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Our Advantage

The JohnsonDiversey Advantage

Beyond clean, we are dedicated to being the best at simplifying the lives of our customers.

We are committed to doing this by:

- investing time to listen, understand and respond to our customers' unique cleaning and hygiene needs
- taking a personal interest to ensure the facilities they care for are consistently clean, safe and attractive
- pursuing innovation in every form likely to make the lives of our customers simpler and more profitable
- partnering with our customers to exceed their expectations every day, everywhere



AN INFORMATION GUIDE TO ENVIRONMENTAL SAFETY

A basic guide to the impact of cleaning chemicals on the environment

An Information Guide to Environmental Safety

*A basic guide to the impact of cleaning chemicals on the
environment*

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JohnsonDiversey 
Clean is just the beginning

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1.0 Introduction

Properly formulated cleaning products are vital to the quality assurance and hygiene practices of the Food Service, Hospitality, Healthcare and Food processing industries. Today's high standards would be almost impossible without modern detergent and sanitation products. However, safe and effective cleaning is not the only requirement for today's cleaners. They must also have acceptable environmental profiles, so that they do not harm the environment after use. At JohnsonDiversey we continually seek improved safety and environmental performance in our product ranges, and promote minimum use technologies.

2.0 How we Assure Environmental Safety

In assessing environmental safety of mixtures of ingredients like cleaning compounds, we normally establish the source, the pathway by which it reaches the natural environment, the receptor and the fate of the ingredients in that pathway i.e. what happens to it, and the effects that the ingredient will have on the environment.

Most of JohnsonDiversey's products can be considered as down-the-drain chemicals, and end up in sewage after use. At this point the product is mixed with innumerable compounds and each ingredient behaves according to its physical, chemical and biological properties. Hence, the environmental safety of a product is assured on the basis of an assessment of its individual ingredients.

The pathways to the environment that spent cleaning products follow are mainly via the sewage system to aerobic or anaerobic treatment with final effluents being discharged to surface waters, with residual sludge solids utilised on farmland, disposed of to landfill, or incinerated.

Should the environmental assessment indicate that the ingredients are not or are incompletely broken down and/or have definite effects, a risk analysis needs to be carried out. In this analysis the predicted environmental concentration (PEC) is determined and compared with the predicted no effect concentration (PNEC).

2.1 Key factors to Assess

2.1.1 Fate

Fate is assessed in terms of the breakdown by biological ('biodegradation') or physicochemical means such as hydrolysis or photolysis. Ideally all organic ingredients should be biodegradable so that they do not leave persistent residues in the environment. If ingredients are not biodegradable or only partially biodegraded, it is important that residues are not harmful to the environment or are present at levels below those which may cause adverse effects (i.e. from the Risk Analysis PEC must be less than PNEC).

All surfactants used in today's detergent products must by law have primary biodegradability of at least 80% measured by methods within the regulations. In fact, JohnsonDiversey imposes its own more stringent restrictions which are applied world wide on the biodegradability of surfactants that can be used in product formulations. Many other common organic ingredients of cleaning compounds like organic acids (e.g. citric acid), bases (e.g. sodium caustic) and

water-soluble solvents (e.g. dipropylene-glycol-ethers) are completely degraded to harmless substances.

2.1.2 Effects

Effects are predicted on the basis of toxicity tests on appropriate species according to international regulations or guidelines. The species chosen represent the food chain of the relevant environment which will receive the ingredient or its breakdown products. Thus for water the species tested could include green algae, small crustaceans and fish. The important cut-off values for aquatic toxicity are EC50 or LC50 (concentration giving 50% inhibition or 50% mortality) < 1.0 mg/L, 1.0-10 mg/L and 10-100 mg/L.

Chemicals falling within these ranges are classed as highly toxic, toxic or harmful respectively.

Along with **Ready Biodegradability**, these ranges form the basis of the European Classification of Substances as Dangerous for the Aquatic Environment. Remember, however, that the toxicity of an ingredient can be high, without any harm being caused in the environment, provided that the ingredient degrades before it reaches the environment.

Bio-accumulation is another important effect that we must consider on materials that do not break down before reaching the environment. Bioaccumulation refers to the concentration through the food chain or through adsorption of chemicals into aquatic organisms. Bio-accumulative materials are preferentially retained by aquatic organisms and build-up or bio-accumulate inside the organism. Bioaccumulation is strongly related to lipophilicity the greater the lipophilicity, the greater the potential for bioaccumulation. The bio-concentration factor (BCF) is the measure used to assess the risk of accumulation of a chemical, and chemicals with BCF>100 are considered bio-accumulatory.

2.1.3 Effects

Components of cleaning products that reach the environment unchanged and have definite effects on small organisms either plant or aquatic need to be the subject of a risk analysis. This is designed to indicate whether the predicted level in the environment will have an adverse effect, and is carried out in two stages.

- i) Determine which environmental compartment(s) an ingredient will reach (air, water, soil) and the likely concentration (predicted environmental concentration or PEC). This is calculated using tonnage data and results from degradation and sorption studies. In special cases, it may be possible to use environmental monitoring to confirm the PEC.
- ii) Determine the highest concentration at which the ingredient causes no adverse effect (predicted no adverse effect concentration or PNEC). This is calculated from the results of toxicity tests e.g. for the aquatic environment small crustaceans (Daphnia), green algae and fish.

As long as the PEC is lower than the PNEC, a safety margin exists.

3.0 Fate and Effects of Common Components of Cleaning Products

3.1 Surfactants

By their nature they are often toxic to aquatic organisms with EC/LC50 values typically between 1.0 and 10 mg/L. Surfactants used in today's Cleaning Chemicals are extensively biodegraded; only very small amounts reach the environment following sewage treatment.

Inorganic and organic acids and bases, and particularly inorganic alkalis are often a substantial part of cleaning compositions. Their adverse environmental effects are mostly associated with high or low pH. These types of materials are not generally considered a problem for the environment unless they are disposed of in large quantities without neutralisation.

3.2 Linear Alkylbenzene Sulphonate (LAS)

Like soap (saponified fatty acids), LAS is a surfactant. Surfactants are necessary constituents in detergents and cleaning agents in order to secure effective cleaning. After soap LAS is the most used surfactant in the world and has been so for more than 30 years. In Europe, for instance LAS counts for 20% of the total use of surfactants.

LAS is not considered hazardous for the environment because it biodegrades well, is no more eco-toxic than soap and it does not bio-accumulate. Consequently LAS is not on the EU's list for hazardous substances and is not subject to the EU criteria for risk assessment. Nor is LAS regulated in any other country except in Denmark (See Appendix 1 section 1.1).

3.3 Phosphates

An essential nutrient for all life forms are another class of ingredient very frequently used in cleaning products. Phosphates in detergents can contribute to eutrophication of waters. Eutrophication occurs as a result of excessive growth of algae stimulated by nutrient enrichment. Concern over this issue has resulted in the limitation of the use of phosphates in detergents in several countries. Since the removal of phosphate from detergents has never been shown to improve eutrophic water, environmentalists now believe that the best way forward is to introduce tertiary treatment of sewage (at the final stage of treatment) to remove phosphate effectively from sewage and recycle it as fertiliser.

3.4 Hypochlorite

Used in cleaning and hygiene products it has received criticism due to the formation of small amounts of halogenated organic by-products. The mixture of by-products formed is complex - some have been identified, whilst the remaining mixture continues to undergo analysis to establish its environmental effect. Current data suggests that the halogenated by-products formed at low levels from the use of hypochlorite does not pose a significant risk to the environment.

3.5 Conclusion

The majority of today's Cleaning Chemicals can be considered to be of low environmental risk provided waste effluent waters are treated adequately to promote biodegradation of surfactants and the removal of poorly degradable organic ingredients from the aquatic environment.

The key to ensuring environmental safety of Cleaning Chemicals is to perform appropriate risk

assessments for the ingredients and to demonstrate satisfactory margins of safety i.e. as long as the Predicted Environmental Concentration is less than the Predicted No Adverse Effect Concentration (i.e. $PEC < PNEC$) a safety margin exists.

4.0 Biodegradability

4.1 Biodegradation

Biodegradation is a concept which applies to organic chemicals only and is not relevant for inorganic materials. Biodegradation can be described as the breakdown of a molecule into smaller molecules by the action of micro-organisms. The smaller molecules, will in general be less harmful to the environment than the original material.

Depending on the nature of the substance, biodegradation can be easy or difficult, fast or slow, complete or partial. Rate and degree of biodegradation are also influenced by parameters like temperature, bacteria population, environmental compartment (e.g. water, air, sludge), oxygen supply (aerobic or anaerobic conditions). If biodegradation is complete the end products are water, carbon dioxide and - depending on the composition of the original substance - other inorganic salts or gases.

4.2 Terms and Tests

In literature and legislation on the subject a number of different terms are used to indicate biodegradation and biodegradability. In most cases these terms refer to the degree of degradation or to the various ways in which biodegradability can be measured in tests.

4.2.1 Ultimate biodegradation

The level of degradation achieved when the material is totally utilised by micro-organisms, resulting in the production of carbon dioxide, water, mineral salts and new microbial cellular constituents (biomass).

4.2.2 Primary biodegradation

The alteration in the chemical structure of a substance, brought about by biological action, resulting in the loss of specific property of that substance. In the case of surfactants that property is surface activity, which is related to the capacity to produce foam.

4.2.3 Readily biodegradable

An arbitrary classification of chemicals which have passed certain screening tests for ultimate biodegradability. In test methods for ready biodegradability, the conditions provide limited opportunity for biodegradation. They are so stringent that it is very likely that compounds which pass the test, will rapidly and completely biodegrade in the aquatic environment under realistic conditions. The biodegradability criteria for classification of substances in general, in the framework of international transport regulations and for supply regulations in the European Union refer to ready (ultimate) biodegradability.

4.2.4 Inherently biodegradable

A classification of chemicals for which there is unequivocal evidence of biodegradation (**primary or ultimate**) in any recognised test of biodegradability. Test conditions in 'inherent tests' are

favourable for biodegradation and hence a fail suggests a material is unlikely to biodegrade under realistic conditions. A pass means that a material **can be biodegraded**, not necessarily that it will biodegrade under realistic condition.

There are also a number of test methods in which the conditions are more representative for 'real life' situations; this is the category of **simulation biodegradability tests**. These tests are the most important in predicting realistic environmental behaviour.

Biodegradability tests normally run for a fixed number of days, and the progress of the degradation process is measured continuously or at fixed intervals. Detection methods in **ultimate/ ready/ inherent** tests are measurement of oxygen depletion, removal of dissolved organic carbon (DOC) and production of carbon dioxide. Detection methods in tests for primary biodegradation of surfactants are analytical procedures specific to the type of surfactant - anionic, non-ionic, cationic or amphoteric.

4.3 Biodegradability and Legislation/Regulations

Biodegradability features in various sections of EU legislation on chemicals, notably the Dangerous Substances and Dangerous Preparations Directives (DSD/DPD) and the Detergents Regulation. However, the DSD/DPD requirements and classification systems are based on ready biodegradability, whereas the Detergents Regulation uses ultimate and primary biodegradability.

In transport regulations (ADR, IMDG) ready biodegradability is also a decisive factor. The ADR classification system for environmental hazards is closely linked to the DSD/DPD system.

4.4 European Union Requirements on Biodegradability of Surfactants

Regulation (EC) No 648/2004 of THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 31st March 2004 on detergents has a pass criterion for primary biodegradability of at least 80% as measured according to the methods in the regulation. Annex III of the legislation says Surfactants in Detergents shall be considered as biodegradable if the level of ultimate biodegradability (mineralization) measured according to the methods in the regulation is at least 60% within twenty eight days.

4.5 JohnsonDiversey & Biodegradability

Because most JohnsonDiversey products ultimately end up in the environment, either through sewage works, or directly as effluent into waterways, biodegradability is for JohnsonDiversey an important aspect of certain product ingredients. Materials which biodegrade to leave a persistent, water soluble organic residue are only used if the residue is relatively innocuous and if its concentration in surface waters remains below the 'Predicted No Effect Concentration' or PNEC.

5.0 European Union Environmental Classification of Substances and Preparations

The Dangerous Substances Directive (DSD) provides rules on classification, packaging and labelling of substances; the Dangerous Preparations Directive (DPD) does the same for preparations. Detergent products can be considered preparations consisting of substances; hence the DPD applies to the products and the DSD to the ingredients.

In the DSD/DPD classification systems biodegradability, ecotoxicity and bioaccumulation are to be taken into consideration together with aspects like physio-chemical properties and toxicity. The DSD includes test protocols for all of these, including several for biodegradability.

Even a readily biodegradable substance may qualify for environmental labelling when it has high eco-toxicity and/or bioaccumulation potential. Depending on these properties the label requirements may include an N-symbol (dead fish/tree) and/or one or more risk phrases.

Surfactants are subject to the biodegradability criteria of both DSD and Detergents Regulation. As explained above, the Detergents Regulation uses ultimate and primary biodegradability, whereas the DSD environmental classification is based on ready biodegradability in combination with ecotoxicity and bioaccumulation potential. This means that surfactants which meet the biodegradability criteria of the Detergents Regulation, may still qualify for environmental classification and labelling under the DSD.

Environmental classification of preparations - like detergent products - is regulated in the DPD. The Directive allows the classification/labelling to be done according to the same testing methodology as described above for substances, but it also allows classification by a "conventional method" whereby the classification of the preparation is established by calculation on the basis of the classifications of its ingredients. The latter is by far the more customary method.

6.0 Regulations on Transport (ADR/IMDG)

The international agreement on transport by road (ADR) uses the DSD/DPD environmental classification as the basis for environmental classification for transport. Any substance or preparation with a DSD/DPD classification which requires an N-symbol (dead fish/tree; note that this covers only part of all environmentally classified materials), which is unclassified in any of the transport Classes 1 to 8, is allocated to transport Class 9 as an "Environmentally Hazardous Substance". For substances and preparations which already classify in any of the Classes 1 to 8 the environmental properties are irrelevant for transport classification.

The rules for sea transport (IMDG) are more complicated. All substances are subject to environmental classification, including those which also classify in other transport classes (e.g. corrosive, flammable). Applying the criteria of the test protocols laid down in the IMDG regulations results in allocation to one of the categories "unclassified", "marine pollutant" or "severe marine pollutant". Materials in the latter two categories must be labelled with the triangular crossed-out fish symbol, in addition to the diamond-shaped label as required by their primary transport classification. If no other transport class applies, a marine pollutant or severe marine pollutant is allocated to Class 9, similar to the ADR system. For preparations

(e.g. cleaning products) the rule is that any preparation which contains $\geq 1\%$ of a severe marine pollutant or $\geq 10\%$ of a marine pollutant is considered to be a marine pollutant and is to be labelled with the crossed-out fish symbol.

7.0 NTA and EDTA

Nitrilotriacetic acid (NTA) and Ethylene Diamine Tetra-acetic Acid (EDTA) or their salts are commonly used as complexing agents in many types of industrial and institutional detergents. Their main purpose is to complex metal ions in the wash solution and prevent them interfering in the detergent process. EDTA is a much more powerful complexing agent than NTA and is usually reserved for those applications in which these special properties are essential e.g. pasteuriser cleaning, bottle-washing and conveyor lubrication. There are few other uses of NTA but EDTA is used in significant amounts in photochemicals, agriculture, cosmetics, paper and textiles. It also finds use in medical and food products. In all of these uses it is the same metal complexing properties of the material that are key.

7.1 Environmental aspects

Extensive trials have shown NTA to be biodegradable and although there is a fall off in the rate of biodegradation with temperature actual experience has shown that no problems are experienced even in the cold winters of Canada. As a result of these studies no extensive environmental risk assessments have been carried out, such as is the case with EDTA, and it does not appear on priority lists of substances for risk assessment.

Although some degradation pathways have been established for EDTA, in practice only limited biodegradation is observed in sewage treatment works and the material passes virtually complete through most sewage treatments. There is no evidence of a long term build up in the environment. The lack of biodegradation of EDTA in sewage treatment works has led to concern that heavy metal ions may be mobilised from sewage sludge or the beds of watercourses during the passage of the material. As a result extensive monitoring of EDTA concentrations in waterways has been carried out and also experimental field modelling and mathematical modelling. No heavy metal mobilisation has been demonstrated at any concentration of EDTA even approaching those found in practice. These studies have been included in a European Union Risk Assessment for a list of priority chemicals. An opinion agreeing with the recommendations of the report has been given by the Scientific Committee on Toxicity and The Environment (CSTEE). Both reports are freely available in full via the internet.

The risk assessment shows that although EDTA does not biodegrade in sewage treatment works and is hence regarded as non-biodegradable there is extensive evidence of its removal from the environment both by photo-degradation, particularly in the presence of iron and slow aerobic degradation in soil. Studies have shown that this degradation is to substances, which are known to rapidly biodegrade. A Predicted No Effect Concentration (PNEC) for EDTA in the aquatic environment was calculated to be 2.2 mg/L. In most normal circumstances such as household use and low volume industrial use this concentration will not be reached. However, for some very high volume use of EDTA in industrial situations this concentration could be exceeded. The recommendation is that risk reduction measures should be continued. These include operating industrial on-site waste water treatment plants at specific conditions to help degradation. For

high volume use a rough guideline would be above 10 tonnes per year.

7.2 Toxicological aspects

Both materials are relatively non-toxic and animals can digest large quantities. Such practice has been shown to lead to a reduction in essential metals in the body especially zinc (it is exactly this property that leads to the use of EDTA in the treatment of metal poisoning cases). Experiments performed many years ago demonstrate that NTA in excess can lead to tumour formation in the liver, however, there is a well defined threshold for this effect which is unlikely to be exceeded. Indeed the World Health Organisation (WHO) states:

“... NTA only induces tumours after prolonged exposure to doses greater than those, which produce nephro-toxicity...”

And goes on to recommend a relatively high guideline maximum value for drinking water (150 micrograms per litre). Similar old data demonstrates that EDTA may cause congenital abnormalities at high dosage levels with dezincification again the proposed mechanism. Given that EDTA is used in both medicines and food and the WHO drinking water maximum is set at 200 micrograms/litre there is little concern that these high dosages are likely to be approached.

Many of the problems postulated with EDTA and NTA are based on studies with non-complexed material. Of course all water contains some dissolved metal ions and in the case of sewage plant influent this can be quite high. In addition used detergent solution or any other use solution contains metal ions which the EDTA or NTA is there to complex. Hence the presence of un-complexed material in the wider aquatic environment is difficult to contemplate.

7.3 JohnsonDiversey and NTA/EDTA

JohnsonDiversey's policy is not to use organic materials, which leave persistent water soluble residues, which result in concentrations in rivers and lakes above a level, which would cause environmental concern. NTA presents no problem in this respect.

EDTA comes much closer if used in high volume applications. As a result of European risk assessment studies it is policy that EDTA be restricted to specialist uses and replaced with materials of lesser concern e.g. MGDA or NTA where local conditions permit.

8.0 Sodium Hypochlorite

Sodium Hypochlorite (NaOCl) is one of the most effective and fast-acting disinfectants against a wide spectrum of micro-organisms. It is widely used across the world in Industrial and Institutional cleaning and hygiene applications. Sodium hypochlorite has a long history of safe use in I&I and household applications. Some of the most important reasons why hypochlorite is so widely used are as follows:

- It is effective against all types of microbes including bacteria, viruses, moulds and spores;
- It is highly effective at low concentrations and temperatures, which means low consumption of chemicals and raw materials;
- Unlike some other disinfectants, no resistance to micro-organisms has been reported;
- It is easy to use and widely available;
- It is more cost-effective than other biocidal agents which are also less effective
- It is an effective bleach and can be used for removing stains on hard surfaces and textiles.

8.1 Human Safety

Hypochlorite has been widely used in many countries for more than a century. Used as recommended, it is safe and no ill-effects have resulted throughout its history.

Hypochlorite solutions are not sensitising. No systematic effects have been observed and they do not have geno-toxic, carcinogenic or reproductive effects. Adverse effects due to exposure to by-products are unlikely.

Under the European Dangerous Preparations Directive, hypochlorite products containing below 5% available Cl_2 are not classified. Products containing between 5 and 10% are classified as irritant and if containing more than 10% as corrosive. Classification of the finished product may differ due to its other constituents. The instruction: "Warning! Do not use together with other products – may release dangerous gases (chlorine)" is to ensure that sodium hypochlorite is not brought into contact with acidic products which could give rise to chlorine gas.

8.2 Environmental Safety

Sodium hypochlorite consists of atoms of sodium, oxygen and chlorine, with chemical formula of NaOCl. It is not possible to isolate the substance in crystalline form, and it is only known in solution, where it is in equilibrium with hypochlorous acid. Sodium hypochlorite is a highly oxidative chemical which reacts rapidly during and after use. The hypochlorite is rapidly reduced during use to yield sodium chloride (common salt) and material oxidized by its use.

In professional cleaning and hygiene active chlorine, derived from sodium hypochlorite or an organic chlorine donor (e.g. sodium dichloroisocyanuric acid DCCA), is used for disinfection, cleaning and bleaching.

All cleaning and disinfecting uses may result in discharge of residual hypochlorite. It is rapidly broken down during use, in the sewer, and if any does reach sewage treatment it will further degrade (half-life around 20 seconds).

Despite the strong anti-microbial potential of hypochlorite, there is little need for concern about

possible inhibition effects on biological sewage treatment with normal use levels of hypochlorite since the majority of its oxidizing/antimicrobial effect will be exhausted before reaching the treatment plant.

8.3 Environmental Aspects of Organo-Halogen By-products

A minor side-reaction (<1%) of the oxidation process of hypochlorite in applications, is chlorination of organic molecules, to form by-products measured as AOX (Absorbable Organic Halogens), a collective parameter covering a wide range of organo-chlorine compounds which may eventually reach the environment. It must be stressed that scientific research on organo-halogen by-products (OBPs) has not shown any link between measured AOX, and potential environmental hazard. The nature, composition and potential environmental effect of organo-chlorine by-products (OBPs) is strongly dependent on their origin. Scientific research on organo-chlorine by-products originating from hypochlorite use in domestic applications (disinfection, toilet bowl cleaning, laundry bleaching, mechanical dishwashing etc.) has shown that:

- The amount of OBPs measured as AOX, is small in absolute terms and in comparison with background levels.
- The OBPs have only a few chlorine atoms in the molecules, and are likely to be biodegradable. Therefore, the organo-chlorine by-products have little chance to reach the aquatic environment, or if they do, will be rapidly eliminated by natural degradation processes.
- The OBPs consist of highly water soluble molecules, with little potential for bioaccumulation
- The OBPs are not toxic to aquatic life, and are not mutagenic

8.4 JohnsonDiversey and Use of Hypochlorite

Hygiene is of vital importance for JohnsonDiversey customers, like food and beverage factories, kitchens, hospitals, pharmaceutical industries, laundries and others. A significant number of pathogenic and food spoiling micro-organisms can be found in those Industrial and Institutional environments and to avoid risk for infections, cleaning with detergents may not be sufficient and disinfection may be required. In such a scenario, disinfection with sodium hypochlorite or formulated cleaners containing hypochlorite is often to be preferred since it offers optimal biocidal performance and cost-effectiveness. There is no evidence to suggest that normal use, as recommended by JohnsonDiversey, of hypochlorite in professional cleaning and hygiene applications is a source of organohalogen by-products which could be persistent and bio-accumulative. In addition, OBP's originating from such use are not toxic at the levels discharged, and therefore no adverse environmental effects are to be expected.

9.0 Phosphates

Phosphorous is the atom from which phosphates are derived, is an element, a mineral and an essential constituent of life forms. Phosphorous (P) occurs in the natural world as phosphate, a compound of phosphorous and oxygen, frequently combined with sodium, potassium or calcium.

Phosphates are vital in living systems and to the cycle of life, and are present in the life process of plants, fish and animals. In humans they are required for strong bones and teeth, in both humans and animals they are necessary for metabolic activity, and in plants for photosynthesis.

Since phosphates are essential minerals for life forms, they are key nutrients in plant, animal and the human world, and a critical part of the food chain, particularly in the case of fish. The phosphates are food for algae, which are food for phytoplankton, which are food for zooplankton which in turn are food for small fish, which feed larger fish.

Phosphate can sometimes cause eutrophication – the environmental problem associated with their use. Eutrophication is the enrichment of natural waters by nutrients to such a degree that significant increases in algae, loss of plant diversity and depletion of oxygen and loss of animal life are seen, and has been studied extensively in the last 20 years.

9.1 Production and Use of Phosphates

The world wide production, use and consumption of phosphates is substantial and was estimated at 90 million tonnes in 1992. By far the largest consumption of phosphates is in fertilizers and the fertilizer market accounts for about 90% of the consumption of phosphates.

Phosphates are used in detergents to soften water and to ensure the detergent can clean properly and efficiently; they loosen and break down soils and help prevent the soils re-depositing. They also, in some formulations, keep the alkalinity of the wash-water at the right level for effective cleaning.

9.2 Entry of Phosphorous to Natural Water Systems

Phosphorous as phosphates in both United States and Europe mostly enters natural water systems as a result of fertilizer run off from agricultural land. The next biggest contribution is from human sewage. These two sources account for some 70% of phosphate delivery. On average, around 5-10% of phosphates entering the environment are from detergents and cleaning products but this varies between regions. Where local environmental levels are too high then all sources of phosphate need to be addressed. Where sewage works are an important source, phosphate should be removed there by phosphate stripping.

9.3 Human Safety

Phosphates have a very low toxicity. Common salt and sodium tripolyphosphate provide with similar results, when evaluated for strictly toxic effects. In both fresh and salt water vertebrates and invertebrates, sodium tripolyphosphate (STP) was found to be non-toxic. A recent review by the UN states that phosphates have very low toxicity both in humans and other species. This is entirely consistent with their function as essential nutrients.

9.4 Phosphates – Eutrophication and Water Quality

Several countries have restricted or banned phosphate in detergents in order to control eutrophication problems. There is general acknowledgement amongst experts, however, that where eutrophication occurs, the problem cannot be solved by only tackling one source – phosphates from detergents, as explained earlier they only account for approximately 20% of the total load to the waterways.

The most appropriate way to prevent phosphate causing an eutrophication problem is to remove all phosphate from wastewater by installing phosphate stripping equipment at sewage treatment plants.

9.5 JohnsonDiversey and Use of Phosphate

JohnsonDiversey is strongly committed both to compliance with national and local laws and legislation, and in countries which have chosen to restrict the use of phosphate we always provide products that meet local requirements. However we are also aware and keep abreast of the latest scientific literature, both on the environmental effects of phosphates and the alternatives to them. And we know from our own work that in many professional applications of detergents, phosphates are the most cost effective builder material to use.

JohnsonDiversey believes phosphate and zero-phosphate products are equally suitable for the environment. Our strategy is to minimize the load of chemicals, including phosphates and phosphate substitutes, to the environment by providing detergents optimised for customers' conditions together with tailored cleaning and hygiene solutions and reliable dosing equipment.

We encourage the use of water softening equipment in professional cleaning applications in order to minimize the use of phosphate and other sequestrants. JohnsonDiversey believe the tertiary sewage treatment (phosphate stripping) is the agreed best solution to remove all phosphate from the sewage.

10.0 Resource Depletion

10.1 Life Cycle Assessment LCA

LCA is an environmental decision support tool. The methodology is designed to identify and quantify all the environmental effects associated with the entire life cycle of a product, system or a service, starting with the origin of the raw materials and ending with and including the final waste disposal after consumption or use. See Appendix 2 for further details.

Resource depletion is the reduction in global stock of raw material as a result of extraction of non-renewable resources or extraction of renewable resources faster than they can be renewed.

10.2 Renewable Resources

Renewable resources are natural materials which can be replenished at rates that are balanced with the current and anticipated rate of consumption.

10.3 Raw Materials in Cleaning and Hygiene Products

All human activities have an impact on the environment and the manufacture, use and eventual disposal of detergents and hygiene products is no exception. The production of renewable raw materials also impacts on the environment and because of the required inputs of energy, fertiliser and pesticides, for example, it can rarely, if ever, be regarded as a truly sustainable activity. It should not be assumed, therefore, that a renewable raw material is invariably a better environmental option and a complete life cycle assessment (LCA) will be required.

10.4 JohnsonDiversey Position

JohnsonDiversey will continue to offer its customers products which satisfy their needs in terms of performance and value and which are safe for disposal to customers' effluent waste water systems and municipal sewage treatment systems. The formulation of detergents and hygiene products is complex and the selection of ingredients cannot be based on single criterion but must take into account: human and environmental safety; overall environmental impact; performance; cost; stability and availability.

Because of this JohnsonDiversey will continue to use both renewable and non-renewable raw materials, however, when LCA and Risk Assessment indicate a preference for renewable alternatives these will be chosen.

JohnsonDiversey is committed to meeting the needs of its customers in an environmentally sound and sustainable manner through continuous improvement in environmental performance in all its activities and will strive to encourage the production of both renewable and non-renewable raw materials in more sustainable ways. In addition, JohnsonDiversey will endeavour to use raw materials responsibly, continuously searching for more effective and sustainable utilisation.

11.0 Packaging

11.1 General

The packaging is a very vital part of a product and the design and construction must be adapted to the chemical and physical properties of the product it is intended to contain as well as the way it is applied.

The following aspects must be considered:

- Ergonomics /convenience in use
- Transport legislation
- Occupational and consumer safety
- Protection of the product (moisture, oxygen, UV-radiation and microbial contamination)
- Appearance

Depending on National Legislation for transport of Dangerous Goods the packaging must fulfil certain, well defined criteria for the safe transportation and handling of the goods.

The geographical, infrastructural and climatic conditions as well as material availability in various countries and regions in the world make global packaging strategies difficult and many times

impossible to implement.

11.2 JohnsonDiversey Strategy

JohnsonDiversey's aims are to minimise the environmental impact of packaging by using LCA (Life Cycle Assessment) and Eco Balance methodology in order to:

- select packaging and packaging materials with an optimal environmental profile and at the same time fulfilling all usage and safety aspects;
- minimising the weight of packaging materials; whenever possible concentrate products in order to use packaging in the most efficient way. To develop and provide customers with reliable and accurate dosing aids and systems in order to prevent excessive use of the product (increased chemical load);
- using packaging materials which can be re-used or recycled (for instance PE, PP, PET, fibre, metal) or when the necessary systems are not available, energy recoverable or compostable materials;
- using packaging materials which are made with an optimal ratio recycled to virgin materials;
- when possible from a safety and application point of view, using light weight packaging and refill systems;
- when possible from a geographical/infrastructure and customer point of view and when LCA indicate an environmental benefit, use return-and-fill systems;
- encourage customers to source separate packaging waste and to use available regional or national waste collection and recycling/recovery/re-use schemes.

JohnsonDiversey is proud of the overall progress it has made in reducing the impact of its packaging by the introduction of low weight packaging, refill systems, bulk and semi-bulk delivery systems and concentrated products.

JohnsonDiversey recognises the need to develop further in this area and is committed to, step by step, further reduce the weight of packaging material used for the distribution of our products, and whenever environmentally sound make use of packaging collection schemes and where capabilities for recycling, recovery or reuse of empty packaging exists, to use them.

12.0 Environmental Management System

In order to make the environmental improvement work in a company it must be:

- Consistent
- Credible
- Well structured

In order to keep focus and not lose track of the environmental dimensions of the business in the daily work it is important to implement an Environmental Management System (EMS). The purpose of the EMS is to commit the Business to specific reduction targets and in the long run minimise the environmental impact of its business.

There are different approaches to Environmental Management and a company can choose a management system which fits its specific circumstances but in order to be able to communicate with external contacts an internationally standardised EMS is often to be preferred.

12.1 ISO 14000 Process

ISO is a global consortium of standards-writing organisations from more than 100 countries, including the United States, which adopt voluntary industry standards for use by industries and business. After first adopting a series of ISO 9000 standards for quality, ISO has developed new standards aimed at improving the manner in which industries and businesses manage environmental risks and compliance requirements. ISO adopted its first environmental standard, known as ISO 14001, on September 1, 1996. This standard is entitled “Environmental Management Systems – Specifications with Guidance for Use” and focuses on the management of environmental impacts which are associated with a company’s activities, products and services. In general terms, ISO 14001 calls for the adoption of an environmental management system (EMS) designed to achieve compliance with applicable laws and regulations and the prevention of pollution. Companies seeking to become certified under ISO 14001 may either “self-certify” through an internal self-audit process and implementation of an EMS, or they may undergo third-party registration/certification.

12.2 Five steps to Certification

ISO 14001 certification involves a five-step process:

12.2.1 The first step

Establish an environmental policy under which the company makes essentially three key commitments:

- To fully comply with relevant environmental laws and regulations and comply with “other requirements to which the organisation subscribes” that may go beyond those which it is currently required to meet.
- To adopt programmes aimed at preventing pollution.
- To continually improve its EMS by having senior management regularly assess its performance and take necessary corrective actions measures to ensure that the company meets its objectives.

12.2.2 The second step

Under ISO 14001 it generally involves the planning aspects of complying with the standard e.g.

- Identification of significant environmental aspects of its activities, products and services.
- Identification of all environmental legal obligations and “other requirements” that it is subject to, as well as the key objectives and targets (including dates).
- Establishment of environmental management programmes to achieve its overall environmental objectives.

12.2.3 The third step

Relates to the implementation of a company’s overall environmental management system. As part of the ISO 14001 process, a company must:

- Establish an internal structure under which the responsibilities for implementing the EMS are defined and communicated.
- Implement a training programme for all employees whose work potentially may affect the environment.
- Adopt procedures for communicating internally about environmental management issues.
- Document the core elements of the EMS and this documentation must be maintained at key operational locations.
- Adopt procedures for responding to accidents and emergency conditions.

12.2.4 The fourth step

The company must evaluate the progress of its EMS and take corrective actions when needed, e.g.

- Monitor compliance with EMS objectives.
- Measure significant environmental impacts associated with the company’s activities.
- Investigate non-compliance situations and take corrective actions.
- Perform periodic EMS compliance audits.

12.2.5 The fifth step

The final stage of the ISO 14001 certification process is incorporating procedures to ensure that top management within the company periodically reviews the EMS system and its continuing suitability, adequacy and effectiveness. For example:

- Developing and reviewing the company’s environmental policy and strategy.
- Reviewing and acting on audit performance reviews.
- Maintaining proper allocation of financial, technical and personnel resources to ensure the success of the company’s EMS and maintaining a commitment to continually improve its EMS.

12.3 Conclusion

Deciding whether to become certified under ISO 14001 involves consideration of a number of practical and legal concerns. Companies should carefully evaluate these concerns in light of their own business and the markets in which they sell their goods and/or services. In this way, these companies can make an informed decision about the benefits and potential drawbacks to ISO certification – be it 3rd party certification, self-declaration, or perhaps building up the EMS becoming “ISO 14000 ready” – and what approach they could adopt in their particular case.

12.4 JohnsonDiversey and ISO 14001

All JohnsonDiversey manufacturing sites have a documented Environmental Management System of the same structure as ISO 14001. All JohnsonDiversey manufacturing sites monitor and measure their environmental performance related to five environmental key parameters (COD, Hazardous and Non-hazardous Waste, consumption of Energy and Water). All JohnsonDiversey manufacturing sites set annual reduction targets for each of the environmental key parameters and, to the Corporate Environmental Group, report their performance.

For further, free advice or information on environmental issues, or any other cleaning and hygiene matter, please do not hesitate to contact our Customer Care Team on:

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Appendix 1.0

1.0 LINEAR ALKYL BENZENE SULPHONATE (LAS)

Like soap (saponified fatty acids), LAS is a surfactant. Surfactants are necessary constituents in detergents and cleaning agents in order to secure effective cleaning. After soap LAS is the most used surfactant in the world and has been so for more than 30 years. In Europe, for instance LAS counts for 20% of the total use of surfactants.

LAS is not considered hazardous for the environment because it biodegrades well, is no more eco-toxic than soap and it does not bio-accumulate. Consequently LAS is not on the EU's list for hazardous substances and is not subject to the EU criteria for risk assessment. Nor is LAS regulated in any other country except in Denmark.

1.1 Why is LAS Regulated in Denmark?

It is about the presence of LAS in sludge and whether LAS represents a risk to the terrestrial environment.

LAS can be found in domestic sewage all over the world, simply because it is an ingredient in detergents. This is by and large all LAS is used for and therefore it can easily be assumed that the LAS found in sewage comes from detergents. A part of the LAS found in sewage is adsorbed onto sewage sludge during the sewage treatment process.

With the new sludge regulation in Denmark, the Danish Environmental Protection Agency has listed LAS as an environmentally hazardous substance and has introduced cut-off values (1.3 g/kg) for LAS contents. Until now the Danish EPA has not been able to state the scientific reasons for perceiving LAS as an environmentally hazardous substance. There is nothing in the existing scientific literature which, out of consideration for the environment, gives adequate reason to introduce such low cut-off values as have been decided or to demand that LAS must not be found in sludge at all.

1.2 Effects of LAS on the Environment

There are many studies of the effects of LAS on living organisms of the ecosystem which can be detected in areas with well known LAS concentrations and several laboratory tests have been made to investigate the fate of LAS in the environment.

- Studies show that LAS biodegrades rapidly. Biodegradation begins already when the sewage flow is flowing along the sewer; it continues in the sewage works and at the waste disposal site and later on, if the sludge is used as an agricultural fertilizer, in the upper layers of the soil.
- The so called half-life of LAS is between 7 and 30 days depending on the soil, climate etc. LAS sticks to the upper layer of the soil (20-30 cm) and no accumulation has been found. The presence of LAS in soil in the concentrations found, have no influence on the mobility of PAH (polycyclic aromatic hydrocarbons) or pesticides.
- LAS is an organic compound. When it degrades the organic carbon and sulphonate are broken down to carbon dioxide, water, sulphates and biomass (living tissue).

1.3 Aquatic Eco-toxicity

LAS has recently been subject to a detailed environmental risk assessment in The Netherlands. The assessment was part of a joint action plan drawn up between the Dutch Ministry of Housing, Spatial Planning and the Environment (VROM) and the Dutch Soap and Detergents Association (NVZ). The Dutch risk assessment concluded that LAS posed no significant risk to the river ecosystems.

As far as LAS is concerned there is a good margin for comfort in the results of the Risk Assessment for The Netherlands. Degradation is faster than the general BOD (biological oxygen demand) and provides no cause for concern over break down residues.

There are no major grounds for concern in the case of rivers receiving sewage effluents from works providing secondary treatment. Such treatment reduces the levels in the effluent to less than the PNEC (predicted no effect concentration) and provides no cause for concern even in situations where dilution is low.

1.4 JohnsonDiversey's Use of LAS.

LAS is used in certain JohnsonDiversey products because it gives a good cleaning performance in many formulations, it is cost effective and has a proven and well documented human and environmental safety.

Appendix 2.0

2.0 Life Cycle Assessment (LCA)

LCA is an environmental decision support tool. The methodology is designed to identify and quantify all the environmental effects associated with the entire life cycle of a product, system or a service, starting with the origin of the raw materials and ending with and including the final waste disposal after consumption or use. The furthering of LCA methodology in an international context has been taken up by Society of Environmental Toxicology and Chemistry (SETAC®), both in the USA and Europe, and LCA is the subject now of one of the ISO 14000 standards.

2.1 Steps in LCA

2.1.1 Goal definition and scope

The first step is definition of goal and scope of the study, which in the case of LCA is of major importance. First of all, the subject of the study needs to be defined – the product, the system or the service. In order to allow objective comparison with other alternatives (either other products on the market or improved products/services to be considered), the “function” of these needs to be defined. LCA speaks about the “Functional Unit” = the unit of function to be delivered by the product under study. Secondly, the product system needs to be described. Since in theory all product systems in the world can be connected through the global economy, some boundary settings must be done; this involves cut-off rules. Thirdly the scope of the environmental effects to be considered needs defining, since that will put certain requirements on the data collection. Finally, the goal definition must describe any rules that will be followed during the study.

2.1.2 Inventory

The inventory steps begins by detailing the product system under study. All the relevant process steps and the connecting transport steps need to be outlined in a process diagram or process

tree. Any level of operation can be taken as one process. Some processes have more than one output or function they are combined processes, and allocation rules are necessary to determine how the environmental impacts, associated with that process, need to be allocated over the various outputs. Then for each process in the process tree, the inventory data must be collected. This includes process data (raw materials, products, energy), emission data (to air, water, soil, solid waste) and systems data (size of operation, type of technology used, age of data, region etc.). The information must be complete enough for anyone to decide whether the situation described is representative for any other situation they have come across. Processes in the process tree are connected via amounts of input and output, and so a total inventory list of the product system can be made.

In the theoretical situation, where all materials flows are backtracked where they originate from the environment, and followed to where they end up, the inventory would only contain so-called elementary flows. In practice, however, the inventory list contains many products, crossing the systems boundary either entering from neighbouring LCA's or leaving to the system being evaluated

2.1.3 Classification

All elementary flows can potentially contribute to some environmental effects. List of factors are being used to calculate these potential contributions. The following environmental effects are usually taken into account:

- Depletion of abiotic resources
- Depletion of biotic resources
- Global warming
- Ozone depletion
- Photochemical oxidant formation
- Acidification
- Nutrification (oxygen depletion)
- Eco-toxicity (aquatic and terrestrial)
- Human toxicity

The list of quantified contributions to these environmental effects resulting from the product system under study is known as the Eco-balance.

2.1.4 Evaluation

The final step in the LCA methodology is the evaluation of the whole analysis process. The LCA practitioner, taking into account inadequate data quality, missing data, effect of cut-off rules and allocation rules, i.e. all the shortcomings of the study and tries to assess how much this can influence the final outcome. This may include an evaluation of the importance of the various environmental effects considered, even involving a weighting procedure.

2.1.5 Problems and shortcomings

Standardisation of LCA's has proven to be very difficult. Because of all the possible differences in products, processes, chosen boundaries etc., the limited information available from literature on industry sectors and all the uncertainties in the scientific models underlying the classification factors, it is not surprising that the results of many published LCA's have led to heated debates. Especially where LCA studies have been used for product comparison and product claims this has been the case. Reliability of LCA studies is still a reason for concern. Therefore the LCA report should show clearly every single step taken in the analysis, reveal every data source etc.

2.2 Applications

As long as one is aware of the shortcomings, LCA can still be put to good use. One can simply stop after the inventory (LCI) and analyse product systems for "hot spots". "Hot spots" can either be major emissions, where the volume of the emissions from the product system under study is the reference, or emissions of specific gases (e.g. SO_x). At this level LCA can be very useful for process optimisation.

The same can be made with the Eco-balance. Of course one can look at the eco-balance of two product alternatives, existing or theoretical, and analyse which improvements could be made to either alternative and at what cost. Or again one can do a "hot spot" analysis, where the "hot spot" is now the biggest contribution to any environmental effect. The possibility exists to apply some form of normalisation, e.g. against total environmental effects in a country, total global effects, or to compare this with some other indicator of the value of the product system studied.

2.3 JohnsonDiversey and LCA

JohnsonDiversey is committed to meeting the needs of customers and consumers in an environmentally sound and sustainable manner, through continuous improvement in environmental performance and prevention of pollution in all our activities".

To achieve this we will use standards of environmental impact assessment which are robust, scientifically sound and general acceptable within the present state of knowledge, at the same time attempting to develop superior methods and to improve current practice.

We use LCA to identify and help quantify areas of highest potential impact. This helps us target areas where we can take action most effectively.

LCA and Eco-balance help us to understand the environmental impact of our business and to continuously improve our environmental performance.