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Plastics for food contact applications

A code of practice for safety in use

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A CODE OF PRACTICE FOR SAFETY IN USE

Introduction

The packaging of foodstuffs is today essential for their conservation, transport, handling and sale, and provides one of the best methods for the avoidance of contamination and the maintenance of hygiene. However, intimate contact between packaging materials and foods introduces the possibility of transfer of part of the packaging material to the food, and the formulation of the package must, therefore, be selected to ensure that any such transfer is at a minimum and that the substances which do migrate from the package into the food cause no toxic hazard when the food is eaten.

The same considerations, of course, apply in the case of materials other than packages, such as processing equipment and utensils which are in contact with food. These considerations apply to all materials which are used in contact with food, and in view of the increasing use of plastics in this area, The British Plastics Federation has studied the problem, issuing in 1958* and in 1962** recommendations, compliance with which eliminates risk.

The Federation now presents this code of practice which, while reiterating the basic principles of the earlier reports, includes direct recommendations on the use of the ingredients of plastics to be used for food contact applications, i.e. the manufacture, processing, wrapping, containing, transport or storage of food. Compliance with these recommendations will ensure a degree of safety at least comparable with that of the food itself.

It should be noted that this code is concerned only with the *safety in use* of plastics materials in contact with foodstuffs in the sense of the migration of a possibly toxic constituent.

In formulating this code of practice the Federation has paid close attention to the activities of workers in other countries and to the principles embodied in legislation enacted or proposed. It has worked throughout in close co-operation with the British Industrial Biological Research Association (BIBRA) and has delegated to that Association the assessment of data on individual substances and the making of recommendations on their use, thus ensuring that considerations of safety are pre-eminent.

A large number of substances are used in plastics for foodstuffs contact in many different parts of the world. Normally approvals or recommendations for their use are where possible first obtained in their country of origin. For each country to insist on separate testing, interpretation of results and legislative clearance would be wasteful of time, effort and facilities, even supposing these to exist. It is therefore a matter of common sense that approval of substances in those countries which exercise critical judgement on data and proposed usage should be recognised. When such approvals are known to exist cognizance of these is demonstrated in the lists of additives in this code of practice by reference to the country concerned. Since such recommendations cannot have the same degree of endorsement by BIBRA as those which are based upon examination of original data no foreign approvals are quoted in this code unless BIBRA, whose judgement is final in these matters, has confirmed or modified the approval with reference to the additive available in the United Kingdom and its use.

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* Report of the Toxicity sub-committee of the Main Technical Committee 1958 BPF Publication 42.

** Second report of the Toxicity sub-committee of the Main

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Insofar as there is any cause for concern in the use of plastics in intimate contact with food, it arises from the migration of the constituents of the plastics composition into the food at a significant level. Hence, it is necessary to consider the intrinsic toxicity of each of the ingredients of the composition, their ability to migrate into the food in their original or an altered form, and the amounts which could be consumed as a result.

Toxic effects can be either 'acute', i.e. more or less immediate, as in most forms of accidental poisoning, or 'chronic', i.e. as a result of the repeated administration of a number of small doses each in themselves insufficient to cause an immediate 'acute' reaction, but in the long term having a cumulative effect. The former effect can be ignored since the materials employed are of a low order of toxicity and only trace quantities are likely to migrate. The possibility of 'chronic' effects must, however, be given close consideration and the results allied to the other two factors.

It is convenient to divide plastics compositions into their two main components, polymers and additives.

Polymers

It is generally accepted that the high molecular weight polymers which are of commercial importance in food contact applications cannot give rise to toxic hazard because they are essentially insoluble in food and inert. They do not migrate into foodstuffs in measurable amounts, nor if they are accidentally swallowed do they react with the body fluids in their passage through the digestive system.

The recommendations made in this code are based on this assumption, but the manufacture of polymers generally involves the use of other materials, such as catalysts, traces of which may remain in the finished polymer, and the polymerization may not be complete, leading to the presence of monomer or low molecular weight polymers. It is thus necessary to specify the purity of the polymer to be used as the basis of a plastics composition for a food contact application.

Additives

These include all those substances such as plasticisers, stabilisers, antioxidants and colourants which are deliberately added to the polymer to alter its processing, realise that the concentration of additives in a plastics composition is generally small. With the exception of plasticisers and a few inert fillers, it is seldom above the 3% level, often below 1% and can be as low as 0·001%. Furthermore, any additive will have had to be handled in bulk by its manufacturer and user with the result that any hazard will have already become apparent. It is believed that the implications of these facts are not fully appreciated. Were it so, the dangers of using an additive at about the 0·2% level in a food contact application would be seen to be practically negligible. That this is so, however, is not yet universally accepted and the recommendations in this code do not generally rely on the assumption that there is no significant hazard from the use of the majority of additives at such low concentrations.

Additives may be considered in three classes:

1. Those materials whose safety has never been questioned under the circumstances in which they are used. These are materials which occur naturally in food or which have been added directly to food for many years in quantities vastly greater than they could appear as adventitious migrants from a plastics composition, and whose behaviour has as a consequence been fully apparent.

2. All other materials not falling into the above category, which must, therefore, be subjected to detailed toxicological study.

3. Colourants, which, although coming strictly within 2, present a special situation which necessitates their treatment as a separate class. No recommendations on colourants are included in this code as published, but a special study of the problems is in hand and an addendum dealing with them will be issued in due course.

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Recommendations are given in two parts, i.e. polymer specifications and a list of additives used in the formulation of plastics compositions.

Polymer specifications

These describe the limits of quantity and type of catalyst and processing chemical residues, and monomer and low molecular weight polymer contents, subject to which the assumption that the polymers are insoluble and inert is valid in practice. Polymers meeting these specifications may be used for food contact applications, either alone or as the basis of plastics compositions which include additives, incorporated in accordance with the additive recommendations, to modify the properties or appearance of the product or its ability to be processed.

In this context the term 'polymer' includes copolymers where these are specified, and mixtures of polymers with each other.

Additive recommendations

Additives used in the production of plastics compositions are listed and recommendations are given on the limitations within which they may safely be used in such compositions for food contact applications. These limitations include, where appropriate, restrictions on:

a. The polymer or polymers with which the additive may be used.

b. The level at which the additive may be used with each polymer.

c. The foods with which the product may come in contact.

The recommendations assume generally that the food concerned is kept in contact with the plastics at temperatures ranging from conditions of refrigeration to those of a tropical climate. Where the recommendations cover temperatures outside these, e.g. for food processing equipment or for containers in which the food will be heated or cooked, specific mention of the temperature limits is made.

Although relatively few foods can be classified under any single one of the four basic categories of (A) dry solid, (B) aqueous, (C) fatty and (D) alcoholic, most can adequately be described by a combination of these. In using the recommendations in cases where there are restrictions on use with any of these categories their relevance to the proposed application must be assessed. Thus, for example, additives to compositions intended for the following foods would be subject to any restrictions on the food categories shown:

Food	*Category*
Milk	(B) and (C)
Mayonnaise	(B) and (C)
Water biscuits	(A)
Fancy biscuits	(A) and (C)
Table wines	(D)
Bacon	(A) and (C)

In formulating the recommendations, consideration has been given to abnormal migration behaviour which may arise through errors of processing and manufacture of the plastics container and appropriate factors of safety have been incorporated. In the same way, in evaluating safety in use it has been assumed that the food in contact with a particular container forms a considerable proportion of the daily diet. This leads to an additional substantial safety factor for the majority whose diet approximates to the average.

Food processing equipment and domestic utensils

Food packaging applications form the largest use of plastics in contact with food and hence the chief application of the recommendations. Plastics are, however, also used to a considerable extent in food processing and handling equipment and for domestic utensils for the preparation, storage and consumption of food in the home. In the case of equipment for food processing, etc., the food category is likely to be more specifically known, but the conditions of use may be outside those upon which the recommendations are formulated. In such cases, the applicability of any recommendations will need to be checked through the manufacturer of the plastics product or material.

In the case of domestic utensils the recommendations can be applied but the utensils will have to be produced using additives which are recommended without restriction as to any food category.

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Warranties

Purchasers of plastics products for use in contact with food can obtain from their suppliers written assurances that the relevant recommendations of this code have been fully complied with, i.e. that the product contains only materials used within the relevant recommendations. Neither The British Plastics Federation nor BIBRA can, however, issue certificates to the effect that a particular plastics material or product is approved in any way, or that it complies with this code. Neither body is in a position to give such assurances, which can only be obtained from the supplier of the goods, and who may indeed have to obtain similar assurances from his supplier of the component materials.

It will be apparent that in order to warrant compliance with the recommendations of this code, a supplier will require to know the purposes for which his goods are to be used, including the food categories with which they will be in contact.

Limitations

The objective of the recommendation is, of course, to prevent hazard to health from the migration of constituents of a plastics into foodstuffs. It is not its object to ensure adequate performance of the plastics in other respects. Thus, while the use of an additive may give rise to no health hazard, it may for other reasons not be acceptable: for example, because it does not give within the limitations on its use technically adequate performance, or because it results in taint or off-odour in the food. The chief use of this code of practice will be to ensure the safety of a composition formulated to provide the performance required of the product.

This code is mainly concerned with plastics in contact with food. Drugs and medical preparations normally involve special considerations which require individual attention and the same is, to a degree, true of cosmetic and toilet products.

These recommendations are not intended to be applied to plastics pipe and fittings for cold water supply, for which special requirements are stipulated in the relevant British Standards, nor to adhesives, printing inks and foils used in decoration which do not generally come into direct contact with the food. Users should, however, satisfy themselves that there is no direct contact in particular cases.

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Polymer specifications

Specifications for polymers to be used as the bases of plastics compositions intended for food contact are concerned only with those features necessary to ensure safety in such uses; they do not relate to other aspects of the performance of the materials.

While the specifications cover the generally known technology in each case there will be instances where a manufacturer will wish to use other polymerisation, etc., ingredients which he would not wish to see disclosed by publication in the specifications. Each specification therefore contains a clause permitting a manufacturer to claim that his polymer complies with the specification although its manufacture has involved the use of ingredients not listed, provided that he has received in confidence authorisation for such use from BIBRA.

BIBRA will give such authorisation only on the presentation of adequate supporting evidence accompanied in each case by an acknowledgement by the Federation of the receipt of an application fee.

Additive recommendations

Before a recommendation is made on the use of an additive, BIBRA must be satisfied that the uses which are proposed will not lead to hazard to health. BIBRA will normally reach a conclusion on a particular recommendation with the aid of its own staff, but it reserves the right to consult its contacts in outside laboratories both at home and abroad, while preserving the confidential nature of information with which it has been supplied.

Requests for recommendations

In order to make a recommendation on a particular additive, BIBRA needs to have information on:

Identity and purity

Proposed use

Toxicity

Extractability

Approval status, if any, in the United Kingdom or elsewhere.

In order to ensure that none of the relevant factors is ignored, a questionnaire has been prepared, calling for full detail under each of the above headings, and suitable for completion in support of applications for recommendations under both chemical identity and trade or brand name, and a company applying for the issue of a recommendation on an additive must complete this questionnaire and submit it to the Federation, with the appropriate examination fee, for evaluation by BIBRA. Copies of the questionnaire are available from the Federation.

It is expected that for some time following the publication of this code, the greatest interest will be centred on the issue of recommendations on additives which are already reasonably well known and indeed the questionnaire was designed chiefly to cater for the submission of information already obtained. It is strongly recommended that, in the case of new additives or of additives which have not previously been considered for use in food contact applications, intending applicants for recommendations should consult BIBRA before embarking on any work. If provided with information on the identity, use and migration characteristics of an additive, BIBRA will be able to make an assessment of the toxicological information which will be required and to suggest an adequate minimal programme of work. Such a programme will generally require investigation to determine the intrinsic toxicity of the additive.

The manufacturer of an additive may, of course, seek the assistance of his customers in completing appropriate sections of the questionnaire, which will be acceptable even if the submitted data originates from several sources – provided of course, that the adequacy of the work can be established.

Biological testing

It is not possible to generalise about the potential toxic hazard of any material, since toxicologically every chemical entity has a unique behaviour. The incidence of the material in the diet as a whole is also relevant.

A standard proforma of biological testing cannot, therefore, be laid down, and the advice of BIBRA should be sought as recommended above before beginning any programme of work. However, when contemplating the introduction of an additive for food contact applications the following should be noted:

(a) Frequently a properly conducted 90-day feeding test in rodents will provide all the

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information needed and this may be regarded as the minimal requirement in the majority of cases. When a chemical relationship between an additive and known carcinogens exists, a special study directed towards the evaluation of possible carcinogenic action should be considered. When additives are suspected of carcinogenic action on the basis of the results of 90-day feeding tests in rodents, it is essential that a study covering the life-span of the animal be carried out.

(b) Evidence of toxicological safety in the form of published work or of approval by some recognised authority will be accepted where the quality of the work done is considered adequate and where the relevance of the work or the approval to the product to be put on the United Kingdom market can be confirmed.

Migration and extraction

Evidence as to migration and extraction must be submitted so that it is possible to assess the level at which the diet as a whole may be expected to contain the material. In general, migration and extraction studies should be conducted using actual foodstuffs in the appropriate categories for up to ten days' duration at temperatures slightly more elevated than the maxima expected in normal service. It is, however, not always possible to analyse actual foodstuffs for trace extracts, and other 'food simulant' extractants may, therefore, have to be substituted. These extractants fall into four classes:

A Distilled water

B Dilute acid solutions

C Ethanol/water solutions

D A solvent simulating the action of fats.

In practice only (D) proves difficult. Various animal or vegetable oils, and materials such as medicinal paraffin and heptane have been used for this purpose and have been accepted by authorities. No pair of these gives the same result, but the use of a selection of them will give a general picture of the migration potential. In all extraction tests it is the order of magnitude rather than precise figures which is required. It will be appreciated that in the absence of adequate data on migration potential, the only assumption that an assessor of toxic hazard can make is that of total extraction; this may well put the permitted level of use at a figure so low as to be of no practical value. In cases where additives are normally used in small proportions, however, the assumption of total extraction from any composition may facilitate the recommendation of its safety as an additive to a wide range of polymers.

Some notes on extraction testing are given in the Appendix on the grey pages following.

Calculation of maximum permitted levels of use of additives

After studying the specification, extraction data and toxicological information, BIBRA first evaluates the acceptable daily intake of an additive for man. To do this, a safety factor (usually 100) is applied to the no-effect level obtained in rats from a 90-day feeding test and the corresponding no-effect level for a 70 kg man is calculated. This acceptable daily intake is the daily dose of the additive that appears to be without appreciable risk on the basis of all the facts known at the time. It is only an estimate and depends upon many factors, all of which are taken into consideration.

Knowing the maximum concentration of additive used in the manufacture of the plastics material and assuming that the daily human intake of food (1 kg) may be contained in 2,000 sq cm (or 10g) of plastics material, the calculation is made to determine whether the total amount of additive present exceeds the acceptable daily intake. When the acceptable daily intake is not exceeded, there is no hazard to health as total extraction of all the additive present in the plastics material would yield an amount lower than the acceptable daily intake. However, when the total amount of additive present in the plastics material exceeds the acceptable daily intake, the additive cannot be recommended unless adequate extraction data are provided. Then the additive is recommended for use, provided the extraction data show that the proportion of the additive present in the plastics material migrating into the food or food simulating solvent does not exceed the acceptable daily intake. But when the extraction data show that the acceptable daily intake is exceeded, the maximum usage level will have to be reduced.

Proprietary mixtures and trade names

In some cases additives which are mixtures of materials are offered for sale under proprietary names without disclosure of the constituent chemicals. It is accepted that the precise nature of such mixtures is a trade asset which the manufacturer would naturally wish to keep to himself. BIBRA cannot, however, approve materials in ignorance of their composition, even though biological work may have been done on the mixture as an entity, and in order that a recommendation can be made, the manufacturer must, therefore, give in confidence full details of the composition and purity of the product. A recommendation will then be made on the use of the mixture and will be published under the proprietary name, with only such indication of its chemical nature as is acceptable to the manufacturer.

Furthermore, additives which are essentially single chemicals will contain minor amounts of other materials either as impurities or by deliberate addition, and the nature and amount of these may vary between different sources of manufacture.

The submission in confidence of detailed information on the manufacture and composition of these materials, identified for inclusion in the recommendations as well as for sale by their trade names, enables BIBRA to take account of the particular impurities or peculiarities of an individual material when drawing up a recommendation, which will then be specific to that material and valid only so long as the declared information remains correct. If a manufacturer makes any changes in his product, which continues to be marketed under the same trade name, he must submit details of the changes to BIBRA so that the recommendation can be confirmed or amended as necessary. Information on the chemical nature of a product identified by its trade or brand-name in a recommendation may be given at the discretion of the manufacturer, but this description is not the subject of the recommendation.

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Restrictions on application and level of use

It should be noted that BIBRA's recommendations of the range of application or maximum level of use of an additive in no case exceed the level declared in a completed questionnaire submitted in application for a recommendation, even though the toxicological data suggest that wider use or higher concentrations would not be hazardous. This is because such extended use might lead to peculiarities of extraction behaviour of the composition as a whole which have not been disclosed by the information submitted. It must not be assumed, therefore, that different recommendations for two materials of apparently identical composition but different source necessarily indicate that one is safer than the other.

It is, of course, open to a manufacturer or user to apply for an amendment to a recommendation to permit its use, for instance, at a higher concentration or with different plastics. In such cases a further questionnaire giving the additional supporting data should be submitted.

Basis of a recommendation

Where an additive recommendation has been made by BIBRA after examination of actual experimental data, this is indicated in the 'Basis of recommendation' column of the list of recommendations by the entry 'BIBRA'. Where, however, the recommendation has been based on the approval of an additive by one or more overseas authority, BIBRA has confirmed or modified the approval, having reference to its relevance to the additive available in the United Kingdom and its use: the 'Basis of recommendation' column in these cases includes an indication of the overseas approvals concerned.

Additions to recommendations and polymer specifications

Further recommendations on both additives and polymers will be published at regular intervals. To obtain these, which are available gratis until December 1970, please complete and return the form which will be found at the front of this publication.

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Vinyl chloride polymer and copolymers

for use in contact with foodstuffs

There are no objections to the use of PVC polymers, copolymers of vinyl chloride or mixtures of these polymers with other polymers as hereinafter defined, provided that vinyl chloride is the major constituent in the composition, that the material is suitable for the intended use, that the use of dispersions of such polymers, copolymers and mixtures thereof is specifically excluded and that it complies with the following conditions:

1. DEFINITION

The following polymers may be used:

1.1 Homopolymers of vinyl chloride

1.2 Copolymers of vinyl chloride (containing at least 50% by weight vinyl chloride) with one or more of the following monomers:

1.201 Vinylidene chloride

1.202 Styrene

1.203 Styrene substituted in the benzene ring or the vinyl group by halogens or by alkyl groups

1.204 Acrylonitrile

1.205 Butadiene

1.206 Ethylene, propylene or any aliphatic mono-olefine

1.207 Divinyl benzene

1.208 Vinyl esters of monobasic aliphatic acids

1.209 Acrylic, crotonic, fumaric, itaconic, maleic or methacrylic acid (up to a maximum of 8% by weight of the total monomer)

1.210 Esters of the acids in 1.209 with saturated monohydric aliphatic alcohols

1.211 Vinyl ethers of saturated monohydric aliphatic alcohols up to C_{20}

1.3 Post-chlorinated homopolymers of vinyl chloride with a total chlorine content by weight of 69% or less

1.4 Mixtures of products listed in 1.1, 1.2 and 1.3

2. SPECIFICATION

To comply with this specification the polymers and copolymers defined in Section 1 shall be made in such a way that they contain no ingredients or residues of ingredients used in their manufacture other than those listed in the following sections and/or coming within the provisions of Section 3:

2.1 Catalysts

The total residues of catalysts and their decomposition products shall constitute less than 0·25% by weight of the finished polymer. The residues of the following catalysts may be present:

2.101 Benzoyl peroxide

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2.4 **Suspension agents**

The total residues of the suspension agents listed in this section shall constitute less than 1·0% by weight of the finished polymer. The residues of the following suspension agents may be present:

2.401 Gelatine

2.402 Methylcellulose

2.403 Hydroxyethylcellulose

2.404 Hydroxypropyl methylcellulose

2.405 Sodium carboxymethylcellulose

2.406 Methylethylcellulose

2.407 Polyvinyl alcohol (having a viscosity of at least 4 centipoise at 20°C in 4% aqueous solution)

2.408 Polyvinyl pyrrolidone and copolymers of vinyl pyrrolidone with vinyl ethers or esters

2.409 Copolymers of vinyl alkyl (C_1–C_{12}) ethers with maleic acid or allyl alcohol

2.5 **Chain transfer agents**

The total residues of chain transfer agents shall constitute less than 0·5% by weight of the finished polymer. The residues of the following chain transfer agents may be present:

2.501 Trichloroethylene

2.502 Perchloroethylene

2.503 *trans.* Dichloroethylene

2.504 Isobutylene

2.505 Xylene

2.506 Chloroform

2.6 **Miscellaneous additives**

Residues of the following other additives may be present:

2.601 Calcium carbonate

2.602 Sodium carbonate and bicarbonate

2.603 Calcium chloride

2.604 Sodium chloride

2.605 Organopolysiloxanes

2.606 Calcium and sodium phosphates and phosphoric acid

2.607 Sodium dialkylsulphonimides up to a maximum of 0·05% by weight of the finished polymer

2.608 Aluminium sulphate

2.609 Magnesium sulphate

2.610 Sodium sulphate

2.611 Calcium acetate

2.612 Sodium sulphite and sodium hydrogen sulphite

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2.102 Aliphatic acid (C_3–C_{16}) peroxide

2.103 *tert.*-Butyl perbenzoate

2.104 Azo-bis-*iso*-butyronitrile, azobis cyclohexyl carboxynitrile and azo bis 2, 4 dimethyl valeronitrile

2.105 *p. tert.*-Butyl perpivalate

2.106 Methyl ethyl ketone peroxide

2.107 Persulphates of ammonium and potassium

2.108 Percarbonates of the structure $R_1OCOOOOCOR_2$ where R_1 and R_2 are alkyl, aryl, alkylaryl, alkoxy, alkoxy alkyl or halogen substituted alkyl, aryl, alkylaryl, alkoxy or alkoxy alkyl (C_2–C_{10})

2.109 Cycloalkyl (C_5–C_8) peroxydicarbonate

2.110 *bis*-4-*tert.*-Butyl cyclohexyl-peroxydicarbonate

2.111 Acetyl cyclohexyl sulphonyl peroxide

2.112 Peresters of the structure R_1COOOR_2 where R_1 and R_2 are alkyl, aryl, alkylaryl, alkoxy or halogen substituted alkyl, aryl, alkylaryl or alkoxy (C_2–C_{10})

2.113 Mixed peroxide percarbonates of structure $R_1OCOOOOCR_2$ where R_1 and R_2 are alkyl, aryl, alkylaryl, or alkoxy, or halogen substituted alkyl, aryl, alkylaryl, or alkoxy (C_2–C_{10})

2.114 Hydrogen peroxide

2.2 **Polymerization inhibitors**

The total residues of polymerization inhibitors and their decomposition products shall constitute less than 0·01% by weight of the finished polymer

2.3 **Emulsifying agents**

The total residues of the emulsifying agents listed in this section shall constitute less than 3·0% by weight of the finished polymer. The residues of the following emulsifying agents may be present:

2.301 Alkyl, aryl and alkylaryl sulphates of sodium, potassium and ammonium, the alkyl group containing C_{10}–C_{20}

2.302 Alkyl, aryl and alkylaryl sulphonates of sodium, potassium and ammonium, the alkyl group containing C_{10}–C_{20}

2.303 Alpha hydroxy octadecane sodium sulphonate

2.304 Sodium, potassium and ammonium salts of sulpho-succinic acid and its mono- and di-esters with saturated monohydric aliphatic alcohols C_4–C_{20}

2.305 Sodium, potassium and ammonium salts of saturated aliphatic acids above C_7

2.306 Esters of sorbitol or of sorbitan with saturated or unsaturated aliphatic acids above C_7

2.307 Calcium, sodium, potassium and ammonium salts of hydroxylic fatty acids C_{12}–C_{20} and their sulphonyl or acetyl derivatives

2.308 Products of condensation of ethylene oxide with monobasic aliphatic acids C_{12}–C_{20} and their sodium and ammonium sulphates

2.309 Products of condensation of ethylene oxide with monohydric aliphatic alcohols C_{12}–C_{20} and their sodium and ammonium sulphates

2.310 Products of condensation of ethylene oxide with alkylphenols having alkyl groups C_7 and above and their sodium and ammonium sulphates

2.311 Polyoxyethylene (20) sorbitan mono-oleate

2.312 Products of condensation of ethylene oxide with alkyl and dialkyl amines C_1–C_{20}

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2.7 **Polymeric additives**

The following polymeric additives may be present provided that there is not less than 50% by weight of polyvinyl chloride or chlorinated polyvinyl chloride in the finished polymer. Each of the polymeric additives present shall comply with any separate specification referring to that polymer:

2.701 Homopolymers of monomers listed in Section 1.2

2.702 Copolymers of two or more of the monomers listed in Section 1.2

2.703 Chlorinated polyolefines with chlorine contents not exceeding 56% by weight

2.704 Copolymers of butyl acrylate and vinyl pyrrolidone containing not more than 95% butyl acrylate

2.705 Polyurethanes (containing no free isocyanates or primary amines) of molecular weight 40,000 to 100,000 made from:

(a) 1,6 hexane diisocyanate and/or 2,4 toluene diisocyanate and/or 2,6 toluene diisocyanate with

(b) 1,4 butane diol and/or polyesters of adipic acid with ethylene glycol, 1,4 butane diol, trimethylolpropane and/or addition products of propylene oxide or ethylene oxide with ethylene glycol, propylene glycol, glycerol, trimethylolpropane, pentaerythritol or sorbitol

3. OTHER INGREDIENTS

3.1 **Polymerization ingredients**

Other polymerization ingredients may be present provided that the manufacturer has obtained specific approval for their use from BIBRA, and that they are used within any limitations imposed by BIBRA

3.2 **Other additives**

Any additive listed in this code of practice as acceptable for vinyl chloride polymers may be present up to the maximum recommended concentration

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