Sustainable Cleaning

A guide for users of professional cleaning products

Users of cleaning products are increasingly aware of the need to conduct cleaning operations in a way that is 'environmentally friendly'. But this doesn't just mean using chemicals that are safe for the environment, it means minimising all the many other environmental impacts that arise in making and using cleaning products, such as energy consumption and waste disposal. The term '**improving sustainability**' is used to refer to making an improvement in the overall impact of cleaning.

There are three key steps which are required to optimise sustainability:

* Choose products that are designed for sustainability as well as safety
* Work with suppliers so that they responsibly manage their manufacturing impacts
* Minimise the environmental impacts that arise during your cleaning operations

This document provides guidance on implementing these steps.

Defra welcomes this guidance as part of its commitment to support sustainable public procurement in the UK in line with its strategy for promoting sustainable development across Government.

The guidance for ingredient selection which appears on pages 6 and 7 of this brochure was first published in 2006, prior to which it was reviewed by the Government's Advisory Committee on Hazardous Substances. The initiative was subsequently welcomed by the UK Chemicals Stakeholder Forum.

defra
Department for Environment
Food and Rural Affairs

Sustainable Cleaning: A summary of the key steps

Sustainable cleaning needs to be tackled in three key steps. Brief guidance on these steps is given below to ensure that cleaning products are bought and used according to best environmental practice. Further detail is given later in this guidance.

Step 1

Choose products that are designed for sustainability as well as safety.

How?

The manufacturer must select and formulate ingredients not only to ensure safety but to optimise the sustainability of the finished product when properly and diligently used.

- Require your supplier to follow the guidance on pages 6 and 7 of this document to ensure that the products are formulated to be safe for people and the environment.
- Avoid specifying other ingredient choices for your supplier as these are unlikely to have any significant benefit and may seriously undermine sustainability, such as by reducing the effectiveness of the product.

Step 2

Work with suppliers so that they responsibly manage their manufacturing impacts.

How?

Challenge your supplier for evidence that they have effective control of impacts during the manufacturing phase. Key areas include:

- Minimising raw material and finished product wastage during manufacture.
- Minimising consumption of energy and water.
- Minimising emissions to sewer and atmosphere and, in particular, controlling emissions of hazardous substances to avoid risk to people or the environment.
- Minimising packaging waste and recycling used packaging.
- Operating an Environmental Management System.
- Operating procedures to prevent accidental emissions.
- Operating Occupational Health & Safety systems to protect staff.

Step 3

Minimise the environmental impacts that arise during your cleaning operations.

How?

Reduce your consumption of product, packaging and energy by buying effective products and using them efficiently to minimise wastage and disposal to landfill.

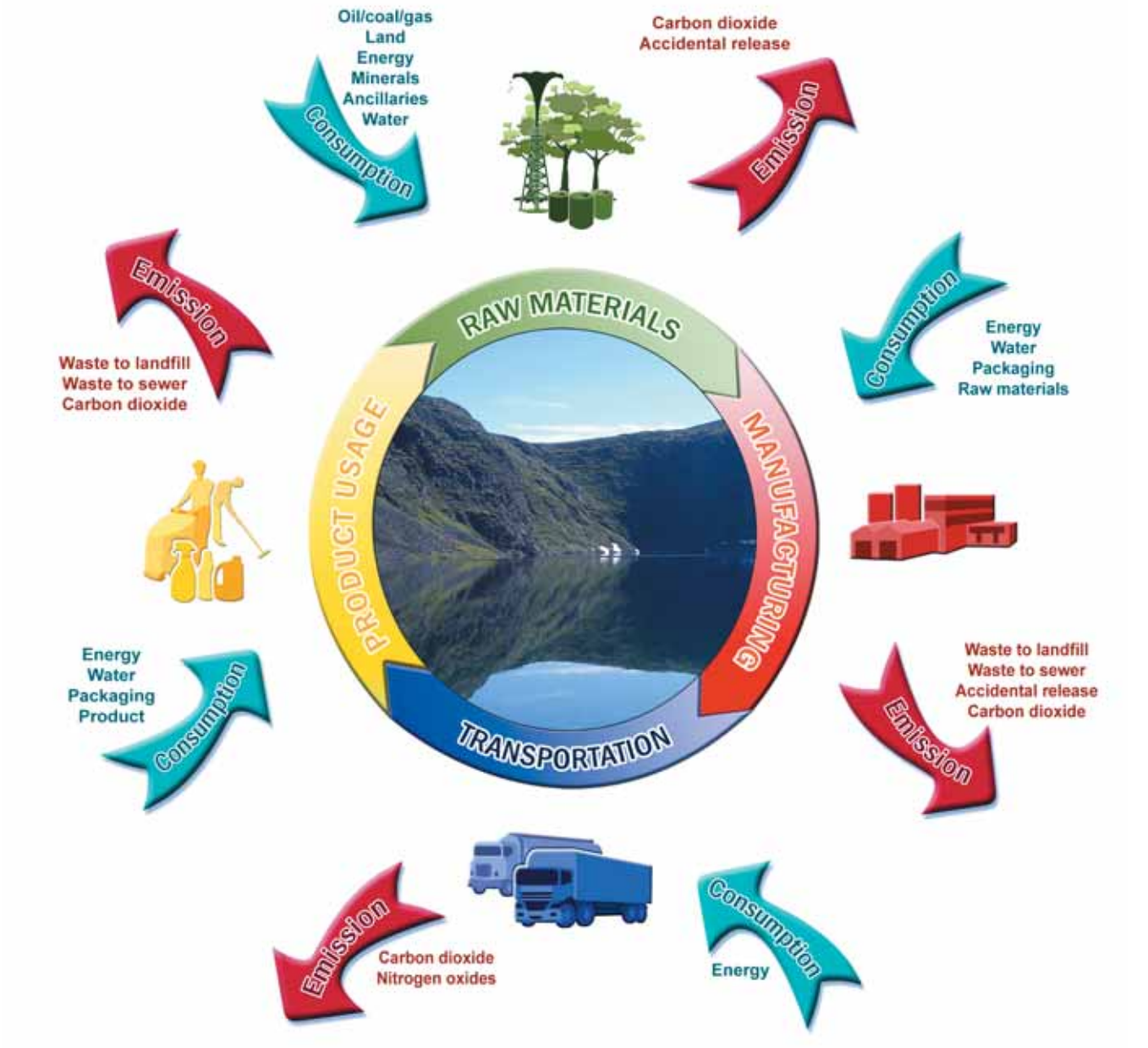
- Define what task the cleaning products will be used for and buy products which deliver the required performance.
- Analyse and reduce rework rates. First time cleaning is essential to minimise waste, particularly in energy intensive operations such as machine dishwashing.
- Favour more concentrated products, where applicable.
- Dilute and use products according to the manufacturer's instructions using accurate dosing systems where appropriate.
- Service cleaning equipment regularly, particularly critical items such as dosing pumps for automated machines.
- Train staff, for example using BICSc courses. Offer instructions in a choice of languages where appropriate.

What is Sustainable Cleaning?

Sustainability is about meeting our own needs - in this context making things clean - without compromising the ability of future generations to meet their own needs. The general concept of improving sustainability is simple: Reduce consumption (to preserve the world's natural resources) and reduce emissions (to minimise pollution).

Consumption and emissions will occur during a product's manufacture, transportation, use and disposal. In many cases consumption and emissions are linked so reducing consumption in one area will bring benefits in other areas.

The term 'life cycle' is used to refer to all these stages in which impact occurs. The life cycle of a typical cleaning product is illustrated below:



Taking the simple steps described in this brochure will improve sustainability by lowering consumption and emissions of the following :

Waste to landfill
Waste to sewer
Accidental releases
Carbon dioxide (CO_2)
Nitrogen oxides (NO_x)

Oil / coal / gas
Minerals
Land use
Energy
Ancillaries (e.g. fertiliser)
Water
Packaging
Raw materials

Impacts during raw material production

Raw materials, in the form of minerals, petroleum and plant-derived substances such as vegetable oils and wood-pulp, are consumed to make ingredients and packaging for products. No source will be completely free from environmental impact since energy will be consumed to make and transport all raw materials.

Other chemicals (such as agricultural fertiliser) may be used in the raw material production and wastes of various types may be created.

As regards packaging, a high proportion of recycled fibre is already used in the manufacture of cardboard from which cartons and boxes are made. Virgin fibre can be sourced from sustainably managed forests. Plastics used for packaging should be chosen as far as possible to be recyclable. Guidance can be found under 'Recyclability by Design' at www.recoup.org. The overall use of packaging materials can be reduced by using refillable containers where practicable and by using efficient, concentrated products that do the job with the smallest volume of product.

Impacts during product manufacturing

To ensure products are manufactured sustainably, suppliers must work to reduce the impacts in this phase of the life cycle. This should include:

- Minimising raw material and finished product wastage during manufacture.
- Minimising consumption of energy and water.
- Minimising emissions to sewer and atmosphere and, in particular, controlling emissions of hazardous substances to avoid risk to people or the environment.
- Minimising packaging waste and recycling used packaging.
- Operating an Environmental Management System.
- Operating procedures to prevent accidental emissions.
- Operating Occupational Health & Safety systems to protect staff.

The following are either regulated or are independently accredited and may prove useful in identifying responsible suppliers:

IPPC — Regulated by the Environment Agency and other authorities, 'permitted' factories must have demonstrated use of 'Best Available Techniques' in environmental protection.

AISE Charter — European Sustainable Cleaning Charter that commits suppliers to making continual improvements in sustainability.

14001 EMAS — Environmental Management Systems, which require continual monitoring, analysis and improvement of environmental aspects.

18001 — Health & Safety Management System, similar to 14001 but focussing on Occupational Health & Safety.

9001 — Quality management system often used as a precursor to attaining higher environmental standards.

Impacts during product transportation

As is the case for raw materials, transportation of finished products contributes significantly to the overall environmental impact of cleaning, through energy use and vehicle emissions.

Increasing the effectiveness and number of doses contained on a pallet of cleaning products can help reduce these impacts. Purchasing smaller volumes of more concentrated products is one way of doing this. Ensuring products are used correctly and clean first time, without wastage, is another (see **Impacts during product usage**).

Impacts during product usage

Even when efficient, sustainably designed and produced products have been purchased, the overall environmental impact of the cleaning process still depends very much on how the products are used. All the impacts in the life cycle thus far can only be minimised if products are accurately and appropriately dosed. Overdosing by 20% not only wastes money, but also adds 20% to all other impacts in the life cycle, including those arising during raw materials and packaging production, manufacturing and transportation.

Key areas to focus on to ensure best environmental practice, minimal resource consumption and minimal emissions include:

- Define what task the product has to do and buy products which deliver the required performance.
- Analyse and reduce rework rates. First time cleaning is essential to minimise waste, particularly in energy intensive operations such as machine dishwashing.
- Favour more concentrated products, where applicable.
- Dilute and use products according to the manufacturer's instructions using accurate dosing systems where appropriate.
- Service cleaning equipment regularly, particularly critical items such as dosing pumps for automated machines.
- Train staff, for example using BICSc courses. Offer instructions in a choice of languages where appropriate.

Product design and ingredient selection

The preceding sections highlight some of the impacts that arise during the cleaning product life cycle, and important ways of reducing them. When a product is being designed and developed, it is the job of the manufacturer to find the optimum balance that ensures effectiveness as well as safety, and minimises the overall environmental impact when properly and diligently used.

Selecting ingredients is a critical step in designing a safe and sustainable product. However, ingredients need to be considered not in isolation but as components in a complete formulation. The safety of a product depends not just on the hazards of the individual ingredients but on the levels at which they are used in the product, on how the product is used and people are exposed to it, and on how it is disposed of after use. As well as formulating to ensure safety, manufacturers should look for opportunities to reduce the use of ingredients that are slow to biodegrade, especially any which may have the potential to bioaccumulate, and should favour the use of ingredients where the margins of safety* are wide. *See back page 'Safety and Risk Assessment' for further explanation.

Similarly, selecting ingredients only on the basis of their apparent individual sustainability can often reduce the performance of the complete product, increasing total resource consumption. Sometimes, use of a small amount of a seemingly less sustainable ingredient can markedly improve performance and/or allow major reductions in the use of others. It is a common misconception that selecting 'natural' ingredients will inevitably improve the safety and sustainability of a product. As explained on page 8, this is not the case. However as petroleum resources are finite, manufacturers should look to favour sources of renewable feedstocks where these do not undermine sustainability in other parts of the life cycle and can be farmed in a sustainable way.

Selecting ingredients for product safety

The ingredient recommendations on the following two pages will help to ensure that cleaning products are safe for people and the environment when used as directed. These list all the major classes of ingredients, as set out in the Detergents Regulation, and others which often appear in tender documents. They review important human and environmental safety aspects of these ingredients, and any concerns that have been raised about them. They then provide a current scientific assessment, based on the best available evidence, and give relevant guidance for procurement in the UK of cleaning products used in the Industrial & Institutional (I&I) and Janitorial markets.

Requiring suppliers to exclude ingredients other than in accordance with this guidance is unlikely to have any significant benefit and in some cases may seriously undermine the sustainability of the formulation.

Most abbreviations used on pages 6 and 7 are referred to on page 8.

Formulator should optimise during product design means that, although there are adequate margins of safety for both humans and the environment, the formulator should optimise the use of each ingredient to produce the most sustainable formulation for the cleaning task.

INGREDIENT	FUNCTION AND ISSUES	GUIDANCE FOR PROCUREMENT
Phosphates	Phosphates are included in cleaning products to soften the water, help disperse and suspend dirt, and inhibit redeposition. Their use allows the use of other ingredients, especially surfactants, to be minimised. Phosphate is an essential nutrient for plant and animal life which must be present in the environment but excessive levels of phosphate in rivers, lakes etc can fuel algal blooms or encourage 'coarse' plants (eutrophication).	The main sources of phosphate entering the aquatic environment are agriculture and human sewage, though the relative contributions vary between regions. Detergents and cleaning products contribute on average around 5-10% of this phosphate, all of which enters via sewage. Where phosphate levels in the environment are locally too high, and sewage flows are an important contributor, treatment at the sewage works (as required by the Urban Waste Water Treatment Directive) removes the small amount of phosphate coming from detergents along with that from the main sources (human sewage, etc). **Formulator should optimise during product design**
Phosphonates	Phosphonates are used in cleaning products as 'chelating agents' which are substances that tie up impurities which interfere with the cleaning process. Many phosphonates are relatively poorly biodegradable. Sometimes, phosphonates have mistakenly been confused with organophosphates used as pesticides for example.	Phosphonates are removed at sewage treatment works, mainly by adsorption to sludge, and are also removed from the environment by photodegradation. Assessments by TCDE and HERA have concluded current uses pose no significant risk for the environment. Phosphonates do not behave like organophosphate pesticides. **Formulator should optimise during product design**
Anionic surfactants **Cationic surfactants** **Amphoteric surfactants** **Non-ionic surfactants**	Surfactants are the active ingredients in cleaning products which provide the foaming and emulsification. In the 1960s poorly biodegradable surfactants produced foaming on rivers and some surfactants (see alkylphenol ethoxylates) had more serious issues.	Surfactants in cleaning products have long been regulated, most recently by the Detergents Regulation 2004/648/EC which requires rapid and complete biodegradation. Many of the surfactants used in cleaning products are also approved under the Cosmetics Directive 76/768/EEC for use in cosmetic and personal care products. **Formulator should optimise during product design**
Oxygen-based bleaching agents	Commonly used bleaching agents in laundry detergents. Alternatives to chlorine based bleaching agents and disinfectants for some uses.	Decompose completely in sewers and sewage treatment works. HERA risk assessments for the major substances sodium perborate, sodium percarbonate and hydrogen peroxide confirm no risk to the environment. **Formulator should optimise during product design**
Chlorine-based bleaching agents	Used in detergents, cleaners and disinfectants to help remove stains, break down soils and kill germs. It was suspected that chlorinated organic by-products produced during use might be environmentally harmful.	The chlorinated by-products formed are similar to those produced in drinking water chlorination. They are generally biodegradable and water soluble and studies show no production of dioxins or PBT (Persistent, Bioaccumulative & Toxic) substances. The quantities emitted to the environment are a fraction of those coming from chlorinated tap water. A TCDE assessment concluded there is no risk to the environment. **Formulator should optimise during product design**
EDTA (ethylenediamine-tetraacetic acid) and its salts	EDTA is used as a 'chelating agent' to tie up metal impurities in water, stopping them reducing cleaning efficiency. EDTA is poorly biodegradable and little removed by sewage treatment plants, but degrades steadily, if slowly, in the environment. There has been concern that it could remobilise heavy metals into the aquatic environment, allowing them to enter water supplies or the food chain.	Although the EU Existing Chemicals risk assessment considers EDTA to be poorly biodegradable, it concludes that there is no risk for the aquatic environment from detergent uses that discharge to municipal sewer, nor from remobilisation of heavy metals. Only discharges without adequate treatment after use in large food plants were a potential concern. However, more biodegradable alternatives are now available that perform adequately, and industry has been able to improve sustainability by substituting EDTA in all bar a few specialist applications. **Use should be justified for specific applications**
NTA (nitrilotriacetic acid) and its salts	Similar to EDTA but chelates metals less strongly. Has superior biodegradability to EDTA so is commonly used as a substitute.	An EU Existing Chemicals Risk Assessment published in December 2005 concluded there was no environmental risk from using the material. **Formulator should optimise during product design**
Phenols and halogenated phenols	Such materials have found limited use as active ingredients of disinfectant preparations in the I&I market. There has been concern that some molecules may be aggressive to human skin, poorly biodegradable or otherwise environmentally harmful.	Use of older molecules such as phenol and cresol that are corrosive to skin was discontinued long ago. Modern types in current use are often sufficiently mild to be used as skin antiseptics. Many are readily biodegradable and of moderate to low aquatic toxicity. The BPD will regulate disinfectant ingredients. **Only ingredients that continue to be supported under the Biocidal Products Directive (BPD) should be used**
Paradichlorobenzene	Category III carcinogen which was formerly widely used in urinal fragrance blocks. Less hazardous alternatives have been developed and this ingredient has been largely substituted.	An EU risk assessment has concluded there are inadequate margins of safety for use in toilet blocks (and also moth repellants and air fresheners). Exposure of users cannot be adequately controlled to avoid significant risk. **Should not be used**
Aromatic hydrocarbons	Concerns exist over adverse human health effects with some examples but such materials have never featured significantly in I&I cleaning formulations.	Should only be used where necessary in specialist products, such as glue removers. **Use should be justified for specific applications**
Aliphatic hydrocarbons	Not widely used in I&I cleaning products except for gases, such as butane, used as aerosol propellants and liquids used in engineering and automotive cleaning. Such chemicals are insoluble in water and thus are poorly biodegraded in sewage treatment plants.	Use in engineering and automotive cleaning industries is declining and is expected to continue to do so. **Use should be justified for specific applications**
Halogenated hydrocarbons	Various concerns over health hazards and/or effects in the aquatic environment and the atmosphere. Their use is restricted to specialised cleaning applications (dry cleaning, cleaning of electronics).	Handling, use, exposure and disposal in specialised cleaning applications are already strictly managed to minimise health or environmental consequences. These have never been used in significant quantities in I&I cleaning. **Use should be justified for specific applications**

Guidance highlighted in amber means that there are important choices to be made.
Guidance highlighted in red means that these ingredients should not be used.

INGREDIENT	FUNCTION AND ISSUES	GUIDANCE FOR PROCUREMENT
Soap	The first synthetic surfactant - actually a type of anionic surfactant. No environmental or safety issues.	**Formulator should optimise during product design**
Zeolites	Often used with polycarboxylates as an alternative to phosphates in laundry detergent systems. Concerns are sometimes expressed that zeolites are not biodegradable.	As they are inorganic substances, biodegradability (breakdown into inorganic substances) is not a relevant concept. Assessments by TCDE and HERA found no risk for the environment. **Formulator should optimise during product design**
Polycarboxylates	Often used with zeolites as an alternative to phosphates in laundry systems. Poorly biodegradable.	Assessment by TCDE found that polycarboxylates are of low toxicity and extensively removed during sewage treatment by adsorption to sludge, thus posing no risk to the environment. **Formulator should optimise during product design**
Enzymes	Enzymes are biological molecules (proteins) that speed up the breakdown of organic dirt and stains such as fats, egg and sweat. They help get better cleaning out of less detergent. Enzymes are respiratory allergens posing hazards for workers during detergent manufacture. There is a separate perception that enzymes can cause skin irritation in consumers.	Environmentally beneficial due to reduced cleaning temperatures or bleaching agent usage. Encapsulation of enzymes and strict handling procedures during product manufacture avoid risks to workers. Despite the perception, studies consistently show enzymes in detergents do not cause skin irritation in users. **Formulator should optimise during product design**
Disinfectants / biocides	Disinfectants and biocides control and/or destroy harmful organisms that are detrimental to human or animal health. Their nature and mode of action raises instinctive concerns about human safety and environmental fate.	Only biocidal active ingredients approved under EU Biocidal Products Directive (98/8/EC) will be able to be used in disinfectant products. The BPD harmonises the European market for biocidal products and provides a high level of protection for humans and the environment. **Only ingredients that continue to be supported under the BPD should be used**
Optical brighteners	Optical Brightening Agents (OBAs) are used in detergents to maintain brightness and counter yellowing of fabrics with age, thus prolonging life. There are concerns that they are poorly biodegradable and little degraded in sewage treatment works. It is sometimes suggested they may be potentially bioaccumulating.	The OBAs used in detergents are partly removed in sewage works by adsorption to sludge. The remainder degrades in the aquatic environment, notably by photodegradation followed by biodegradation of the initial breakdown products. They are water soluble so will not bioaccumulate. Environmental monitoring studies and HERA risk assessments show no risk for the environment. **Formulator should optimise during product design**
Perfumes, including phthalates & musks	Perfumes are used at low levels (<1%) in cleaning products. Concerns are sometimes expressed about the biodegradability, potential bioaccumulation or endocrine disrupting potential of particular ingredients used in such perfumes, including phthalates and musks. Phthalates are used as solvents for other perfume ingredients and musks provide important components of many aromas.	Some components of perfumes are poorly biodegradable and potentially bioaccumulative. Certain ingredients that may pose a risk (e.g. nitro-musks) have been, or are being, phased out. The principal polycyclic musks have been shown by HERA risk assessments and SCCP opinions to be safe for both human health and the environment. Cleaning products account for an extremely small proportion of total phthalate use and exposure. The phthalates used (mainly diethyl phthalate) have been assessed by the SCCP as safe for use in cosmetics and use in cleaning products should pose no significant risks. **Nitro-musks in products should be substituted**
Alkylphenol ethoxylates (APEs)	A class of nonionic surfactants once used in high volumes (particularly nonylphenol and, to a lesser extent, octylphenol ethoxylates, NPEs and OPEs) in I&I applications. Biodegradation releases alkylphenols which can disrupt hormones in fish (an oestrogenic effect).	Severe restrictions on NP and NPEs for cleaning products and applications under the Marketing & Use Directive 2003/53/EC. UK industry Voluntary Agreement prior to restrictions coming into force to substitute these and not promote OP and OPEs as replacements. **Cleaning products containing APEs should not be used**
Preservatives	As preservatives are used to control bacterial spoilage, concerns are raised over toxicological properties and environmental fate.	Preservatives are necessary to protect products from spoilage due to natural ageing throughout the declared shelf-life. As with biocides and disinfectants, preservatives must be approved under the Biocidal Products Directive. **Only ingredients that continue to be supported under the BPD should be used**
Colouring agents	There are concerns that some dyes and pigments may release carcinogenic materials as they degrade.	Consumers' greatest exposure to these materials will be through textiles with a tiny proportion coming from cleaning chemicals. Colouring agents are a vital form of product recognition and spill identification. The dyes used in cleaning products must be stable for several years which limits choice substantially. Cosmetic, Pharmaceutical and Food colouring agents undergo stricter safety assessment and so should be favoured where a stable material is available. **Formulator should optimise during product design**
VOCs (Volatile Organic Compounds)	VOCs are most commonly used in cleaning products as solvents. Certain VOCs can react with air pollutants (typically from cars) to form more hazardous materials, such as ozone. Concerns are sometimes expressed about effects of VOCs in indoor air on health.	Solvents are used in low quantities in janitorial products and generally limited to ready-to-use products (such as aerosols). Low VOC products should be favoured. Government studies find no evidence of adverse health effects of VOCs from cleaning products in indoor air. **Low VOC products should be preferred where possible**
Glycol ethers	Used as solvents to help remove oils, fats and grease. Concerns over adverse health effects and their status as VOCs.	Adverse health effects are restricted to particular chemical structures which are not used in cleaning products. EU and HERA risk assessments for one of the main types used in cleaning products finds this poses no risk for health or the environment. **Formulator should optimise during product design**

Natural v. Synthetic

It is a common misconception that an ingredient from a plant or other naturally-derived source will necessarily be superior in terms of human safety, biodegradability, aquatic toxicity and sustainability than one from a petrochemical source.

Vegetable oil raw materials are already extensively used by cleaning product manufacturers. Although 'green purchasing' criteria sometimes specify 'naturally' based materials, each ingredient must be assessed on its individual merit, and on how it affects the sustainability of the whole formulation, not simply on whether it is from a plant-derived or petrochemical source.

To illustrate:

- In terms of sustainability, the energy used in processing and transport must be assessed for each material. The fossil fuel consumed in providing some 'renewable' materials can be very substantial. Plantations to grow palm trees and coconuts, for example, to provide vegetable oil raw materials take a great deal of space. Clearing rainforest to create new plantations can be highly unsustainable and damage biodiversity. Of the land currently used for growing non-food crops it is not necessarily clear which crops, such as those providing biofuels or feedstocks for chemical factories, will offer the best returns in terms of improving sustainability and preserving petroleum resources.

- Essentially all 'natural' ingredients that could be used in cleaning products involve some element of chemical processing. Many synthetic ingredients have been developed to be better performing, and thus potentially more sustainable, versions of natural substances.

- Plants and trees naturally produce many compounds that are hazardous and have other characteristics which would be regarded as an undesirable trait for a cleaning product ingredient. For example, some garden plants contain natural toxins to guard against being eaten and are very poisonous to humans. Some natural substances produced by plants are highly poisonous to fish and could be environmentally very damaging if released in the wrong place. Many chemicals found in nature would not meet the standards of biodegradability now required of surfactants in cleaning products and some would be classified as having the potential to bioaccumulate.

Safety and Risk Assessment

All substances, including common chemicals such as salt, vinegar, and even water, can be harmful to humans and other organisms given a sufficient dose. Understanding a chemical's hazards is important when handling the neat chemical, but assessing whether these hazards will pose a risk when the chemical is used as an ingredient in a product requires many other factors to be taken into account.

Risk assessment works out whether products will be safe to use by comparing the foreseeable exposure to the product and its ingredients with the levels at which these could potentially cause harm. The difference between the potential exposure and the maximum safe dose is known as the 'margin of safety'. Even though risk assessments may show products are safe, favouring materials with higher margins of safety is an important part of product design.

The technical guidance on ingredients, on pages 6 and 7, has drawn as far as possible on detailed risk assessments and opinions on safety which have been undertaken and published by the following:

- The EU Existing Chemicals programme
- The EU Scientific Committee on Consumer Products (SCCP)
- The UK's Technical Committee on Detergents and the Environment (TCDE)
- The Human and Environmental Risk Assessment project (HERA)

Further information can be provided on request.

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