Survey of Chemical Substances in Consumer Products

Survey no. 19, 2002

Mapping and exposure of chemical substances in Christmas sprays

Jette Laursen and Lone Trap, Chemtox A/S

Miljøstyrelsen
Miljø- og Energiministeriet

Contents

Preface

This report contains results from the project "Mapping and exposure of chemical substances in Christmas decorations, Project 2 - spray cans". The project is a part of the total effort of the Environmental Protection Agency (EPA) to map chemical substances in consumer products.

The project has been carried out by the consultants, Chemtox A/S.

To evaluate the progress and results of the project a group has been appointed with the following persons:

Frank Jensen, EPA (responsible for the project)
Anette Albjerg Ejersted, EPA
Jette Laursen, Chemtox A/S (project manager)

Summary and conclusions

The project is about mapping spray products to be used for Christmas decorations as well as evaluation of the exposure to ingredients in connection with the use of these.

The market

The mapping of the market took place in the off season. This means that only few shops had Christmas sprays in their assortments, as these types of products are often sold as seasonal goods. To ensure the essential pieces of information for the mapping it was thus necessary to contact suppliers and importers within this area.

It turned out that relatively few companies make spray products whereas there are many suppliers and importers for even more points of sale.

The points of sale are typically paint dealers and hobby shops all year and groceries in the season. Normally a dealer only sells one series of products from one supplier. This means that in the purchase situation it is not possible for the consumer to compare different products.

The consumption of different types of spray products depends very much on the fashion. This means that some years large quantities of metal spray are sold whereas other years it is fashionable to use raw natural products, which reduces the consumption of spray products. As an example glitter spray (clear lacquer with metal glitter) was often used earlier, but today it is almost impossible to find it in the shops, as it is no longer in fashion.

Regulations

The mapping has shown that the Danish regulations within this area does not seem to be very accessible to Danish as well as foreign manufactures. Foreign manufactures often have to have Danish partners, who know Danish regulations, to ensure that their products comply with Danish rules.

Products

Information about the products' composition comes from safety data sheets and formulations. The review of the compositions of spray products shows that the organic solvents and the propellants are the reason for the dangerous properties of the spray products.

All products - except one - is based on organic solvents. According to Danish law a major part of the used organic solvents is not legal to use in spray products but it is possible to apply for an exemption from the ban on most of the substances.

The propellants in the products are the normally used mixture of propane and butane.

Due to lack of sufficient information it has not been possible to uncover which types of binders are typically used. Usually binder types are not stated in the safety data sheets of the products.
The colour of all metal spray products comes from pure metals like eg. copper, aluminium and zinc.

Exposure

In this project different circumstances have been outlined under which the ordinary consumer may be expected to use the spray products.

Naturally, the inhalation of aerosol and vapours/gases represents the largest risk of exposure. When using large quantities (150 g) very high strains are seen comparing the concentrations with the exposure limits of the Working Environment Service, and it make take several hours before an acceptable level is reached. Even if small quantities 6 g (1/25 of a can) is used, the strain exceeds an acceptable level. Even though the compositions of different products seem different, this does not necessarily mean that there is a large difference in the strain of the solvents when used.

An evaluation of the health risk, under which the effects of the propellants are not considered, does not change the danger level substantially.

All products have in common that they have a considerable content of flammable substances. Therefore, there is a substantial risk of fire and explosion if the spray can is handled wrongly and if the products are used near open fires or hot surfaces. This has to be stated on the label.

Based on the exposure assessments you can only advice the consumers to use the products in well-ventilated areas, eg. outside. If this is not possible the spray products should only be used in well-ventilated rooms eg. with open windows. Persons should not stay in the room afterwards and the room has to be aired thoroughly.

1 Introduction to spray cans

The tradition to decorate things is strong and especially at Christmas time. This means that many Christmas decorations are made to decorate homes. Eventhough is it a tradition to decorate things there is a tendency to a certain fashion. Sometimes everything has to be made in raw nature, whereas other times colours, gold, silver and glitter are used.

In this project the spray products used to make different types of decorations at Christmas time are focused on. However, spray products are also used during the rest of the year for eg. gold, silver and copper weddings.

The uses of spray cans/aerosols started at the end of the 1920'ties when the Norwegian engineer and inventor Erik Rotheim took out a patent for using a container under pressure with a nozzle to disperse various products.

Today an aerosol is defined as being a container of steel, aluminium, glass or plastic which contains a mixture of the product and a propellant under pressure. When you press the activator of the can, the propellant pushes the product through a riser pipe to the nozzle of the can and thus a particle mist/aerosol, foam or gel is formed. The propellant will be a gas.

Europe is the world's main area for the production of spray cans. In 2001 4675 million spray cans were produced. These spray cans are used for products within the following areas: paint/lacquer (3%), medicine (6%), industry (7%), foods (8%), households (21%) and cosmetics (55%).

In this project the following types of spray products are included:

- metal spray (gold, silver, copper and bronze)
- glitter spray
- snow spray.

When dry they all give the desired surface. Spray glue, to which glitter is added to achieve an effect, is not included.

Metal and glitter products form a particle mist made of paint/lacquer whereas snow spray forms a mixture of foam and particles.

2 Accessible spray products

This project is based on the situations in which the consumer may be expected to use a spray product for decoration purposes. This will thus influence where the consumer chooses to buy spray products.

The situation of the consumer may be one of the following:

- decorating in connection with Christmas
- making Christmas decorations
- decorating in connection with weddings
- painting/decoration of ordinary decorative objects.

When the consumer is about to make Christmas decorations and decorate windows at Christmas time he/she will typically buy spray products at the same time as other hobby materials. These hobby materials will be available in hobby shops but also as seasoning goods in groceries.

When making Christmas decorations with spruce and other materials from florists the consumer is expected also to purchase the spray products at this place.

In connection with weddings and painting/decoration of decorative objects the purchase of spray products takes place all year. For these purposes consumers are expected to buy their products in hobby shops, paint shops and DIY centres.

2.1 Mapping of the market

In connection with this project shops within the categories: groceries, hobby shops, paint shops, DIY and florists were visited. When the mapping took place in August/September it was clear which shops had seasonal goods and which always sell spray products.

Groceries only sell spray products during the Christmas season, which means from the end of October.

Hobby shops typically sell spray products all year but they see to it that they have a complete assortment including Christmas snow at the Christmas season, which means from the end of October.

Paint shops and DIY centres typically only sell metal sprays and several of these are only for painting car rims and the like, which acquires a high quality and durability towards eg. wear. Some have qualities only suited for indoor use or some directly state that they are to be used for decoration purposes.

Florists may sell spray products but not normally. However, they use spray themselves for decorative purposes. Several florists state that the extent very much depends on the fashion.

Groceries, hobby shops and florists typically buy their goods at importers/agents/ wholesalers. Their turnover of spray products is relatively small and as there are some special rules, which spray products have to comply with, they do not want to be responsible for the import themselves. Large chains of shops can on the basis of their size make demands to the composition of the products and the shape of labels, which means that it is not always possible to see where the products come from.

Paint shops and DIY centres normally have other products within this line of business, so they either buy directly from the manufactures or at importers/agents/ wholesalers.

Importers/agents/wholesalers purchase their goods from the manufacturer. In this project only European manufactures were identified. As many companies have their products made under private labels, the products of one manufacturer may be available in various shades. This project shows that actually only a few manufactures of the many products have been identified. As much as five different product series/suppliers of the products from one manufacture were found. The reason might be that special production equipment is required to produce spray products.

This project shows that the products are produced in very few countries (Denmark, Italy, Belgium and Germany).

2.2 Products

The purchase of products mainly took place at late summer, which means off the Christmas season. Therefore, it was only possible to buy Christmas spray products at hobby shops, paint dealers and DIY centres and not at groceries. The range of several shops was however not complete. Therefore, purchasers of groceries and Danish importers/agents were contacted to collect information about the products that it would be possible to buy later.

23 products were bought and information was collected about 28 products within the groups stated below.

Table 2.2.a. Product survey

Product type	Number of purchased products	Number of non-purchased products	Total
Gold spray	9	7	16
Silver spray	4	11	15
Copper spray	3	4	7
Bronze spray	0	2	2
Glitter spray	4	4	8
Snow spray	3	0	3
Total	23	28	51

This means that the project includes a total of 51 products.

Information about gold, silver, copper and bronze sprays is often mentioned in the same safety data sheet or formulation. Therefore, a statement of the series of metal sprays is relevant. In this project metal series contain as much as three products.

Table 2.2.b. Total number of metal series:

	Number
Metal series	17
Series, in which at least one product has been bought	9

Even though the project includes the largest chains of shops within groceries, hobby shops and DIY centres there can easily be other products on the market than the ones mentioned in this project. Among other things this is due to the fact that the project was carried out at a time in which the goods were not available in all shops. However, the most essential agents/importers within the hobby area have participated in the project, which ensures a reasonable mapping.

3 Regulations concerning spray products

Spray products/aerosols, which are marketed in Denmark, have to comply with common European laws as well as special Danish laws. In the following the most relevant laws are briefly described.

3.1 Common European laws

3.1.1 Aerosols

All aerosols are comprised by "the statutory order about aerosols" (1). According to this order an aerosol has to be tested in accordance with the technical requirements mentioned in the order. As a confirmation that the aerosol meets the order it has to be marked with a laterally reversed epsilon (Ǝ).

The order also requires that the following pieces of information are mentioned on the label:
- Name and address or trade mark of the company responsible for the marketing.

- A code used to identify the bulk no.

- The net content in weight and bulk.

- A special warning text which varies depending on the content of flammable components:

> Irrespective of the content:
> "Pressurised container: protect from sunlight and do not expose to temperatures exceeding 50°C. Do not pierce or burn, even after use".
>
> Containing combustible components:
> " Pressurised container: protect from sunlight and do not expose to temperatures exceeding 50°C. Do not pierce or burn, even after use. Do not spray on a naked flame or any incandescent material. Keep away from sources of ignition - No smoking. Keep out of the reach of children".

All text has to be in Danish.

3.1.2 Danger labels

All chemical products, which are regarded as being dangerous, are required to have a danger label. The rules are described in statutory order about classification, packaging, labelling, sale and storage of chemical substances

and products (2). In the following the regulations, which might be relevant for the spray products in question, are described.

3.1.2.1 Required information
The danger label has to inform about the following:

1. The trade name of the product.
2. The assigned quantity of the content.
3. Name, company address, and telephone number of the EU-company responsible for the marketing.
4. Possible special labelling rules.
5. Hazard designations and symbols.
6. R-phrases.
7. S-phrases.

All text has to be in Danish.

3.1.2.2 Labelling rules
The following special labelling rules may be relevant for the spray products in question:

- If the content of flammable components is so low that the aerosol does not involve any risk of ignition under normal circumstances the manufacturer/importer may omit the labelling with danger symbols and R-phrases of flammability at his own risk. In these cases the aerosol needs to have the following labelling "Contains x weigh percentages flammable components" to which the quantity of flammable components is added.

- By a content of at least 15% of a substance classified with R67, the following needs to be stated ”Vapours may cause drowsiness and dizziness”.

As products are applied by spraying S23 (do not breathe gas/fumes/vapour/spray) as well as either S38 (in case of insufficient ventilation, wear suitable respiratory equipment) or S51 (use only in well ventilated areas) have to be mentioned.

3.1.2.3 Label shape
As a minimum the label has to have the proportions: 52 x 74 mm. Each danger symbol must take up at least 1/10 of the label and be at least 1 cm^2. Danger symbols and hazard designations have to be stated. Combined labels covering several countries only need to have one danger symbol with the hazard designations of the languages in question.

3.1.2.4 Child-resistant fastenings and tactile warnings
In addition to the above there may be demands for child-resistant fastenings if the aerosol is labelled with the danger symbol "corrosive" or demands for a tactile warning if the aerosol is labelled with the danger symbol "corrosive" or "harmful".

3.2.1 Toxic substances and Ae-labelled substances

Aerosols are not allowed to contain substances which have the remark "Ae" in 'The List of dangerous substances'(3), please see 'Statutory order about limitations in sale and use of certain dangerous chemical substances and products for a special purpose' (4). These substances are classified as being very toxic or toxic or the EPA has evaluated that they are not to be used in aerosols.

3.2.2 Limitations in the use of propellants and solvents

'The statutory order about use of propellants and solvents in aerosol cans' (5) lists legal solvents and propellants in products used retail and commercially but not industrially. This order will be referred to as Bek. 571 in the rest of the report. Aerosols in this project will thus be comprised by this order.

This order defines propellants and solvents as chemical substances with a boiling point below 168°C. The order comprises the substances mentioned above and which are part of the product with at least 1 weight percentage.

It is only legal to use the propellants and solvents which are mentioned in the order. However, it is possible to apply for an exemption from the order. In addition to the above some substances are subject to special requirements. The following may be relevant for the products handled in this project:

Limitations in field of application:
- the aerosol shall not be used indoors in households indoors.

The order does not require that this is stated on the label.

Further limitations:
- shall only be used for coarse atomisation.

The order does not defined the words "coarse atomisation".

Highest allowable concentration in the product ready for use:
- maximum allowable quantity in the aerosol. Irrespective of the use the maximum allowable quantity applies.

Labelling:
- requirements to mention S38 (in case of insufficient ventilation, wear suitable respiratory equipment) at the danger label.

3.2.3 Code number (MAL-code)

According to the statutory order about determination of code numbers (7) as well as the statutory order about work with code numbered products (8) all coating materials need to have a code number, when they are used professionally.

The spray products in this project can be regarded as being coating materials and therefore they need to have a code number. According to the law the code number does not have to be stated at the label, but it has to be in writing and it also has to be written on the safety data sheet.

4 Review of the products

In the following spray products are divided into three main groups, viz. metal, glitter and snow spray. In each group the main composition and the type of ingredients are described.

Information about compositions arise from safety data sheets and formulations of the products. Information from formulations has to be handled confidentially and therefore these pieces of information cannot be published in this report. However, they have made it possible to make the final evaluation of the products and to show which substances are used in the spray products in this project.

Table 4.0. Survey of collected data

Product type	Information from safety data sheets	Elaborated information from the formulation
Gold spray	14	7
Silver spray	14	8
Copper spray	7	4
Bronze spray	2	1
Glitter spray	8	2
Snow spray	2	1
Total	47	23

The project comprises a total of 47 products.

4.1.1 Metal spray

In this project gold, silver, copper and bronze spray products are evaluated at the same time as only the pigments differ in most product series. Among other things this means that the different types of metal sprays have one safety data sheet and one formulation.

4.1.1.1 Propellants

Four different substances have been identified as propellants.

Mixtures of propane and butane are commonly used in spray cans. In metal sprays the mixture of butane, propane and isobutane is used. Crude oil gases, condensed, sweetened is a mixture of butane and propane.
The highest concentration of propellants was 55%.

Table 4.1.1.1. Propellants in metal spray

Substance name	CAS-no.	Lowest conc.	Highest conc.	Is used in x of the 37 products	Note
Butane	106-97-8	1	45	22	-
Isobutane	75-28-5	1	10	4	-
Propane	74-98-6	5	30	22	-
Propane/butane	74-98-6 / 106-97-8	25	40	12	-
Crude oil gases, condensed, sweetened	68476-86-8	10	30	4	**) 571

**)571 means, that the substance is not mentioned in statutory order no. 571 (5) and therefore it is not legal to use it in spray products unless an application for exemption has been made. It is not stated in the collected material if an exemption has been granted.

4.1.1.2 Solvents

23 different organic solvents have been identified in the metal spray. As much as nine different organic solvents were found in one product. Several of the organic solvents are used in more than one product in mixtures with various other organic solvents.

Table 4.1.1.2. Solvents in metal spray

Substance name	CAS-no.	Lowest conc.	Highest conc.	Is used in x of the 37 products	Note
1,2,4-trimethylbenzene	95-63-6	0,1	15	4	**) 571
2-butoxyethanol	111-76-2	0,1	1	3	**) 571
2-methoxy-1-methylethylacetate	108-65-6	1	3	2	**) 571
Acetone	67-64-1	2,5	60	30	-
Butylacetate	123-86-4	0,1	25	13	*) 571; 100 %
Cyclohexane	110-82-7	10	30	2	*) 571; 100 %
Diisobutylketon (2,6-dimethyl-4-heptanon)	108-83-8	1	5	2	Ae
Ethylacetate	141-78-6	0,1	30	13	-
Ethylenglycol monobutylether	111-76-2	3	5	1	**) 571
Isoparaffin mixture	90622-57-4	0,1	15	7	**) 571
Isopropylalcohol	67-63-0	5	10	4	-
Hydrocarbons with an aromatic content 1-25%	-	15	20	1	**) 571
Mesitylene	108-67-8	1	5	4	**) 571
Mineral spirits	64742-88-7	5	10	2	**) 571
Naphtha (crude oil) hydrotreated, heavy	64742-48-9	1	30	16	Ae **) 571
Naphtha (crude oil) light hydro cracked	64741-69-1	10	25	1	Ae **) 571
Naphtha (crude oil), hydrodesulfurized, heavy	64742-82-1	10	30	1	Ae **) 571
n-butanol	71-36-3	1	5	4	*) 571; 5 %
Phenylpropane/isopropylbenzene	103-65-1	1	5	3	**) 571
Solvent naphtha (crude oil) light aromatic	64742-95-6	0,1	25	29	Ae **) 571
Solvent naphtha (crude oil) light aliphatic	64742-89-8	1	60	6	Ae **) 571

Substance name	CAS-no.	Lowest conc.	Highest conc.	Is used in x of the 37 products	Note
Toluene	108-88-3	5	10	5	*) 571; 20 % med xylen
Xylene	1330-20-7	4	25	21	*) 571; 20 % med toluen

*) 571; x %" means that the product is only allowed to contain a concentration of x % of the substance and the product cannot be used indoors in households.

**)571 means that the substance is not mentioned in statutory order 571 (5) and therefore it is not legal to use in spray products unless an application for exemption has been made.

It appears from the table of organic solvents in metal sprays that six ingredients have the remark 'Ae' in the 'List of dangerous substances'. Among other things this is due to a possible contamination with carcinogenic substances. The safety data sheet of the products in question state that the substances are not carcinogenic. If the product contains carcinogenic substances in concentrations larger than or equal to 0.1% it has to be labelled toxic and it is not legal to sell it retail. Furthermore, aerosols are not allowed to contain toxic substances.

Of the 37 metal spray products mentioned in this project, 28 contain substances which are comprised by lawful limitations in concentrations. If the concentration is below the mentioned limits it is legal to market the product but not for use indoors.

4.1.1.3 Pigments

Six different descriptions of pigments have been identified in metal sprays. Four of these are based on aluminium.

Table 4.1.1.3. Pigments in metal spray

Substance name	CAS-no.	Lowest conc.	Highest conc.
Aluminium powder	7429-90-5	1	5
Aluminium flakes	7429-90-5	5	10
Copper	7440-50-8	1	5
Aluminium powder, stabilised	-	0	10
Aluminium paste	-	-	-
Bronze paste	-	-	-

Aluminium gives the 'silver look', whereas bronze and pure copper give golden colours. These are adjusted with aluminium to get a more or less red metal colour.

It also appears from the formulations that products may contain zinc-based pigments.

4.1.1.4 Binders

The safety data sheets of a few products state that they are based on acrylic binders. The formulations contain confidential information about other types of binders.

4.1.1.5 Other ingredients

Only one additive has been mentioned in connection with metal sprays.

Table 4.1.1.5. Other ingredients in metal sprays

Substance name	CAS-no.	Lowest conc.	Highest conc.
Rheological additive	-	-	-

Rheological additives are added to give the product a suitable flow. Further comments are not possible due to a lacking knowledge of the substance type.

4.1.2 Glitter spray

There are different types of glitter spray. Some glitter sprays are total coating paints to which glitter is added whereas other are clear lacquers with added glitter.

In this project information has been collected on eight products. A suitable number of products based on clear lacquer has not been found, and therefore the information cannot be regarded as being general to the type.

4.1.2.1 Propellants

Two different substances have been identified to be used as propellants.

Table 4.1.2.1. Propellants in glitter spray

Substance name	CAS-no.	Lowest conc.	Highest conc.	Is used in x of the 8 products	Note
Butane	106-97-8	10	55	6	-
Propane	74-98-6	5	30	6	-
Propane/butane	74-98-6 / 106-97-8	30	50	2	-

Mixtures of propane and butane are commonly used in spray cans. The highest concentration of propellants in a product is as much as 55%.

4.1.2.2 Solvents

Nine different organic solvents have been identified in glitter sprays.

There may be as much as seven different organic solvents in a product. Several of the organic solvents are used in more than one product in mixtures with various other organic solvents.

Table 4.1.2.2. Solvents in glitter spray

Substance name	CAS-no.	Lowest conc.	Highest conc.	Is used in x of the 8 products	Note
2-methoxy-1-methylethylacetate	108-65-6	1	5	2	**) 571
Acetone	67-64-1	10	50	4	-
Butanol	71-36-3	1	5	6	*) 571; 5 %
Diisobutylketon (2,6-dimethyl-4-heptanon)	108-83-8	1	5	1	Ae **) 571
Ethylacetate	141-78-6	5	25	6	-
Hydrocarbons aromatic content 1-25%	-	10	15	4	**) 571

Substance name	CAS-no.	Lowest conc.	Highest conc.	Is used in x of the 8 products	Note
White spirit	8052-41-3	5	10	2	Ae ***) 571
Naphtha(crude oil) hydrotreated light	64742-49-0	10	30	2	Ae **) 571
Xylene	1330-20-7	10	25	2	*) 571; 20 % med toluen

*) 571; x % means that the product is only allowed to contain a concentration of x % of the substance and the product cannot be used indoors in households.

**) 571 means that the substance is not mentioned in statutory order no. 571 (5) and therefore it is not legal to use it in spray products unless an application for exemption has been made.

***) 571 means that the substance is mentioned in order no. 571 (5) and that there are further demands and limitations in connection with the use of this substance in spray cans.

The table of organic solvents in glitter sprays shows that four ingredients have the remark 'Ae' in the 'List of dangerous substances'. This is due to a possible contamination with carcinogenic substances. The purity of the ingredients is not stated in the material received. If the product contains carcinogenic substances in concentrations larger than or equal to 0.1% it has to be labelled toxic, and it is not legal to sell it retail. Furthermore, aerosols are not allowed to contain toxic substances.

4.1.2.3 Pigments

In addition to traditional pigments glitter spray contains glitter based on polyester.

4.1.2.4 Binders

Neither the safety data sheets nor the formulations contain information about the type of binders used in the products.

4.1.2.5 Other ingredients

The safety data sheets of glitter spray do not state whether they contain other ingredients or not. The formulations mention some not clearly defined substances whose function cannot be estimated.

4.1.3 Snow spray

It was possible to find information about two products. The composition of snow spray differs substantially from the other Christmas spray products. As information has not been gathered about more than two snow sprays, the following pieces of information cannot be regarded as being general for snow sprays.

4.1.3.1 Propellants

At least three substances have been identified as propellants.

The mixture of propane and butane is commonly used as propellants in spray cans. In the other types of spray products in this project hydrofluorocarbons (HFC) was not used.

Table 4.1.3.1. Propellants in snow spray

Substance name	CAS-no.	Lowest conc.	Highest conc.	Is used in x of the 2 products	Note
Butane	106-97-8	25	30	1	-
Hydrofluorocarbons (HFC)	-	-	-	1	**) 571 #) 552
Propane	74-98-6	1	5	1	-

**) 571 means that the substance is not mentioned in statutory order no. 571 (5) and therefore it is not legal to use it in spray products unless an application for exemption has been made.

#) 552 refers to statutory order 552, which among other things describes that HFC in spray products is not legal after 1 September 2002, unless the product was marketed in Denmark before this date.

4.1.3.2 Solvents

Two organic solvents have been identified in snow spray:

Table 4.1.3.2. Solvents in snow spray

Substance name	CAS-no.	Lowest conc.	Highest conc.	Is used in x of the 2 products	Note
Butanol	71-36-3	1	5	1	*) 571; 5 %
Ethyl acetate	141-78-6	10	15	1	-

*) 571; 5% means that the product is only allowed to contain a concentration of 5% of the substance and the product cannot be used indoors in households.

The data basis is too modest to comment this statement further.

4.1.3.3 Binders

Based on the gathered information acrylic polymers are the only kind of binders.

4.1.3.4 Other ingredients

Snow spray contains some other types of substances than metal spray and glitter spray.

Table 4.1.3.4. Other ingredients in snow spray

Substance name/substance description	CAS-no.	Lowest conc.	Highest conc.
Demineralised water	-	-	-
Anti-corrosion agent	-	-	-
Emulsifier	-	-	-
Perfume	-	-	-
Stearic acid	-	-	-

Water functions as a solvent. The function of the other substances is defined in the substance description. The function of stearic acid is the ”snow effect”.

5 Exposure to chemical substances

When spray products are used an aerosol is formed, which is a mist of particles and vapours/gases.

In paint and glitter products the particles are pigments, binders and solvents, whereas the particles in the snow products are "artificial snow".

The vapours/gases in all three types of spray products are propellants and solvents.

The particles are sprayed onto the surface and gives the desired result as soon as the product is dry - when the solvents have evaporated. The evaporation of the products in this project takes place quite fast.

When persons use spray products they may be exposed to chemical substances through inhalation of vapours and particles but also to some extend by skin contact, if they touch the wet spray product.

The propellants and many of the solvents also make up a large fire and explosion risk, as the substances are flammable, highly flammable and extremely flammable respectively. Therefore, laws make requirements for the special labelling of aerosols.

5.1 Application

There is not one unambiguous application, as the use depends on the task for which the spray product is used. Some use a whole can at a time whereas others only use small doses.

Snow products will normally be used in large quantities for e.g. decoration of windows, and many will use a whole can so they do not have to save anything for next year.

Metal sprays will be used in small doses, eg. when a cone or other decorative things have to be lacquered. A family may also choose to give everything the same gloss and in connection with this several cans may be used.

Glitter spray which is used in connection with decorations to give them a "glow" will probably only be used in small quantities at a time.

5.2 Inhalation

5.2.1 Description of exposure calculations

To be able to evaluate the exposure of humans by inhalation we have lay down a row of standard conditions. These conditions are based on the various ways to use the products.

Therefore, the calculations have been carried out in two scenarios, viz. by using a whole can within relatively short time and by using small doses. In this project small doses are defined as 1/25 of a 150 ml can.

The use of spray products may take place in various kinds of rooms. As several of the products are not allowed to be used indoors two different circumstances are mentioned under which the products can be used:

- in garages or the like (3m x 6m x 2,5m) with an air change twice an hour

- indoors eg. in a kitchen (3m x 4m x 2,5m) with an air change ½ time an hour.

It is assumed that spraying only takes place once within a period and that all solvents evaporate right away.

This means that it is possible to use the general formula for decay known from for instance decomposition of radioactive substances:

$$c_t = c_0 \, e^{-kt}$$

c_t: the concentration at a given time
c_0: start concentration
k: air change each unit of time
t: a given time.

By following the air concentration in the course of time you can an the impression of how the circumstances will be under various use conditions.

To be able to evaluate the size of the effects the concentrations are compared with the occupational exposure limits of substances and materials (9) from the Working Environment Service. In connection with this it has to be mentioned that the purpose of exposure limits is to evaluate the harmful effects of substances and materials during work with these. Exposure limits are established on the basis of administrative norms and express the value of the average concentration of the substance during an eight-hour workday.

The exposure limit itself is not an expression of the toxicity of a substance but may give a guiding assessment of the substance when you compare the exposure limit with the way the substance works, its volatility and other properties. It will show the risk by exposure to the substance. This means that the further below the exposure limit a concentration is the smaller the risk of harmful effects from the substance.

As a rule-of-thumb situations with less than 1/10 of the exposure limit with contamination with organic solvents are estimated as being acceptable.

There is a group of substances which have such a fast acute effect that the exceeding of exposure limits is not legal at any times. These substances have a ceiling value.

The spray products each contain several substances. By the evaluation of these the calculation model of the Working Environment Service is used to calculate the total effect.

Formula (fraction sum):

$C_1/GV_1 + C_2/GV_2 + C_3/GV_3 + \ldots\ldots\ldots + C_n/GV_n$

in which C is the concentration of the substances in question and GV is the corresponding exposure limit.

A fraction sum of 1 corresponds to the exposure limit of the total effect. This means if the fraction sum is larger than 1 the conditions of the working environment are unacceptable. In connection with indoor climates the rule-of-thumb is that if the fraction sum is larger than 0.1 the circumstances are problematic.

5.3 Evaluation of the products

In the following the air concentration of organic solvents and propellants in relation to their exposure limits is shown, which means the fraction sum. Random products have been selected and in each case the most precise information has been used, which means information about the composition if available. In those cases in which information about compositions was only available from safety data sheets the highest concentrations stated were used for the calculations. This means that subsequent calculations describe the worst possible conditions.

5.3.1 Metal spray

Two metal spray products from different manufactures have been evaluated.

The table contains the calculated values which are also shown graphically. Two situations of each metal spray are mentioned.

- the can (150 g) is used at one time
- small quantities corresponding to 6 g metal spray (1/25 of a can).

Table 5.3.1.a. 150 g Metal spray A

Garages												
Time/ hours	0	0.25	0.5	0.75	1	1.5	2	3	4	-	-	-
Fraction sum	4.1	2.5	1.5	0.9	0.5	0.2	0.1	0.0	0.0	-	-	-
Kitchens												
Time/ hours	0	0.25	0.5	0.75	1	1.5	2	3	4	5	6	7
Fraction sum	6.1	5.4	4.7	4.2	3.7	2.9	2.2	1.4	0.8	0.5	0.3	0.2

Figure 5.3.1.a. 150 g Metal spray A

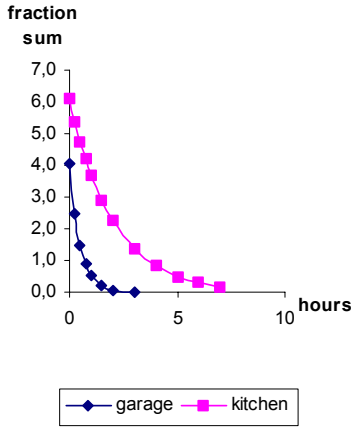
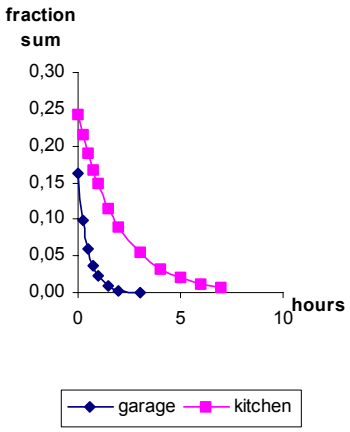


Table 5.3.1.b. 6 g Metal spray A

Garages												
Time/ hours	0	0.25	0.5	0.75	1	1.5	2	3	4	-	-	-
Fraction sum	0.16	0.10	0.06	0.04	0.02	0.01	0.00	0,00	0,00	-	-	-
Kitchens												
Time/ hours	0	0.25	0.5	0.75	1	1.5	2	3	4	5	6	7
Fraction sum	0.24	0.21	0.19	0.17	0.15	0.12	0.09	0.05	0.03	0.02	0.01	0.01

Figure 5.3.1.b. 6 g Metal spray A



Similar calculations have been made for another metal spray.

Table 5.3.1.c. 150 g Metal spray B

Garages												
Time/ hours	0	0.25	0.5	0.75	1	1.5	2	3	4	-	-	-
Fraction sum	11.8	7.2	4.3	2.6	1.6	0.6	0.2	0.0	0.0	-	-	-
Kitchens												
Time/ hours	0	0.25	0.5	0.75	1	1.5	2	3	4	5	6	7
Fraction sum	17.7	15.6	13.8	12.2	10.8	8.4	6.5	4.0	2.4	1.5	0.9	0.5

Figure 5.3.1.c. 150 g Metal spray B

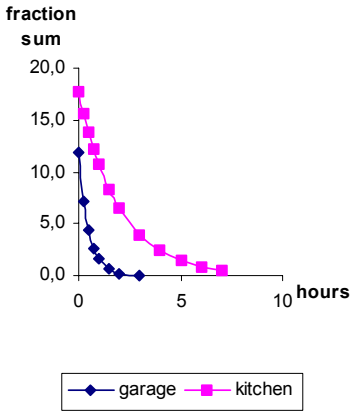
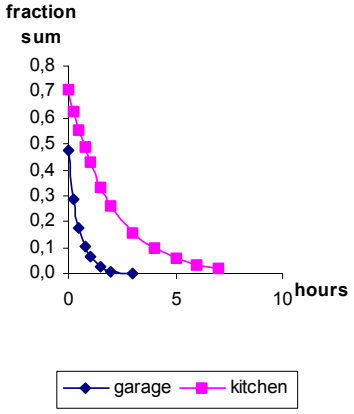


Table 5.3.1.d. 6 g Metal spray B

Garages												
Time/ hours	0	0.25	0.5	0.75	1	1.5	2	3	4	-	-	-
Fraction sum	0.5	0.3	0.2	0.1	0.1	0.0	0.0	0.0	0.0	-	-	-
Kitchens												
Time/ hours	0	0.25	0.5	0.75	1	1.5	2	3	4	5	6	7
Fraction sum	0.7	0.6	0.6	0.5	0.4	0.3	0.3	0.2	0.1	0.1	0.0	0.0

Figure 5.3.1.d. 6 g Metal spray B



There is a large difference between the two products, as Metal spray B results in approx. three times as high values as Metal spray A.

When using a whole can (150 g) the results of the calculations clearly show that both products cause an exceeding of the exposure limit from 4.1 times (Metal spray A, garage) to 17.7 times (Metal spray B, kitchen) under the circumstances stated.

In the garage with the high air change the contamination level falls to the exposure limit after 3/4 – 1½ hours but an acceptable level of 1/10 of the exposure limit is not reached until two hours after spraying at the earliest. In kitchens with less air change the contamination level is reduced to the value of the exposure limit after 3-6 hours, but it takes 7 hours before an acceptable level of 1/10 of the exposure limit is seen.

This clearly shows that large quantities of metal spray products should be used under well-ventilated conditions and in places in which people are not supposed to stay right afterwards.

If only small quantities are used the exposure limit will not be exceeded, as the contamination level is 0.16 – 0.7 times the exposure limit. However, this still exceeds the acceptable level of 1/10 of the exposure limit. By work in kitchens with a low air change it will take 1½-3 hours before the conditions are acceptable. In garages with a high air change it will take ¼-¾ hour before the contamination level is reduced to 1/10 of the exposure limit.

To evaluate the effect of the propellants on the fraction sum the calculations have been repeated without the contribution from the propellants. In connection with Metal spray A this only gives a minor difference, as the concentration is reduced to the exposure limit ¼ hour faster by the use of a whole can in the garage. When using small quantities in a kitchen the concentration is reduced to 1/10 of the exposure limit ½ hour faster.

On the basis of the above it can be concluded that it is always important to use metal spray products outside. If this is not possible spraying should only take place in well ventilated rooms, which are left afterwards and thoroughly aired at the same time.

5.3.2 Glitter spray

Two glitter spray products from various manufactures have been evaluated. The table contains calculated values which are also shown graphically. There are two situations of each glitter spray:

- the can (150 g) is used at one time
- small quantities corresponding to 6 g glitter spray (1/25 of a can).

Table 5.3.2.a. 150 g Glitter spray A

Garages												
Time/ hours	0	0.25	0.5	0.75	1	1.5	2	3	4	-	-	-
Fraction sum	6.6	4.0	2.4	1.5	0.9	0.3	0.1	0.0	0.0	-	-	-
Kitchens												
Time/ hours	0	0.25	0.5	0.75	1	1.5	2	3	4	5	6	7
Fraction sum	9.9	8.7	7.7	6.8	6.0	4.7	3.6	2.2	1.3	0.8	0.5	0.3

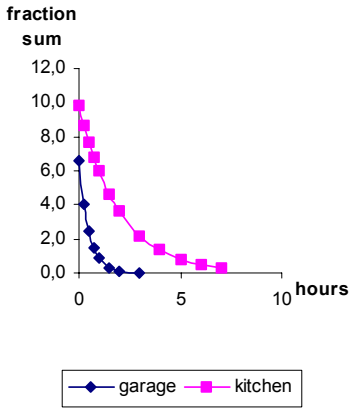
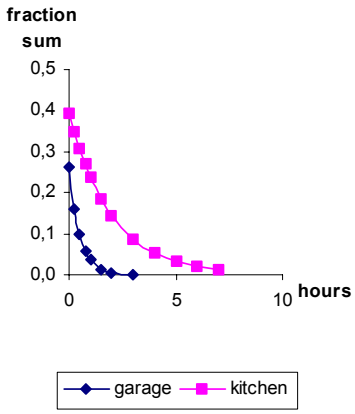


Figure 5.3.2.a. 150 g Glitter spray A

Table 5.3.2.b. 6 g Glitter spray A

Garages												
Time/ hours	0	0.25	0.5	0.75	1	1.5	2	3	4	-	-	-
Fraction sum	0.3	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	-	-	-
Kitchen												
Time/ hours	0	0.25	0.5	0.75	1	1.5	2	3	4	5	6	7
Fraction sum	0.4	0.3	0.3	0.3	0.2	0.2	0.1	0.1	0.1	0.0	0.0	0.0

Figure 5.3.2.b. 6 g Glitter spray A



Similar calculations have been made of another glitter spray.

Table 5.3.2.c. 150 g Glitter spray B

Garages												
Time/ hours	0	0.25	0.5	0.75	1	1.5	2	3	4	-	-	-
Fraction sum	7.5	4.6	2.8	1.7	1.0	0.4	0.1	0.0	0.0	-	-	-
Kitchen												
Time/ hours	0	0.25	0.5	0.75	1	1.5	2	3	4	5	6	7
Fraction sum	11.3	10.0	8.8	7.8	6.9	5.3	4.2	2.5	1.5	0.9	0.6	0.3

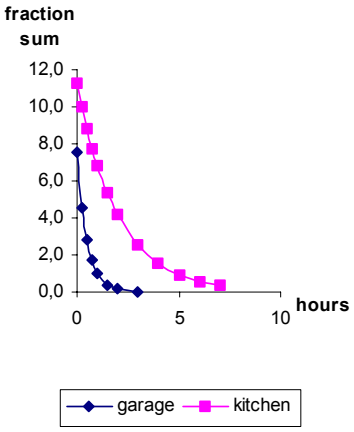
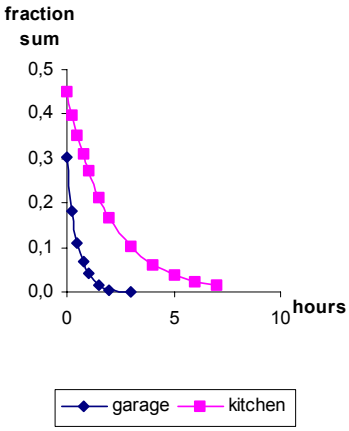


Figure 5.3.2.c. 150 g Glitter spray B

Table 5.3.2.d. 6 g Glitter spray B

Garages												
Time/ hours	0	0.25	0.5	0.75	1	1.5	2	3	4	-	-	-
Fraction sum	0.3	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	-	-	-
Kitchen												
Time/ hours	0	0.25	0.5	0.75	1	1.5	2	3	4	5	6	7
Fraction sum	0.5	0.4	0.4	0.3	0.3	0.2	0.2	0.1	0.1	0.0	0.0	0.0

Figure 5.3.2.d. 6 g Glitter spray B



The results of Glitter spray A and Glitter spray B are very similar comparing the calculated values. It has to be noticed that the chemical composition of the two products is very different, which means that you cannot recommend one product over the other based on the ingredients alone.

If a whole can (150 g) of glitter spray is used, the results of the calculations clearly show that both product cause an exceeding of the exposure limit from 6.6 times (Glitter spray A, garage) to 11.3 times (Glitter spray B, kitchen) under the circumstances stated.

In a garage with a high air change the exposure limit is reached after approx. one hour and the acceptable level of 1/10 of the exposure limit is reached after two hours at the earliest. In a kitchen with a low air change the contamination level drops to the exposure limit after approx. 5 hours, but it takes more than 7 hours before an acceptable level of 1/10 of the exposure limit is reached.

Glitter spray B contains the organic solvent, butanol, which has a ceiling value, which means an exposure limit which is not to be exceeded at any time. This means if large quantities of Glitter spray B is used conditions will be unacceptable, if it is used in a work situation. To avoid exceeding the ceiling value it is not legal to use more than 60% of a can indoors and max. 90% outdoors.

This clearly shows that if glitter spray products are to be used large-scale it has to take place under well ventilated conditions and in a place in which persons are not supposed to stay afterwards.

If only small quantities are use the exposure limit is not exceeded, as the contamination level is 0.3 (Glitter spray A, garage) - 0.5 times (Glitter spray B, kitchen) the exposure limit, but still it exceeds the acceptable level of 1/10 of the exposure limit. By work in a kitchen with a small air change it will take 2-3 hours until the conditions are acceptable. In a garage with a high air change it will take approx. ½ hour before the contamination level is reduced to 1/10 of the exposure limit.

To evaluate how much the content of propellants influences the fraction sum the calculations have been repeated without the contribution of the propellants. This does not result in substantial differences regarding the time at the contamination concentration is reduced to the exposure limit and 1/10 of the exposure limit respectively.

From this it can be concluded that it is always important to use the glitter spray products outdoors. If this is not possible spraying should only take place in well-ventilated rooms which are left and aired thoroughly afterwards.

5.3.3 Snow spray

Only one snow product has been evaluated, as it has not been possible to gather sufficient information about several products.

The table contains calculated values, which are also show graphically. Two situations of snow sprays are shown:

- all the can (150 g) it used at one time
- small quantities corresponding to 6 g snow spray (1/25 of a can)

Table 5.3.3.a. 150 g Snow spray

Garages												
Time/ hours	0	0.25	0.5	0.75	1	1.5	2	3	4	-	-	-
Fraction sum	3.0	1.8	1.1	0.7	0.4	0.1	0.1	0.0	0.0	-	-	-
Kitchens												
Time/ hours	0	0.25	0.5	0.75	1	1.5	2	3	4	5	6	7
Fraction sum	4.4	3.9	3.5	3.1	2.7	2.1	1.6	1.0	0.6	0.4	0.2	0.1

Figure 5.3.3.a. 150 g Snow spray

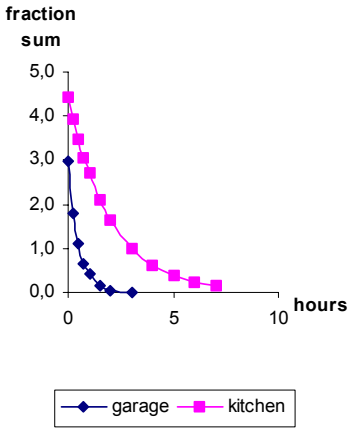


Table 5.3.3.b. 6 g Snow spray

Garages												
Time/ hours	0	0.25	0.5	0.75	1	1.5	2	3	4	-	-	-
Fraction sum	0.12	0.07	0.04	0.03	0.02	0.01	0.00	0.00	0.00	-	-	-
Kitchens												
Time/ hours	0	0.25	0.5	0.75	1	1.5	2	3	4	5	6	7
Fraction sum	0.18	0.16	0.14	0.12	0.11	0.08	0.07	0.04	0.02	0.01	0.01	0.01

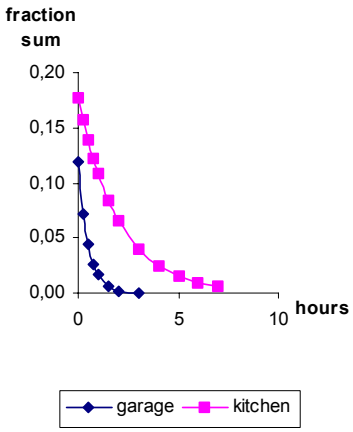


Figure 5.3.3.b. 6 g Snow spray

The result of the snow spray shows like for the other products that the exposure limit is exceeded when using a whole can at the same time. The exceeding is 3-4.4 times the exposure limit immediately after spraying. The values are reduced to approximately the exposure limit after ¾ - 3 hours depending on the air change.

In the garage an acceptable level of 1/10 of the exposure value is achieved after 1½ hours but in the kitchen it takes 7 hours. This clearly shows that the snow spray is to be used under well-ventilated conditions and at a place at which no persons have to stay afterwards. The snow spray contains the organic solvent, butanol, which has a ceiling value, which means an exposure limit which is not to be exceeded at any time. This means if large quantities of snow spray are used the conditions will be unacceptable if it is used in a work situation. To avoid exceeding the ceiling value max. 60% of a can should be used indoors and max. 90% should be used outdoors.

If only small quantities are used the exposure limit will not be exceeded, as the contamination level is 0.12-0.18 times the exposure limit but still it exceeds the acceptable level of 1/10 of the exposure limit. By work in a kitchen with a low air change it will take 1-1½ hours before the conditions will be acceptable whereas conditions in a garage will be less than 1/10 of the exposure limit within 1/4 hour.

To assess how large an effect the content of propellants has on the fraction sum the calculations have been repeated without the contributions of the propellants.

In connection with snow spray this gives a small difference, as the concentration is reduced to the exposure limit ½ time faster when a whole can is used in a kitchen. If small quantities are used in a kitchen the concentration is reduced to 1/10 of the exposure limit ½ time faster.

On the basis of the above it can be concluded that it is always important to use snow spray products outside. If this is not possible spraying should only take place in well-ventilated rooms which are left and aired thoroughly afterwards.

5.4 Skin contact

The user may get in contact with the non-dried product if he/she touches the surface before it is dry. Furthermore, the user may get spray mist onto his/her hands if small things are hand-hold during spraying.

In this project a row of organic solvents has been identified which seem irritating and degreasing by skin contact. Some of the substances may be absorbed through the skin. Therefore, it is recommendable to use protective gloves by risk of skin contact.

Appendix A : Sources

1) Statutory order about aerosols from the Working Environment Service, no. 844 of 30 September 1994.

2) Statutory order about classification, packaging, labelling, sale and storage of chemical substances and products from the Environmental Protection Agency, no. 329 of 16 May 2002.

3) Statutory order about the list of dangerous substances from the Environmental Protection Agency, no. 439 of 3 June 2002.

4) Statutory order about limitations in sale and use of certain dangerous chemical substances and products for special purposes from the Environmental Protection Agency, no. 1042 of 17 December 1997.

5) Statutory order about the use of propellants and solvents in aerosol containers from the Ministry of the Environment, no. 571 of 29 November 1984.

6) Statutory order about regulation of certain industrial greenhouse gases from the Environmental Protection Agency, no. 552 of 2 July 2002.

7) Statutory order about establishment of code numbers from the Working Environment Service, no. 301 of 13 May 1993.

8) Statutory order about work with code numbered products from the Working Environment Service, no. 302 of 13 May 1993.

9) At-guidance no. C.0.1 October 2000 about occupational exposure limits of substances and materials from the Working Environment Service.