Conseil
Supérieur de la Santé

PUBLICATION DU CONSEIL SUPERIEUR DE LA SANTE N° 9108

L'exposition humaine aux substances caustiques et/ou corrosives (acides et bases)

In this scientific advisory report on public health policy, the Superior Health Council of Belgium provides an overview of products that are authorized in Belgium for consumer use and that contain caustic substances, as well as of the risks linked to exposure to these products.

This report aims at suggesting protection measures for consumers, and formulates recommendations that apply to the different stages of the chain that begins with the formulation of the product, followed by its regulation/marketing/application and post-application and ends with its monitoring.

Version validée par le Collège de
4 novembre 2015[1]

Résumé

Cet avis a été émis en réponse à une série d'incidents de brûlures qui ont été signalés au Centre Antipoisons belge et qui ont été causés par un agent de nettoyage contenant des détergents et de l'hydroxyde de potassium. La ministre a alors demandé au Conseil Supérieur de la Santé (CSS) d'émettre un avis sur les risques sanitaires posés par les acides et les bases. Les questions soumises au CSS étaient les suivantes :

- Quelles bases et quels acides ou mélanges de ces substances entraînent un risque inacceptable pour la santé publique lorsqu'ils sont vendus au grand public, compte tenu des incidents qui sont ou pourraient être signalés au Centre Antipoisons?
- Outre la manière dont ces substances ou mélanges sont actuellement commercialisés (conformément à la législation en vigueur), quelles mesures et conditions complémentaires recommandez-vous pour leur vente au grand public afin de réduire à un niveau acceptable les risques posés par ces acides et bases? La demande précise en outre que le CSS tienne également compte de leurs propriétés dangereuses connues, des risques qu'ils impliquent en fonction de leur concentration, de l'utilisation prévue et de la manière dont ils sont appliqués.

Le Conseil a décidé d'étendre l'avis aux substances caustiques. Les substances caustiques (telles que les acides et les bases) sont couramment utilisées par les consommateurs pour toute une panoplie d'applications. Certaines sont des biocides appartenant au groupe des désinfectants (types de produits (TP) 1-4) et sont utilisées dans le cadre de l'hygiène humaine, comme désinfectants et produits algicides, pour l'hygiène vétérinaire et pour le traitement de surfaces en contact avec les denrées alimentaires et les aliments pour animaux. De nombreux autres produits caustiques sont également disponibles pour le grand public.

[1] Le Conseil se réserve le droit de pouvoir apporter, à tout moment, des corrections typographiques mineures à ce document. Par contre, les corrections de sens sont d'office reprises dans un erratum et donnent lieu à une nouvelle version de l'avis.

Cet avis propose un aperçu des autres produits à base de substances caustiques autorisés en Belgique pour un usage par le consommateur. Ces produits peuvent être définis en fonction de leur utilisation comme des produits d'entretien pour piscine, nettoyants/lustrants, déboucheurs, dégraissants/ nettoyants pour vitre de poêle/nettoyants pour roues et camions, décapants (détartrants/agents anticalcaires, décapants de peinture, antirouille et agents de gravure), des produits cosmétiques/d'hygiène personnelle (défrisants, peroxyde d'hydrogène et primers pour les ongles), eau de javel/désinfectants (produits contenant des sels d'hypochlorite, des composés d'ammonium quaternaire, du peroxyde d'hydrogène, du glutaraldéhyde et du formaldéhyde), des agents utilisés dans les piles, des produits chimiques couramment disponibles, des produits dérivés du ciment et de la chaux.

Les produits à base d'agents caustiques peuvent être dangereux en raison de leurs effets sanitaires sur la peau, les yeux, l'appareil digestif et l'appareil respiratoire ainsi que leurs conséquences pour le système nerveux après une exposition cutanée, une ingestion ou une inhalation. Ils peuvent être classés comme corrosifs ou irritants selon leur pouvoir irritant/corrosif, qui est fonction de leur concentration en acides ou en bases.

Plusieurs facteurs sont impliqués dans le risque d'exposition à des produits caustiques, par exemple la quantité, le type de formulation, la fréquence d'application et l'utilisation d'équipements de protection individuelle (EPI), tels que des vêtements, des gants, des lunettes de protection, etc. Les données sur l'épidémiologie des expositions et brûlures caustiques ne sont que très fragmentaires. Une étude exploratoire a été réalisée par le Centre Antipoisons au cours des 6 premiers mois de 2016. En outre, un petit sondage a été réalisé dans les 6 centres de brûlés belges. La conclusion en est qu'en 2014, quelque 1 250 consultations ont été enregistrées au Centre Antipoisons pour des expositions à des substances caustiques, bien que qu'il s'agisse sans doute d'une sous-estimation. Aucun cas de symptômes mortels ou potentiellement mortels n'a été enregistré, mais cela pourrait être dû à un biais dans les appels au Centre Antipoisons, comme le suggèrent les données des centres de brûlés. Quelque 20 % des cas analysés par le Centre Antipoisons concernaient l'exposition d'un enfant, tandis que dans 75 % des cas, il s'agissait d'accidents impliquant des consommateurs non professionnels. Les cas dans lesquels des bases étaient en cause étaient nettement plus fréquents que ceux impliquant des acides. Chez les adultes, l'exposition cutanée ou oculaire était la plus fréquente. Chez les enfants, l'exposition orale était prépondérante. Les données obtenues auprès du Centre Antipoisons et des centres de brûlés mènent à la conclusion que les brûlures caustiques constituent un véritable problème de santé publique du fait de leur fréquence, mais aussi de leur gravité.

Les mesures de protection englobent des recommandations formulées pour les différentes étapes de la chaine dont la formulation du produit constitue le premier maillon et sa surveillance le dernier, en passant par la réglementation/commercialisation/application et post-application.
Il s'agit notamment des bonnes pratiques en matière d'étiquetage, une meilleure information sur les risques pour l'utilisateur, des meilleures techniques d'application, la prévention des mauvais usages et la stimulation de la sensibilisation des consommateurs.

Keywords and MeSH *descriptor terms*[2]

MeSH terms*	Keywords	Sleutelwoorden	Mots clés	Schlüsselwörter
“human exposure”	human exposure	menselijke blootstelling	exposition humaine	menschliche Exposition
“caustics”	caustic substances	bijtende stoffen	substances caustiques	kaustische Stoffe
	corrosive substances	corrosieve stoffen	substances corrosives	ätzende Stoffe
“acids”	Acids	Zuren	acides	Säuren
“bases”	Bases	Basen	bases	Basen
“alkalies”	Alkalis	alkaliën	alcalis	Alkalien
“burns, chemical”	chemical burns	chemische brandwonden	brûlures chimiques	Chemische Brandwunden

MeSH (Medical Subject Headings) is the NLM (National Library of Medicine) controlled vocabulary thesaurus used for indexing articles for PubMed http://www.ncbi.nlm.nih.gov/mesh.

[2] The Council wishes to clarify that the MeSH terms and keywords are used for referencing purposes as well as to provide an easy definition of the scope of the advisory report. For more information, see the section entitled "methodology".

CONTENTS

ABBREVIATIONS AND SYMBOLS

ADR	*Accord européen relatif au transport international des marchandises dangereuses par route*
ARAB	*Algemeen Reglement voor de Arbeidsbescherming*
BIT	Benzisothiazolinone
BPC	Belgian Poison Centre
CAB	*Comité voor Advies inzake Biociden* (Advisory Committee on Biocides)
CAS	Chemical abstracts service
CLP	Classification, labelling and packaging of substances and mixtures
CMIT	Chloromethylisothiazolinone
CNS	Central nervous system
CPAP	Continuous Positive Airway Pressure
CR	Neoprene
DDAC	Didecyldimethylammoniumchloride
DMSO	Dimethyl sulfoxide
DPD	Dangerous preparations directive
ECHA	European Chemicals Agency
ENT	Ear, Nose and Throat
EU-OSHA	European Agency for Safety and Health at Work
FPS HFCSE	Federal Public Service Health, Food Chain Safety and Environment
HCL	Harmonised classification and labelling
HF	Hydrofluoric acid
m/v	mass per volume
MIT	Methylisothiazolinone
OIT	Octylisothiazolinone
PBT	Persistent, bioaccumulative and toxic
PPE	Personnel Protective Equipment
PSS	Poisoning Severity Score
PT	Product Type
PVC	Polyvinyl chloride
NR	Natural rubber
RAC	Risk Assessment Committee
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals
RD	Royal Decree
RGPT	*Règlement Général pour la Protection du Travail*
RTU	Ready to use
SHC	Superior Health Council
TAR	Titratable acid or alkaline reserve
TNsG	Technical notes for guidance
vPvB	Very persistent and very bioaccumulative

1. INTRODUCTION ET QUESTIONS

Cet avis a été établi en réponse à une série d'incidents de brûlures qui ont été signalés au Centre Antipoisons belge et qui ont été causés par un agent de nettoyage contenant des détergents et une concentration élevée en hydroxyde de potassium. A l'époque, la ministre de la Santé publique a soumis au CSS une demande urgente d'avis sur cette problématique. En raison de l'urgence de cette demande, le Conseil a alors limité la portée de son avis au produit en question. Cet avis se fondait exclusivement sur les données du Centre Antipoisons (CSS 2012). La conclusion relevait en outre qu'en ce qui concerne des mesures analogues pour des produits similaires, un nouvel avis du CSS sur cette problématique devrait être plus complet. La ministre a ensuite demandé au CSS d'émettre un avis sur les risques sanitaires posés par les acides et les bases.

Les questions soumises au CSS étaient les suivantes :

- Quelles bases et quels acides ou mélanges de ces substances entraînent un risque inacceptable pour la santé publique lorsqu'ils sont vendus au grand public, compte tenu des incidents qui sont ou pourraient être signalés au Centre Antipoisons?
- Outre la manière dont ces substances ou mélanges sont actuellement commercialisés (conformément à la législation en vigueur), quelles mesures et conditions complémentaires recommandez-vous pour leur vente au grand public afin de réduire à un niveau acceptable les risques posés par ces acides et bases? La demande précise en outre que le CSS tienne également compte de leurs propriétés dangereuses connues, des risques qu'ils impliquent en fonction de leur concentration, de l'utilisation prévue et de la manière dont ils sont appliqués.

Le Conseil a également décidé d'étendre l'avis aux substances caustiques. Une substance caustique est un xénobiotique qui induit des dommages tant fonctionnels qu'histologiques en cas de contact avec les surfaces tissulaires (Goldfrank et al., 2013). Une certaine confusion règne quant aux termes « caustique » et « corrosif » : alors que certaines publications utilisent le terme « caustique » exclusivement pour désigner une exposition à des substances alcalines, ces deux termes sont généralement considérés comme similaires.

De même, l'utilisation des termes « alcalin » et « base » est empreinte d'une certaine confusion. Le terme « alcalin » est le plus courant, mais sur le plan scientifique, le terme « base », qui désigne une molécule capable de capter des protons, est à préférer. Le terme « base » est dès lors plus approprié dans le contexte de l'évaluation de l'exposition aux produits caustiques/corrosifs.

2. FURTHER DETAILS AND ARGUMENTATION

2.1 Methodology

After analysing the request, the Board and the Chair of the working group identified the necessary fields of expertise. An *ad hoc* working group was then set up which included experts in the following fields:

- staff from the BPC and Burns Centres;
- scientists with expert knowledge in dermatology, ophthalmology, pulmonology, risk analysis and occupational health and safety.

The experts of this working group provided a general and an *ad hoc* declaration of interests and the Committee on Deontology assessed the potential risk of conflicts of interest.

Also experts on the licensing procedures of these products (Advisory Committee on Biocidal Products (CAB), FPS HFCSE - DG Environment) were consulted.

This advisory report is based on a review of the scientific literature published in both scientific journals and reports from national and international organisations competent in this field (peer-reviewed), as well as on the opinion of the experts.

Once the advisory report was endorsed by the working group and by the standing working group "Chemical agents", it was ultimately validated by the Board.

2.2 Elaboration

1. The licensing and regulation of biocides that contain acids and bases

Licensing of products containing acids and bases depends on the fact if they are classified as biocides or not. The licensing policy for products classified as biocides is considerably more stringent than that for products which do not fall into this category. In fact, the issue of biocides with caustic substances and the question whether or not these products should be available to the general public does not really pose a problem with their registration, or at any rate, a much less significant one than the marketing of other substances with corrosive properties.

The conditions for granting an authorisation to a biocidal product (regardless of the product family the biocide belongs to) are described in Article 19 of the Biocidal Products Regulation (Regulation (EU) No. 528/2012). The conditions for granting an authorisation are the same for all product families to which biocides may belong. Point 4 of this article specifically mentions the criteria that a product intended for the general public must comply with. These criteria have been incorporated in the Royal Decree (RD) of 8 May 2014 (*Koninklijk Besluit van 8 mei 2014).* Indeed, as regards biocidal products, a system has been set up by the RD of 8 May 2014 concerning the placing on the market and use of biocidal products. The RD provides for the development of a system (registered circuit/free circuit) to replace the class-A system that had been laid down by the RD of 22 May 2003. Until the new system is in place, the class-A system will remain in effect. According to the existing class-A system, the access to biocidal products that have been assigned to one of the following danger categories of Directive 1999/45/EC of the European Parliament and of the Council of 31 May 1999 concerning the approximation of the laws, regulations and administrative provisions of the Member States relating to the classification, packaging and labelling of dangerous preparations (DPD – “Dangerous preparations directive”), viz.

- very toxic;
- toxic;
- carcinogen category 1 and 2;
- mutagen category 1 and 2;
- toxic for reproduction category 1 and 2;

shall be restricted to licensed sellers and licensed users, in other words they shall not be available to the general public. In addition, the CAB can always consider that for other nonbiocidal products too (including corrosive products), the exposure of non-professional users should be reduced e.g. by wearing personal protective equipment, and that these products too shall therefore be classified as class-A products.

Any product that requires greater protective measures than, e.g. wearing ordinary gloves (gardening gloves, kitchen gloves) shall automatically be restricted to professional users. If additional measures need to be taken to reduce the risk of exposure, such as wearing a face mask, specific gloves, etc., the product becomes a class-A product and shall no longer be available to the general public. These products shall only be sold by registered sellers, who may only sell them to licensed users or to certain professionals.

According to this new system applied in Belgium, biocidal products shall be assigned to a registered or a free circuit based on their risk assessment. This is essentially an extension of the existing class-A system.

Biocides shall be assigned to the registered circuit if:

- The biocidal product meets the criteria of Directive 1999/45/EC to be assigned to one of the following categories:
    - very toxic or toxic;
    - carcinogenic, category 1 and 2;
    - mutagenic, category 1 and 2;
    - toxic for reproduction, category 1 and 2.
- The biocidal product meets the criteria of Regulation (EC) No. 1272/2008 to be assigned to one of the following categories:
    - acute oral toxicity, category 1, 2 or 3;
    - acute dermal toxicity, category 1, 2 or 3;
    - acute inhalation toxicity, category 1, 2 or 3;
    - carcinogenic, category 1A or 1B;
    - mutagenic, category 1A or 1B;
    - toxic for reproduction, Category 1A or 1B.
- The biocidal product meets the criteria of Regulation (EC) No. 1907/2006 to be considered PBT (persistent, bioaccumulative and toxic) or vPvB (very persistent and very bioaccumulative).
- The biocidal product displays endocrine disrupting properties or induces developmental neurotoxicity or immunotoxicity.
- Wearing personal protective equipment is necessary to reduce the exposure to the biocidal product to an acceptable level.

Yet exceptions are possible in cases where limitations on the use of the biocidal product in question could have significant adverse consequences for society.

Biocidal products shall only be assigned to the free circuit if, based on the risk assessment, the view is taken that no personal protective equipment is required when using the biocidal product.

Biocidal products that belong to the registered circuit may only be placed on the market by a registered seller and be used by a registered user. The RD sets out the criteria for registration. For biocides that belong to the free circuit, there are no conditions regarding their sale and use.

The RD also provides for the development of an online registration system.

These restrictions on biocidal product sellers and users, result in there being few corrosive biocidal products on the market that are available to the general public.

Most of the problems involving irritation/corrosiveness caused by the use of biocides by the general public mainly revolve around the use of the swimming pool disinfectants mentioned above and the use of quaternary ammonium compounds such as algaecides, or the use of hypochlorite-based household bleach products.

The list of authorised biocides with information on their classification, labelling and whether or not they belong to class A can be accessed via the following web site: http://www.health.belgium.be/eportal/Environment/Chemicalsubstances/Biocides/PublicationsBiocides/index.htm

Active substances with irritant/corrosive properties that are commonly found in biocidal products that are authorised on the Belgian market and which the general public may come into contact with, are listed in Table 1. In most cases, this concerns the active substances that are used in disinfectants (PT1-2-3-4-5) and algaecides (PT2). There are also quite a few irritant/corrosive substances that are added to water-based products as a means to preserve them. These substances (PT6) are used in very low concentrations, which lie well below the cut-off value for irritant/corrosive. The irritation/corrosion problems mainly concern the disinfectant (PT 1-2-3-4) and algaecide (PT2) groups. The legend of table 1 gives a more detailed description of the PTs that are concerned.

For biocidal products, the general rule is that only non-classified products or products that have been classified as harmful or irritant are authorised for use by the general public. As soon as a more stringent classification applies, the products shall only be intended for professional users and shall be assigned to class A based on the required protective measures.

Table 1: Active substances with irritant/corrosive properties (see also Appendix 1)

Active substance	PT1	PT2	PT3	PT4	PT5	PT6
Formaldehyde		X	X			X
Bronopol						X
Peracetic acid	X	X	X	X	X	X
Symclosene		X	X	X	X	
Glyoxal		X	X	X		
Glutaraldehyde		X	X	X		X
BIT (Benzisothiazolinone)						X
MIT (Methylisothiazolinone)						X
Sodium dichloroisocyanurate dihydrate		X	X		X	
DDAC (Didecyldimethylammoniumchloride)	X	X	X	X		
Sodium hypochlorite	X	X	X	X	X	
Hydrogen peroxide	X	X	X	X		
Calcium hypochlorite		X	X	X	X	
Chlorine dioxid		X	X	X	X	
OIT (Octylisothiazolinone)						X
Quaternary ammonium compounds, benzyl C12-C18 alkyldimethyl chlorides	X	X	X	X		
Quaternary ammonium compounds, benzyl C12-C14 alkyldimethyl chlorides	X	X	X	X		
Mixture of CMIT (Chloromethylisothiazolinone)/MIT						X

PT1: Biocidal products used for human hygiene purposes, applied on or in contact with human skin
PT2: Disinfectants and algaecides not intended for direct application to humans or animals
PT3: Biocidal products used for veterinary hygiene
PT4: Biocidal products used for the disinfection of materials which may enter into contact with food
PT5: Products for the disinfection of drinking water
PT6: Preservatives for products during storage

A survey of the properties of these products is given in Appendix 1.

2. The licensing and regulation of nonbiocidal caustic products

There are a lot of other irritant and corrosive products on the market not subject to the Biocidal Products Regulation. This means that in Belgium their use and corresponding risks are not very well regulated and are posing potentially problems for public health.

The major obligations for products destined for the general public regard the classification, labelling and packaging of dangerous substances and mixtures (Regulation 1272/2008). Irritant products shall bear an “irritant pictogram” (exclamation mark) whereas corrosive products shall bear a corrosive pictogram. Moreover, packaging containing corrosive products intended for consumers shall be fitted with child-resistant fastenings. There is the obligation for declaration to the BPC before marketing.

A new regulation on explosive precursors (Regulation EU 98/2013) introduces a concentration limit of 3 % of nitric acid in consumer products. There is currently no other general restriction at European or national level for corrosive products intended for general public.

3. Non exhaustive survey of the products on the Belgian market containing acids and bases and potentially leading to chemical burns

a. Algae removers

Because these products are well regulated by the Biocidal Products Regulation the problems with these products are minor. As regards algaecides, the quaternary ammonium compound concentrations used always reside on the borderline between irritant and corrosive. Algaecides can be applied by spraying with a handheld pressurized sprayer or with a watering can.

Simply applying such ready-to-use applications with a watering can usually does not pose any problem, unless the clothing gets soaked. This can happen through spilling the product from the watering can or through leakage or tube failure when using a backpack sprayer. However, when they are sprayed, there may also be irritation of the respiratory tract depending on the size of the droplets.

b. Swimming pools agents

Swimming pool maintenance products are typically highly concentrated products as they are used to treat big volumes of water. The most relevant products in this respect are products to adjust the pH and hypochlorite containing products. The latter are discussed below under “g. Bleach/Disinfectants - i. Products containing hypochlorite salts”. The pH increasing agents may contain sodium hydroxide (liquid, up to 50 %) or sodium carbonate (solid, 100 %). The pH decreasing agents do exist as well in solid (sodium hydrogen sulfate, up to 100 %) and liquid (sulfuric acid, > 50 % or hydrochloric acid, up to 16 % respectively) formulation.

Swimming pool disinfectants intended for the treatment of private pools are irritant products that contain sodium dichloroisocyanurate or trichloroisocyanurate and are sold in granular or tablet form. The CAB grants exceptions for these products because there are no other disinfectants available for such pools. Making them unavailable for the general public is hardly advisable from a health perspective.

For these swimming pool disinfectants, the main problem is posed by the inhalation of irritants upon opening the packaging. The tablets or granules are often packed in plastic containers. When

the latter are opened, chlorine fumes or dust particles are released and may be inhaled, with all the attendant consequences. One possible solution are e.g. single tablet packages.

c. Drain cleaners

Chemical drain cleaners are the most dangerous products that are found in households. As they serve to dissolve clogs in drains, they have to be caustic and thus by definition they are dangerous to human tissue.

The classic and most prevalent drain cleaners on the Belgian market are alkaline products based on sodium hydroxide or exceptionally potassium hydroxide. They exist in liquid and in solid formulations in concentrations up to 50 % and 100 % respectively. They can dissolve proteins and fats via alkaline hydrolysis. The dissolution or the dilution of sodium hydroxide yields a lot of heat, which can even make the water in the drain boil. If pressure can build up, this can lead to a geyser effect. Apart from these strong bases, less concentrated alkaline drain cleaners can contain up to 10 % sodium hydroxide and up to 1 % ammonia.

Acid drain cleaners are usually based on sulfuric acid in a concentration of 50 up to 99 %. They act by acid hydrolysis of proteins, fats and carbohydrates. These formulations are intended for professional use and bear the term “industrial” or “professional” in their name. According to REACH (Registration, Evaluation, Authorisation and Restriction of Chemicals), this is described in the registration dossier of substances and should normally be used for this purpose only. However no restriction exist for these formulations that can also be made available to the general public if the correct description exists in the registration dossier. It is to be noted that the term “industrial” or “professional” can be a marketing argument as there is a general believe that they are more efficient. Rarely, acid drain cleaners contain nitric acid or hydrochloric acid. This kind of products which are based on nitric acid will however gradually disappear from the market (Regulation (EU) 98/2013 on explosives precursors).

Biological drain cleaners are based on the action of enzymes or bacteria to declog. They have no known caustic effects. Their effect is not so pronounced as and slower than that of chemical drain cleaners, but they can be considered as possible safer alternatives.

d. Degreasing agents / stove glass cleaners / wheel and truck cleaners

Degreasing agents for barbecues and ovens can contain enzymes, solvents, detergents but many of them contain alkaline substances like ethanolamine, potassium hydroxide or sodium hydroxide up to 25 %. They are sold in liquid formulations, sometimes with a spray mechanism.

Stove glass cleaners are typically liquid formulations, mostly with a spray mechanism, to clean stove glasses. They may contain solvents, detergents and alkaline substances like ethanolamines, sodiumhydroxide and potassiumhydroxide up to 12 %.

Degreasing wheel and truck cleaners typically contain strong detergents and solvents, but may contain bases like sodium hydroxide, potassium hydroxide, trisodium nitrilotriacetate or metasilicates. In some cases, these products can be very concentrated, e.g. potassium hydroxide up to 25 %. Wheel rim cleaners can also contain anticorrosive substances like hydrofluoric acid (see e.iii. Rust removers and etching agents).

e. Removers

Removers are products that are used to remove substances from surfaces and thus cleaning them.

i. Lime scale removers / Descaling agents

Chemical descaling agents have multiple applications: percolators, water heaters, sanitary installations, etc.

Chemical descaling agents are acid based liquids or solids to remove lime scale. Depending on the trade mark and on the application, they can be rather innocuous or very aggressive. The composition is diverse. Solid formulations typically contain weak acid like citric acid and sulfamic acid and are sold as effervescent tablets or powder. Liquid formulations ready-to-use can contain from about 10 % of a variety of weak acids like citric acid, lactic acid or sulfamic acid but can go up to 20 % of stronger acids like formic acid, phosphoric acid and hydrochloric acid. The more aggressive heavy duty descalers (household cleaners in general) seem to be increasingly promoted to the general public. These product are sometimes sold in bottles with a spray mechanism.

Professional products can contain higher concentrations of acids, e.g. 50 % of phosphoric acid. In professional products for specific applications, such as explosive precursors, one can also encounter solutions containing up to 30 % of nitric acid. The SHC mentioned in an previous advisory report (SCH, 2010) that, following a risk assessment carried out by Germany (BfR Opinion, 2010) products with a HNO_3 content of more than 20 % are not acceptable for use in the home, garden and kitchen. It should be advisable to do this also for professional use.

ii. Paint strippers

Caustic paint strippers are liquid formulations that contain up to 30 % of sodium hydroxide or potassium hydroxide. They act by decomposing the chemical bonds in certain types of paint.

Solvent based paint strippers act by softening and swelling of the paint thereby making the removal easier. Solvent based paint strippers nowadays contain mixtures of solvents including aliphatic hydrocarbons, acetone, alcohols, ethyl- of butylacetate, N-methylpyrrolidone, dimethylformamide, dimethyl sulfoxide (DMSO), gamma-butyrolactone, dioxolane, butylterpene solvents, aromatic solvents and the newer dibasic esters. Most of these solvents may cause skin irritation and even first degree skin burns in case of prolonged contact.

iii. Rust removers and etching agents for metal or glass

Caustic chemicals that can be found in rust removers and products to etch or clean metal include phosphoric acid up to 60 %, hydrochloric acid up to 25 % and weaker acids like oxalic acid or citric acid.

A special point of attention is hydrofluoric acid (HF). In everyday uses, it can be found in concentrations of up to 40 % in products to remove rust (wheel and rim cleaner, inox and aluminum cleaner), to etch or polish glass and as a façade cleaner. As no restriction currently exists under REACH, it can be accessible to consumers. It can also be found under the form of ammoniumbifluoride in combination with an acid. HF behaves like a weak acid in commonly used dilutions. Because it is mostly undissociated, it readily penetrates the skin before complexing with calcium causing destruction of deep tissue layers up to the bone. Pain and visible damage can be delayed for hours which leads frequently to underestimation of the lesions. Important exposures can lead to loss of fingers or death.

f. Cosmetic/Personal Hygiene Products

i. Hair straighteners

Hair straightener (relaxer) is used to chemically relax curly hair. Typical products can contain up to 7 % of calcium hydroxide in the final, mixed product and can have a pH up to 12.7 ("Cosmetics Regulation" (EC) No 1223/2009. Annex/Ref III/15c.) Alternatively sodium and lithium hydroxide are allowed in products for this same application ("Cosmetics Regulation" (EC) No 1223/2009.ref IIi/15a and b respectively). Concentrations up to 2 % and up to pH 12.7 are allowed in the non-professional products. If not properly washed out after use, these products can lead to severe burns and permanent baldness. If there is contact with the eyes, this can lead to severe eye burns.

ii. Hydrogen peroxide

Hydrogen peroxide is also used in cosmetic formulations such as hair bleach. The maximally allowed concentration in hair bleaching products is 12 %. Burns due to the use of hydrogen peroxide as hair bleach are sometimes described.

iii. Nail primers

Nail primers are used to get better adhesion of artificial nails onto one's own nails. These products can contain up to 100 % methacrylic acid and are thus caustic.

g. Bleach/Disinfectants

i. Products containing hypochlorite salts

Hypochlorite salts can be used as a bleaching or a disinfectant agent.

These so-called bleach products are usually classified as irritant and not as corrosive. The reason is that in this case too, the levels of active ingredient lie just below the boundary beyond which they would have been classified as corrosive. Problems with bleach products are sometimes the result of their being used in combination with acids, with chlorine gas release as a corollary.

Household bleach and sanitary cleaning agents contain up to 5 % of sodium hypochlorite and are typically stabilized with sodium hydroxide. The final pH of these products typically varies between 11 and 12, but in some cases they can reach a pH of 13. They behave like irritants in case of short contact, but may cause burns in case of prolonged contact. In case of accidental ingestion, they give rise to minor problems only, e.g. transient vomiting. There are also concentrated products (up to 10.5 % sodium hypochlorite) on the market that have to be diluted before use. The risk of burns is consequently higher.

The sodium and calcium salts of dichloroisocyanuric acid can be used to generate sodium hypochlorite when mixed with water. It is typically marketed in tablet form, sometimes as granules. The resulting bleach is less alkaline than ordinary ready to use bleach, but in case of misuse, they can lead to more concentrated solutions that are still corrosive because of the high hypochlorite content. The accidental ingestion of (part of) a tablet can cause burns of the digestive tract because of the extreme high concentrations that are reached locally.

A few biocidal products based on hypochlorite are available to the general public. These anti-mould products contain hypochlorite concentrations similar to household bleach, but they can contain around 1 % of sodium hydroxide with a final pH of 13.5. Also some algae removers contain hypochlorite in high concentrations which have to be diluted before use.

ii. Quaternary ammonium compounds

See the section 3.h on "Detergents".

iii. Hydrogen peroxide

Hydrogen peroxide and compounds that release hydrogen peroxide can be used as bleaching agents or weak disinfecting agents. The most typical application is as a stain remover for laundry. They are sold most often in liquid formulations that may contain up to 15 % of hydrogen peroxide combined with detergents, enzymes, etc. Very often, the bottle is supplemented with a spray mechanism. Alternatively they come in a powder formulation containing up to 90 % of sodium percarbonate, sometimes combined with sodium carbonate or other agents.

Hydrogen peroxide has two main toxicity mechanisms: local tissue injury and gas formation. Diluted hydrogen peroxide is an irritant. Concentrated hydrogen peroxide is a caustic. Ingested hydrogen peroxide is rapidly decomposed into water and oxygen. Ingestion of concentrated hydrogen peroxide can be life-threatening due to tissue destruction and gas embolization.

iv. Glutaraldehyde and formaldehyde

Glutaraldehyde and formaldehyde are mostly present in professional products only. Formalin solutions are however available to the general public and can be caustic. The situation with formaldehyde will evolve in the future since it did receive a new harmonized classification as carcinogen of category 1B, this new classification entered into force from 1st December 2014 for substances and from 1 June 2015 for mixtures. This directly implies that formaldehyde will be no longer available for the general public as a substance or in a mixture (additional 6 months of time to adapt annex XVII of REACH).

h. Detergents

The classic anionic and nonionic detergents in general can be considered as not caustic. In concentrated formulations however, they can cause corneal ulceration, probably because of the strong detergent effect. These accidents are outside the scope of this study.

For special applications, e.g. terrace cleaners, detergents can be combined with up to 15 % of strong bases, e.g. potassium hydroxide. In that case the detergent preparation does become caustic.

Cationic detergents are quaternary ammonium compounds used in disinfectants and anti-moss formulations. If RTU (ready to use), they can contain from 0.1% (e.g. hand washing gel) up to 2 to 5% of quaternary ammonium compounds for surface disinfecting or anti-moss applications. Formulations that have to be diluted can contain higher concentrations for which they become clearly corrosive. They are labelled accordingly.

i. Agents used in batteries

A detailed discussion of battery chemistry is out of the scope of this text. Most accidents with batteries provide not enough caustic substance to cause significant burns. The only significant battery type in this context is the classic lead acid battery. The electrolyte solution inside contains 30 to 45 % of sulfuric acid which can be dangerous in case of splashes, e.g. in case of filling the battery up or dismantling the battery.

j. Commonly available chemicals

A lot of commonly available chemicals can be bought in do-it-yourself stores or in more specialized chemist's stores. Some of them are caustic agents: e.g. hydrogen chloride, ammonia, sodium hydroxide, formic acid.

k. Products derived from cement and lime

Cement and lime have numerous applications in construction. Both quicklime (CaO) and cement are prepared by calcination. For most applications, quicklime which is a caustic solid, is converted to slaked lime ($Ca(OH)_2$), e.g. for use in lime plaster or lime mortar. Both cement and slaked lime give rise to an aqueous slurry with a pH close to 13. Prolonged intense contact with wet cement or lime can lead to very severe caustic burns that can extend to the bone (Peters, 1984; Early and Simpson, 1985). A typical situation is kneeling on wet cement. Dry cement or lime is less dangerous (e.g. see site of EU-OSHA (European Agency for Safety and Health at Work) https://osha.europa.eu/en).

4. Classification of corrosive or skin irritant products containing acids or bases

A caustic is a xenobiotic that causes both functional and histological damage on contact with tissue surfaces (Goldfrank et al., 2013). The injury is incurred as neutralisation of the substance takes place at the expense of the tissues, releasing heat and inducing burns. The extent of injury is determined by duration of contact; ability of the substance to penetrate tissues; volume, pH of the solution and concentration of the agent; and a property known as titratable acid or alkaline reserve (TAR). TAR defines the volume of neutralising substance needed to bring the pH of a caustic to that of physiologic tissues. The larger the TAR is, the more caustic the agent.

An acid is a proton donator and causes significant injury, generally at a pH below 3. An alkaline agent is a proton acceptor with significant caustic injury generally occurring at a pH above 11.

Even agents with a pH between 3 and 11 can cause severe burns due to molecular properties of the substance and its TAR. Both zinc chloride and phenol are examples of caustics with a near physiologic pH (Rao & Hoffman, 1998).

Classification of chemicals is commonly made on the intrinsic hazard properties. Regulation 1272/2008 on classification, labelling and packaging replaces the former European Directives 67/548 and 1999/45 (implemented in Belgian law in ARAB-RGPT (*Algemeen Reglement voor de Arbeidsbescherming, Règlement général pour la protection du travail*) article 723 bis). Dangerous substances are classified according to the degree of hazard and the nature of this hazard. Hazard phrases H314, H315, H318 andH319 are referring to irritants and corrosives.

ADR (*Accord européen relatif au transport international des marchandises dangereuses par route* - European Agreement Concerning the International Carriage of Dangerous Goods by Road, 2012) also identifies "corrosive substances" in class 8. Distinction of caustic agents can also be made on the state of matter (gas, liquid, solid or plasma) or most typically classified as acids or bases.

5. Toxicology

a. Toxicology by system

i. Dermal health effects

The most common effect of accidental caustic exposure is dermal chemical burns. Chemical burns follow standard burn classification and may cause extensive tissue damage (Hardwicke et al., 2012). Bases typically produce liquefaction necrosis which results in a transformation of the tissue into a liquid, viscous mass. As a result, penetration is only limited by the availability of OH^- ions. Bases can therefore penetrate very deeply. Acids on the other hand produce a coagulation necrosis, which results in a kind of crust, thereby limiting the penetration of the agent. Moreover, acid burns are felt more quickly than alkaline injuries, leading to immediate avoidance and a quick reaction (rinsing), resulting in shorter exposure. Therefore acids tend to cause less serious problems than bases.

ii. Ocular hazards

Ocular exposure from liquid splashes or corrosive aerosols can result in a chemical burn of the cornea and/or of the conjunctiva. This can be painful and cause corneal opacification with vascularisation. Keratoconjunctivitis sicca ('dry eye') can also occur as a long-term complication.

iii. Gastro-intestinal health effects

Alkaline agents cause tissue injury within seconds of ingestion, resulting in almost immediate pain. The histological injury is classically described as liquefactive, in which the agent saponifies the tissues, causing deep and progressive damage as it penetrates mucosal surfaces. This process results in immediate oedema of the mucosa and a subsequent inflammatory reaction extending of the submucosa and muscular layers of the oesophagus. Long-term results are ulceration and later on scar formation, clinically presented as stricture.

Acid ingestion gives similar presentation as those of bases. The burns are often seen in oesophagus as well in the antrum.

Following ingestion, acids can rapidly traverse the stomach mucosa and cause systematic acidemia

Classification:

- Grade I: hyperaemia or oedema of the mucosa
- Grade II: grade I + submucosal lesions, ulcerations and exudates
  Variable progression to stricture formation
  - Grade IIa: noncircumferential lesions, which rarely form strictures
  - Grade IIb: near-circumferential lesions with stricture formation
- Grade III: deep ulcers and necrosis into the peri-oesophageal tissues
  Progression to strictures and high risk for perforation

iv. Respiratory health effects

There is a recent trend to use more and more aerosol applications for consumer products (disinfectants, oven cleaners, rust removers, etc.). Although it is claimed that these formulations are user friendly, there is a potential hazard that very small droplets can persist in the air and can give rise to several side effects after inhalation.

Inhalation exposure to acids or bases can result in chemical/toxic pneumonitis. Asthma developing shortly after exposure to high concentrations of inhaled respiratory irritants reflects non-immunological mechanisms. (Knapp et al., 1991; Benomran et al., 2008; Ploner and Rentz, 2008; Chibishev et al., 2014)
This condition is described as reactive airways dysfunction syndrome (Kern, 1991; Hannu et al., 2012). Asthma occurring after repeated exposures to chemicals or gases (even lower concentrations) is called irritant-induced asthma or low-dose IIA.

v. *Central nervous system (CNS)*

CNS depression is described following exposure to antiseptics, disinfectants and related compounds as ethanol, isopropanol, formaldehyde, quaternary ammonium compounds and phenols.

b. Toxicology by product

Table 2. Toxicology by product

Chemical		CAS [1] N°	Domestic use	Toxic effects	Harmonised Classification [2]	Pictograms
Acids						
Sulfuric acid	H_2SO_4		Detergents, antifreeze.	Irritation up to burns of mucosa and skin, eyes and irritation of airways.	Skin Corr. 1A	
Hydrochloric acid	HCl			Irritation up to burns of mucosa and skin, eyes and irritation of airways	Skin Corr. 1B	
Hydrogen fluoride	HF		Etchant, cleaning agent.	Irritation up to burns of mucosa and skin, eyes and irritation of airways, nerve dysfunction, cardiac arrest.	Skin Corr. 1A	
Phosphoric acid	H_3PO_4		Rust inhibitor, food additive, dental etchant, dispersing agent, industrial etchant, detergents.	Irritation up to burns of mucosa and skin, eyes and irritation of airways.	Skin Corr. 1B	
Bases						
Potassium hydroxide	KOH		Detergent, cleaning agent, disinfectant, drain unblocker, paint stripper.	Irritation up to burns of mucosa and skin, eyes and irritation of airways.	Skin Corr. 1A	
Sodium hydroxide	NaOH		Drain unblocker, depilatory agents, hair decurler.	Irritation up to burns of mucosa and skin, eyes and irritation of airways.	Skin Corr. 1A	
Ammonia	NH_3		Detergent, paint stripper.	Irritation up to burns of mucosa and skin, eyes and irritation of airways.	Skin Corr. 1B	

Methylene chloride	CH_2Cl_2		Paint stripper, degreaser	Irritation up to burns of mucosa and skin, eyes and irritation of airways, CNS-effect on foetus, carcinogen. Both respiratory and dermal exposure can lead to fatal solvent induced narcosis (direct CNS-effect) and carbon monoxide poisoning due to metabolic degradation (http://www.ncbi.nlm.nih.gov/pubmed/2222600 http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1714874/pdf/brmedj00049-0023a.pdf).	No HCL [3] for corrosivity (just for H351). Some self-classification as Skin Irrit. 2	 
Quaternary ammonium compounds			Disinfectants, surfactants, fabric softeners, antistatic agents.	Mild skin and respiratory irritation up to severe caustic burns on skin, eyes and gastro-intestinal lining, coma, convulsions, hypotension.		
Quaternary ammonium compounds, benzyl-C8-18-alkyldimethyl, chlorides		63449-41-2			Skin Corr. 1B	
Quaternary ammonium compounds, benzyl-C12-18-alkyldimethyl, chlorides		68391-01-5			No HCL but self-classified as Skin Corr. 1B	
N-alkyl(C8-C16)dimethylbenzylammonium chloride		8001-54-5			No HCL but self-classified as Skin Corr. 1B	

[1]: CAS: Chemical abstracts service.
[2]: For more details: see appendix 2.
[3]: HCL: Harmonised classification and labelling.

c. Limit values

i. Methods for determining exposure threshold values

In Belgium, occupational exposure limit values are described in the Royal Decree of March 11th, 2002 (see appendix 1 and 2 of the Decree). Those exposure limits for gases and vapours are expressed in ml/m^3, for particles in suspension in mg/m^3. Only the inhalable fraction is considered, unless otherwise stated. Unfortunately for several substances values are unavailable.

Skin corrosion means the production of irreversible damage to the skin such as visible necrosis through the epidermis into the dermis. This contrasts with the reversible inflammatory changes seen in case of skin irritation. Normally the classification of products as corrosive or irritant to skin is based on animal testing (*in vivo* and *in vitro*). On the basis of the results of animal testing a substance is classified as corrosive or irritant (Annex I: 3.2.2.2. of Guidance on application of the

CLP criteria (Classification, labelling and packaging of substances and mixtures), Version 4.0, p. 296 (ECHA, 2013)). Concentration limits are set as threshold values for a certain hazard. Although human data from accidents or poison centre databases can provide evidence for classification, absence of accidents is no evidence for no classification.

Solutions with extreme pH (≤ 2 and ≥ 11.5) in combination with high buffering capacity may indicate the potential to cause skin effects. The buffering capacity is quantified by the so called acid/alkaline reserve, expressed as grams of NaOH (equivalent) required to attain pH values of 4.0 or 10.0 respectively in 100 g of test material (Young et al., 1988). Low values of acid or alkaline reserve indicate low buffer capacity and are less or not corrosive or skin irritant. The following relations are derived by Young, based on comparisons between pH-acid/alkali reserve and classification based on data from animal skin tests:

Indication for corrosivity:	pH + 1/12(alkaline reserve) ≥ 14.5	(equation 1)
	pH – 1/12(acid reserve) ≤ -0.5	(equation 2)
Indication for skin irritancy:	pH + 1/6(alkaline reserve) ≥ 13	(equation 3)
	pH – 1/6(acid reserve) ≤ -1	(equation 4)

As a first tier approach this estimation of skin irritancy without animal testing can be used as indicative values for comparison with the legal classification limits. For mixtures the sum of the component concentrations is taken as criterion. If products or mixtures with extreme pH also contain other chemicals (e.g. surfactants), the irritancy might be amplified (Kartono and Maibach, 2006). An additional complicating factor is the effect the heat released by exothermic reactions like the dissolution of strong bases, the dilution of concentrated sulphuric acid or the neutralisation of acids or bases. If these reactions happen in human tissue, the resulting heat can contribute to the burns.

ii. Identification of skin irritancy according to Young et al. (1988)

The pH of a product is considered as the most important measure of its potential for irritancy/corrosivity. However, in addition to that, the quantity of base or acid also plays a role in determining these effects. Thus a combination of both values is important as illustrated in table 3. Comparison of the indication values obtained from the equation 1 to 4 of Young et al. (1988) shows that they are not always conform with the classifications of irritant/corrosive properties.

Table 3. Identification of skin irritancy according to Young et al (1988)

Substance	Concen-tration	pH	Acid/base reserve	Indicative value	Classify-cation	Conform with criteria?
NaOH	1 %	13.4	1.0	Eq. 3 = 13,56	Irritant	Yes
	5 %	14.1	5.0	Eq. 1 = 14,52	Corrosive	Yes
NH_3	10 %	12.2	7.2	Eq.3 = 13,40	Irritant	Yes
	35 %	13.3	25.2	Eq. 1 = 15,40	Corrosive	Yes
CH_3COOH	10 %	2.2	1.3	Eq. 4 = 1,98	Irritant	No
	25 %	1.9	3.4	Eq. 2 = 1,62	Corrosive	No
HCl	10 %	-0.4	10.8	Eq. 4 = -2,2	Irritant	Yes
	25 %	-0.8	27.2	Eq. 4 = -3,06	Corrosive	Yes

6. Exposure to caustic products

a. Influence of the formulation and application method

Risk assessment of chemical products is based on a comparison of the predicted dose with its potential toxic effect. The potential level of exposure for the user (primary exposure) and also for

the others who may be exposed following the application such as residents and bystanders (secondary exposure) can be estimated with special developed models. So-called “Technical notes for guidance (TNsG) on human exposure to biocidal products” (European Commission, 2002) have been produced as calculation sheets based on database of exposure studies. Although these TNsG are developed for biocides, exposure of other consumer products can also be evaluated with adapted default values. In a later stage more sophisticated computer models (e.g. ConsExpo) are developed. Nowadays models are available for the estimation of primary and secondary exposures for several groups of similar products (e.g. pest control products, cleaning products, disinfectants, do-it-yourself products, cosmetics, etc.).

The influence of the formulation type and the application method is very important for the evaluation of the human exposure. The following examples give an illustration of simulation results of exposure models and represent situations of “reasonable worst case activities” (e.g. splash or spilling of liquids, overpressure spraying) including some foreseeable incorrect use (over-dosing, not recommended use, use of concentrates). However, exposure situations which result from accidents, malfunction or deliberate misuse are not addressed here but are further discussed in section 6.b.

i. Exposure to aerosol sprays

There is a great concern about the indoor use of sprays of all kinds of products. The presence of aerosol particles in the air and the resulting dermal and respiratory exposure is often related to recent human health problems (allergies, asthma, etc.). Apart from these chronic problems, there is also an acute risk of serious burns, both respiratory and dermal burns (Lorette and Wilkinson, 1988; Knapp et al., 1991; Benomran et al., 2008; Ploner and Rentz, 2008). Because of the new and increasing trend to apply some products (detergents, disinfectants, etc.) under the form of spraying systems (which give no extra efficiency but only more easy handling) these risks are becoming more important. It is thus advisable to avoid as much as possible unnecessary spraying.

Spray applications can be done with aerosol spray cans under high pressure or with making use of the so-called Venturi effect. They have a dispensing system which creates a fine aerosol mist of liquid particles. The can contains a liquid formulation of the product and is under high pressure of a compression gas. The aerosol is released by opening a small valve ending with a spray nozzle. Another type of spray applicators are the hand-held trigger sprayers. They consist of a system that can put air pressure in the spray bottle. The liquid can then also escape through a nozzle that can be opened by a trigger.

Aerosol applications can result in dermal exposure (occurring mainly during the period of the aerosol release) as well as in inhalation exposure (occurring after the release period). Because of the higher pressure, aerosol spray can have much smaller droplet sizes than the trigger types. Small droplets prolong the inhalation exposure time and also result in a larger inhaled fraction.

Spray applications can be used for different treatments such as (1) a total air space treatment (e.g. biocide for flying insects), (2) general surface application (e.g. disinfection of surfaces, algae remover, etc.), (3) targeted spot application (e.g. rust remover, disinfection of machine parts, etc.) and (4) crack and crevice application (e.g. fungi remover, crawling insects, etc.).

The human exposure due to spray applications can be estimated by the use of the above mentioned models. These models give only indicative exposure values which are based on default values for specific conditions. However these defaults can be replaced by more case specific values obtained by experimental data or by expert judgment. The following examples give an idea about a realistic worst case approach (e.g. as the 75th percentile). However more extreme values are possible and it is possible that these (often occurring) extreme worst case situations are giving risk of skin irritancy and inhalation risks.

Example 1:

Spraying during one minute a disinfectant containing sodium hypochlorite 5 % in a small kitchen on the surfaces and other parts (surface and crack&crevice treatment).

For an aerosol can spray the dermal exposure of the hands and forearms is 3.24 mg and the inhalation exposure 1.71 mg. For an hand-held trigger application the total human exposure is respectively 1.81 mg and 0.50 mg, mainly external.

Example 2:

Treating the inner wall of an oven with a degreasing agent spray can contain 25 % sodium hydroxide.

The dermal exposure on the applicators hand can vary between 0.1 and 2.5 gram.

ii. Exposure to liquid formulations

Several products containing acids and bases are formulated as liquids: detergents, disinfectants, drain cleaners, paint strippers, hair care products, etc. Exposure can occur mainly by dermal contact with the hands or other body parts (e.g. the head for hair care products). This exposure can occur (1) before the application (by handling the ready-for-use product or by mixing and loading the concentrated product from the original vessel into a diluted form) and (2) during the application of the product. Although it is often not really necessary to use hand protective gloves it is advisable because this can reduce the hand exposure in a considerable way (see below).

Example 3:

A non-professional uses a liquid all-purpose cleaner (type “household bleach”) during half a day in his house. The dermal exposure can occur during different steps during a day time.

The dermal exposure of the hands during the preparation of the cleaning fluid is 1 mg. The exposure during the cleaning period is about 300 mg.

Example 4:

A non-professional uses a bleaching product containing 15 % hydrogen peroxide by hand treatment of the laundry.

The dermal exposure of the hands during the mixing&loading period is 5.8 grams. During the laundry treatment the exposure can be as high as 1.25 grams.

Example 5:

For an adult person a hair bleaching treatment with a product containing 12 % hydrogen peroxide gives a dermal exposure of the head of 1.5 to 4.0 mg/cm².

iii. Exposure to powders and solid products (granules, tablets)

Acids and bases can also be applied as solid formulations (swimming pool disinfectants, drain cleaners, etc.). They can be formulated as powders, granules or tablets. It is obvious that especially the fine powders can give dust drift effects. Special attention must also be paid to inhalatory exposure by the opening of bags and containers containing chlorine releasing formulations.

Example 6:

A non-professional is treating his swimming pool with a granular disinfectant formulation containing hypochlorite.

During the opening, handling and sampling of the product from a large bag can the hand exposure be as high as 60 mg/cm². During the application of the product is the dermal load 0.26 mg/cm².

b. Exposure due to inappropriate use or accidents

The mere utilization or even the mere presence of a caustic product may be hazardous. In case of appropriate use, an accident can typically happen in case of failure of protective clothing, e.g. perforation of a glove. The BPC is however incidentally confronted with situations of inappropriate use. Typical examples are the use of a pool disinfectant in a foot bath to disinfect the feet, the consecutive use of an acid and an alkaline drain cleaner or the mixing of a descaler with a bleach solution.

Accidents can happen because of lack of communication, e.g. drain cleaner is left in the toilet without informing the users of the toilet. Special attention is warranted towards accidents with children, elderly persons with dementia or with persons with an intellectual disability. Such accidents can happen because the product is used in the presence of these persons at risk or because the product is readily accessible, e.g. product in use left unattended or stored in an accessible place.

Another cause of concern are decanted products, e.g. bleach in a beaker, ammonia in a water bottle or an industrial cleaning agent taken home from work in a food container. Finally accidents frequently happen while decanting the product (splash) or because of breaking or knocking over a recipient.

c. **Epidemiology** (based on unpublished data of the Belgian Poison Centre)

Exposure to caustic substances is a common reason for consulting the BPC. Caustic burns are relatively uncommon in comparison with thermal burns and are typically around 4 % of all burns that are referred to burn centres (Dokter et al., 2014). Nevertheless, it concerns potentially very serious exposures leading to significant injuries, surgical procedures and sequelae. Mortality is more frequent in chemical burns than in thermal burns (Luterman et al., 1990). Often the victims are children. Accidental ingestion of caustic substances by children remains a significant cause of hospital admissions in Western Countries (Johnson and Brigger, 2012). There is an important psychological burden and a heavy economical cost associated with these injuries.

Nevertheless, data on the epidemiology of caustic exposures and caustic burns are scarce. Data collection is often limited to cases admitted to single institutions. As only the most severe cases arrive in hospitals and burn centres, many less serious cases are not included. No systematic study has been published to estimate the prevalence of these exposures and their consequences. An exploratory study on the incidence of caustic accidental exposures was performed at the BPC.

i. Data collection

All the call files recorded between 01/01/2014 and 30/06/2014 at the BPC were reviewed. The number of files was restricted by applying the following parameters:

- Only files with exposures were included, and not files with preventive or informative questions.
- The way of exposure was limited to (per)oral, cutaneous and ocular exposures.

- Agents were limited to household products, industrial products, biocides and plant protection products.
- Veterinary, suicidal and criminal exposures were excluded. Suicidal and criminal exposures were considered less relevant to prevention. Additionally, data collection is very difficult in case of suicidal exposures.[3]
- If several calls were recorded for a single event, only one was taken into consideration.

There was no restriction on the level of symptoms. All cases, regardless of symptoms were included to be examined in the next phase.

ii. Results

Reviewed & retained cases

Table 4. Number of cases of caustic burns

	Cases included	Cases rejected	Cases Total
January	72	898	970
February	93	778	871
March	138	937	1075
April	144	1035	1179
May	146	987	1133
June	140	928	1068
	733	5563	6296

There were 6296 cases selected in the first phase (see table 4). They were individually studied to decide if they should be included in the study. In a lot of cases, this implied consulting the composition of the preparation in the BPC database. The following cases were excluded:

- exposure to substances that are not expected to cause caustic injury, e.g. lake water, silica gel, compost, essential oils, rodenticide, ink, etc.;
- hydrocarbon exposure;
- exposure to abrasive cleaners;
- (per)oral exposure to diluted hypochlorite solutions;
- minor exposure to dishwasher tablets (< 1/3 of a tablet);
- household detergents (all-purpose cleaner, dishwashing detergent);
- cases that were impossible to analyse because of insufficient quality of the record.

A total of 733 cases were retained for follow-up, but a further 105 cases were excluded from the analysis, because the case was finally not judged to be relevant or because of technical aspects during data extraction.

Analysis of the cases after final inclusion

A total of 628 cases were included in the final analysis. In 96 cases a successful follow-up was performed by telephone. In at least 15 cases follow-up has been performed by telephone, but had not been successful (impossible to trace the patient, promise to send information by mail that has not been fulfilled, etc.). In a number of cases, follow-up was not necessary because the case file contained already enough information to definitely classify the case. In a further number of cases, follow-up was impossible because the phone number had not been recorded, because the phone call arrived via a central number, because there was no contact person mentioned, etc.

[3] A criminal attack on a supermarket (February 2015) created a lot of suspense in Belgium. The BPC made an additional analysis to identify criminal exposures during the study period. Three cases were identified: one case of aggression by spraying ammonia in the face, a case of burns caused by an unidentified product applied on a car seat, and an ingestion of ammonia, probably diluted.

Victims

In 20.2 % (127) of the 628 cases, the victims were children, in 79.8 % (501) of the cases adults. Table 5 shows the age distribution of the victims. The problems are clearly concentrated in the range of 0-4 years of age, with a peak around the age of 2.

Table 5. Age distribution of cases of caustic burns

Age distribution	
< 1 year	1
> 1 ≤ 2 years	24
> 2 ≤ 3 years	38
> 3 ≤ 4 years	22
> 4 ≤ 5 years	7
> 5 ≤ 10 years	8
> 10 ≤ 14 years	6
Child, not otherwise specified	21
Adult > 14 years	501
Total	**628**

Products involved (Table 6)

Of the 501 exposures in adults, 380 (75.8 %) were non-professional accidents and 121 (24.2 %) were professional accidents. Exposures in children are always non-professional. Table 6 shows the non-professional exposures, separated in adult and pediatric cases. The distribution of agents is very similar. The exposures to acids and bases represent 65 % of all cases. Bases are clearly more frequently involved (n = 195; 38.5 %) than acids (n = 135; 26.6 %).

The analysis of non-professional and professional accidents apart, shows a clear difference in agents involved. At home, bases are clearly more prominent than acids (n = 141; 37.1 % versus n = 97; 25.5 %), but for professional exposures, there is no difference (both n = 44; 36.4 %). Not unexpectedly, exposures to hypochlorite are very frequent in the household (n = 80; 21.1 %), but more surprisingly, there is an important number of cases with quaternary ammonium compounds (n = 24; 6.3 %), with lime and cement (n = 11; 2.9 %), and even accidents with surprising agents like formaldehyde (n = 4; 1.1 %) and phenol (n = 1; 0.3 %) were detected.

Table 6. Products involved in caustic burns cases

Victims			
Non-professional accidents			
Adults	**380**	**Children**	**127**
Base	141	**Base**	**54**
Inorganic	106	Inorganic	39
Ammonia	25	Mixed or not specified	12
Organic	6	Ammonia	3
Mixed or not specified	4	**Acid**	**38**
Acid	97	Inorganic	20
Inorganic	58	Organic	7
Organic	12	Mixed	5
Hydrogen fluoride	9	Not specified	3
Nitric acid	8	Nitric acid	2
Not specified	6	Hydrogen fluoride	1
Mixed	4	**Hypochlorite**	**25**

Hypochlorite	80
Liquid	74
Solid	5
Not specified	1
Quaternary ammonium compounds	24
Quaternary ammonium compounds	24
Lime and cement	11
Lime and cement	11
Caustic, not specified	11
Caustic, not specified	11
Others	5
Others	5
Peroxides and perhydrates	4
Peroxides and perhydrates	4
Formaldehyde	4
Formaldehyde	4
Chemically incompatible combinations	2
Chemically incompatible combinations	2
Phenol	1
Phenol	1
Total	**380**

Liquid	18
Solid	7
Quaternary ammonium compounds	**5**
Quaternary ammonium compounds	5
Lime and cement	**2**
Lime and cement	2
Others	**1**
Others	1
Formaldehyde	**1**
Formaldehyde	1
Caustic, not specified	**1**
Caustic, not specified	1
Total	**127**

Adult victims

Non-professional accidents	**380**
Base	141
Inorganic	106
Mixed or not specified	4
Organic	6
Ammonia	25
Acid	97
Hydrogen fluoride	9
Inorganic	58
Mixed	4
Nitric acid	8
Not specified	6
Organic	12
Hypochlorite	80
Not specified	1
Liquid	74
Solid	5
Quaternary ammonium compounds	24
Quaternary ammonium compounds	24
Lime and cement	11
Lime and cement	11
Caustic, not specified	11
Caustic, not specified	11
Others	5
Others	5

Professional accidents	**121**
Base	44
Inorganic	35
Mixed or not specified	6
Organic	1
Ammonia	2
Acid	44
Hydrogen fluoride	6
Inorganic	21
Mixed	1
Nitric acid	5
Not specified	1
Organic	10
Hypochlorite	9
Not specified	1
Liquid	7
Solid	1
Others	6
Others	6
Quaternary ammonium compounds	6
Quaternary ammonium compounds	6
Phenol	5
Phenol	5
Peroxides and perhydrates	4
Peroxides and perhydrates	4

Peroxides and perhydrates	4
Peroxides and perhydrates	4
Formaldehyde	4
Formaldehyde	4
Chemically incompatible combinations	2
Chemically incompatible combinations	2
Phenol	1
Phenol	1
Total	**380**

Formaldehyde	1
Formaldehyde	1
Caustic, not specified	1
Caustic, not specified	1
Lime and cement	1
Lime and cement	1
Total	**121**

A more detailed analysis into concentration subgroups has been performed, non-professional and professional cases taken together (table 7).

Table 7. Number of cases of caustic burns, details of concentration subgroups

Agents – concentration ranges	
Acid	**179**
Inorganic	**99**
> 50 %	56
15-50 %	29
5-15 %	6
? %	3
0-5 %	3
smoke	2
Organic	**29**
>50 %	12
5-15 %	6
? %	6
15-50 %	3
0-5 %	2
Hydrogen fluoride	**16**
15-50 %	7
? %	5
5-15 %	2
>50 %	1
0-5 %	1
Nitric acid	**15**
? %	7
15-50 %	5
>50 %	3
Not specified	**10**
? %	10
Mixed	**10**
15-50 %	6
5-15 %	3
>50 %	1
Base	**239**
Inorganic	**180**
? %	61
15-50 %	44
0-5 %	35
5-15 %	20
>50 %	20
Ammonia	**30**
5-15 %	29
15-50 %	1
Mixed or not specified	**22**
Lime and cement	**14**
Lime and cement	**14**
> 50 %	14
Caustic, not specified	**13**
Caustic, not specified	**13**
? %	13
Phenol	**6**
Phenol	**6**
> 50 %	3
? %	3
Formaldehyde	**6**
Formaldehyde	**6**
15-50 %	5
? %	1
Hypochlorite	**75**
Liquid	**60**
? %	27
0-5 %	25
5-15 %	7
15-50 %	1
Solid	**13**
Solid	13
Not specified	**2**
? %	2
Chemically incompatible combinations	**2**
Chemically incompatible combinations	**2**
? %	2
Others	**12**
Others	**12**
? %	9
> 50 %	2
15-50 %	1
Peroxides and perhydrates	**8**
Peroxides and perhydrates	**8**
> 50 %	5
15-50 %	3
Quaternary ammonium compounds	**35**
Quaternary ammonium compounds	**35**
5-8 %	18
0-4 %	7

5-15 %	9	9-12 %	6
? %	7	15-50 %	4
15-50 %	4	**Total**	**628**
>50 %	1		
0-5 %	1		
Organic	**7**		
? %	3		
5-15 %	2		
15-50 %	1		
0-5 %	1		

Route of exposure

There is an obvious preponderance of cutaneous exposures in the professional cases (62.8 %). Among the non-professional exposures, there is a clear difference between the pediatric and the adult cases. Adults are more frequently exposed through the skin and the eyes (respectively 45.0 en 31.6 %). Children are most frequently orally exposed. Probably, adults are more often exposed through manipulation errors, while children are mostly exposed because of exploration behaviour. This difference has important consequences for the prevention of accidents. (see recommendations). Detailed figures concerning the way of exposure are given in table 8.

Table 8. Way of exposure

Way of exposure		
	Absolute	**% of category**
Non-professional		
Adults	**380**	**100.0**
Skin	171	45.0
Eyes	120	31.6
(Per)oral	81	21.3
Mixed	5	1.3
Respiratory	3	0.8
Children	**127**	**100.0**
(Per)oral	63	49.6
Skin	41	32.3
Eyes	19	15.0
Mixed	4	3.1
Professional	**121**	
Adults	**121**	**100.0**
Skin	76	62.8
Eyes	39	32.2
Mixed	3	2.5
(Per)oral	3	2.5

The (per)oral exposure of children is not unexpected, but not less than 81 private accidents involving oral exposure of adults were detected. Decanted products or products that are diluted in food recipients are frequently encountered. Typically, it concerns a product that is decanted at the workplace in a drinking bottle in order to take it home. Another example is a product poured in a glass that is confused with a beverage. As this behaviour is expected to be a frequent cause of these kind of accidents, an extra analysis to test this hypothesis was performed. The call files of the BPC do not provide a zone to record this information specifically, so the free text zone was checked looking for this information. This information could be retrieved in 32 cases (table 9) of which 12 (37.5 %) cases were caused by decanting or siphoning. The product was decanted in a

bottle (n = 8), in a glass or a cup (n = 3) and once the accident was caused by siphoning. In conclusion, decanting is an important cause of these kind of accidents.

Table 9. Non-professional (per)oral exposure due to decanting or siphoning

Decanting or siphoning		
Non-professional exposures	**number**	**% of known**
Adults	**81**	
(Per)oral	81	
Unknown	49	
Known	32	
Decanting or siphoning	12	37.5 %
In bottle	8	
In glass or cup	3	
Siphoning	1	
Not decanted	20	62.5 %
Total	**81**	

Symptoms

The symptoms encountered are presented in table 10. There are both minor and very severe symptoms. The number of symptoms counted is higher than the number of patients because one patient can present multiple symptoms.

Table 10. Symptoms of caustic burns

The symptoms could be scored according to their severity, e.g. using the Poisoning Severity Score (PSS) (Persson et al., 1998). The PSS is a standardized scale to score the severity of poisoning

Number of symptoms[4]			
623	**Non-professional exposures**	**157**	**Professional exposures**
109	Eye irritation	35	Skin burns, not specified
85	Skin irritation	32	Eye irritation
75	Skin burns, not specified	20	Skin irritation
39	Mouth/throat irritation or salivation	16	Skin burns, 2nd degree
35	Eye pain	11	Eye pain
34	Skin burns, 2nd degree	9	Vision loss or corneal damage
27	Burns lips, mouth or oesophagus	4	Skin discoloration
20	Vomiting	4	Pain
16	Pain	4	Others
16	Others	3	Skin burns, 3rd degree
14	Vision loss or corneal damage	3	Edema
12	Edema	2	Vomiting
11	Tears	2	Burns lips, mouth or esophagus
8	Skin discoloration	1	Breath shortness
7	Airway irritation	1	Mouth/throat irritation or salivation
5	Skin burns, 3rd degree		
91	No symptoms	6	No symptoms
19	Unknown	4	Unknown

with an emphasis on the vital prognosis. As an alternative way of scoring, for adult victims only, one could consider the number of days that the victim is unable to work. In tables 11 and 12, both

[4] Number of symptoms does not equal number of exposures: more than one symptom per exposure is possible.

ways of scoring are presented for those cases where scoring was possible, based on the available information. Professional and non-professional cases are counted together. The working status of the person was not taken into account. It is therefore possible that no inability to work was scored, e.g. because the person was jobless or retired.

The agents are essentially the same as seen in the sections “Victims” and “Products involved”. The severity does not seem to be strongly connected to the agent. Nevertheless, the accidents with bases are somewhat more frequent in the more severe categories as compared with the acids. For PSS = 0, there are more acids (n = 6) involved than bases (n = 3). For the score PSS = 2, inversely, more cases with exposure to bases (n = 9) are involved than with exposure to acids (n = 6). The fact that bases result in more serious burns is classic finding, logically resulting from the pathophysiology (see higher). The fact that exposures to bases are initially rather painless can play a role as well, as this can prolong the exposure and delay the decontamination. This is well illustrated by the cases presented below.

Less expected is the observation of some serious cases with products that do not bear the label “corrosive”, e.g. cases 2014-5321, 2014-9120 and 2014-15330 (see 6.c.iv). Not accidentally, in each of these cases, the victims delayed decontamination, because they did not realise the severity of the lesions.

Remarkably, not any lesion was found with PSS = 3, which corresponds to severe or life threatening symptoms. Nevertheless, dermal expositions with 3rd degree burns and permanent scars were observed. Because these lesions covered less than 2 % of the total body surface, they were scored as PSS = 2. The PSS is designed to predict the severity of medical outcome and puts less emphasis on the long term effects. Residual lesions on the hands, in the face or in the genital region can have a heavy psychological or functional impact, even if the lesion is scored only PSS 2. Case 2012-22831 is a good example of this (see 6.c.iv).

Table 11. Lesions scored following Poisoning Severity Score

Lesions scored following PSS, label and agent			
Adults	105	**Children**	19
PSS 0	10	**PSS 0**	8
Corrosive	6	Corrosive	4
Acid	3	Acid	3
Base	2	Base	1
Quaternary ammonium compounds	1	Irritating	4
Irritating	3	Acid	1
Base	2	Base	1
Hypochlorite	1	Hypochlorite	2
Hypochlorite, liquid	1	Hypochlorite, liquid	2
Hazardous	1		
Peroxides and perhydrates	1		
PSS 1	69	**PSS 1**	10
Corrosive	50	Corrosive	6
Acid	21	Acid	1
Base	25	Base	5
Formaldehyde	1	Irritating	3
Hypochlorite	1	Acid	2
Hypochlorite, liquid	1	Hypochlorite	1
Peroxides and perhydrates	2	Hypochlorite, liquid	1
Irritating	17	Hazardous	1

Lesions scored following PSS, label and agent			
Adults	105	**Children**	19
Acid	3	Hypochlorite	1
Hypochlorite	11	Hypochlorite, liquid	1
Hypochlorite, liquid	11		
Quaternary ammonium compounds	3		
Hazardous	2		
Hypochlorite	2		
Hypochlorite, solid	2		
PSS 2	26	**PSS 2**	1
Corrosive	18	Irritating	1
Acid	6	Quaternary ammonium compounds	1
Base	9		
Hypochlorite	1		
Hypochlorite, liquid	1		
Chemically incompatible combination	1		
Others	1		
Irritating	6		
Acid	2		
Hypochlorite	3		
Hypochlorite, liquid	3		
Quaternary ammonium compounds	1		
Hazardous	2		
Others	1		
Peroxides and perhydrates	1		
		Total (adults + children)	124

Table 12. Lesions in function of the number of days of inability to work

Lesions in function of the number of days of inability to work, label and agent	
No inability to work	**70**
Corrosive	**50**
Base	25
Acid	21
Peroxides and perhydrates	2
Hypochlorite	1
Hypochlorite, liquid	1
Formaldehyde	1
Irritating	**17**
Hypochlorite	9
Hypochlorite, liquid	9
Acid	5
Quaternary ammonium compounds	2
Base	1
Hazardous	**3**
Hypochlorite	2

Hypochlorite, solid	1
Peroxides and perhydrates	1
1 to 5 days	**8**
Corrosive	**5**
Acid	3
Base	2
Irritating	**1**
Acid	1
Hazardous	**2**
Peroxides and perhydrates	1
Others	1
11 to 15 days	**3**
Corrosive	**1**
Base	1
Irritating	**2**
Quaternary ammonium compounds	1
Hypochlorite	1
Hypochlorite, liquid	1
Total	**80**

Belgian burns centres

Additionally, a small survey was done by the BPC in the 6 Belgian burn centres. All centres provided some data concerning the number of chemical burns, but not always from the same years and with the same degree of detail. Most data concerned the year 2012 and therefore, the BPC tried to estimate the number of cases in 2012. For one centre, the data for 2011 were used, for a second centre the data of 2013, and for a third centre, the mean of a three years period 2012-14 was taken. The number of chemical burns represents 7.6 % of the total number of burns (4 centres). There were 171 cases of chemical burns obtained, but in most centres only hospitalised patients were counted, even though the number of ambulant patients is higher than the number of hospitalised patients. These 171 are probably a serious underestimation of the real number of cases. In 140 cases, it is known whether it concerns a professional exposure or not. This was the case in 89 cases (63.6 %), 51 (36.4 %) of exposures happened in a non-professional setting. Only 4 % of cases involved children (15.5 % of all non-professional exposures). The adults victims were male in 90 % of cases. The accidents in the professional exposure cases are very diverse. Often these accidents took place in the chemical industry. For the non-professional exposures, the cause could be retrieved in 50 cases. The results are represented in table 13.

Table 13. Burn centres: agents involved in non-professional exposure

Agents involved in non-professional exposure, burn centres	
Base, inorganic	12
Acid, hydrogen fluoride	8
Hypochlorite	8
Lime and cement	6
Acid, inorganic	5
Base ammonia	1
Others or unknown	10
Total	50

These data are roughly in agreement with the data from the BPC, with the exception of the seemingly overrepresentation of lime and cement and especially of hydrogen fluoride in the burn centre cases. The burns seen in burn centres are 2nd or 3rd degree burns, in two third of the cases involving 5 % or less of total body surface.

iii. Discussion

Calls received at the BPC do not represent the totality of caustic exposures in Belgium. In some cases, the victim can decide to consult directly a general practitioner or an emergency ward. Neither do all medical doctors consult the BPC, e.g. because they are themselves very experienced. Nevertheless, 628 exposures could be analysed over a 6-month period during 2014. Consequently it can be concluded that in 2014 about 1250 consultations for caustic exposures were registered at the BPC, although this is probably an underestimate.

In the analysed cases no life threatening or deadly symptoms were observed. This may be due to the exclusion of suicidal exposures. Suicidal cases are in general a lot more severe. A second explanation could be the fact that serious cases are often transferred immediately to a hospital or a burn centre and not registered at the BPC. The BPC on the other hand has a very low threshold to consult and will therefore on average pick up less severe cases. The data from the burn centres seem to confirm this explanation. A third limitation of this study is the underestimation of the severity of the symptoms because of incomplete data. In some cases, the first aid advice (rinsing!) is more important than obtaining more details about the case. In other cases, doctors consult without knowing details of the case. This leads to underestimation of the case if the follow-up does not succeed. Despite these limitations, a lot of serious cases are detected, e.g. 48 cases with 2nd to 3rd degree skin burns. This illustrates that caustic burns are a real public health problem, not only because of their frequency, but also because of their severity.

iv. Illustrative cases

A few cases from the period studied, that are exemplary, are mentioned below.

Case 2014-1502

In a company, a man is working on his knees, dressed in a protective suit because of potassium hydroxide on the ground. At a certain moment, he discovers a hole in his suit at the knee. Purple lesions are already present. A rinsing is performed on site during 20 minutes, followed by another 20 minutes of rinsing in the hospital. The next day, a 3rd degree lesion has developed on the whole surface of the knee. After 2 months, the lesion has closed, but there is still a very painful scar. He has been unable to work for 4 days and has done thereafter a job adapted to his constraints.

Case 2014-1582

A man wants to declog his drains with sodium hydroxide pearls. He pours hot water upon the pearls and the hefty reaction makes the product splashes in his eyes. As he feels immediate pain, he immediately starts to rinse thoroughly on site. A second rinsing is performed in the hospital. Only first degree burns of the conjunctivae are observed, the cornea remains intact.

Case 2014-3549

A man dissolves a hypochlorite tablet destined for pools to prepare a thoroughly disinfecting footbath. After a certain time, he feels a burning sensation and he puts some Flamigel® on his feet. After 45 minutes, his wife consults the BPC and they start rinsing. First degree burns are

present all over his feet. After a week, the lesions have visibly disappeared, but there is remaining pain up to two weeks after the exposure.

Case 2014-5321

A man cleans tiles at home with a household hypochlorite solution of 3 % that is further diluted 1:3. He has safety gloves to protect himself, but there is a cotton part on the back of the hand where the hypochlorite solution can penetrate the glove. After 6 hours of cleaning, his hands are aching and he rinses for an undetermined time. After 3 days, the BPC is contacted because the back of the hand presents a deep 2nd degree burn. After consultation at the emergency ward, a treatment with an ointment is started for 6 weeks. After 6 weeks, only depigmentation remains. He was never unable to work as he is a singer.

Case 2014-9103

A man in a temporary employment spills formic acid 85 % on his skin. As there is Diphoterine® present, a commercial product that is proposed to rinse chemical burns, rinsing is performed with Diphoterine® only. When the recipient is empty no rinsing with water is performed. When the BPC is consulted, there are already vesicles on 12 cm^2 of skin. The patient could not be traced for follow up. Remarkably, there was no thorough rinsing because of trust in the “neutralizing” product.

Case 2014-9120

A woman is using a household hypochlorite solution in a backpack sprayer to clean her terrace. The product flows upon her buttock. After 90 minutes she feels discomfort and starts rinsing for 15 minutes. A burn of 200 cm^2 develops, mostly 1st degree with approximately 25 cm^2 of second degree burns. The woman is treated by the general practitioner and is unable to work for 2 weeks. After 2 months, there are still scars visible.

Case 2014-9857

An independent entrepreneur drinks accidentally a swallow of an industrial degreasing agent containing 3 % of sodium hydroxide and 3 % of metasilicate. The product had been decanted in a drinking bottle. After 30 minutes he feels throat pain and he consults the BPC. He refuses medical examination because he has to work on. During a few days his throat remains red and painful, but heals without complications.

Case 2014-10018

A cleaning lady is confronted with a bucket containing a leaking bottle of a professional cleaning product containing 10 % of potassium hydroxide and 10 % of metasilicate. The product had been left that way by a colleague who did not inform her about the problem. As she moves the bucket, the product splashes in her eye. She immediately starts a thorough rinse at the tap. An ophthalmologist identifies a lesion of the cornea. She is treated by eye drops during one week and she is able to work all the time.

Case 2014-15330

A professional is working for an undetermined period with an anti-moss product containing 4.5 % of a quaternary ammonium detergent (didecyldimethylammoniumchloride). His clothes become soaked with the product, but nevertheless, he continues to work. When he consults at the emergency ward, there are extended first degree burns visible on his right buttock. Four days later he is consulting again because the lesion has evolved to a second degree burn with blisters. Staphylococci are cultured from a hemoculture and the man is treated at the ward during 4 days

with intravenous antibiotics. After 3 weeks, important scars are still visible, needing aftercare. He is still unable to work at that moment.

Case 2014-28135

A girl aged 2 swallows an unknown quantity of a stain remover based on sodium carbonate and sodium percarbonate, each in concentrations of around 50 %. Her parents call the emergency services and when they arrive, the girl has vomited and present acute breath shortness (with stridor and tirage). Oxygen is administered. After arriving in the emergency ward, the child gets an aerosol with Pulmicort® and adrenalin and she is treated with oxygen by CPAP (Continuous Positive Airway Pressure) during 3 hours. Her condition improves quickly. Examination by the ENT (Ear, Nose and Throat) doctor reveals redness up to the vocal cords. The gastroscopy and the radiography of the lungs are impeccable. The child remains 24 hours on the intensive care. Healing without sequelae.

A few other cases are mentioned that are typical for the issue, but that were not included in the analysed data for the first 6 months of 2014.

Case 2009-24023

A boy aged 2 drinks a drain cleaner containing 15 % of sodium hydroxide. After 30 minutes he arrives at the emergency ward. He has vomited once at home and vomits once again at the hospital. He salivates a lot, has a lot of pain and breaths very quickly with the mouth wide open. The mucosae of the mouth and the lower lip are red and swollen, the tongue is peeling off. The boy is transferred to the intensive care and an endoscopy is performed. The lower part of the oesophagus is burned and approaching the cardia, the lesion becomes circular. The stomach has a normal aspect. Oral feeding is suspended for 48 hours and the boy is treated with corticosteroids, antibiotics and antiacids. After 48 hours, the boy starts to eat again and he is transferred to the paediatric ward. The boy has been lost from follow up thereafter, but the risk of stricture of the oesophagus is high for this kind of lesions, and there is a higher incidence of oesophageal cancer.

Case 2012-22831

A man is applying a terrace cleaner containing up to 10 % of potassium hydroxide with a leaking backpack sprayer during 2 hours. The product is slowly leaking in his glove. As the product is irritating his hand, he changes his contaminated glove four times and each time, he rinses his hand with the garden hose. Nevertheless he develops 3rd degree burns on 3 fingers. The fingers are treated in the burns centre and can be saved. One finger needs a skin graft. After 3 months, the patient is still treated by a physiotherapist (120 sessions in total). The fingers remain stiff, but he succeeds in using his keyboard (he has an office job). The fingers are sensible again, but he experiences paraesthesia's (= abnormal sensations).

Case 2014-40966

In a beauty salon, a nail primer containing 55 % of methacrylic acid is spilled onto the arm of a customer. The arm is rinsed, but a 2nd degree burn with a diameter of 20 cm develops on her arm. The victim is lost from follow up.

Caustic exposures from compounds not included in the study

Medication

Some caustic medicines are on the market to treat warts. These products burn the skin and the wart within. The products concerned are Aporil® (Thuya tinct. 45 mg/g, Chelidonium tinct. 45 mg/g, salicylic acid 135 mg/g, lactic acid 20 mg/g and acetic acid 80 mg/g), Duofilm® (salicylic acid 167

mg/g) and Molutrex® (potassium hydroxide 5%). These products are sold in small bottles of respectively 10, 15 en 10 ml. They give rise to accidental ingestion, mainly by children. In 2014 we recorded 43 cases. Often there are burns of the mouth, tongue and oesophagus.

"Health supplements"

Recently the BPC is confronted with products against the "acidification of the body". Typically, concentrated solutions containing sodium hydroxide or potassium hydroxide are sold in small bottles with a dropper. One is advised to drink three times a day alkaline water. These solutions are caustic and they cause burns if swallowed undiluted or if mistaken for eye drops. The BPC is aware of three products on the market: "Vayuvit pH-druppels", "Lucovitaal Zuur Base druppels" and "Alka druppels".

7. Protective measures limiting the exposure to acids and bases

In general professional users are better trained and are better protected by the use of PPE. A non-professional user is a member of the general public and is often not taking the necessary measures to control exposure because he is not always following exactly the descriptions of use. Another important aspect of consumer practices is the very limited use of PPE to control exposure. So consumers will not use PPE unless it is convincingly and clearly recommended on the label or packaging. Especially the indoor use of these products is often done with limited protective clothing (T-shirt, short, etc.). Non-professional users wearing only long-sleeved shirt and trousers or skirt with shoes are already partially protected for 50 % of the total potential skin exposure. Cotton boiler suits can reduce the potential exposure with 75 % for dry substances but may offer only little protection from wet substances because they can absorb the liquid.

Although normal use of most commercial products is in most cases not causing serious threats of exposure incidents it is always advised to take measures to reduce the risks. Most important is the use of protective clothing, gloves, goggles and shoes. In some cases (e.g. aerosols) also inhalatory exposures must be taken into consideration.

When selecting PPE for occupational health and safety, the following minimum requirements are considered:

- the PPE is suitable for the hazard without increasing the risk;
- the PPE should correspond to the prevailing conditions;
- the PPE should be adaptable to the requirements of ergonomics, comfort and health of the user;
- PPE fits the wearer.

Standards EN 420: 2003 and EN 374: 2003 are instrumental in choosing the suitable PPE.

a. Clothing

It should be advised to the public that when using these products, one should wear (tight) long sleeved shirts and trousers. Avoid shorts, short-sleeved shirts and miniskirts in handling caustic agents. Exposed body skin gives added risk to irritation and burns by corrosive chemicals and gases.

It should be advised to wear a plastic apron over the normal clothing to protect the user from corrosive liquids, especially when pouring or mixing. Snaps or fasteners are preferable to buttons for quicker removal in case of an emergency.

b. Gloves

The use of protective gloves is always advisable. It is generally accepted that protective gloves when used properly can give a protection of more than 90 %.

Standard EN 374: 2003 specifies the capability of gloves to protect the user against chemicals and/or micro-organisms. Three important characteristics of the gloves need to be considered: penetration resistance, permeation resistance (breakthrough time and rate) and degradation characteristics:

- Penetration is the movement of a chemical and/or micro-organism through porous materials, seams, pinholes or other imperfections in a protective glove material at a non-molecular level.
- Permeation is a process by which a chemical can pass through a protective film without going through pinholes, pores, or other visible openings. It is therefore necessary to measure breakthrough times, or the time taken for the hazardous liquid to come in contact with the skin (= permeation rate).
- Degradation is a reduction in one or more physical properties of a glove material due to contact with a chemical.

The same standards are considered for household protective equipment with the use of caustic agents. This information should be given on the label or, even more advisable, appropriate gloves should be included in the packaging.

Table 14 provides an overview of some glove materials.

Table 14. Overview of some glove materials

Material	Features
Polyvinyl chloride (PVC)	Cheap raw material with high abrasion resistance. Good resistance to oils and greases, average resistance to acids, bases and aqueous solutions.
Neoprene (CR)	Neoprene is very durable and known for its mechanical strength and broad chemical resistance. Thus, this material provides an excellent protection against acids, solvents, animal fats and oils.
Natural rubber (NR)	Natural rubber guarantees by its elasticity an excellent fit, dexterity and comfort and impermeability. Good abrasion and cut resistance and flexibility. Suitable for acids and bases.
Neoprene / Natural Rubber (CR / NR)	The mix of neoprene with latex provides a high quality with excellent resistance to acids and bases.
Nitrile	Nitrile gloves for single use (standard EN 455). Suitable for chemical, medical and food industries. A very strong and reliable alternative to latex or vinyl, due to its high puncture and tear resistance. Also good resistance to chemicals. Chlorinated for better protection against chemicals. Protects against acids, bases, alcohols and glycols. Resistant to hydrocarbons.
Vinyl	Vinyl gloves for single use (standard EN 455). Suitable for medical, industrial and food. Overall product features: - non-toxic; - allergy free; - protein free; - better fit with stretch fabric; - optimal protection against microbiological, communicable diseases.

	A good alternative for latex gloves (due to low-allergogene features). Vinyl disposables are available in powdered and powder-free form.

c. Goggles

If there is a risk for chemical splashes then safety goggles, instead of safety glasses, are recommended to the user. Goggles are tight fitting, completely covering the eyes and area immediately surrounding the eyes. They can provide protection from impact, dust and splashes. Some goggles will fit over prescription glasses.

Chemical splash goggles meeting EU-OSHA requirements EN 166:2001 are preferable.

Goggles are to be put on as soon as you start handling (just like any other PPE) and should not be removed until the very end of the completed job.

It is unsafe to wear contact lenses. A chemical splashed into the eye will be trapped against the cornea by the contact lens, increasing the likelihood of eye damage. Vapours such as hydrogen chloride or ammonia are absorbed by some lenses and can cause severe irritation or injury. If possible, one should wear ordinary glasses under the goggles or other suitable eyewear.

The use of a face shield in addition to eye goggles for face and neck protection when pouring or mixing alkali/base/caustic solutions is further recommended. Face shields have transparent sheets of plastic, which cover the face and protect against potential splashes or sprays of hazardous liquids and dust.

d. Shoes/Boots

Shoes provide a great deal of initial protection in the case of dropped containers, spilled chemicals, and unseen hazards on the floor. Always wear closed shoes when working with acids of bases.

When working with 5 liter or more of base/acid or any other caustic solution, or where shoes may come in contact with the solution, wear rubber boots.

8. Important information

a. Label

Substances and mixtures that are placed on the market must comply with the CLP Regulation (1272/2008/EC). A substance or mixture contained in packaging has to be labelled according to the CLP rules where:

- the substance or mixture is classified as hazardous;
- a mixture, even if not classified as hazardous, is addressed in Part 2 of Annex II of the CLP Regulation. In this case the supplemental label elements as set out in that part shall be applied.

As a general rule, CLP requires labels to be firmly affixed to one or more surfaces of the packaging immediately containing the substance or mixture, and requires that they shall be readable horizontally when the package is set down normally (see CLP Regulation Article 31(1)). The label elements themselves, in particular the hazard pictograms, shall stand out clearly from the background (see CLP Regulation Article 31(2) and (3)). Furthermore, all label elements shall be

of such size and spacing as to be easily read. A physical label is not required when the label elements are shown clearly on the packaging itself (see CLP Regulation Article 31(5)).

b. Pictogram

The pictogram is a pictorial presentation to communicate information on the hazard concerned. The classification determines which of the 9 pictograms has to be applied on the label. The colour and presentation of a label must allow the hazard pictogram and its background to be clearly visible. The size of the pictogram shall be at least one fifteenth of the label and not less than 1 cm². (See table 2.)

c. Instructions for use

Irrespective of the legal aspects of a label, the authorities have to consider as well the information on the instructions for use. Labels sometimes promote the use of hot water with sodium hydroxide pearls. This is a dangerous practice as the strongly exothermic reaction between water and sodium hydroxide very rapidly brings the water to its boiling point, which can lead to splashes as in case 2014-1582 (see chapter 6.c.iv.). Even worse, in case drain cleaners used in a small drain canal, pressure can build up, causing a geyser. The risk will be higher if the proportion of sodium hydroxide to hot water is higher. This practice is highly inadvisable. If nevertheless, the combination of sodium hydroxide with hot water is unavoidable, then it seems logical to mention explicitly the need for protective clothing. In an illustrative example in figure 1, one can see that the legally required phrase P 280 is mentioned in the list of P-phrases. In many cases however, the consumer will not read further than the instructions for use, although the safety phrases are very important to read (e.g. P 280 protective gloves, protective clothing and eye protection as illustrated in figure 1). It would be logical to mention there the need for protective clothing, and to provide protective gloves with the product.

Figure 1. Label of a drain opener containing sodium hydroxide

9. Education and training

A lot of accidents can be avoided by proper education. At the selling points potential users should be informed by the presence of posters and/or displays with appropriate information. The general public should be educated about the following points:

- Always ask yourself if you really need to have the caustic product at home, especially if small children or persons with an intellectual disability are living in the home.
- Use these products in absence of children or persons with an intellectual disability.
- Read the label before using the product.
- How to read the label.
- Wear gloves and goggles.
- Never mix caustic products, not with other caustics, not with hot water nor with other chemicals like bleach solutions. Some reactions can cause the product to boil and splash while mixes with bleach can generate suffocating gases.
- As long as the product is in place, limit access to treated sites and warn other people that the product has been used.
- After use, rinse abundantly, as a few drops can already cause serious burns.
- Never decant the product in another container, especially not in food containers. Food containers are not fit for caustic products as they can give rise to dangerous situations. They do not bear a safety cap and the product can be confused with beverages. The decanting of products in a glass or a cup before use, can cause similar problems.
- Store caustic products out of reach of children. The same is true for “empty” bottles as a few drops can already cause serious burns.
- In case of accident:
    - Rinse as quickly as possible. This is the most important factor that will limit the caustic burns. This is true for ALL caustic products, including sulphuric acid or quicklime. Rinsing should be done with lukewarm, running water and should be continued for at least 10 (eyes) to 20 minutes (skin).
    - If symptoms are more serious than skin redness (e.g. white colour, vesicles, etc.) or if there is vision impairment, then consult a medical doctor.
    - In case of ingestion: do not provoke vomiting, call 112 and give a few sips of water to drink.

3. CONCLUSIONS ET RECOMMANDATIONS

Conformément à la demande de la ministre, les conclusions et les recommandations suivantes concernent uniquement les utilisateurs non professionnels.

Il est évident que l'utilisation de substances caustiques peut comporter une menace sérieuse pour la santé publique.

Les produits caustiques sont couramment utilisés dans diverses applications de produits d'entretien ménager et biocides appartenant aux différents types de produits (PT 1, 2, 3, 4, 18). Les biocides peuvent être scindés en 2 groupes : les désinfectants et les produits de lutte contre les nuisibles. Les produits caustiques sont aussi très couramment utilisés dans une panoplie de produits d'entretien ménager n'appartenant pas aux biocides.

Ces produits caustiques contiennent souvent des concentrations élevées en acides ou en bases qui sont susceptibles d'engendrer un risque potentiel pour l'utilisateur non-professionnel. Différentes voies d'exposition (par la voie cutanée, oculaire, gastro-intestinale et respiratoire) sont possibles. De nombreuses mesures s'imposent pour éviter des risques très variés pour la santé publique.

Compte tenu du fait que plusieurs secteurs sont impliqués dans les différentes étapes de la chaine dont la formulation du produit constitue le premier maillon et sa surveillance le dernier, en passant par la réglementation/commercialisation/application et post-application, le CSS émet les recommandations suivantes sur les différents maillons de cette chaîne à l'égard des acteurs concernés:

- Formulation
    - Envisager les problèmes d'exposition posés par des formulations haute-pression à base d'aérosols et produisant des fines gouttelettes qui, outre un danger d'exposition cutanée, sont susceptibles d'entrainer une exposition respiratoire importante. Ces dispositifs générateurs d'aérosols devraient être conçus de façon à exclure les très fines gouttelettes. Par conséquent, des critères et des facteurs de production spéciaux (pression, type d'embout pulvérisateur, etc.) sont à prévoir.
    - Une limite légale correspondant à un niveau sûr pour les utilisateurs doit être imposée pour les concentrations des produits commerciaux. Ces limites doivent être spécifiques au produit. Les valeurs de référence font défaut. Sur la base de l'avis des experts, une concentration maximale de 5% en substances inorganiques caustiques est recommandée pour les produits de consommation suivants :
        - agents dégraissants puissants ;
        - nettoyants pour vitre de poêle ;
        - nettoyants pour roues et camions ;
        - anticalcaires ;
        - autres détergents.

      Les produits à base d'acide fluorhydrique (HF) ne sont jamais acceptables pour une utilisation par le consommateur.
    - Favoriser les formulations prêtes à l'emploi et éviter des formulations hautement concentrées en produits caustiques et qui doivent être diluées avant utilisation.
    - Les déboucheurs biologiques sont basés sur l'action des enzymes ou des bactéries. Ils n'ont pas d'effets caustiques connus. Leur effet est moins marqué et plus lent que celui des déboucheurs chimiques, mais ils peuvent être considérés comme des alternatives plus sûres.
    - Continuer à veiller à améliorer les emballages, qui ne peuvent pas être confondus avec les emballages contenant des denrées alimentaires ou des substances non

dangereuses, et doivent être suffisamment solides pour remplir leurs fonctions (éviter les gouttes, les fuites, les déformations, etc.).
    - Prendre en considération l'emballage: toute déperdition du contenu de l'emballage est interdite, surtout lorsque le produit requiert un changement de conditionnement avant son application (par exemple la mise en place d'un dispositif de détente ou d'un embout de pulvérisation sur le récipient/flacon avant son utilisation).
    - Éviter les formulations pour réservoir dorsal ou arrosoir. Interdire de suggérer son utilisation sur l'étiquette ou les instructions d'utilisation.

- Réglementation
    - Meilleur étiquetage obligatoire pour les produits (non biocides) d'entretien ménager en ajoutant des informations plus pertinentes, lisibles (format du texte, contraste) et compréhensibles (langage courant).
    - Éviter de commercialiser le produit sous une apparence trompeuse (labels environnementaux, présentations attrayantes pour les enfants, design des emballages et des étiquettes, des affirmations telles que « non toxique », « écologique », etc.).
    - Élaborer une procédure plus efficace pour scinder les utilisations professionnelles et non-professionnelles à l'instar de ce qui a récemment été réalisé pour l'utilisation des pesticides.
    - Intégrer des dispositions règlementaires pour l'implication et l'utilisation d'EPI, la mise à disposition de lunettes de protection et de gants appropriés pour les produits hautement corrosifs (voir la liste ci-dessus).
    - Préciser que certains produits ne peuvent pas être manipulés par des enfants ou des personnes atteintes d'une déficience intellectuelle.
    - Introduire des mesures légales en vue d'une utilisation plus sûre similaires à celles mises en place pour d'autres produits de consommation dangereux (par exemple, les restrictions sur la publicité pour les produits du tabac, les informations sur les risques sur les emballages des boissons alcoolisées, etc.).
    - Tenir compte des mesures légales prises à l'étranger.

- Commercialisation
    - Mise en place de systèmes de sensibilisation pour l'utilisateur (campagnes d'information, dépliants, sites internet, etc.) par les entreprises et les autorités publiques (par exemple l'action *'produits ménagers'* en France: http://www.inpes.sante.fr/CFESBases/catalogue/pdf/887.pdf), y compris la promotion d'alternatives plus sûres (par exemple les méthodes mécaniques).
    - Les organisations de protection des consommateurs devraient être impliquées dans des campagnes de sensibilisation dans le cadre d'une coopération avec le Centre Antipoisons, par exemple en diffusant un dépliant contenant des conseils généraux présentés de manière complète et pratique, par exemple en proposant une liste des produits les plus dangereux, en décrivant les mauvaises utilisations possibles, les éventuelles alternatives, l'impact sur la santé humaine et les risques environnementaux.
    - Une attention particulière doit être accordée aux risques pour les enfants (0 à 5 ans) à travers les voies de communication ad hoc, par exemple *Kind en Gezin*, l'*Office de la naissance et de l'Enfance*, les pédiatres.
    - Obligation de veiller à une séparation physique de ces produits caustiques et des autres produits d'entretien ménager (à l'instar de ce qui s'applique aux pesticides et aux biocides) afin d'accroître la sensibilisation aux dangers. Des lunettes de protection et des gants pourraient être vendus au même endroit, voire dans le même emballage. Des dépliants et des écrans d'information démontrant l'utilisation correcte de ces produits peuvent également être proposés à cet endroit.
    - Obligation de démontrer l'utilisation correcte de ces produits dans des dépliants publicitaires ou spots télévisés.

- Application
    - Promouvoir l'utilisation de vêtements de protection adéquats, de gants, lunettes de protection, etc.
    - Éviter les surdosages et mauvaises utilisations grâce à une information de meilleure qualité sur l'emballage ou l'étiquette.
    - Être conscient de l'importance de prendre contact avec le Centre Antipoisons et/ou les services d'urgence des hôpitaux en cas d'exposition. De même, les médecins généralistes et médecins hospitaliers devraient être davantage impliqués dans la déclaration des accidents.
    - Veiller à ce que l'étiquette fournisse des informations de meilleure qualité quant aux mesures correctives à prendre après une exposition (excessive).
    - Préciser que ces produits ne peuvent pas être utilisés par ou en présence de personnes moins ou non expérimentées (les enfants, les personnes qui ne peuvent pas lire les consignes de sécurité sur l'étiquette, les personnes atteintes d'une déficience intellectuelle, etc.).
    - Mener des campagnes de sensibilisation quant à l'utilisation abusive de produits industriels à des fins personnelles par le consommateur, par exemple transvaser des produits sur le lieu du travail en vue d'une utilisation privée.
    - Éviter l'utilisation d'un réservoir dorsal ou d'un arrosoir (en raison du danger de fuites sur le dos ou d'autres parties du corps).

- Après l'application
    - Veiller à fournir des informations de meilleure qualité sur l'emballage et l'étiquette quant aux risques d'exposition secondaire après l'application du produit, par exemple suite à la manipulation de conteneurs vides, l'utilisation de toilettes ou de bains traités avant leur rinçage, le stockage inapproprié après utilisation.

Surveillance

- Veiller à recueillir davantage de données de meilleure qualité sur les quantités, les concentrations, les façons d'appliquer ces produits d'une manière coordonnée et structurée.
- L'optimisation de la surveillance du marché et des mesures correctives pertinentes est vivement recommandée.
- Veiller à une meilleure implémentation de la réglementation existante.
- Les résultats de la surveillance doivent être évalués de façon à permettre une hiérarchisation des risques posés par ces produits.
- Des conseils en matière de gestion des risques doivent être émis à l'attention des autorités sur la base des résultats de la surveillance, plus précisément sur les mesures correctives qui s'imposent.

4. REFERENCES

ARAB - Algemeen reglement voor de bescherming van de arbeid, titel III. (Art. 184 - N5723 quinquies). BS van 3 oktober 1947.

Benomran FA, Hassan AI, Masood SS. Accidental fatal inhalation of sulfuric acid fumes. J Forensic Leg Med 2008;15:56-8.

BfR – Bundesinstitut fûr Risikobewertung. Health risks of nitric acid containing cleaning products. 2015.
Available from :
URL:<http://www.bfr.bund.de/cm/349/health_risks_of_nitric_acid_containing_cleaning_products.pdf>

Chibishev AA, Simonovska N, Bozinovska C, Pereska Z, Smokovski I, Glasnovic M. Respiratory Complications from Acute Corrosive Poisonings in Adults. Mater Sociomed 2014;26:80–3.

CSS – Conseil Supérieur de la Santé. Projet d'arrêté ministériel portant l'interdiction de la mise sur le marché et de l'utilisation du produit Total Clean. Bruxelles: 2012. Avis n° 8897.

Dokter J, Vloemans AF, Beerthuizen GI, van der Vlies CH, Boxma H, Breederveld R et al. Epidemiology and trends in severe burns in the Netherlands. Burns 2014;40:1406-14.

Early SH, Simpson RL. Caustic burns from contact with wet cement. Jama 1985;254:528-29.

EC - European Commission. Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), establishing a European Chemicals Agency, amending Directive 1999/45/EC and repealing Council Regulation (EEC) No 793/93 and Commission Regulation (EC) No 1488/94 as well as Council Directive 76/769/EEC and Commission Directives 91/155/EEC, 93/67/EEC, 93/105/EC and 2000/21/EC.

EC – European Commission. Regulation (EC) no 1272/2008 of the European Parliament and of the Council of 16 December 2008 on classification, labelling and packaging of substances and mixtures, amending and repealing Directives 67/548/EEC and 1999/45/EC, and amending Regulation (EC) No 1907/2006.

EC – European Commission. Regulation (EC) no 1223/2009 of the European Parliament and of the Council of 30 November 2009 on cosmetic products.

EU - European Union. Regulation (EU) no 528/2012 of the European Parliament and of the Council of 22 May 2012 concerning the making available on the market and use of biocidal products.

EU – European Union. Regulation (EU) no 98/2013 of the European Parliament and of the Council of 15 January 2013 on the marketing and use of explosives precursors.

EC - European Communities. Council Directive 67/548/EEC of 27 June 1967 on the approximation of laws, regulations and administrative provisions relating to the classification, packaging and labelling of dangerous substances.

EC – European Communities. Directive 1999/45/EC of the European Parliament and of the Council of 31 May 1999 concerning the approximation of the laws, regulations and administrative provisions of the Member States relating to the classification, packaging and labelling of dangerous preparations.

EC - European Commission. Technical notes for guidance. Human exposure to biocidal products. Guidance on exposure estimation. 2002. Available from: URL:<http://ihcp.jrc.ec.europa.eu/our_activities/public-health/risk_assessment_of_Biocides/doc/TNsG/TNsG_ON_HUMAN_EXPOSURE/VERSION_2002/TNsG%20Human%20Exposure%202002.pdf>

ECHA – European Chemicals Agency. Guidance on application of the CLP criteria - Guidance to Regulation (EC) N° 1272/2008 on classification, labelling and packaging (CLP) of substances and mixtures. Version 4. 2013.

Goldfrank L, Flomenbaum N, Lewin N, Howland MA, Hoffman R, Nelson L, editors. Goldfrank's Toxicologic Emergencies. New York: McGraw-Hill; 2013.

Hannu T, Riihimäki V, Piirilä P. Reactive airways dysfunction syndrome from acute inhalation of dishwasher detergent powder. Can Respir J 2012;19:25-7.

Hardwicke J, Hunter T, Staruch R, Moiemen N. An historical comparison and review of the literature. Burns 2012;38:383-87.

Johnson CM, Brigger MT. The public health impact of pediatric caustic ingestion injuries. Arch Otolaryngol Head Neck Surg 2012;138:1111-5.

Kartono F, Maibach HI. Irritants in combination with a synergistic or additive effect on the skin response: an overview of tandem irritation studies. Contact Dermatitis 2006;54:303-12. Review.

Kern DG. Outbreak of the reactive airways dysfunction syndrome after a spill of glacial acetic acid. Am Rev Respir Dis 1991;144:1058-64.

Knapp MJ, Bunn WB, Stave GM. Adult respiratory distress syndrome from sulfuric acid fume inhalation. South Med J 1991;84:1031-33.

Koninkrijk België - Koninklijk besluit van 11 maart 2002 betreffende de bescherming van de gezondheid en de veiligheid van de werknemers tegen de risico's van chemische agentia op het werk. BS van 14 maart 2002.

Koninkrijk België - Koninklijk Besluit van 22 mei 2003 betreffende het op de markt brengen en het gebruiken van biociden. BS van 11 juli 2003.

Koninkrijk België - Koninklijk Besluit van 8 mei 2014 betreffende het op de markt aanbieden en gebruiken van biociden. BS van 8 september 2014.

Lorette JJ Jr, Wilkinson JA. Alkaline chemical burn to the face requiring full-thickness skin grafting. Ann Emerg Med 1988;17:739-41.

Luterman A, Currari P. Chemical burn injury. In: Jurkiewcz M, Krizek T, Mathes S, editors. Plastic Surgery: Principles and Practice. Saint-Louis: CV Mosby; 1990. p.1355-1440.

Persson HE, Sjoberg GK, Haines JA, Pronczuk de Garbino J. Poisoning Severity Score: Grading of acute poisoning. J Toxicology - Clinical Toxicology 1998;36:205-13.

Peters WJ. Alkali burns from wet cement. Can Med Assoc J 1984;130:902-03.

Ploner Y, Rentz K. Respiratory insufficiency after inhalation of baking oven cleaner. Dtsch Med Wochenschr 2008;133:2505-506.

Rao RB, Hoffman RS. Caustics and Batteries. In: Goldfrank LR, Flomenbaum NE, Lewin NA, Weisman RS, Howland MA, Hoffman RS, editors. Goldfrank's Toxicologic Emergencies. 6th ed. New York: McGraw-Hill; 1998. p. 1401.

SHC – Superior Health Council. Hazards posed by nitric acid-containing cleaning products. Brussels: SHC; 2010. Advisory report n° 8701.

UNECE – United Nations Economic Commissions for Europe. European Agreement Concerning the International Carriage of Dangerous Goods by Road. UN 2012. Available from: URL< http://www.unece.org/trans/danger/publi/adr/adr2013/13contentse.html>

Young JR, How MJ, Walker AP, Worth WM. Classification as corrosive or irritant to skin of preparations containing acidic or alkaline substances, without testing on animals. Toxic in Vitro 1988;19-26.

5. APPENDICES

Appendix 1. Overview of substances with irritant/corrosive properties which are commonplace in biocides, and which may be available to the general public provided that the product has not been classified as a Class A product on the basis of the risk assessment

***Alkyldimethylbenzylammoniumchloride* (CAS 68424-85-1)**
PT 1-2-3-4

Classification and labelling

with regard to physical/chemical data	No classification
with regard to toxicological data	C-Corrosive; Xn-Harmful R22; R34; S26, S28; S36/37/39; S45 Danger - GHS05, GHS06 Acute Tox 3 H301; Skin Corr. 1B H314
with regard to fate and behaviour data	No classification

Corrosive (R34)
The maximum concentration reported in the literature that does not produce irritating effect on intact skin is established at 0.1% a.s.

The maximum concentration reported in the literature without irritating effect in the eyes = 0.02% a.s.

***CMIT/MIT* (CAS 26172-55-4/ 2682-20-4)**
PT 2 - 4

Directive 67/548/EEC	
Class of danger	T - Toxic C – Corrosive N - Dangerous for the environment
R phrases	R23/24/25: Toxic by inhalation, in contact with skin and if swallowed. R34: Causes burns. R43: May cause sensitization by skin contact. R50-53: Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.
S phrases	S2: Keep out of the reach of children. S26: In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. S28: After contact with skin, wash immediately with plenty of water S36/37/39: Wear suitable protective clothing, gloves and eye/face protection. S45: In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible). S60: This material and its container must be disposed of as hazardous waste.

	S61: Avoid release to the environment. Refer to special instructions/Safety data sheets.
Regulation 1272/2008	
Hazard classes and categories / hazard statements	Acute Tox. 3/H331: Toxic if inhaled Acute Tox. 3/H311: Toxic in contact with skin Acute Tox. 3/H301: Toxic if swallowed Skin Corr. 1B/H314: Causes severe skin burns and eye damage Skin Sens. 1/H317: May cause an allergic skin reaction Aquatic Acute 1/H400: Very toxic to aquatic life Aquatic chronic/H410 Very toxic to aquatic life with long lasting effects.

***DDAC (didecyldimethylammoniumchloride)* (CAS 7173-51-5)**
PT 1-2-3-4

Current Classification and Labelling of the substance as in Directive 67/548/EEC	
Classification	Xn; R22 C; R34
Labelling	
Symbol	C (Xn optional)
R phrases	R22 Harmful if swallowed R34 Causes burns
S phrases	S2 Keep out of the reach of children S26 In case of contact with eyes, rinse immediately with plenty of water and seek medical advice S36/37/39 Wear suitable protective clothing, gloves and eye/face protection S45 In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible)

Proposed Classification and Labelling of the active substance based on Regulation EC 1272/2008:	
Classification:	
Hazard Class and Category	Acute Tox 3* Skin Corr. 1B_ Aquatic Acute 1_
Hazard Statement Codes	H301 H314 H400
Labelling:	
GHS Pictogram	GHS05, GHS06, GHS09
Signal Word	Danger
Hazard Statement	H301: Toxic if swallowed H314: Causes severe skin burns and eye damage H400: Very toxic to aquatic life
Specific concentration limits for the aquatic hazard classification	M factor=10

Table 2-1 Proposed classification of formaldehyde based on Directive 67/548/EEC

	Classification	Wording
Indications of danger, R phrases	T, R23/24	Toxic by inhalation and in contact with skin
	Xn, R22	Harmful if swallowed
	C, R34	Corrosive, Causes burns
	Xi, R43	Irritant, May cause sensitisation by skin contact
	T, Carc. cat 1, R49	Cacinogenic category 1, May cause cancer by inhalation
	Xn, Muta cat.3, R68	Mutagenic category 3, Possible risk of irreversible effects

Table 2-2 Proposed classification of formaldehyde based on Regulation (EC) No 1272/2008

	Classification	Wording
Hazard classes, Hazard categories, Hazard statements	Acute Tox. ,4 H302	Acute oral toxicity category 4, Harmful if swallowed
	Acute Tox. 3, H311	Acute dermal toxicity category 3, Toxic in contact with skin
	Acute Tox. 2, H330	Acute inhalation toxicity category 2, Fatal if inhaled
	Skin Corr. 1B, H314	Skin corrosion/irritation category 1B, Causes severe skin burns and eye damage
	Skin Sens. 1, H317	Skin sensitisation category 1, May cause an allergic skin reaction
	Muta. 2, H341	Mutagenicity category 2, Suspected of causing genetic defects
	Carc. 1A*, H350i	Carcinogenicity category 1A, May cause cancer by inhalation

* Within RAC opinion of 30.11.2012 Carc 1B was proposed.

	Value	Study	Safety factor
AEL_{acute} $AEL_{medium\text{-}term}$ $AEL_{long\text{-}term}$	0.15 mg/kg bw/d	Rat, overall (28-d, 90-d, 2-yr)	100
$AEC_{acute,\ inhalative}$ $AEC_{medium\text{-}term,\ inhalative}$ $AEC_{long\text{-}term,\ inhalative}$	0.12 µg/L	Human, eye irritation (subjective)	3
		Human, overall ocular/respiratory irritation	1#
		Rat, Monkey, 6-mo	10*

***Glutaraldehyde* (CAS 111-30-8)**
PT 2-3-4

Classification and proposed labelling (Annex IIA, point IX.)

with regard to physical/chemical data	No classification
with regard to toxicological data	**Proposed classification of glutaraldehyde (pure) according to Directive 67/548/EEC:** T; R23/25; C R34; Xn; R42/43 Specific Concentration Limits: T; R25 C ≥ 50 % Xn;R22 2 % ≤ C < 50 % T; R23 C ≥ 25 % Xn; R20 2 % ≤ C < 25 % C; R34 C ≥ 10 % Xi; R37/38-41 2 % ≤ C < 10 % Xi; R36/37/38 0.5 % ≤ C < 2 % R43 C ≥ 0.5 % R50 C ≥ 2.5 % **Proposed classification of glutaraldehyde (pure) according to Regulation 1272/2008:** Acute Tox. 1 *; H330 Acute Tox. 3 *; H301 Skin Corr. 1B; H314 Resp. Sens. 1; H334 Skin Sens. 1; H317 Specific Concentration Limits: C ≥ 10 % Skin Corr. 1B; H314 0.5 % ≤ C < 10 % Skin Irrit. 2; H315 2 % ≤ C < 10 % Eye Dam. ; H318 0.5 % ≤ C < 2 % Eye Irrit. 2; H319 C ≥ 0.5 % STOT SE; H335 C ≥ 0.5 % Skin Sens. 1; H317
with regard to fate and behaviour data	No classification
with regard to ecotoxicological data	**Proposed classification of glutaraldehyde (pure) according to Directive 67/548/EEC:** N; R50 Specific Concentration Limits: N; R50 C ≥ 2.5 % **Proposed classification of glutaraldehyde (pure) according to Regulation 1272/2008:** Aquatic Acute 1; H400 M Factor: M = 10; Aquatic Acute 1; H400

***Hydrogen peroxide* (CAS 7722-84-1)**
PT 1-2-3-4

				
Signal Word (Code)	Danger (Dgr)			
Specific Concentration Limits M Factors	Ox. Liq.1; H271 C ≥ 70 %(****) Ox. Liq. 2; H272:50 % ≤ C < 70 %(****)(*) Skin Corr. 1A; H314: C ≥ 70 % Skin Corr. 1B;H314: 50 % ≤ C <70 % Skin Irrit. 2;H315: 35 % ≤ C <50 % Eye Dam. 1;H318: 8 % ≤ C <50 % Eye Irrit. 2; H319:5 % ≤ C < 8 % STOT SE 3;H335; C ≥ 35 %			
Notes	B			

In accordance with Regulation (EC) No 1272/2008, Annex VI Table 3.1, hydrogen peroxide is classified and labelled as follows:

Hazard Class and Category Code(s)	Ox. Liq. 1 Acute Tox. 4 * Acute Tox. 4 * Skin Corr. 1A			
Hazard Statement Code(s)	H271 May cause fire of explosion; strong oxidiser H332 Harmful if inhaled H302 Harmful if swallowed. H314 Causes severe skin burns and eye damage			
Supplemental Hazard Statement Code(s)	-			
Pictogram(s) and Code(s)	GHS03	GHS05	GHS07	

In accordance with Directive 67/548/EEC, Annex VI Table 3.2, hydrogen peroxide is classified and labelled as follows:

Class of danger	O Oxidising C Corrosive Xn nn
R phrases	R5 R8 R20/22 Harmful by inhalation, in contact with skin and if swallowed R35 Causes severe burns
S phrases	S1/2 Keep locked up and out of the reach of children S17 S26 S28 S36/37/39 Wear suitable protective clothing and gloves S45 In case of accident or if you feel unwell seek medical advice immediately (show the label where possible)
Concentration Limits	Xn; R20: C ≥ 50 % Xn; R22: C ≥ 8 % C; R35: C ≥ 70 % C; R34: 50 % ≤ C < 70 % Xi; R37/38: 35 % ≤ C < 50 % Xi; R41: 8 % ≤ C < 50 % Xi; R36: 5 % ≤ C < 8 % Footnote: O; R8: C ≥ 50 %

Skin irritation	35%≤ c <50% H_2O_2: irritant
Eye irritation	5%≤ c <8% H_2O_2: irritant ≥8% H_2O_2: severe irritant

Summary	Value	Study	Safety factor
Non-professional user Skin irritating threshold	35%	limit for irritation	
Provisional AEC inhalation	0.363 mg/m^3	NOAEC in 28-day inhalation study (rat). To be replaced, based on value from a 90-day study	8

In accordance with Regulation (EC) No 1272/2008, Annex VI Table 3.1, peracetic acid is classified and labelled as follows:

Hazard Class and Category Code(s)	Flam. Liq. 3 Org. Perox. D **** Acute Tox. 4 * Acute Tox. 4 * Acute Tox. 4 * Skin Corr. 1A Aquatic Acute 1			
Hazard Statement Code(s)	H226 Flammable liquid and vapour H242 Heating may cause a fire H332 Harmful if inhaled H312 Harmful in contact with skin H302 Harmful if swallowed H314 Causes severe skin burns and eye damage H400 Very toxic to aquatic life			
Supplemental Hazard Statement Code(s)	-			
Pictogram(s) and Code(s)	GHS02 	GHS05 	GHS07 	GHS09 
Signal Word (Code)	Danger (Dgr)			
Specific Concentration Limits M Factors	STOT SE 3; H335: C ≥ 1 %			
Notes	B D			

In accordance with Directive 67/548/EEC, Annex VI Table 3.2, peracetic acid is classified and labelled as follows:

Class of danger	O Oxidising C Corrosive N Dangerous for the environment
R phrases	R7 May cause fire R10 Flammable R20/21/22 Harmful by inhalation, in contact with skin and if swallowed R35 Causes severe burns R50 Very toxic to aquatic organisms

Summary (Annex IIA, point 6.10)	Value	Study	Safety factor
ADI (acceptable daily intake, external long-term reference dose) (if residues in food or feed)	n.a.; PAA is not systemically available	-	-
AEL acute/ medium term/ long term	n.a.; PAA is not systemically available	-	-
Indicative AEC dermal	0.2% for short/medium term	Human volunteer study	-
	0.1% for long-term	rabbit one year study	2
Indicative AEC inhalation	0.23 mg/m^3 (0.075 ppm)	RD_{10} 0.6 ppm in Sensory irritation study in mice (Gagnaire et al. 2002, Doc.	8

S phrases	S1/2 Keep locked up and out of the reach of children S3/7 Keep container tightly closed in a cool place S14 Keep away from ... (incompatible materials to be indicated by the manufacturer) S36/37/39 Wear suitable protective clothing and gloves S45 In case of accident or if you feel unwell seek medical advice immediately (show the label where possible) S61 Avoid release to the environment. Refer to special instructions / safety data sheets
Concentration Limits	Xn; R20/21/22: C ≥ 10 % C; R35: C ≥ 10 % C; R34: 5 % ≤ C < 10 % Xi; R36/37/38: 1 % ≤ C < 5 %
Notes	B D

Sodium hypochlorite (CAS 7681-52-9)

Acidity / alkalinity:

The ph values of sodium hypochlorite solutions are alkaline. The ph value of a 5 % sodium hypochlorite solution was determined to be:

- Ph = 12.52 at 19.1 °c for the pure test item
- Ph = 10.30 at 21.3 °c for a 1 % (m/v) solution

pH of traditional household bleach

Current classification of b.p.

10 % ≤ C < 25 % (free available chlorine)	
Classification	as in Directive 67/548/EEC
Class of danger	C
R phrases	R31 R 34
S phrases	S1/2, S28, S45, S50, S61
5 % ≤ C < 10 % (free available chlorine)	
Classification	as in Directive 67/548/EEC
Class of danger	Xi
R phrases	R31 R 36/38
S phrases	S1/2, S28, S45, S50, S61

In addition to sodium hypochlorite, traditional household bleach also contains sodium hydroxide as a stabiliser.

***Sodium dichloroisocyanurate dihydrate* (CAS 51580-96-0)**

Acute Tox 4, H302
Eye Irrit. 2, H319
STOT SE 3, H335
Aquatic acute 1, H400
Aquatic Chronic, H410
GHS07
GHS09
Warning

Xn, R22
R31
Xi, R36/37
N, R50/53

***Symclosene = Trichloroisocyanuric acid* (CAS 87-90-1)**

Ox. Sol 2, H272
Acute Tox 4, H302
Eye Irrit. 2, H319
STOT SE 3, H335
Aquatic acute 1, H400
Aquatic Chronic, H410
GHS07
GHS09
GHS03
Danger

Calcium hypochlorite (CAS 7778-54-3)

with regard to physical/chemical data	O	Oxidising
	R8	Contact with combustible material may cause fire
with regard to toxicological data	C R 31 R34	Corrosive Contact with acids liberate toxic gas. Causes burns
	Xn R22	Harmful Harmful, if swallowed
with regard to fate and behaviour data	No classification	
with regard to ecotoxicological data	N	Dangerous for the environment
	R50	Very toxic to aquatic organisms

BIT (CAS 2634-33-5)

Hazard Class and Category Code(s)	Hazard Statement Code(s)	Hazard Statement Code(s)	Pictograms, Signal Word Code(s)
		H301+H311	GHS07 GHS06 GHS09 GHS05 Dgr
Acute Tox. 3	H301		
Acute Tox. 3	H311		
Skin Corr. 1B	H314	H314	
Skin Sens. 1	H317	H317	
Eye Dam. 1	H318	H318	
STOT SE 3	H335(Lungs)	H335	
Aquatic Acute 1	H400	H400	

MIT (CAS 2682-20-4)

Hazard Class and Category Code(s)	Hazard Statement Code(s)	Hazard Statement Code(s)	Pictograms, Signal Word Code(s)
		H301+H311	GHS07 GHS06 GHS09 GHS05 Dgr
Acute Tox. 3	H301		
Acute Tox. 3	H311		
Skin Corr. 1B	H314	H314	
Skin Sens. 1	H317	H317	
Eye Dam. 1	H318	H318	
STOT SE 3	H335(Lungs)	H335	
Aquatic Acute 1	H400	H400	

OIT (CAS 26530-20-1)

Classification		**Labelling**			**Specific Concentration limits, M-Factors**
Hazard Class and Category Code(s)	Hazard Statement Code(s)	Hazard Statement Code(s)	Supplementary Hazard Statement Code(s)	Pictograms, Signal Word Code(s)	
Acute Tox. 4 *	H302	H302		GHS06 GHS09 GHS05 Dgr	Skin Sens. 1; H317: C ≥ 0.05%
Acute Tox. 3 *	H311	H311			
Skin Corr. 1B	H314	H314			

Skin Sens. 1	H317	H317			
Acute Tox. 3 *	H331	H331			
Aquatic Acute 1	H400				
Aquatic Chronic 1	H410	H410			

Signal Words	Pictograms		
Danger			
	Skull and crossbones	Environment	Corrosion

DSD Classification (Table 3.2)

Classification	Risk Phrases	Safety Phrases	Indication of danger	Concentration Limits	
				Concentration	Classification
T; R23/24 Xn; R22 C; R34 R43 N; R50-53	22 23/24 34 43 50/53	(1/2) 26 36/37/39 45 60 61	T N	C ≥ 0.05 %	R43

Bronopol **(CAS 52-51-7)**

Classification		Labelling			Specific Concentration limits, M-Factors
Hazard Class and Category Code(s)	Hazard Statement Code(s)	Hazard Statement Code(s)	Supplementary Hazard Statement Code(s)	Pictograms, Signal Word Code(s)	
Acute Tox. 4 *	H302	H302		GHS07 GHS09 GHS05 Dgr	M=10
Acute Tox. 4 *	H312	H312			
Skin Irrit. 2	H315	H315			
Eye Dam. 1	H318	H318			
STOT SE 3	H335	H335			
Aquatic Acute 1	H400	H400			

Signal Words	Pictograms		
Danger			
	Exclamation mark	Environment	Corrosion

DSD Classification (Table 3.2)

Classification	Risk Phrases	Safety Phrases	Indication of danger	Concentration Limits	
				Concentration	Classification
Xn; R21/22 Xi; R37/38-41 N; R50	21/22 37/38 41 50	(2) 26 36/37/39 61	Xn N	C ≥ 2.5 %	N; R50

Glyoxal **(CAS 107-22-2)**

Classification		Labelling			Specific Concentration limits, M-Factors	Notes
Hazard Class and Category Code(s)	Hazard Statement Code(s)	Hazard Statement Code(s)	Supplementary Hazard Statement Code(s)	Pictograms, Signal Word Code(s)		
Skin Irrit. 2	H315	H315		GHS07 GHS08 Wng	*	Note B
Skin Sens. 1	H317	H317				
Eye Irrit. 2	H319	H319				
Acute Tox. 4 *	H332	H332				
Muta. 2	H341	H341				

Signal Words	Pictograms	
Warning	 Exclamation mark	 Health hazard

DSD Classification (Table 3.2)

Classification	Risk Phrases	Safety Phrases	Indication of danger	Concentration Limits	
				Concentration	Classification
Muta. Cat. 3; R68 Xn; R20 Xi; R36/38 R43	20 36/38 43 68	(2) 36/37	Xn	C ≥ 10 %	Xn; R20
				C ≥ 10 %	Xi; R36/38

Chlorine dioxid (CAS 10049-04-4)

Classification		Labelling			Specific Concentration limits, M-Factors	Notes
Hazard Class and Category Code(s)	Hazard Statement Code(s)	Hazard Statement Code(s)	Supplementary Hazard Statement Code(s)	Pictograms, Signal Word Code(s)		
Acute Tox. 3 *	H301	H301				

					Eye Irrit. 2; H319: 0,3% ≤ C < 3% M=10	

Signal Words	Pictograms		
Danger			
	Skull and crossbones	Environment	Corrosion

DSD Classification (Table 3.2)

Classification	Risk Phrases	Safety Phrases	Indication of danger	Concentration Limits	
				Concentration	Classification
T; R25 C; R34 N; R50	25 34 50	(1/2) 23 26 28 36/37/39 45 61	T N	C ≥ 10 %	C; R34
				3 % ≤ C < 10 %	Xi; R37/38
				0,3 % ≤ C < 10 %	Xi; R36
				C ≥ 2,5 %	N; R50

***Quarternary ammonium compounds, benzyl C12-18, alkyldimethyl chlorides* (CAS 68391-01-5)**
***Quarternary ammonium compounds, benzyl C12-14, alkyldimethyl chlorides* (CAS 85409-22-9)**

Hazard Class and Category Code(s)	Hazard Statement Code(s)	Hazard Statement Code(s)	Pictograms, Signal Word Code(s)
Acute Tox. 4	H302	H302	GHS07 GHS09 GHS05 Dgr
Skin Corr. 1B	H314	H314	
Aquatic Acute 1	H400	H400	

Appendix 2. Harmonised classification

The classification and labelling of certain hazardous chemicals must be harmonised to ensure adequate risk management throughout the European Union.

Member States, manufacturers, importers and downstream users may propose a harmonised classification and labelling (HCL) of a substance. Member States can also propose a revision of an existing harmonisation.

When a dossier for HCL is introduced to ECHA (European Chemicals Agency), it first undergoes a public consultation in order to gather all existing and relevant data on the substance. All the information is then transferred to the RAC (Risk Assessment Committee) composed of independent experts. The RAC adopts an opinion and sends it to the European Commission which is responsible for proposing a new legislative amendment of the Annex VI of the CLP regulation. All existing HCL are listed in this Annex VI. When a substance is classified as an HCL, this one is mandatory for the suppliers of this substance so that users are better informed about its potential hazardous effects and how to make best use of it safely.

6. COMPOSITION OF THE WORKING GROUP

The composition of the Committee and that of the Board as well as the list of experts appointed by Royal Decree are available on the following website: composition and mode of operation.

All experts joined the working group ***in a private capacity***. Their general declarations of interests as well as those of the members of the Committee and the Board can be viewed on the SHC website (site: conflicts of interest).

The following experts were involved in drawing up and endorsing this advisory report. The working group was chaired by **Walter STEURBAUT**; the scientific secretary was Marleen VAN DEN BRANDE.

JACQUEMIN Denise	Burns Centre	CHU Liège
KEIRSBILCK Stephan	Occupational health	UZ Leuven
LAFAIRE Cynthia	Burns Centre	ZNA Stuivenberg Antwerpen
STEURBAUT Walter	Human exposure	UGent
VAN BRUSSEL Michel	Burns Centre	UZ Leuven
VERSTEGEN Geert	Toxicology	Belgian Poison Centre
ZEYEN Thierry	Ophtalmology	UZ Leuven

The standing working group Chemical Agents has endorsed the advisory report. The standing working group was chaired by **Luc HENS**; the scientific secretary was Marleen VAN DEN BRANDE.

ADANG Dirk	Health and environment	UCL
DUBRUEL Peter	Organic chemistry	UGent
GODDERIS Lode	Occupational & environmental medecine	KULeuven
HENS Luc	Human ecology	VITO
PASSCHIER Wim	Environmental health risk assessment	Maastricht University

The following administrations and/or ministerial cabinets were heard:

DUSSART Aurélie	MRB - Chemicals	FPS Health, Food Chain Safety and Environment
NIJS Eric	MRB - Biocides	FPS Health, Food Chain Safety and Environment

Au sujet du Conseil Supérieur de la Santé (CSS)

Le Conseil Supérieur de la Santé est un organe d'avis fédéral dont le secrétariat est assuré par le Service Fédéral Santé publique, Sécurité de la Chaîne alimentaire et Environnement. Il a été fondé en 1849 et rend des avis scientifiques relatifs à la santé publique aux ministres de la Santé publique et de l'Environnement, à leurs administrations et à quelques agences. Ces avis sont émis sur demande ou d'initiative. Le CSS s'efforce d'indiquer aux décideurs politiques la voie à suivre en matière de santé publique sur base des connaissances scientifiques les plus récentes.

Outre son secrétariat interne composé d'environ 25 collaborateurs, le Conseil fait appel à un large réseau de plus de 500 experts (professeurs d'université, collaborateurs d'institutions scientifiques, acteurs de terrain, etc.), parmi lesquels 300 sont nommés par arrêté royal au titre d'expert du Conseil. Les experts se réunissent au sein de groupes de travail pluridisciplinaires afin d'élaborer les avis.

En tant qu'organe officiel, le Conseil Supérieur de la Santé estime fondamental de garantir la neutralité et l'impartialité des avis scientifiques qu'il délivre. A cette fin, il s'est doté d'une structure, de règles et de procédures permettant de répondre efficacement à ces besoins et ce, à chaque étape du cheminement des avis. Les étapes clé dans cette matière sont l'analyse préalable de la demande, la désignation des experts au sein des groupes de travail, l'application d'un système de gestion des conflits d'intérêts potentiels (reposant sur des déclarations d'intérêt, un examen des conflits possibles, et une Commission de Déontologie) et la validation finale des avis par le Collège (organe décisionnel du CSS, constitué de 40 membres issus du pool des experts nommés). Cet ensemble cohérent doit permettre la délivrance d'avis basés sur l'expertise scientifique la plus pointue disponible et ce, dans la plus grande impartialité possible.

Après validation par le Collège, les avis sont transmis au requérant et au ministre de la Santé publique et sont rendus publics sur le site internet (www.css-hgr.be). Un certain nombre d'entre eux sont en outre communiqués à la presse et aux groupes cibles concernés (professionnels du secteur des soins de santé, universités, monde politique, associations de consommateurs, etc.).

Si vous souhaitez rester informé des activités et publications du CSS, vous pouvez envoyer un mail à l'adresse suivante : info.hgr-css@health.belgium.be.