it may be necessary to carry out the operation two or more times in order to obtain sufficient quantity for the degradation tests.

Experience has shown that there are advantages in using a number of small extractions rather than one large extraction.

## Isolation of alcohol-soluble constituents

- 5.4.2. Add 250 g of the synthetic detergent to be analysed to 1 250 ml ethanol and heat the mixture to boiling point and reflux for one hour with stirring. Pass the hot alcoholic solution through a coarse-pored suction filter heated to 50 ° C and filter rapidly. Wash the flask and suction filter with approximately 200 ml hot ethanol. Collect the filtrate and filter washings in a filter flask.

In the case of pastes or liquid products to be analysed, make sure that not more than 25 g anionic surfactants and 35 g soap are contained in the sample. Evaporate this weighed sample to dryness. Dissolve the residue in 500 ml ethanol and proceed as described above.

In the case of powders of low apparent density (< 300 g/l) it is recommended to increase the ethanol ratio in the relation 20:1.

Evaporate the ethanolic filtrate to complete dryness, preferably by means of rotary evaporator. Repeat the operation if a greater quantity of extract is required. Dissolve the residue in 5 000 ml isopropanol/water mixture.

- 5.4.3. Preparation of ion-exchange columns

## CATION-EXCHANGE COLUMN

Place 600 ml cation-exchange resin (5.3.5) in a 3 000 ml beaker and cover by adding 2 000 ml hydrochloric acid (5.3.7). Allow to stand for at least two hours, with occasional stirring.

Decant the acid and transfer the resin into the column (5.3.11) by means of deionised water. The column should contain a glass-wool plug. Wash the column with deionised water at a rate of 10-30 ml/min until the eluate is free of chloride.

**▼B**

Displace the water with 2 000 ml isopropanol/water mixture (5.3.3) at a rate of 10-30 ml/min. The exchange column is now ready for operation.

**ANION-EXCHANGE COLUMN**

Place 600 ml anion-exchange resin (5.3.6) in a beaker and cover by adding 2 000 ml deionised water. Allow the resin to swell for at least two hours. Transfer the resin into the column by means of deionised water. The column should contain a glass-wool plug.

Wash the column with 0,3 M ammonium bicarbonate solution (5.3.4) until free of chloride. This requires about 5 000 ml solution. Wash again with 2 000 ml deionised water.

Displace the water with 2 000 ml isopropanol/water mixture (5.3.3) at a rate of 10-30 ml/min. The exchange column is now in the OH form and ready for operation.

**5.4.4. Ion-exchange procedure**

Connect the exchange columns so that the cation-exchange column is placed on top of the anion-exchange column. Heat the exchange columns to 50 ° C using thermostatic control. Heat 5 000 ml of the solution obtained in item 5.4.2 to 60 ° C and pass the solution through the exchanger combination at a rate of 20 ml/min. Wash the columns with 1 000 ml hot isopropanol/water mixture (5.3.3).

To obtain the non-ionic surfactants collect the filtrate and filter washings and evaporate to dryness, preferably by means of a rotary evaporator. The residue contains the BiAS. Add deionised water until a defined volume is obtained and determine the BiAS content in an aliquot. The solution is used as a standard solution of non-ionic surfactants for the degradation test. The solution should be kept at a temperature below 5 ° C.

**5.4.5. Regeneration of ion exchange resins**

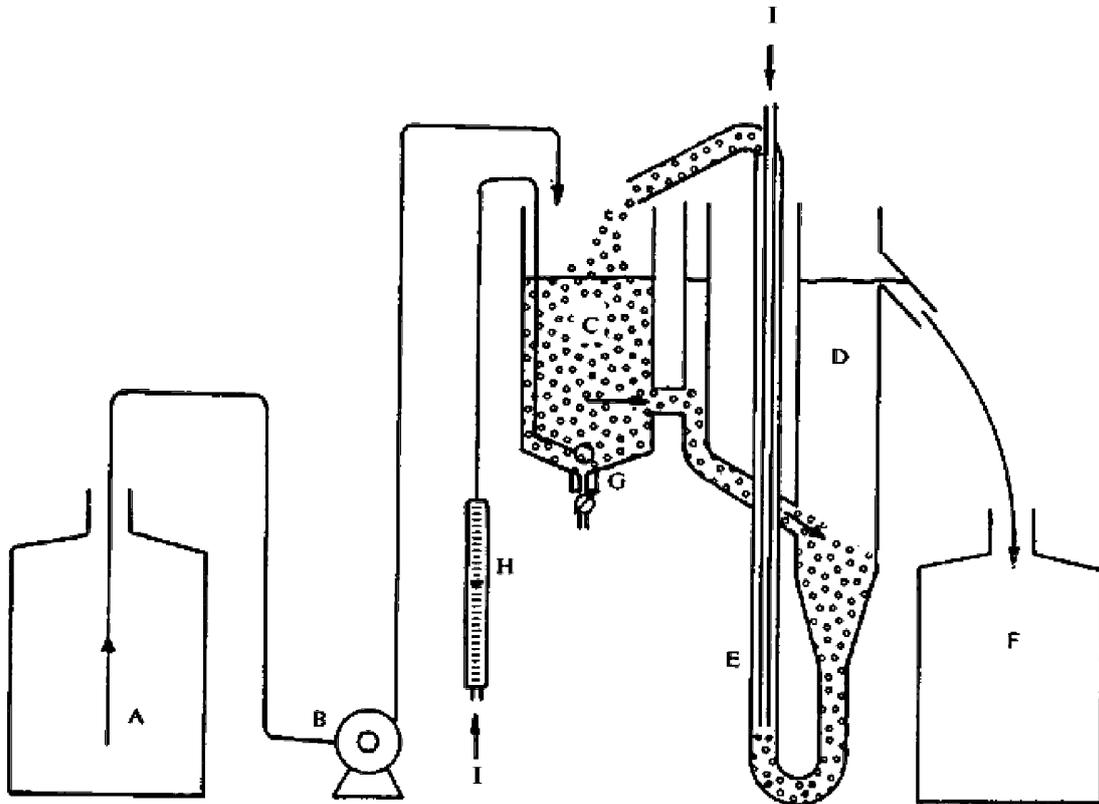
The cation exchanger is rejected after use.

Passing about 5 000-6 000 ml of ammonium bicarbonate solution (5.3.4) down the column at a flow rate of approximately 10 ml/min until the eluate is free from anionic surfactants (methylene blue test) regenerates the anion-exchange resin. Then pass 2 000 ml isopropanol/water mixture (5.3.3) down the anion exchanger to wash. The anion exchanger is again ready for operation.

▼B

Figure 1

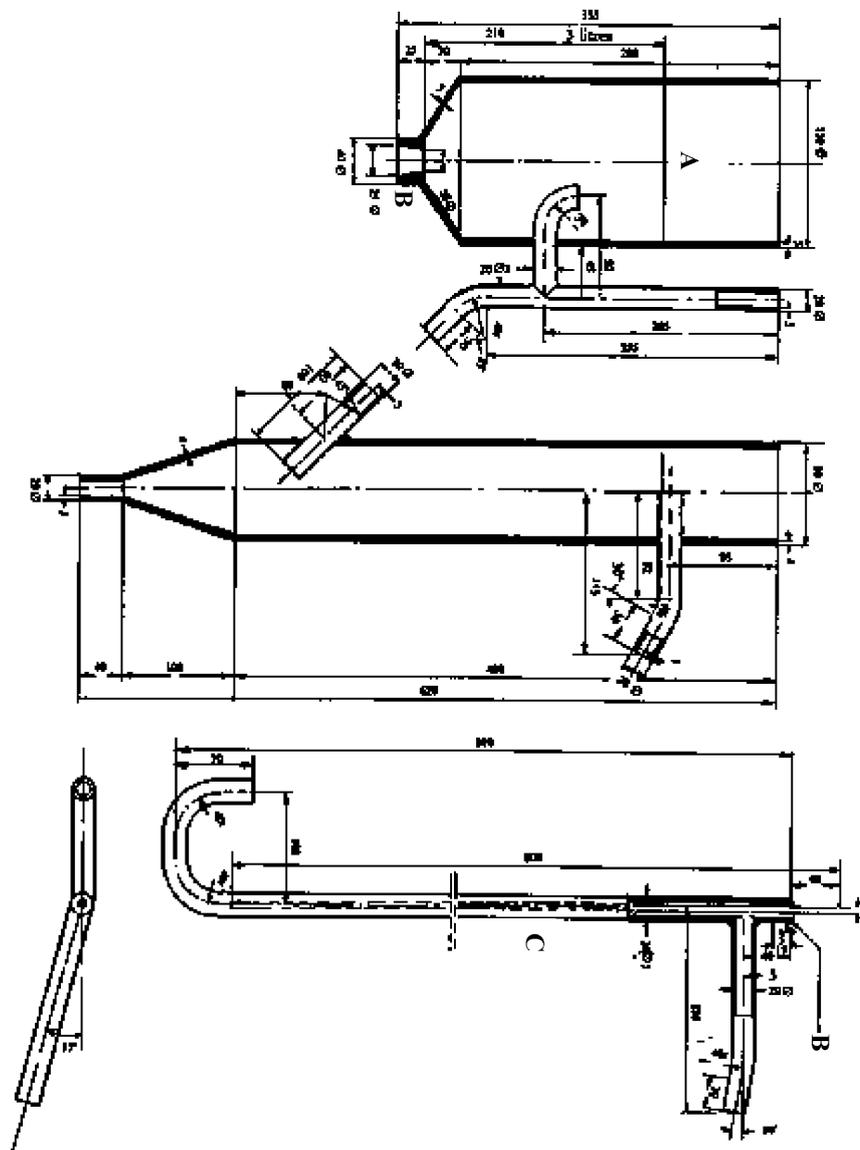
Activated sludge plant: overviews



- A Storage vessel
- B Dosing device
- C Aeration chamber (three litres capacity)
- D Settling vessel
- E Air-lift pump
- F Collector
- G Sintered aerator
- H Air-flow meter
- I Air

▼ B

Figure 2  
Activated sludge plant: detail  
(dimensions in millimetres)

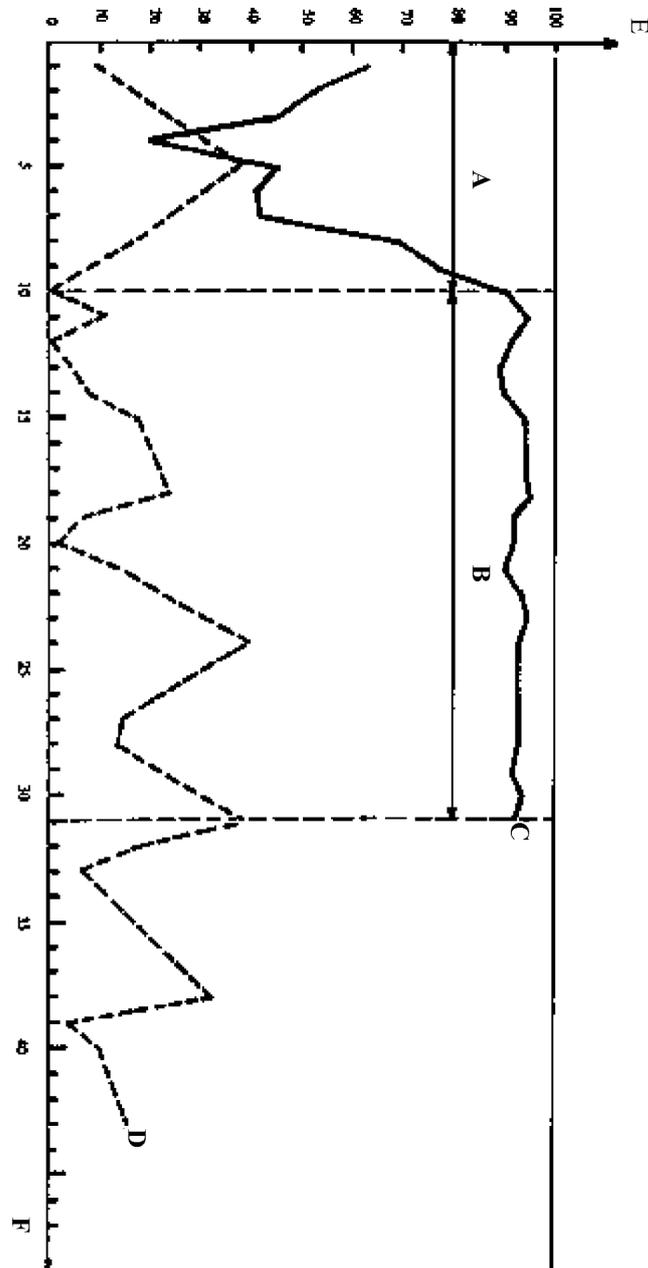


- A Liquid level
- B Hard PVC
- C Glass or waterproof plastic (hard PVC)

▼B

Figure 3

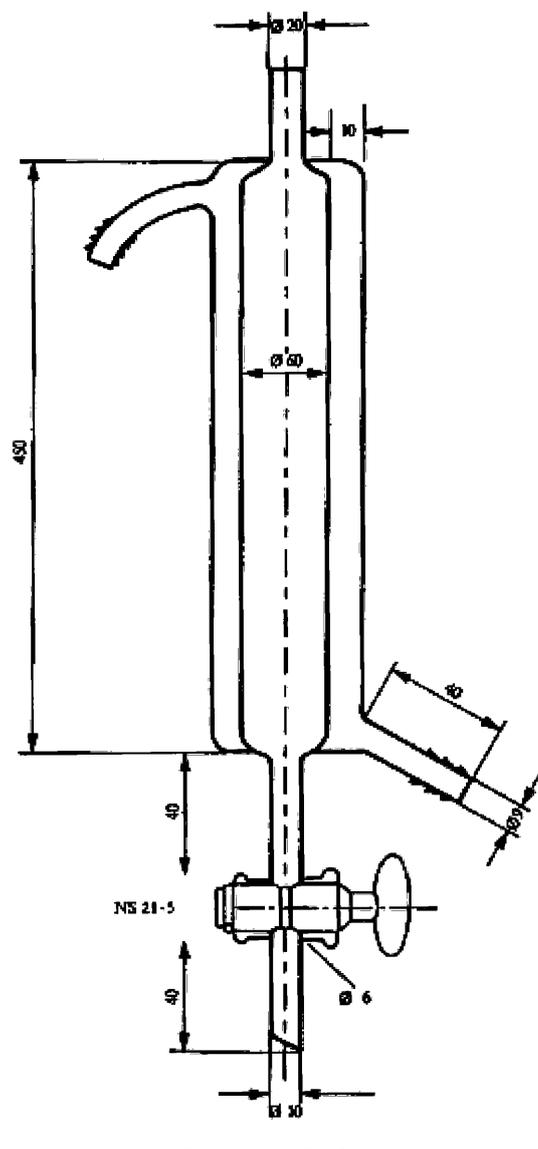
Calculation of biodegradability — Confirmatory test



- A Running-in period
- B Period used for calculation (twenty-one days)
- C Readily biodegradable surfactant
- D Surfactant not readily biodegradable
- E Biodegradation ( %)
- F Time (days)

▼B

Figure 4  
Heated exchange column  
(dimensions in millimetres)



▼ B

Figure 5  
Gas stripping apparatus  
(dimensions in millimetres)

