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Survey and risk assessment of beauty product adhesives

Mapping of chemical substances in consumer products

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Foreword

Survey and risk assessment of beauty product adhesives

This project investigated the ingredients in transparent adhesives used with beauty products, such as artificial nails, artificial lashes and facial decorations. The results of the survey, chemical analyses and risk assessment of selected chemical substances in this type of adhesive are presented in the report.

The project was conducted by FORCE Technology (survey and chemical analyses), with DHI A/S as a subcontractor for the risk assessment.

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Summary

Adhesives are used for a variety of beauty products, such as artificial nails, artificial eyelashes, hair extensions, and facial decorations, such as glitter or rhinestones. There are several types of adhesives on the market which contain different types of ingredients, as well as both coloured and transparent/colourless adhesives. This project focused exclusively on transparent beauty product adhesives (i.e., adhesives without colourants) and on beauty product adhesives used by younger generations: teenagers and young adults up to about 25 years of age.

Legislation
Transparent adhesives for beauty products come into contact with skin and nails but are not intended to cleanse, perfume, change appearance, correct body odour or protect. Cosmetic products are defined by law as products that perform these functions. On the other hand, artificial nails, eyelashes, and facial decorations are intended to change one's appearance. As a result, adhesives for beauty products – when transparent – are not covered by the Cosmetic Products Regulation, but by the REACH and CLP regulations (i.e., the EU's general chemicals legislation and its regulation on the classification, labelling and packaging of chemical substances, respectively).

This means that transparent adhesives for beauty products must be labelled if an adhesive contains substances classified as hazardous, such as acrylates or solvents, at a concentration that results in an overall classification for the mixture. Given that transparent adhesives are not covered by the Cosmetic Products Regulation, in practice, this means that the consumer does not necessarily have access to information about ingredients and thus cannot make informed choices based on factors including allergy risks and substances of particular concern. This also means that transparent adhesives are not subject to the same safety requirements as cosmetic products.

Purpose
The aim of this project was to conduct a survey of ingredients in transparent adhesives for beauty products and assess the potential risk posed by using these products. The project additionally sought to investigate whether the ingredients used in transparent adhesives are adequately regulated, as they are not covered by the safety requirements of the EU's Cosmetic Products Regulation.

Survey of beauty product adhesives
Investigating which transparent adhesives consumers in Denmark typically purchase was another goal of this project. To that end, a small user survey was conducted to collect data on where these products are typically purchased, which brands are purchased, and whether users have experienced discomfort when using these adhesives.

A survey of adhesives for beauty products was conducted primarily on the Danish market, as a majority of the respondents from the user survey purchased their adhesives from physical stores in Denmark or Danish websites. We also contacted a number of trade associations and research institutions to gather information about ingredients in adhesives for beauty products, as well as any discomfort associated with their use.

A total of 15% of the respondents in the user survey reported experiencing discomfort on one or more occasions when using beauty product adhesives. In addition, 17% of the respondents knew someone who had experienced discomfort or an allergic reaction when using beauty product adhesives.

The Danish Allergy Centre and Asthma-Allergy Denmark, which we contacted as part of this project, reported receiving inquiries from consumers who had allergic reactions to adhesives for artificial nails. Several examples of discomfort and allergic reactions from both lash adhesive and nail adhesive have been found in the literature, while it was not possible to identify studies on irritation associated with the use of skin adhesives.

The survey showed that acrylates are the main ingredient in most nail and lash adhesives. Skin adhesives contain other ingredients with adhesive film-forming properties, such as PVP or various resins. The absence of acrylates may be related to the lack of reports of discomfort associated with the use of skin adhesives. Water or an alcohol is typically used as a solvent. In water-based adhesives (which are primarily lash and skin adhesives), a preservative is often used. In most cases, this is phenoxyethanol, but other preservatives are also used. A few of the adhesives contain fragrances, but this is not typical.

Chemical analyses

For the chemical analyses, a total of 32 unique transparent beauty product adhesives were purchased: including 13 nail adhesives, 13 lash adhesives, 5 skin adhesives, and 1 product that could be used as both a lash adhesive and skin adhesive. The majority (25 products) were purchased from Danish websites or physical stores in Denmark, six products came from EU-based online shops, and one product came from SHEIN (an online shop based outside the EU), to represent the sources from which the respondents in the user survey purchase their adhesives.

Initially, the following chemical analyses were carried out: semi-quantitative formaldehyde analyses and GC-MS screening to identify volatile organic compounds released from the 32 adhesives.

Formaldehyde release was measured semi-quantitatively by the so-called CA method. This screening analysis showed that 13 of the 32 adhesives released formaldehyde at concentrations above 10 ppm, which is the limit value for labelling cosmetic products with the warning "releases formaldehyde", if the product contains a formaldehyde releaser. One of the 13 adhesives declared the presence of formaldehyde in its ingredient list. Content of formaldehyde is not permitted in cosmetic products.

Based on the GC-MS screening results and the classifications of the identified substances, we decided to perform quantitative analyses for three of the most frequently detected acrylates in the screening. These acrylates were methyl methacrylate, ethyl-2-cyanoacrylate, and 2-ethylhexyl acrylate. The substance ethyl-2-cyanoacrylate was a main ingredient in many of the adhesives purchased. Only nail and lash adhesives containing acrylates (27 products in total) were analysed quantitatively for their content of these three acrylates. The results showed that ethyl-2-cyanoacrylate was detected in the highest concentrations by far, consistent with the fact that the substance is also a main ingredient in many of the adhesives analysed. Ethyl-2-cyanoacrylate was detected in 13 of the 27 nail and lash adhesives, at concentrations ranging from 57% to 100%. As the harmonised classification of ethyl-2-cyanoacrylate includes skin irritant and eye irritant hazard statements, these products must be hazard-labelled according to the CLP Regulation. One of the 13 adhesives did not have the required hazard labelling and was reported to the Danish Chemical Inspection Service, the regulatory compliance division of the Danish EPA.

Methyl methacrylate was detected in 17 of the 27 adhesives at concentrations between 25 and 3200 mg/kg (corresponding to up to 0.3%). 2-ethylhexyl acrylate was identified in 12 of the 27 adhesives above the limit of detection in amounts between 5 and 345 mg/kg (corresponding to at most 0.03%).

Hazard and risk assessment
Two nail adhesives release formaldehyde at concentrations above 100 ppm, equivalent to 0.1 µg/mg. For these two nail adhesives, there is a risk of sensitisation to formaldehyde.

In considering realistic worst-case scenarios involving exposure of eyelids and nail beds, no risk of sensitisation was found for either formaldehyde or the three acrylates (with the exception of the two products mentioned above). Even when we consider combinations of acrylates in single products and the use of adhesives on both nails and eyelids simultaneously, there is no risk of sensitisation. Nonetheless, this does not exclude the possibility that people who are already sensitised may react to the adhesives. Such sensitisation can, for example, be caused by inappropriate use of products, as might occur when more adhesive is applied to the skin than intended, or via exposure from other products (sealants, car care products, air fresheners, paint, etc.).

It should also be noted that the REACH registration for the substance 2-ethylhexyl acrylate does not foresee the use of the substance in direct-to-consumer products. Consequently, the registrant did not prioritise providing data that could be used to calculate a limit value for sensitisation of individual consumers. For ethyl 2-cyanoacrylate, there is also a lack of data for a consumer sensitisation threshold, although this project indicates that this could be relevant.

Some adhesives contain high concentrations of ethyl-2-cyanoacrylate. These adhesives may irritate the respiratory tract in environments without local exhaust ventilation, such as typical private usage environments. Although ethyl-2-cyanoacrylate can cause contact allergy, no sensitisation threshold has been found to which the measured levels can be compared.

Nonetheless, recent literature indicates that the incidence of allergic reactions associated with the use of artificial nails is on the rise, especially since the development of UV-curing gels and varnishes. Do-it-yourself kits are contributing to this rise due to a lack of experience among their users. Contact allergy is due mainly to the continuous release of unpolymerised and allergenic monomers of (meth)acrylates in the artificial nails and dust produced during filing. Symptoms occur between 2 and 4 months, or even up to 16 months, after the first applications. Cyanoacrylates can cause eczema on the fingertips and eyelids. Toxic reactions in the form of severe paraesthesia (numbness, etc.) and white fingers (pseudo-Raynaud's syndrome) have been observed, as well as permanent nail loss. This is thought to be due to the toxic effect of acrylates on nerve fibres.

Although this project cannot demonstrate a risk of sensitisation associated with the individual acrylates in the analysed products, this problem still exists. There is also the possibility that sensitisation and/or irritation caused by exposure to low pH, formaldehyde, and/or cyanoacrylate may lead to sensitisation to the acrylates which consumers are exposed to when using these adhesives.

Discussion and conclusion
The argument that transparent adhesives should not be covered by cosmetics legislation seems to be inconsistent with the purpose of the legislation, as this deprives consumers of the opportunity to receive appropriate warnings and instructions for use. Furthermore, adhesives are sold as essential accessory products for products which are covered by the cosmetics legislation; thus, it would be reasonable to also consider the adhesives as cosmetic products. These products could additionally be restricted to professional use under the Cosmetic Products Regulation or, alternatively, at least be supplied with clearer warnings about the allergenic risks associated with the use of nail and lash adhesives with such high concentrations of allergenic acrylates.

Sensitisation to methacrylates may create some risk for reactions during dental treatment using methacrylate-based polymers. Allergies to acrylates have also been observed to be provoked by medical devices, such as patches for transdermal administration of drugs, as well as adhesives in tapes for securing wigs to the scalp. Such allergies can restrict the application of commonplace healthcare treatments, leaving a sensitised individual to seek less advantageous options in order to receive appropriate treatment.

1. Introduction

Adhesives for beauty products often contain known allergenic substances, such as acrylates. This project investigated the ingredients in transparent adhesives for beauty products.

Adhesives are used for a variety of beauty products, such as artificial nails, artificial eyelashes, hair extensions, and facial decorations, such as glitter or rhinestones. There are several types of adhesives on the market which contain different types of ingredients, as well as both coloured and transparent/colourless adhesives.

This project focuses exclusively on transparent adhesives for beauty products. This focus on transparent adhesives, rather than all adhesives, is due to the fact that transparent adhesives are subject not to the provisions of the Cosmetic Products Regulation (see chapter 2 "Legislation"), but by those that apply to chemical mixtures in general. With this project, the Danish EPA sought to investigate whether this regulatory disparity could lead to reduced consumer safety, especially in relation to the lack of ingredient declarations and possibly inadequate regulation of product safety.

Consumers are able to purchase transparent adhesives directly from both physical and online shops for home use. Additionally, services including the application of artificial nails, artificial eyelashes, and various types of facial decorations are offered at beauty salons.

1.1 Purpose

The purpose of this project was to identify ingredients in transparent adhesives for beauty products and assess the potential risk of using these products. The project additionally sought to investigate whether the ingredients used in transparent adhesives are adequately regulated, as they are not covered by the safety rules of the EU's Cosmetic Products Regulation.

The project aimed to investigate transparent adhesives typically purchased by consumers in Denmark. One of this project's sub-goals was to conduct a small-scale user study to clarify where consumers typically purchase their transparent adhesives; that is, whether these adhesives are purchased from physical stores in Denmark, Danish online shops, online shops based in the EU, or large online marketplaces (such as TEMU or SHEIN) based outside the EU.

1.2 Project scope

This project focused exclusively on transparent adhesives used for beauty products, such as artificial nails and lashes, as well as facial decorations. In this project, transparent adhesives are considered to be adhesives without added colourants.

Some adhesives are white or look white when applied but become transparent as they dry. These adhesives are included in the study. Adhesives containing colourants, on the other hand, were not investigated in this project.

The project focused on transparent adhesives for beauty products used by younger generations; that is, teenagers and young adults up to around 25 years old.

The project has investigated the following types of liquid transparent adhesives:

- Adhesive for attaching artificial nails
- Adhesive for attaching artificial eyelashes
- Adhesive for applying facial decorations, such as glitter or rhinestones (so-called skin adhesive)
- Adhesives that can be used for several of the above purposes

Both artificial lash and artificial nail products were included in the survey if a tube of adhesive for application was included as part of a kit. In these cases, however, only the included transparent adhesive was analysed in the project.

Although transparent adhesive can also be used to attach hair extensions, this type of adhesive was not included in this project as it does not necessarily come into direct contact with the skin. Skin adhesives used exclusively for costumes, such as masks, beards, wigs or similar are also beyond the scope of this project.

In the project survey, a few so-called eyebrow adhesives were observed. However, these products seem to contain slightly different ingredients than adhesives designed for use with (for example) artificial lashes and nails. Furthermore, most of these types of products are sold under the category 'eyebrow gel'. For this reason, this product category was not included in the project; their purpose is not to affix eyebrows to the skin, but to shape existing brows.

Adhesive pads ("glue pads") are also sold for affixing artificial nails. This product category was not included, as the project focused exclusively on liquid transparent adhesives for beauty products.

In addition, there is no particular focus on adhesives produced for professional use, as the survey gave the impression that these adhesives are not available for purchase by individual consumers.

1.3 Listing of ingredients in the report

Many of the transparent adhesives analysed in this project have their ingredients listed on the packaging. This is because in some cases, manufacturers of beauty adhesives also produce cosmetic products which require them to list ingredients on the packaging. However, these ingredient lists are not required by law because transparent adhesives are not subject to the Cosmetic Products Regulation.

In this report, ingredients are listed as they appear on the packaging, often by their INCI designations. INCI stands for International Nomenclature of Cosmetic Ingredients and is the standard nomenclature used for ingredients in cosmetic products. On cosmetic products marketed in the EU, ingredient lists must be provided which use the same common designation (name) for a given ingredient. The so-called INCI names are typically used for this purpose instead of other typical chemical names for the substances (such as trivial names or the official, unambiguous IUPAC names). As a general rule, the ingredient names listed on the products/packaging have been used; otherwise, mainly the IUPAC names.

In cases where ingredients are reported from websites or products, the chemical names are reported as stated in these places.

2. Legislation

The relevant legislation for transparent adhesives for beauty products is described and discussed in this chapter. Transparent adhesives are not covered by the Cosmetic Products Regulation and are therefore considered general chemical mixtures, subject to the REACH and CLP regulations. This is described in a sub-group about so-called 'borderline' products in the working group on cosmetic products (Working group on cosmetic products, 2023).

2.1 The Cosmetic Products Regulation

The current rules for cosmetic products on the Danish market are set out in the EU's Cosmetic Products Regulation (EU Regulation 1223/2009 (adopted 30 Nov 2009)). The EU's Cosmetic Products Regulation applies to cosmetic products, which are defined (according to Article 2, paragraph 1.a) as "*any substance or mixture intended to be placed in contact with the external parts of the human body (epidermis, hair system, nails, lips and external genital organs) or with the teeth and the mucous membranes of the oral cavity with a view exclusively or mainly to cleaning them, perfuming them, changing their appearance, protecting them, keeping them in good condition or correcting body odours".*

Adhesives for beauty products come into contact with the surface of the human body (skin and nails), but they are not intended to clean, perfume, change appearance, correct body odours or protect. Rather, it is the artificial nails, eyelashes or facial decorations attached with these adhesives that seek to change the appearance. However, it can be argued that adhesives that are coloured, such as lash adhesives that are black to blend in better with artificial black lashes being applied, or skin adhesives with colour and shimmer, are also intended to change one's appearance and would therefore as a general rule be covered by the Cosmetic Products Regulation. Transparent adhesives per se do not change one's appearance because they do not contain colour and are therefore not considered to be covered by the Cosmetic Products Regulation. Transparent adhesives are thus considered chemical mixtures, regulated under the EU's general chemical regulations; specifically, REACH and CLP.

According to the Cosmetic Products Regulation, ingredients used in cosmetic products must be indicated on the packaging. Given that there are beauty product adhesives which both are covered (coloured) and are not covered (transparent) by the Cosmetic Products Regulation, several manufacturers list the ingredients for the transparent adhesives they sell. This project's findings suggest that many manufacturers perceive transparent adhesives for facial use as cosmetic products, as the vast majority of products purchased in stores or online have ingredient lists, as is required for cosmetic products. This information has been used in the survey of ingredients in transparent adhesives in this project.

2.2 REACH

When transparent adhesives are not covered by the Cosmetic Products Regulation, they are considered ordinary chemical mixtures and are therefore subject to the REACH and CLP regulations. The REACH Regulation is the EU's overarching chemicals legislation to ensure that chemical substances and mixtures are used responsibly (EU Regulation 1907/2006). One of REACH's requirements is that chemical substances must be registered and assessed before production and use. Specific problematic substances must be authorised before production and use in the EU.

For chemical substances and articles (physical products) alike, Annex XVII of the REACH Regulation sets out a number of restrictions for certain chemical substances alone, in mixtures, or in certain types of articles. Among other things, entries 28-30 of Annex XVII stipulate restrictions on the content of substances classified as carcinogenic (Carc 1A or 1B), mutagenic (Muta 1A or 1B) and toxic to reproduction (Repr. 1A or 1B) in mixtures supplied to the general public (private use) if the content of these substances is equal to or greater than the concentration limits set for these types of substance in the CLP Regulation. However, this only applies to substances listed in Appendices 1 to 6 of the REACH regulation, including 2,3-epoxypropyl methacrylate. This means that it does not apply to all CMR (carcinogenic, mutagenic or reprotoxic) substances, as only substances listed in Appendices 1 to 6 are covered; nor does it apply to Category 2 substances, which are substances suspected of being CMR.

2.3 CLP

The CLP Regulation is the EU's regulation on the classification, labelling and packaging of chemical substances and mixtures (EU Regulation 1272/2008). According to the CLP Regulation, manufacturers and importers of chemical substances and mixtures must know their hazardousness and must label them according to the rules described in the regulation. According to article 1, paragraph 5 of the CLP Regulation, the provisions of the CLP Regulation do not apply to cosmetic products, such as coloured adhesives. For transparent adhesives, the following rules apply:

- If transparent adhesives contain substances classified as hazardous, such as acrylates or solvents, at a concentration that results in an overall classification for the mixture, the adhesive must be labelled with a warning.
- If the adhesive is classified as hazardous and requires a warning label, a safety data sheet must also be available for the product.
- However, the safety data sheet is not required to list all ingredients in the product, only those ingredients that contribute to its classification.
- All chemical mixtures must nonetheless be reported to the Poison Centres Notification (PCN) portal if they are classified as dangerous (for physical properties and/or health related aspects), where government agencies and national poison information centres can access the information.

2.4 Discussion

Although the majority of the transparent adhesives in this project listed their ingredients on their packaging, there is no legal requirement for them to do so, as these products are not covered by the Cosmetic Products Regulation. In practice, this means that consumers may not always have access to information about ingredients and, by extension, they may be deprived of the opportunity to make informed choices based on factors including allergy risks and particularly problematic substances. This lack of an obligation to declare ingredients can have several practical consequences. For example, it can make it more difficult for authorities to carry out market surveillance and risk assessments, as it may not always be possible to assess what substances consumers are exposed to. It can also make it difficult to follow up on claims or health incidents if full information about product contents is not available.

At the same time, this means that transparent adhesives are not subject to the same safety requirements as cosmetic products. For example, the Cosmetic Products Regulation prohibits and restricts a number of substances based on known health risks. These prohibitions and restrictions may not apply to similar products classified as chemical mixtures. As a result, there is a risk that consumers – including particularly vulnerable groups, such as children and young people – will be exposed to harmful substances.

This points to a potential regulatory challenge whereby certain types of cosmetic-like products are not covered by legislation that aims to protect consumers from harmful substances.

3. User study

As part of our survey of transparent adhesives for beauty products, we conducted a small survey among users of these adhesives. A description of the survey methodology and results is presented in this chapter.

3.1 Purpose of the user study

The purpose of this small-scale user study was to capture data about where young consumers buy transparent adhesives (in Denmark, in the EU or outside the EU) and which types of adhesives are used the most among young people. It was thus planned to use the survey results in assessing where to buy adhesives and which adhesive products to buy for the chemical analysis portion of this project.

Through the user study, we also hoped to capture data on discomfort experienced when using this type of adhesive, as well as on usage patterns (frequency and amount).

There was no intention to conduct an in-depth, comprehensive, representative user study in this project. Due to budget and time constraints, only a small-scale user study was carried out, intended solely to provide guidance regarding the choice of products for chemical analyses. For example, the most commonly mentioned brands in the user study were purchased for the chemical analyses.

3.2 Description of the user study

As described, the user study was designed as a small, questionnaire-based study with the purpose of collecting input for the following phase of the project: purchasing products for chemical analyses. This was a small-scale user study that was by no means representative of the Danish population or young consumers in Denmark. The results of the user study should therefore also be seen in this light. Despite this, however, the results were used as input to purchase products for use in the project.

3.2.1 Questionnaire content

In order to maximise the response rate among young users of cosmetic adhesives, the questionnaire was deliberately kept short and with as many closed questions as possible. The questionnaire consisted of 14 items in total, with some supplementary fields to describe discomfort, product brands, stores, and so on (open-ended questions / comment fields). The questions asked in the user study included:

- The respondent's age
- What types of adhesive they used and for what purpose (nails, lashes, skin or other)
- How the adhesive is used; that is, whether it is used for purposes other than those described on the packaging
- How often these types of adhesives are used
- How long a tube/tub of adhesive lasts
- Whether the respondent applies adhesive for beauty products themselves or visits beauty salons
- Where the adhesive is purchased (from a physical store or online shop in Denmark, online from within the EU, or outside the EU)
- Which stores/online shops they buy this type of product from
- Which products they use (by name/brand)

- What kind of discomfort the respondent and those in their social circles have experienced when using these adhesives

The questions and response options from the user study are listed in full in Appendix 1.

The focus of the questionnaire was on information about what types of products are purchased and used, as well as where they are purchased and what kind of discomfort (if any) respondents experienced. Open-ended questions were used to collect information about which products (by name) are purchased, where they are purchased from (name of store / online shop), and discomfort.

A few questions dealt with the frequency of use of the different types of adhesive, as well as the quantity used. However, the questionnaire did not ask for precise amounts of adhesive used per application (e.g., in ml or mg), as it was not expected that respondents would be able to assess this while taking the survey. The question about quantities was kept simple and phrased in terms of the number of applications a single tube/tub of adhesive is normally good for.

It was generally assumed that those answering the questionnaire would be users of transparent adhesives for artificial nails, artificial lashes and facial decorations, but workarounds were used in the questionnaire in case a respondent started the questionnaire without using these types of adhesives.

3.2.2 Dissemination of the questionnaire

The questionnaire was configured in GetFeedback for respondents to submit their answers online. The questionnaire was kept open for a total of seven days in May 2025 due to time constraints associated with the project schedule. The volume of responses was highest in the first few days, right after posting on various social media channels. Interest in taking the survey decreased over the last few days.

The questionnaire was posted internally on both FORCE Technology's and the Danish EPA's intranets, encouraging people to share it with friends and family. In addition, the Danish EPA posted a link to the user study on Facebook from their "Hverdagskemi" ["Everyday Chemistry"] page, highlighted it in a newsletter, and made a post about it on Instagram. Employees at both FORCE Technology and the Danish EPA shared a link to the questionnaire with young people they know attending secondary schools and continuation schools. The Danish Consumer Council also contributed by sharing a post on its Instagram profile.

Responses show that the questionnaire reached beyond the Danish mainland, including areas like Bornholm, Funen, and Jutland, as some respondents included city names when naming physical stores where they purchased their adhesives.

During the seven days the questionnaire was open, a total of 233 people started the questionnaire and 194 people completed it, meaning that they reached the end of the questionnaire and answered all or almost all of the questions. While this small-scale user study is representative of neither the Danish population in general nor young Danes, this response count is sufficient to provide evidence of some trends.

3.3 Results of the user study

In total, 233 people started the survey and 194 people completed it. The 39 people who did not complete it got stuck at different points in the questionnaire. As only a few (six) of those who submitted partial responses were able to answer the question on where they buy the

products, only the complete responses are included in the reporting of the user study results below.

3.3.1 Excluded responses

The responses excluded from the reporting of the user study results are as follows:

- The 39 partial responses (i.e., not all questions answered).
- The 24 responses where the respondent indicated that they do not use any adhesives. This response caused the survey to end, so these respondents did not answer any of the remaining questions.
- The 9 responses where the respondent reported that they use coloured adhesive, but not transparent adhesive. These responses were excluded because the focus of this project is solely on transparent adhesive.

In addition, 11 respondents answered that they do not know if they use coloured or transparent adhesive. These responses are still included in the results below, as the survey showed that some adhesives appear white when applied, but then become transparent as they dry.

In addition, in response to the question "Where do you primarily get your nails and lashes done?", eight respondents included an indication that they do not use adhesive for these purposes. However, these respondents indicated in another question that they use adhesive either for facial decorations, artificial lashes, artificial nails or for eyebrow laminate, so these answers are still included in the reporting.

In total, the results below are based on 155 responses.

3.3.2 What is adhesive used for?

Respondents were asked what they use adhesive for. The breakdown is presented in TABLE 1 below. The 161 respondents were able to select multiple response options, which is why the sum of all options exceeds 161.

The question was: "What kind(s) of adhesive do you use? Adhesive to apply artificial lashes, artificial nails or facial decorations? (select all that apply)".

TABLE 1. Overview of what users use adhesive for

What kinds of adhesive do you use?	Artificial lashes	Artificial nails	Facial decorations (e.g., rhinestones, stickers, glitter)	Other
Number	84	126	23	4
Percentage of all respondents	52%	78%	14%	2%

The table shows that just over three-quarters of respondents (78%) use adhesive for artificial nails, and over half of them use adhesive for artificial lashes (52%).

Adhesive for facial decorations is less common, but 14% of respondents do use adhesive on their faces. Only one respondent reported using adhesive exclusively for facial decorations. Aside from that person, users of adhesives for either artificial lashes or artificial nails also use adhesives for facial decorations.

Five respondents indicated that they also use adhesive for purposes other than those listed. These respondents indicated that they use eyebrow laminate and lash lift/curl adhesive (i.e., for holding lashes in place during curling).

3.3.3 Age distribution and adhesive usage

Of the 161 responses, around two-thirds are teenagers and young people up to the age of 25 (102 responses in total). The age distribution is shown in FIGURE 1 below.

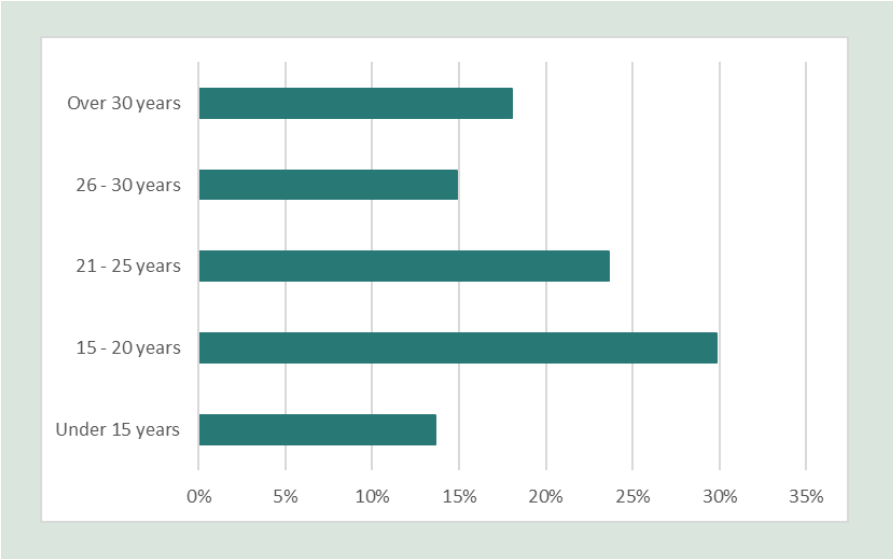

FIGURE 1. Age distribution in percent for the 161 total respondents in the user study

For the two most commonly used types of adhesive; that is, nail adhesive and lash adhesive, the percentage distribution of the use of these types of adhesive across the five age groups is given below in TABLE 2 and TABLE 3. The questions asked were "How often do you use nail adhesive?" and "How often do you use lash adhesive?" The response options for both questions were "daily", "weekly", "monthly", "less often" and "I do not use this type of adhesive".

As shown in TABLE 2, the use of nail adhesive is most common among teenagers and young people up to the age of 25. From above the age of 25 years, the usage drops. It is worth noting that in the under-15 category, one-third of respondents said they use artificial nail adhesive weekly and 41% said they use it adhesive monthly.

While this figure is not shown in the table, from the results, it can be seen that a total of 91% of the 108 young respondents up to the age of 25 say they use adhesive for artificial nails, compared to 53% of the 53 respondents over the age of 25.

TABLE 2. Percentage distribution of nail adhesive use across the five age groups

How often do you use nail adhesive?	Under 15 years	15-20 years	21-25 years	26-30 years	Over 30 years	Total
Daily	0%	2%	0%	0%	7%	2%
Weekly	32%	19%	8%	4%	7%	14%
Monthly	41%	35%	26%	38%	24%	32%
Less often	23%	42%	55%	33%	28%	39%
I do not use this type of adhesive	5%	2%	11%	25%	34%	14%

Meanwhile, TABLE 3 shows that the situation for eyelash adhesive is not as clear-cut. The results in the table suggest that eyelash adhesive use is more common among those over the age of 25.

While this figure is not shown in the table, from the results of the user study, it can be seen that a total of 47% of the 108 young respondents up to the age of 25 indicated that they use adhesive for artificial lashes, while this figure is 62% for the 53 respondents over the age of 25.

TABLE 3. Percentage distribution of lash adhesive usage across the five age groups

How often do you use lash adhesive?	Under 15 years	15-20 years	21-25 years	26-30 years	Over 30 years	Total
Daily	5%	2%	5%	8%	7%	5%
Weekly	18%	17%	3%	8%	3%	10%
Monthly	5%	15%	26%	25%	14%	17%
Less often	23%	25%	21%	38%	38%	28%
I do not use this type of adhesive	50%	42%	45%	21%	38%	40%

Of the total of 23 people who indicated that they use adhesive for facial decorations or other purposes ("other" in TABLE 1), 16 of these (70%) are up to 25 years old and 7 of these (30%) are over 25 years old. The main part of the respondents does not use adhesive for purposes other than nails and lashes (134 out of 161, corresponding to 83%).

3.3.4 How is the adhesive used?

In the questionnaire, users were asked where they primarily have their lashes and nails done: at home or professionally at a salon. Here, 127 out of 161 (79%) responded that they get their nails done at home (DIY/friend/acquaintance). This did not appear to differ between respondents over and under 25 years old.

The majority of respondents (150 out of 161, 93%) use the adhesive for the purpose stated on the packaging. Of the remainder, 11 people (7%) answered that they use the adhesive for purposes other than those stated on the packaging. A few people did not answer the question. The majority of those who have used an adhesive for other purposes say they have used lash adhesive for facial decorations or nail adhesive for dental jewellery. The 10 descriptions provided were:

- "I used it one time on my teeth, but only once, because I read what it could do and haven't done it since"

- "e.g., using lash adhesive to apply facial decorations (shimmer stones)"
- "Eyelash adhesive for stones on the face"
- "I once used nail adhesive to glue a piece of wood to a drawer where it had fallen off"
- "Lash adhesive for facial decorations"
- "Nail adhesive for dental jewellery"
- "Nail adhesive on teeth to apply small gems"
- "Nail adhesive on teeth"
- "Gems on teeth"
- "Teeth"

3.3.5 How much adhesive is used?

A single question asked how much adhesive is used (though not in absolute quantities). The question was phrased as "How long does a tube/tub of adhesive last?" with the following response options (proportions in brackets):

- "Only for a few uses" (5%)
- "About 10 uses" (20%)
- "More than 10 uses" (43%)
- "It often hardens before I finish it, so I have to buy a new one" (31%)
- No answer (0.1%)

In other words, more than half (63%) say a tube of adhesive lasts for 10 or more uses. As can be seen from the survey of adhesives for beauty products, the different adhesives typically contain between 4 and 10 g or ml of adhesive, but variations in content of between 0.7 ml and 14 g have been observed. Thus, it is expected that far less than 1 g of adhesive is used per application based on this information. However, these quantities were verified through interviews with a selection of beauty salons in the survey (see later).

3.3.6 Where is adhesive bought?

According to the small-scale user study, cosmetic adhesives are mainly purchased from physical stores (79%) and Denmark-based online shops (28%). Their responses are presented in TABLE 4 below. Respondents were able to mark more than one response option, so the total exceeds 100%.

TABLE 4. Overview of where adhesive is bought

Where do you buy the adhesive? (select all that apply)	At a physical store	At a beauty salon	On social media	From a Danish online shop	From an EU-based online shop	From an online shop outside Europe
Number	127	10	3	45	6	13
Percentage of all respondents	79%	6%	2%	28%	4%	8%

We analysed the distribution of responses across categories between respondents ages 25 and under and those older than 25. That is, we sought to determine whether the distribution of responses varies significantly between the two-thirds of younger respondents (up to age 25) and the one-third of older respondents (older than 25). It does in the following cases:

- At a physical store (90 out of 108, 83%, are in the younger group ≤ 25)
- Social media (3 out of 3 respondents are in the younger group ≤ 25)
- From an online shop outside Europe (11 out of 13, 85%, are in the younger group ≤ 25)

One respondent in the 26-30 age bracket indicated that they buy these adhesives from physical stores outside Europe (in Japan and Korea). This respondent "stocks up" on these products while in these countries.

Respondents had the option to name the online shops where they purchased these products. Responses included the following online shops in and outside the EU:

- SHEIN (10 answers)
- Duffbeauty (3 answers)
- Makeup.dk (1 answer) – this website is Polish
- eBay (1 answer)
- TEMU (1 answer)
- Lyko (1 answer)
- Notino (1 answer)
- Primark (1 answer)

3.3.7 Which brands are purchased?

Half of the respondents (51 out of 161, 50%) remembered which brand of adhesive they use and wrote it in a comment in the questionnaire. A selection of brands available from physical stores and Danish online shops were commonly named in the responses. The most frequently mentioned brand was mentioned 27 times.

3.3.8 Frequency of discomfort

The user study asked a single question about discomfort. The question was: "Have you or anyone you know experienced discomfort or irritation, such as a rash, itching or redness when using adhesive for artificial nails, artificial lashes or facial decorations?" The number of answers for the static answer options is listed in TABLE 5 below. Descriptions of the discomfort respondents experienced are provided in section 6.3.

TABLE 5. Overview of frequency of discomfort when using adhesives for beauty products

Have you or someone you know experienced discomfort or irritation?	No	Yes, I've experienced it once myself	Yes, I've experienced it several times myself	Yes, I know someone who has experienced discomfort or allergic reactions
Number	109	9	15	28
Percentage of all respondents	68%	6%	9%	17%

We can see that the majority (68%) of respondents have neither experienced discomfort when using beauty adhesives nor know someone who has. 15% of respondents have experienced discomfort once or more, and 17% know someone who has experienced discomfort or allergic reactions. There is no obvious difference between experiences of discomfort among those ages 25 and below and those older than 25.

3.4 Use of the user study results in the project

This small-scale user study showed that the vast majority of respondents use adhesive for artificial nails and artificial lashes. Adhesive for facial decorations is much less commonly used but still used by 14% of respondents. Therefore, the adhesives purchased for the chemical analyses were also chosen to reflect this fact.

The user study also shows that adhesives for beauty products are predominantly purchased at physical stores in Denmark (true for 83% of young people up to 25 years) and from Danish

online shops (24% of young people up to 25 years)[1]. Only 10% of younger respondents buy beauty adhesives from online shops outside Europe, such as from SHEIN, TEMU, and similar shops. A further 4% of young respondents say they buy beauty adhesives from online shops within the EU. This means that a total of 14% of young respondents indicated that they buy adhesives for beauty products from outside of Denmark. For this reason, the majority of the products for the chemical analyses were purchased from physical stores in Denmark or on Danish online shops, and a few products were purchased from online shops outside the EU. See chapter 7 "Selection and procurement of products".

Half of the respondents (50%) indicated which brand of adhesive they use. This brand information was used when purchasing products for the chemical analyses.

[1] Because respondents could select multiple response options, these numbers add up to over 100% for this question.

4. Market survey

In this project, a survey of transparent adhesives for beauty products was conducted. This chapter describes how the survey was conducted and what the results show.

4.1 Approach to the survey process

The survey of transparent adhesives for beauty products was carried out through the following activities:

- Contacting relevant industry associations and research institutions
- Searching for products on the market online and in physical stores
- Running a small-scale survey among users of adhesives for beauty products
- Contacting selected beauty salons

A description of how the small-scale user study was conducted and the results of the survey are given in the previous chapter (chapter 3 "User study").

When searching for adhesive products on the market, a search was also conducted for ingredients in this type of product. However, these results are described in Chapter 5 "Ingredient survey".

This chapter describes the information received through contact with industry associations and research institutions, as well as through contact with selected beauty salons.

4.2 Contacting industry associations and research institutions

During the survey, the following industry associations and research institutions were contacted:

- Cosmetics and Hygiene Industry of Denmark (Danish abbreviation: KOH)
- Danish Detergents, Cosmetics and Household Products Industry (Danish abbreviation: VKH)
- Cosmetics Europe
- Danish Dye and Adhesive Industry (Danish abbreviation: DFL)
- Danish Allergy Centre
- Danish Ophthalmologists' Organisation (Danish abbreviation: DØO)
- Asthma-Allergy Denmark
- Danish Consumer Council's Think Chemicals initiative (Danish abbreviation: TÆNK)

Data and results gathered from contacting the above organisations are detailed below.

4.2.1 Cosmetics and Hygiene Industry of Denmark (KOH)

The industry association forwarded information about the project and a few questions to its members. The questions were mainly about ingredients in transparent adhesives for beauty products, as well as whether the ingredients used in transparent adhesives are the same as those in coloured adhesives (apart from the dyes) and any information about the pH values of these products[2].

[2] An inquiry was submitted regarding pH values for adhesives, although pH value is a property of only aqueous solutions.

Some of the manufacturers sent responses directly to FORCE Technology and others sent responses to KOH, which then collated them and forwarded the results to FORCE Technology.

In total, 13 responses were received from different manufacturers, only two of which market transparent adhesives for beauty products. Their responses are presented in TABLE 6 below. One company has only listed the acrylate used and not the other ingredients.

TABLE 6. Responses received from manufacturers via contact with the industry association KOH

Company	Do you sell transparent adhesive?	Do you sell coloured adhesive?	Ingredients	pH value
Company 1	No	No	-	-
Company 2	No	No	-	-
Company 3	No	No	-	-
Company 4	No	No	-	-
Company 5	No	No	-	-
Company 6	No	No	-	-
Company 7	Yes, nail adhesive	No	Ethyl 2-cyanoacrylate, CAS 7085-85-0	Not an aqueous solution
Company 8	No	No	-	-
Company 9	No	No	-	-
Company 10	No	No	-	-
Company 11	No	No	-	-
Company 12	No	No	-	-
Company 13	Yes, eyelash adhesive	No	Acrylic polymer Aqua Hydroxyethyl cellulose Ethanol Sodium dehydroacetate Laureth-20	No

One other company approached KOH, despite not producing adhesive for artificial nails, artificial lashes or facial decorations. This company markets adhesives for other facial applications. It markets two different adhesives, one of which is an adhesive with no hazardous ingredients (no ingredients listed in section 2 of the safety data sheet); the other adhesive contains water, a urethane-based acrylic dispersion, and preservatives. The exact ingredients are not specified.

4.2.2 Danish Detergents, Cosmetics and Household Products Industry (VKH)

The Danish Detergents, Cosmetics and Household Products Industry was contacted, but none of its members market adhesives for beauty products.

4.2.3 Cosmetics Europe

In addition, the European cosmetics industry organisation Cosmetics Europe was contacted and sent out a request to its members regarding ingredients in transparent adhesives for beauty products.

Cosmetics Europe received a single response from one of its members, which listed the following ingredients in its transparent adhesive for beauty products:

- Ethyl 2-cyanoacrylate (CAS no. 7085-85-0) at a concentration of 95% or more
- Poly(methyl methacrylate) (CAS no. 9011-14-7) at a concentration between 1 and < 5%.
- Water at a concentration of less than 0.1%.

4.2.4 Danish Dye and Adhesive Industry (DFL)

As it was unclear whether only manufacturers of cosmetic products market transparent adhesive for beauty products, the Danish Colour and Adhesive Industry association was also contacted. DFL investigated whether any of its members market adhesives for beauty products, but its members only produce and sell adhesives for industrial, professional (e.g., construction) and hobby purposes (paper and wood adhesives, etc.) and not adhesives for beauty products.

4.2.5 Danish Allergy Centre

The Danish Allergy Centre was contacted to investigate whether its staff encounter patients experiencing allergic reactions to beauty product adhesives. The Danish Allergy Centre is located at Gentofte Hospital. The Centre states that the staff do see patients with problems in the form of reactions to nail polish / nail adhesive, but not from lash adhesive or facial decoration adhesive.

The Danish EPA has received enquiries from consumers who experience reactions when using lash adhesive. These consumers then typically go directly to an ophthalmologist, rather than to their primary care doctors. Furthermore, it is expected that the Danish Allergy Centre is only aware of patients referred to their clinic at Gentofte Hospital. For this reason, we also contacted the Danish Ophthalmologists' Organisation.

4.2.6 Danish Ophthalmologists' Organisation (DØO)

The Danish Ophthalmologists' Organisation (DØO) is an organisation for all specialists in eye diseases. DØO was contacted to find out if Danish ophthalmologists receive patients with reactions to lash adhesive, and if so, how common these reactions are. DØO made a post on their website for all practising ophthalmologists in Denmark and encouraged them to reach out to share their experiences in this area. A few did respond to the post, and the information they provided is reproduced in chapter 6 "Discomfort and irritation when using adhesives".

4.2.7 Asthma-Allergy Denmark

Asthma-Allergy Denmark was contacted to learn about its experience with allergic reactions to adhesives for beauty products. Their experiences are primarily related to discomfort and irritation, which is why the comments from Asthma-Allergy Denmark are reviewed in chapter 6 "Discomfort and irritation when using adhesives" instead.

4.2.8 Contacting the Danish Consumer Council's Think Chemicals initiative

The Danish Consumer Council's Think Chemicals initiative has developed the Kemiluppen ["the chemistry loupe"] app, which allows users to look up ratings (A, B, or C) by scanning the barcode of a cosmetic product, based on the Danish Consumer Council's assessment of the ingredients declared on the product. The database behind Kemiluppen contains information about all ingredients declared in the roughly 20,000 current/non-discontinued products on the Danish market. The database also contains historical data on discontinued products.

Adhesives for beauty products are not a category that the Danish Consumer Council normally reports on or publishes in its app, but there is still some data in the database that the Council has sent to FORCE Technology. The Kemiluppen database contains information on a total of 18 unique relevant products, including eight lash adhesives and ten nail adhesives. One of the products has no ingredients listed, two of the products contain a colourant, and one product is

a set of several products for which it is not clear which ingredients belong to which product. Therefore, these products are not included in this survey. The ingredients for the remaining 14 products are listed in chapter 5 "Ingredient survey".

The Danish Consumer Council's database also contains data on the number of times a product's barcode has been scanned and when the product was last scanned; 15 of the 18 products were last scanned in 2025, two in 2024, and one as far back as June 2023. The oldest products may be outdated or discontinued. This has not been investigated further.

The number of scans may be an indication of how many consumers buy these products or are interested in buying these products. The product names / brands of the most scanned products (up to 640 scans) match the brands that were most often mentioned in the user study (chapter 3).

4.3 Search for products on the market

In connection with the purchase of products for the chemical analyses carried out for selected products in this project, a search for adhesives for beauty products was conducted both on various online shops and in physical stores in Denmark. The search was primarily for products available in Danish stores and on Danish online shops – or what appear to be Danish online shops; that is, sites with Danish-language content and URLs ending in ".dk". However, several of these online shops turned out to be located elsewhere in the EU when the products were delivered.

The reason we searched for beauty product adhesives primarily in Danish stores and on Danish online shops was because the user study showed that this type of adhesive is predominantly purchased from physical stores or Danish online shops.

SHEIN was one of the online shops outside of Denmark that was mentioned most often in the responses from the user study, and so two products from there were also included in the search for products on the market.

All products identified were put into an Excel sheet where information about product name, product type, manufacturer/brand, ingredients, content, price, and so on was noted. If colourants were identified on the ingredient list, or if images on the website indicated that the product contained colour, the products were excluded.

In total, 52 unique products were identified, of which:

- 24 products were adhesive for artificial eyelashes
- 21 products were adhesive for artificial nails
- 5 products were adhesive for the face (skin adhesive)
- 1 product was adhesive for the face and eyelashes
- 1 product was an all-purpose adhesive for the face

Thus, the products identified consisted primarily of adhesive for artificial eyelashes and artificial nails. In general, it was difficult to identify face adhesives that were not sold solely as skin adhesives for costume/theatrical use. The skin adhesives included in the study were chosen because the websites stated that they could also be used to adhere rhinestones to the skin, or because they were sold on websites that also sold decorative stones for the face.

Of the 52 identified adhesives for beauty products, ingredient information was available for 30. Ingredients in these adhesives are described in more detail in section 5.5 "Ingredient information from online shops". Of the 30 adhesives with ingredients listed, 28 contained some form of acrylate.

The 52 products contained between 0.7 ml (in a pen) and 15 ml of adhesive. The vast majority of products came with a screw cap and a small brush attached to the lid. Most products contained between 4 and 10 ml (or g) in one tube of adhesive. At first glance, there was no difference in content amounts for the different types of adhesive (lash adhesive, nail adhesive or skin adhesive); however, there were no skin adhesives in containers holding less than 5 ml.

The price of the products varied from DKK 14 up to DKK 159 per product, but 80% of the products had a price of DKK 75 or less. A single product cost DKK 275, but it was a set that included both artificial eyelashes and eyelash adhesive.

4.4 Contacting selected beauty salons

Selected beauty salons were contacted to both request information about the amount of product applied per use and gather knowledge about products and ingredients used in adhesives for beauty products.

In total, nine beauty salons were contacted, of which five were visited in person and four were contacted by phone. Information was obtained about the type of adhesive used in two of the beauty salons visited, and four others were subsequently contacted by email. However, these four salons did not respond to our enquiry with further information.

Information about the ingredients in the two adhesives used at the two beauty salons we received data from is described in the next chapter (chapter 5).

Based on information from the two salons, very little adhesive is used to apply both artificial nails and artificial eyelashes. One salon reported using one drop of adhesive per customer to apply artificial eyelashes. Another salon said that a 5 g tub of adhesive lasted "a very long time" for applying artificial nails, and that the adhesive was typically replaced before it ran out due to the lid becoming worn / sticking. The salon could not provide an exact amount used per application.

None of the salons that provided information for the project sold adhesive to their customers. They only used adhesive themselves at the salon.

4.5 Survey approach summary

The survey process involved contacting various industry associations and research institutions, as well as contacting selected beauty salons. This contact provided some information about ingredients in transparent adhesives for beauty products, but the most informative part of the survey was based on searching ingredient lists from products (discussed in the next chapter).

Contact with various research institutions also provided information about the discomfort and irritation experienced following use of this type of consumer product. Such discomfort and irritation are discussed in more detail in chapter 6 "Discomfort and irritation when using adhesives".

5. Ingredient survey

In this project, a survey of ingredients in transparent adhesives for beauty products was carried out through a number of activities:

- General literature review
- Information on ingredients in safety data sheets for transparent adhesives
- Information from the Danish Consumer Council and the beauty adhesives recorded in its Kemiluppen database
- Ingredient information from manufacturers/importers of adhesive for beauty products
- Search for ingredients listed for transparent adhesives for beauty products sold by various online shops

Information on ingredients in transparent adhesives for beauty products from the sources mentioned above is reproduced and discussed below.

5.1 Literature review

A general literature search was conducted for ingredients in transparent lash adhesive, nail adhesive and transparent adhesive for other beauty products. However, the search showed that this information could generally be found either in ingredient lists for products from various online shops (reviewed in section 5.5) or information found in safety data sheets (reviewed in section 5.2). In addition, several articles were identified regarding acrylates in this type of adhesive; however, they primarily addressed discomfort and irritation (reviewed in chapter 6).

In the literature search on discomfort caused by the use of adhesives, in addition to allergic reactions to acrylates, allergic reactions to formaldehyde were also mentioned. Possible formaldehyde content in transparent adhesives for beauty products is therefore described in more detail below.

5.1.1 Formaldehyde in adhesives for beauty products

According to Amano et al. (2012), 107 patients in Japan were studied for discomfort or irritation caused by the use of artificial lashes. To identify the cause of the discomfort, three lash adhesives were purchased from beauty salons and analysed for their content. Formaldehyde was identified in all three lash adhesives at concentrations of 520 ppm, 500 ppm and 650 ppm. The authors point out that all three adhesives were so-called formaldehyde adhesives and were not based on cyanoacrylate. The study concludes that the discomfort may be due to an allergic reaction to formaldehyde.

Xiang et al. (2022) cite the above study from Amano et al. (2012) and, in view of this article, sought to investigate the presence of formaldehyde in lash adhesives on the US market. A total of 37 lash adhesives were purchased, of which 17 were consumer products and 20 were lash adhesives for the professional market. Two of the 17 consumer products had a declared formaldehyde content, and none of the 20 lash adhesives on the professional market had a declared formaldehyde content. Of the 37 products, 34 products contained some form of acrylate (predominantly ethyl cyanoacrylate), two products did not contain acrylates but a rubber latex and cellulose rubber, and the last product had no declaration.

The release of formaldehyde was analysed by a screening method (CA method), which is a colour reaction method that gives an approximate level of formaldehyde in the product. The article does not state what levels of formaldehyde are released, but a strong positive result for

formaldehyde in this method usually means a formaldehyde content of more than 40 ppm, and it is stated that the detection limit of the method is 2.5 ppm. The results showed that the two consumer products with a declared formaldehyde content had a strong positive result for formaldehyde, and two other consumer products had a mild positive result for formaldehyde content. Of the 20 professional lash adhesives, 15 products released formaldehyde; one product with a strong positive result, one product with medium release, and 13 products with a mild positive result (Xiang et al., 2022).

The authors conclude from this study of lash adhesives on the US market that although no formaldehyde content is declared in lash adhesives, the majority (75%) of the products did have a measurable formaldehyde content, especially lash adhesives for professional use.

Thus, it will also be relevant in this project to investigate whether the purchased adhesives release formaldehyde, as many of them are also based on acrylates.

5.2 Information in safety data sheets

A search for transparent adhesives for use in beauty products found a few products with associated safety data sheets. The search used the words "transparent", "translucent" and "clear" to find safety data sheets for transparent adhesives only.

These safety data sheets contain information about the ingredients in the transparent adhesives. Examples of ingredients in nail adhesive and lash adhesive found in safety data sheets can be found in TABLE 7 below.

None of the adhesives listed in TABLE 7 below are included in the survey of adhesive products from online shops and physical stores described in section 5.5 "Ingredient information from online shops". Several of the adhesives listed are based on American safety data sheets and American products. We came across a few products with both safety data sheets and ingredient lists on online shops. These products are reported in section 5.5 instead and not included in the table below.

The REACH regulation does not require all ingredients to be mentioned in a safety data sheet, only those that contribute to the overall classification of the mixture. Consequently, safety data sheets do not present exhaustive lists of the ingredients in a given product. If a colourant is not classified, it will not appear on the safety data sheet for this reason. Therefore, there is no guarantee that the list of ingredients below comes exclusively from transparent adhesives. For cosmetic products, on the other hand, all ingredients are required to be listed.

TABLE 7. Examples of ingredients in transparent adhesives listed in safety data sheets found online

Product type	Ingredients	Source
Nail adhesive gel	Vinyl caprolactam / dimethylamino ethyl methacrylate copolymer (CAS 102972-64-5) (50-100%) Glyceryl Polyacrylate (CAS 104365-75-5) (15-25%) Glyceryl Polymethacrylate (CAS 28474-30-8) (10-20%)	Nailster, 2024
Lash adhesive	Alkoxy cyanoacrylate (CAS 7085-85-0) (90-95%) Poly(methyl methacrylate) (CAS 9011-14-7) (3-5%)	HPT, 2024

Product type	Ingredients	Source
Nail adhesive gel	Acrylates copolymer (CAS 25035-69-2) (80-100%) Acryloyl Morpholine (CAS 5117-12-4) (1 < 10%) Ethyl phenyl (2,4,6-trimethylbenzoyl) phosphinate (CAS 84434-11-7) (1-2%) Dimethone (CAS 9016-00-6) (0.1%)	Kandii, 2024
Lash adhesive	Acrylic Resin (CAS 25767-39-9) (50-60%) Water (30-40%) Propylene Glycol (1-2%)	Kandii, 2025a
Adhesive for rhinestones (nails) Gel and UV	Isobornyl acrylate (CAS 5888-33-5 / 227-561-6) (75-100%) (1-methyl-1,2-ethanediyl)bis[oxy(methyl-2,1-ethanediyl)] diacrylate (CAS 42978-66-5 / 256-032-2) (5-15%) Hydroxypropyl methacrylate (CAS 27813-02-1 / 248-666-3) (1-5%)	Kandii, 2025b
Nail adhesive	Ethyl 2-cyanoacrylate (CAS 7085-85-0) (75-100%)	Wella, 2023
Nail adhesive	Ethyl 2-cyanoacrylate (CAS 7085-85-0) (60-100%) Poly(methyl methacrylate) (CAS 9011-14-7) (10-30%) The safety data sheet is old, from 2006	Nail Superstore, 2006
Lash adhesive	Ethyl Cyanoacrylate (CAS 7085-85-0) (approx. 79%) Ethoxyethyl Cyanoacrylate (CAS 21982-43-4) (≥ 10%) Poly(methyl methacrylate) (CAS 9011-14-7) (7-11%)	Lash Shop, 2025a
Nail adhesive	Ethyl cyanoacrylate (CAS 7085-85-0) (88-99.5%) Poly(methyl methacrylate) (CAS 9011-14-7) (0.5-12%) Water Hydroquinone (CAS 123-31-9) (0.01-0.02%)	Purenails, 2025
Lash adhesive	Water Butyl acrylate (CAS 141-32-2) (35%) Propylene glycol (10%) Dextrin (CAS 9004-53-9) (5%) Polyvinylpyrrolidone (PVP) (CAS 9003-39-8) (5%)	Lash Shop, 2025b
Nail adhesive	Ethyl cyanoacrylate (CAS 7085-85-0) (80-100%) Poly(methyl methacrylate) (CAS 9011-14-7) (10-20%) Hydroquinone (CAS 123-31-9) (< 0.1%)	Kiara Sky, 2025

During the search, we observed that many online shops do not have safety data sheets available to consumers, which is not a legal requirement (only for professional users). Most often, the ingredients are listed in a 'sub-tab' under the product itself on the website. In cases where a safety data sheet was associated with a product, it could sometimes be found under the 'product description' or 'ingredients' tabs. Usually, all the safety data sheets for the products a company sold were gathered in one place under a separate tab. This could indicate that many retailers/manufacturers may perceive the adhesives as cosmetic products that do not require a safety data sheet.

As shown in TABLE 7, all of the above products contain some form of acrylate, the most common being ethyl 2-cyanoacrylate (CAS 7085-85-0). Other relevant ingredients to highlight are hydroquinone (CAS 123-31-9) and acryloyl morpholine (CAS 5117-12-4).

Hydroquinone has a harmonised classification as Skin Sens. 1, H317 (May cause an allergic skin reaction), Muta 2, H341 (Suspected of causing genetic defects) and Carc. 2, H351 (Suspected of causing cancer).

Acryloyl morpholine (CAS 5117-12-4) has a harmonised classification as Skin Sens. 1, H317 (May cause an allergic skin reaction).

Thus, the acrylates are not the only ingredients in the above-mentioned adhesives that are classified as allergenic. As previously mentioned, none of the products listed above are included in the Danish market survey in this project. This is partly due to the fact that several of the above-mentioned safety data sheets originate from American companies.

5.3 Information from the Kemiluppen database

As described in section 4.2.8, the Danish Consumer Council was contacted regarding possible adhesives for beauty products in their database behind their Kemiluppen app. The ingredients for 14 products without colourants are listed below.

TABLE 8. Ingredients in lash and nail adhesives scanned into the Kemiluppen app's database

Product type	Ingredients
Lash adhesive 1	Acrylates/ethylhexyl acrylate copolymer Aqua Tocopherol (Vitamin E) Ethylhexylglycerin Phenoxyethanol
Lash adhesive 2	Acrylates/ethylhexyl acrylate copolymer Propylene glycol Phenoxyethanol Ethylhexylglycerin
Lash adhesive 3	Natural latex Acrylate copolymer Di-Ionic water HPC (probably hydroxypropyl cellulose) Fragrance
Lash adhesive 4	Aqua, Alcohol denat. Polyvinyl alcohol Acrylates/diacetone acrylamide copolymer Glycerine PVP (polyvinylpyrrolidone) Sorbitol Dextrin Hydroxyethyl cellulose Lecithin Allantoin Methylparaben
Lash adhesive 5	Acrylates/ethylhexyl acrylate copolymer Alcohol denat. Amp-acrylates copolymer Phenoxyethanol Ethylhexylglycerin
Nail adhesive 1	Ethyl cyanoacrylate
Nail adhesive 2	Ethyl cyanoacrylate Polymethyl methacrylate

Product type	Ingredients
Nail adhesive 3	Ethyl cyanoacrylate Polymethyl methacrylate
Nail adhesive 4	Ethyl cyanoacrylate Polymethyl methacrylate
Nail adhesive 5	Ethyl cyanoacrylate Polymethyl methacrylate
Nail adhesive 6	Ethyl cyanoacrylate
Nail adhesive 7	Ethyl cyanoacrylate Polymethyl methacrylate
Nail adhesive 8	Ethyl cyanoacrylate Polymethyl methacrylate
Nail adhesive 9	Acrylates copolymer Aqua Phenoxyethanol

As shown in the table above, all five lash adhesives and all nine nail adhesives in Kemiluppen contain some form of acrylate. Ethyl cyanoacrylate and polymethyl methacrylate are the most commonly used acrylates in nail adhesives, with some form of acrylate copolymer most frequently used in the five lash adhesives.

In addition, the aqueous adhesives contain phenoxyethanol as a preservative, and one nail adhesive contains methylparaben, which is a suspected endocrine disruptor. Other adhesives contain alcohol (ethanol) as a solvent. One of the listed adhesives also contains fragrance, which may be allergenic.

5.4 Ingredient information from manufacturers/importers

The following adhesives were identified with ingredient information from different manufacturers/importers. The adhesives listed are partly derived from the adhesives identified in beauty parlours, but also include the information received from manufacturers through industry associations.

TABLE 9. Ingredients in adhesive for beauty products - information received from manufacturers / professional users

Product type	Ingredients	Source
Lash adhesive UV	Ethyl cyanoacrylate Sodium stearate Photoinitiator	Salon
Nail adhesive	Ethyl cyanoacrylate Polydimethyl Methacrylate Boron Trifluoride Diethyl Etherate Polyethylene Glycol Dimethacrylate Trans-Aconitic Acid BHA	Salon
Nail adhesive	Ethyl 2-cyanoacrylate	Manufacturer

Product type	Ingredients	Source
Lash adhesive	Acrylic polymer Aqua Hydroxyethyl cellulose Ethanol Sodium dehydroacetate Laureth-20	Manufacturer

All of the above-mentioned adhesives contain an acrylate. Ethyl cyanoacrylate (or ethyl 2-cyanoacrylate) is the most commonly used.

Preservatives used in the above adhesives are ethanol (also used as a solvent) and sodium dehydroacetate.

In addition, the above adhesives contain the following ingredients that should be highlighted: BHA (butylhydroxyanisole, CAS no. 25013-16-5) and boron trifluoride diethyl etherate (CAS 109-63-7).
BHA has a notified classification as Carc. 2, H351 (Suspected of causing cancer) and Repr. 2, H361 (Suspected of damaging fertility or the unborn child). BHA is also listed on list III on EDlist.org[3]; that is, it is considered to have endocrine-disrupting properties by one of the national authorities behind EDlist.org.
Boron trifluoride diethyl etherate is classified as Acute Tox. 4, H332 (Harmful if inhaled).

5.5 Ingredient information from online shops

As stated in section 4.3 "Search for products on the market", a total of 52 adhesives were identified in Danish physical stores and online shops in the survey of adhesives for beauty products on the market. These were primarily nail adhesive and lash adhesive, as well as some skin adhesives. Ingredient information was not available online for all products, but ingredient information was available for a total of 30 of the products. The combined total of 48 unique ingredients contained in these 30 products is listed in TABLE 10 below.

The fact that 30 products only contain a total of 48 unique ingredients indicates that adhesives for beauty products are generally low in ingredients and contain many of the same ingredients. The ingredients are listed in TABLE 10 in descending order of frequency across products. Ingredient names are listed as they appear on the ingredient list.

TABLE 10. Ingredients identified in 30 adhesives for beauty products on the Danish market.

Ingredient (often listed under INCI name)	In no. of products (out of 30)
Aqua (water)	15
Phenoxyethanol	13
Ethyl 2-cyanoacrylate (also listed as ethyl cyanoacrylate)	11
Acrylates/ethylhexyl acrylate copolymer	10
Ethylhexylglycerin	9
Polymethyl methacrylate	7

[3] EDClist.org is a website launched by Belgium, Denmark, France, the Netherlands and Sweden in 2020 with the aim of providing information about the current status of substances identified as or suspected to be endocrine disruptors in the EU.

Ingredient (often listed under INCI name)	In no. of products (out of 30)
Acrylate copolymer	5
Propylene glycol	5
Alcohol denat.	3
Caprylyl glycol	3
Cyanoacrylate	3
Glycerine	3
Tocopherol	3
BHA	2
C13-14 Isoparaffin	2
Laureth-7	2
Polyacrylamide	2
PVP	2
VP/VA Copolymer	2
2-cyanoacrylate glycol	1
Acrylates / C10-30 Alkyl Acrylate Crosspolymer	1
Amp-acrylates copolymer	1
Ascorbic acid	1
Bambusa Vulgaris (Bamboo) Extract	1
Boron trifluoride	1
Butylene Glycol	1
Camellia Sinensis (Tea) Leaf Extract	1
Dimethicone	1
Ethyltrimethylbenzoyl Phenylphosphinate	1
Hexylene glycol	1
Hydroxypropyl cellulose	1
Isobornyl acrylate	1
Laurtrimonium Chloride	1
Microcrystalline Wax	1
Mineral oil (paraffinum liquidum)	1
Panthenol	1
Perfume/fragrance	1
Polyacrylate Crosspolymer-6	1
Poly(ethyl 2-cyanoacrylate)	1
Polyvinyl acetate	1
PPG-1 Trideceth-6	1
Retinol	1
Rubber Latex	1
Sodium acrylate polymer	1
Sodium Bisulfite	1
Sodium dehydroacetate	1
T-Butyl alcohol	1
Triethanolamine	1

The table shows that a total of 12 different acrylates were used in the 30 products, but that ethyl 2-cyanoacrylate (in 11 products), acrylates/ethylhexyl acrylate copolymer (in 10 products) and polymethyl methacrylate (in 7 products) are the three most frequently used acrylates.

Half of the products are water-based and contain water. Many of these therefore also contain preservatives, with phenoxyethanol (in 13 products) being virtually the only preservative used. Sodium dehydroacetate is also a preservative but is only present in one of the products. Alcohol (ethanol) is used as a solvent (or preservative) in three products.

Fragrance was only seen in one of the 30 products, and another product contains two different plant extracts – Camellia Sinensis (Tea) Leaf Extract and Bambusa Vulgaris (Bamboo) Extract – which may be some form of essential oils.

The following ingredients should be highlighted:
- BHA
- Boron trifluoride
- Ethyltrimethylbenzoyl phenylphosphinate

BHA (CAS no. 25013-16-5) (butylated hydroxyanisole) has a notified classification as Carc. 2, H351 (Suspected of causing cancer) and Repr. 2, H361 (Suspected of damaging fertility or the unborn child). BHA is also listed on list III on EDlist.org, meaning it is considered to have endocrine-disrupting properties. BHA was seen in two nail adhesives.

Boron trifluoride (CAS no. 7637-07-2) has a harmonised classification as corrosive (Skin Corr. 1A, H314 (Causes severe skin burns and eye damage) and Acute Tox. 2, H330 (Fatal if inhaled). Boron trifluoride was observed in a nail adhesive. It should be noted that according to the Cosmetic Products Regulation, Annex II, entry 191, "hydrogen fluoride, its normal salts, its complex compounds and hydrofluorides" may not be used in cosmetic products. As this nail adhesive does not contain colour, the product is not considered a cosmetic product; therefore, the prohibition on the use of these compounds does not apply to the adhesive.

Ethyltrimethylbenzoyl phenylphosphinate (CAS no. 84434-11-7) has a notified classification as Skin Sens. 1B, H317 (May cause an allergic skin reaction). The substance was observed in a nail adhesive.

5.6 Information about ingredients in different types of adhesives

Based on the survey in this project, a total of 32 products were purchased for the chemical analyses (see chapter 7 "Selection and procurement of products"). The ingredient lists for these products could therefore be read from the packaging, except for one product which bore no ingredient list. Of these 31 products, 13 products were nail adhesives, 13 products were lash adhesives (of which 12 had ingredient lists) and 5 products were face adhesives (skin adhesives). One final adhesive was labelled as a skin adhesive, but also sold as a lash adhesive, and so this product is not included in TABLE 11 below.

TABLE 11 lists the most common ingredients in the three types of transparent adhesives: nail adhesive, lash adhesive and skin adhesive. Not all ingredients are listed, only those used in two or more adhesives of the same type.

TABLE 11. Ingredients in the different types of adhesives

Ingredient	Function according to CosIng database	Nail adhesive (13 products)	Lash adhesive (12 products)	Skin adhesive (5 products)
Acrylates/ethylhexyl acrylate copolymer	Binder		6	
Aqua	Solvent	2	9	3
BHA	Antioxidant	2		
Cellulose gum	Binder		2	
Cyanoacrylate	Film-forming agent	2		
Ethyl 2-cyanoacrylate	Film-forming agent	11		
Ethylhexylglycerin	Skin softener		5	
Fragrances	Fragrances		2	
Isopropyl alcohol	Solvent			3
Phenoxyethanol	Preservative		6	1
Polymethyl methacrylate	Binder	7		
Propylene glycol	Moisturiser		3	
PVP	Binder			2
Resin/resin extract	Film-forming agent			2
Rubber Latex	Film-forming agent		2	
Sodium dodecylbenzenesulfonate	Surfactant		2	
Tocopherol	Antioxidant Moisturiser		3	

The three different types of adhesives contain different ingredients, as their applications also require different properties. Nail adhesive is intended to adhere plastic artificial nails to natural fingernails and last for a few weeks at a time. However, the adhesive also comes into contact with the skin of the fingers and fingertips when the artificial nails are attached to the fingernails. Lash adhesive must be applied to the eyelids, which requires a flexible adhesive to avoid a tightening/shrinking effect. The durability requirement for this adhesive is only a few days. Skin adhesive, like lash adhesive, must be flexible, as rhinestones or similar items must be adhered to the skin. A hard adhesive will feel uncomfortable on the skin. It is expected that stones and similar decorations need not remain on the skin for more than a few hours.

These three uses are the reason the three adhesives contain different ingredients.
Based on the ingredients, **nail adhesive** more closely resembles a general-purpose adhesive than a cosmetic product. Nail adhesives contain only a few ingredients, and there are mainly three acrylates used in most of the nail adhesives purchased for the project:

- Cyanoacrylate,
- 2-ethyl-cyanoacrylate, and
- Polymethyl methacrylate.

Lash adhesive is applied close to the eye and on the skin, which requires an adhesive that forms a flexible film. This is also indicated in the ingredients. Lash adhesive contains more unique substances than nail adhesive and more closely resembles a cosmetic product based on the ingredients. Ingredients with adhesive properties that form flexible films in the purchased lash adhesives are:

- Cellulose gum,
- latex, and

- acrylate copolymers.

Cellulose gum (carboxymethyl cellulose) is an ingredient that, in addition to its use in cosmetic products, is also used in adhesives for paper. Latex can be allergenic.

Lash adhesive also contains substances with protective properties, such as tocopherol (vitamin E) and sodium dodecylbenzene sulfonate (anionic surfactant and emulsifier). In addition, two of the lash adhesives have added fragrances. Most lash adhesives are water-based and therefore also contain preservatives, such as phenoxyethanol.

Skin adhesives contain only a few ingredients and do not resemble a cosmetic product in composition, as there are no substances with protective properties in the adhesives. The purchased skin adhesives contain PVP (polyvinylpyrrolidone) or resin/resin extract from plants, with adhesive properties that help form a flexible film. Skin adhesives are also typically water-based but also contain an alcohol as a preservative.

5.7 Acrylates

The various sources of information on ingredients in transparent adhesives for beauty products show that the majority of these adhesives (especially lash and nail adhesives) contain some form of acrylate, and that acrylates make up a large percentage of the content. Different types of acrylates have been identified. These are listed in TABLE 12 below, including their classification.

TABLE 12. Overview of acrylates identified in nail and lash adhesives

Acrylate	CAS no.	Classification	Explanation of H-phrases
Vinyl caprolactam / dimethylamino ethyl methacrylate copolymer	102972-64-5	No health classification	
Glyceryl Polyacrylate	104365-75-5	Not found in ECHA's C&L database	
Glyceryl Polymethacrylate	28474-30-8	Not classified	
Alkoxy cyanoacrylates Ethyl 2-cyanoacrylate Ethyl cyanoacrylate	7085-85-0	Skin Irrit. 2, H315 Eye Irrit. 2, H319 STOT SE 3, H335	Causes skin irritation Causes severe eye irritation May cause respiratory irritation
Poly(methyl methacrylate)	9011-14-7	Not classified	
Acrylates copolymer	25035-69-2	Not classified	
Acryloyl Morpholine	5117-12-4	Acute Tox. 4, H302 Eye Dam. 1, H318 Skin Sens. 1, H317 STOT RE 2 H373	Harmful if swallowed Causes serious eye damage May cause an allergic skin reaction May cause damage to organs through prolonged or repeated exposure
Acrylic Resin	25767-39-9	Not found in ECHA's C&L database	
Isobornyl acrylate	5888-33-5 / 227-561-6	Skin Sens. 1A, H317	May cause an allergic skin reaction

Acrylate	CAS no.	Classification	Explanation of H-phrases
(1-methyl-1,2-ethanediyl)bis[oxy(methyl-2,1-ethanediyl)] diacrylate	42978-66-5 / 256-032-2	Skin Irrit. 2, H315 Eye Irrit. 2, H319 Skin Sens. 1, H317 STOT SE 3, H335	Causes skin irritation Causes severe eye irritation May cause an allergic skin reaction May cause respiratory irritation
Hydroxypropyl methacrylate	27813-02-1 / 248-666-3	Skin Sens. 1, H317 Eye Irrit. 2, H319	May cause an allergic skin reaction Causes severe eye irritation
Ethoxyethyl Cyanoacrylate	21982-43-4	Not classified	
Butyl acrylate	141-32-2	Skin Irrit. 2, H315 Eye Irrit. 2, H319 Skin Sens. 1, H317 STOT SE 3, H335	Causes skin irritation Causes severe eye irritation May cause an allergic skin reaction May cause respiratory irritation
Acrylates/ethylhexyl acrylate copolymer	unknown		
Acrylates copolymer	25133-97-5	Not classified	
Acrylates/diacetone acrylamide copolymer	unknown		
Amp-acrylates copolymer	9010-92-8	Not classified	
Polyethylene Glycol Dimethacrylate	25852-47-5	Not classified	
Cyanoacrylate	137-05-3	Skin Irrit. 2, H315 Eye Irrit. 2, H319 STOT SE 3, H335	Causes skin irritation Causes severe eye irritation May cause respiratory irritation

Acrylates is the term for a range of man-made substances that are soft or liquid. Some acrylates can cure and become hardened when exposed to UV light or heat, but not all acrylates do. A common acrylate-based adhesive for home use should not harden under (e.g.) UV light and therefore takes longer to cure.

Acrylates are chemicals derived from acrylic acid with the chemical formula CH_2=CHCOOH. Acrylates are esters of acrylic acid and have the general chemical formula CH_2=$CHCO_2R$, where R can be a variety of organic groups. The simplest acrylate is methyl acrylate, which is the methyl ester of acrylic acid (CH_2=$CHCOOCH_3$).

Asthma-Allergy Denmark writes on its website (Asthma-Allergy Denmark, 2025a) that adhesive for artificial nails often contains acrylates, and that the acrylates most often used are:

- Ethyl methacrylate (EMA)
- Methyl methacrylate (MMA)
- Hydroxyethyl methacrylate (HEMA)

Acrylates are allergenic until fully cured. If acrylates do not cure properly, they can be allergenic and cause contact dermatitis on skin contact. Meanwhile, the risk from fully cured acrylates is minimal. Proper curing often depends on time and application method. The acrylate compounds mentioned are small molecules that can easily penetrate the skin and activate the immune system. MMA evaporates easily and there is therefore a risk of inhalation when applying artificial nails with adhesive containing MMA (Asthma-Allergy Denmark, 2025a; Danish Allergy Centre, 2025b).

Asthma-Allergy Denmark states that allergic reactions to acrylates in connection with the application of artificial nails typically occur among professional nail technicians, but given that consumption of these adhesives is on the rise among private consumers, there is also an increase in the incidence of allergies here.

Symptoms of allergy to acrylates include (Asthma-Allergy Denmark, 2025a):
- Redness
- Swelling
- Small blisters that can turn into ulcers
- Cracks on the fingertips
- Partial detachment of the nail
- Permanent deformation of the nails

Symptoms are often seen on the fingertips but can spread to the hand. In nail technicians, eczema on the face and swelling around the eyes have also been observed. Depending on the severity, symptoms can last from weeks to months (Asthma-Allergy Denmark, 2025a).

Products that contain acrylates include (Asthma-Allergy Denmark, 2025a):
- Artificial nails and UV-curable nail polish
- Glucose sensors and insulin pumps for use in diabetics
- Plastic fillings in teeth and denture manufacturing
- Bone cement for orthopaedic procedures

5.8 Summary of ingredients in transparent adhesives

Acrylates are the main ingredient in most nail and lash adhesives. Skin adhesives contain other ingredients with adhesive film-forming properties, such as PVP or various resins. Water or alcohol (ethanol or isopropyl alcohol) is typically used as a solvent. For water-based adhesives, a preservative is often used, which in most cases is phenoxyethanol, but methylparaben and sodium dehydroacetate have also been seen. A few of the adhesives contain fragrances, but this is not typical.

The following ingredients of concern have been identified in addition to the allergenic acrylates:
- BHA (suspected endocrine disruptor)
- Methylparaben (suspected endocrine disruptor)
- Formaldehyde (Carc. 1B, H350 - May cause cancer; Skin Sens. 1, H317 - May cause an allergic skin reaction)
- Boron trifluoride (Acute Tox. 2, H330 - Fatal if inhaled)
- Ethyltrimethylbenzoyl phenylphosphinate (Skin Sens. 1, H317 - May cause an allergic skin reaction)
- Boron trifluoride diethyl etherate (Acute Tox. 4, H332 - Harmful if inhaled)
- Hydroquinone (Skin Sens. 1, H317 - May cause an allergic skin reaction; Muta 2, H341 - Suspected of causing genetic defects; Carc. 2, H351 - Suspected of causing cancer)
- Acryloyl Morpholine (Skin Sens. 1, H317 - May cause an allergic skin reaction)
- Methanol (Acute Tox. 3, H311 - Toxic in contact with skin)

Thus, the acrylates are not the only ingredients in the above-mentioned adhesives that are classified as allergenic.

Many of these substances have been identified from ingredient lists on the products (or safety data sheets), but transparent adhesives are not required by law to include an ingredient list as they are not covered by the Cosmetic Products Regulation. In the case of transparent

adhesives that do not list their ingredients, it is not possible for a consumer to make an informed choice or reject a product based on the possible presence of substances of concern.

6. Discomfort and irritation when using adhesives

Contact dermatitis is an inflammatory skin condition that can be triggered by contact with allergenic chemicals. The most common symptoms of contact dermatitis according to Asthma-Allergy Denmark (2025b) are:

- Redness
- Small blisters
- Cracks in the skin
- Hives
- Peeling
- Itching

Furthermore, there are two types of contact dermatitis: irritant and allergic contact dermatitis. Irritant contact dermatitis is caused by repeated exposure of the skin to irritants, such as through frequent hand washing, while allergic contact dermatitis is caused by an allergic reaction to a specific substance (Asthma Allergy Denmark, 2025b).

According to the Danish Allergy Centre (2025b), acrylates are used in artificial nails (acrylic nails) and gel nail polish. These acrylates cure under UV light and typically contain ethyl methacrylate (EMA) and/or methyl methacrylate (MMA) and/or hydroxyethyl methacrylate (HEMA), but others can also be used. As indicated in chapter 5 "Ingredient survey", the same types of acrylates are also used in nail adhesives.

The Danish Allergy Centre (2025b) writes that acrylates are highly allergenic before they cure if they get on the skin, but when fully cured, they do not trigger allergies. In the nail area, symptoms of allergies often include redness, swelling and small blisters on the fingertips and around the nail. This reaction can spread to the rest of the hand, and dermatitis can occur on the face, with swelling around the eyes. The blisters can burst and turn into small ulcers. Later in the process, the skin may become scaly, and deep cracks may appear in the fingertips. Often, the nail will become partially or completely detached, and in some cases the natural nail will be permanently deformed. Symptoms can last from weeks to months, depending on the severity.

6.1 Information from research centres

The Danish Allergy Centre has stated that its staff have not encountered patients with reactions to lash adhesive. This is probably because these patients are referred to an ophthalmologist instead.

Asthma-Allergy Denmark has reported that it regularly receives enquiries from consumers who are either themselves experiencing problems with adhesive for artificial nails or observing such problems among their children. Reactions are typical contact allergic reactions, with redness, swelling, itchy blisters, peeling and possibly cracking of the skin and ulceration of the fingertips, skin around the nails and – in severe cases – spreading to the rest of the fingers and hand. Another typical reaction is that the nail itself detaches, and the natural nails become deformed either temporarily or permanently. Symptoms can persist for a long time, even after the artificial nails have been removed.

These symptoms also complicate the use of the hands, making normal everyday tasks difficult or even impossible to perform. For some, this can lead to sick leave from work. In addition to physical discomfort, many also express embarrassment about the appearance of their hands and the overall psychological impact of the condition.

Asthma-Allergy Denmark does not keep statistics on these enquiries and therefore cannot comment on trends or how widespread this problem is. In addition, Asthma-Allergy Denmark does not know which adhesive was used, where it was purchased or if it was used at home or at professional nail services.

6.2 Literature review on discomfort and irritation from adhesive use

A literature review on discomfort and irritation associated with the use of adhesives identified different types of discomfort, all of which are summarised in TABLE 13. The search used key-words including "allergy", "allergic reactions", "reactions", "nuisance" and "patients" in combination with "transparent glues" for "nails" or "lashes". It should be noted that it is not clear from the literature whether the adhesive used is transparent or coloured. However, some sources have confirmed that it is the acrylates in the adhesives that the patient is allergic to and has reacted to. These acrylates are found in both transparent and coloured adhesives, so it is likely that the discomfort will be the same regardless of whether the adhesive is transparent or coloured. However, it cannot be ruled out that some patients may also be allergic to colourants, though this is not specifically mentioned in the sources.

When using nail adhesive and lash adhesive, a large proportion of cases have been reported where the user has developed allergic contact dermatitis. Symptoms mainly appear as redness and swelling of the fingers, hands and eyelids. These cases are listed in TABLE 13 below.

It should also be noted that there are numerous cases (Aggarwal et al., 2021; Coles et al., 2016; Brambilla et al., 2020; Alhumsi & Mardan, 2021) where children have inadvertently come into contact with nail adhesive and lash adhesive. In several cases, this has resulted in first- and second-degree burns. This is because cyanoacrylate polymerises in the presence of moisture. The reaction is exothermic, meaning heat is released, causing burns. These cases are not included in the table below. No articles were identified reporting discomfort associated with the use of skin adhesives for decorative purposes.

TABLE 13. Types of discomfort from beauty product adhesives reported in the literature

Product type	Age of person	Symptoms	Diagnosis	Source
Nail adhesive	13	Redness, swelling, cracking and peeling around the nails and upper part of the fingers Severe nail dystrophy	Allergic contact dermatitis Positive patch test for the substances - all on day 7: 2-Hydroxyethyl methacrylate (HEMA), Ethylene glycol dimethacrylate (EGDMA), Ethyl acrylate, Methyl methacrylate (MMA), Ethyl cyanoacrylate (ECA)	Quaade & Simonsen, 2023

Product type	Age of person	Symptoms	Diagnosis	Source
Lash adhesive	Not specified	-	Asthma and hay fever Two people: salon professionals Lash adhesive containing ethyl cyanoacrylate (ECA)	Lindström et al, 2013
Lash adhesive	17	Red and swollen eyelid with superficial skin loss	Thermal burn	Nardeosingh & Tung, 2020
Lash adhesive	31	Redness and swelling of the eyelids Itchy throat and nose	Allergic contact dermatitis Lash adhesive contained cyanoacrylate	Bhargava et al, 2012
Lash adhesive	49	Itching Swelling of the eyelids	Allergic contact dermatitis Lash adhesive contained butyl acrylate, 2-ethylhexyl acrylate, ethyl acrylate, and propylene glycol. Positive patch test for ethyl acrylate on days 2 and 4.	Kim & Chung, 2014
Nail adhesive	27	Greenish discolouration	None Nail adhesive contained cyanoacrylate	Mahajan & Mahajan, 2024
Nail adhesive	40	Itching on fingertips Redness of fingertips	Allergic contact dermatitis Positive patch test for 2-hydroxyethyl methacrylate (HEMA) and ethyl acrylate. Nail adhesive contained both HEMA and isobornyl acrylate.	Baek & Adler, 2024
Lash adhesive	48	Redness, swelling and itching on eyelids	Allergic contact dermatitis Positive patch test on days 2 and 4 for n-butyl methacrylate, 2-hydroxyethyl methacrylate, 2-hydroxypropyl methacrylate, ethylene glycol dimethacrylate, ethyl cyanoacrylate, among others. Lash adhesive containing 2-cyanoacrylate (CAS 7085-85-0)	Shanmugam & Wilkinson, 2012
Nail adhesive	43	Redness and swelling of fingers and hands Rash around the mouth and lumpy feeling in the throat	Allergic contact dermatitis Positive patch test for 2-hydroxy ethyl acrylate (2-HEA), triethylene glycol diacrylate (TREGDA), 2-hydroxy ethyl methacrylate (2-HEMA) and ethylene glycol dimethacrylate (EGDMA).	Kepiro, 2016

Product type	Age of person	Symptoms	Diagnosis	Source
Nail adhesive	1	Periorbital oedema (swelling around the eyes)	Allergic contact dermatitis Case from the Danish Allergi Centre, where a patient responds to ethyl cyanoacrylate in nail adhesive (but is originally sensitized by lash adhesive).	Søgaard et al., 2025

As shown in TABLE 13, several cases of allergic reactions have been reported in either professional or private users in connection with both lash adhesive and nail adhesive. In several cases, it has been documented that the reaction is most likely due to the presence of acrylates in the adhesive, as the user's adhesive contained an acrylate that the user was found to be allergic to in a patch test (allergy test).

In addition to the above cases dealing specifically with allergic reactions to lash adhesive and nail adhesive, there are numerous studies of allergic reactions to acrylates in general, typically associated with various nail products (not just nail adhesive) containing acrylates. Some of these studies are listed below.

In 2020, the Danish Allergy Centre conducted a survey (Havmose et al., 2022) sent out to almost 5,000 hairdressers in Denmark. Around 1,200 hairdressers reported that they worked with artificial nails either themselves or with customers in their salons. Of these, 4.3% said they had experienced dermatitis on their hands/fingers due to this work. Allergic reactions are reported to be caused by acrylates in nail products.

The Danish Allergy Centre (Goncalo et al., 2017) also participated in a European study covering 11 countries from 2013 to 2015, where more than 18,000 patients with allergic reactions were reviewed. Of these, 0.75% of patients had allergic reactions due to acrylates around the nails (nail polish, artificial nails, adhesive). Most of the patients with allergic reactions to acrylates had positive patch tests for the following acrylates (with the percentage of patients with allergic reactions in brackets):

- 2-hydroxyethyl methacrylate (HEMA) (92.5%)
- 2-hydroxypropyl methacrylate (HPMA) (88.6%)
- ethylene glycol dimethacrylate (69.2%)
- ethyl cyanoacrylate (9.9%)

In addition, a total of 230 cases of allergic contact dermatitis to acrylates were investigated in Portugal between 2011 and 2015 (Raposo et al., 2017). Patients were both professionals (nail technicians) and private users. The studies showed that allergic reactions to the following acrylates were most common:

- 2-hydroxyethyl methacrylate (HEMA), patch tests were positive in 90% of patients tested
- 2-hydroxypropyl methacrylate (HPMA), patch tests were positive in 64.1% of patients tested
- ethylene glycol dimethacrylate, patch tests were positive in 54.5% of patients tested

A study of approximately 26,000 patients in seven European countries (Wilkinson et al., 2024) who were tested for allergy to the acrylate HEMA (2-hydroxyethyl methacrylate) in 2016 to 2023 showed that HEMA was the cause of 3.4% of all work-related skin diseases. The study also showed that nail-related contact allergy was on the rise from 2016 to 2023, with the percentage of those affected doubling. One result of the study was that between 2019 and 2023, a total of 3,000 patients in the Netherlands were tested for allergy to HEMA. Of these, there was a positive patch test in 3% of cases. Of these, nail adhesive was the cause of 10% of allergic reactions.

6.3 Comments from the user study regarding discomfort and irritation

In the small-scale user study that was conducted (see chapter 3), 15% of the respondents stated that they had experienced discomfort once or more, and a further 17% of the respondents knew someone who had experienced discomfort or had allergic reactions. This was a total of 52 respondents. Of them, 17 indicated what kind of discomfort they experienced. The questionnaire comments from these 17 people are listed below, with the type of adhesive they usually use in brackets (where ambiguous). These 17 people have only stated that they experienced discomfort when using an adhesive. It is therefore assumed that they are describing their own discomfort.

It should be noted that responses from users who only used coloured adhesive are not included below. However, one user who uses both coloured and transparent adhesive has described the discomfort they experienced. It is not known whether the reported discomfort is due to using only transparent adhesive, coloured adhesive or both.

The types of discomfort and irritation reported by users in the user study are:

- Redness around the eyes.
- The adhesive is difficult to remove, so trying to remove it causes irritation. It causes dry skin and redness + stinging eyes (artificial lashes and facial decorations).
- My eyelids became red and swollen.
- Eye inflammation, itching, burning, swollen eyelids, red eyes.
- My eyes have become really swollen, red and itchy, so I've stopped using false lashes.
- With adhesive for lashes: itching around the eyes, but it is tolerable. Slight red marks where a face stone has been placed after using lash adhesive there.
- Allergy. Itching. (artificial lashes)
- Slightly painful (artificial nails)
- Red eyes and redness around the eye.
- Taking off and applying false eyelashes made one eye swell up completely.
- When getting eyelash extensions, I had an allergic reaction after an independent lash technician got some adhesive on my skin.
- My nails are totally destroyed and split after the last time I used nail adhesive.
- Swollen and red eyes and eyelids. Itching.
- Redness and swelling (artificial lashes).
- I developed a permanent contact allergy. I can no longer use it. (artificial nails)
- Redness (artificial nails).
- Itching by using it around the eyes, but also eczema around the attached artificial nails with transparent glue (artificial lashes and nails).

Note that the majority of those who reported discomfort primarily use adhesive for artificial lashes (13 people), with the remainder experiencing discomfort with either artificial nails or adhesive for decorative stones applied to the face.

15 of the 24 people who answered yes to having experienced discomfort once or more use adhesive for artificial eyelashes, and the same number use adhesive for artificial nails (given that a few people use both).

6.4 Information from Danish ophthalmologists

In response to a post on the website of the Danish Ophthalmologists' Organisation, which is a website operated on behalf of all ophthalmologists in Denmark, some ophthalmologists sent in

information about their experiences with discomfort and irritation in relation to lash adhesive. The reports received are provided below:

- In the last 5 years, there have been two patients where a cosmetologist accidentally glued the upper and lower eyelids together, requiring an incision to separate them. There have been no patients with irritative discomfort due to the adhesive.
- Had a total of three patients with severe chemical eye inflammation after contact with lash adhesive. Considering the number of customers who have false lashes applied, the problem is probably not of great concern.

6.5 Summary of discomfort when using adhesives

Both the Danish Allergy Centre and Asthma-Allergy Denmark report that they receive inquiries from consumers with allergic reactions to adhesive for artificial nails. Both the Danish Allergy Centre and Asthma-Allergy Denmark only describe reactions to nail adhesive.

Several examples of discomfort and allergic reactions from both lash adhesive and nail adhesive have been found in the literature, while it was not possible to identify studies on skin adhesive.

However, it should be noted that it is not possible to distinguish whether the reactions are caused by coloured adhesives or transparent adhesives, as this is not stated in the literature or noted by the research centres.

In the small-scale user study conducted as part of the project, 15% of the respondents indicated that they had experienced discomfort once or more, and a further 17% of the respondents knew someone who had experienced discomfort or had allergic reactions. This means that up to 32% of respondents have either personally experienced or know someone who has experienced discomfort from using adhesives in beauty products.

7. Selection and procurement of products

Based on the survey and overview of the 52 transparent adhesives for beauty products, a total of 32 products were selected and purchased for the chemical analyses. The 32 products were selected according to the following criteria:

- Priority was given to selecting brands and stores that were mentioned frequently in the user study.
- The products that were scanned most frequently in Kemiluppen (from the Danish Consumer Council) were selected.
- Primarily nail adhesives and lash adhesives were purchased, as the survey showed that these were the most commonly used and are the product types with the greatest market shares in Denmark.
- Products were primarily purchased on Danish websites (or what appeared to be Danish websites); however, due to the responses in the user study, two products from SHEIN were also chosen.
- Equal numbers of nail adhesives and lash adhesives were purchased; the remainder were skin adhesives. One product was labelled as a skin adhesive, but according to the website, it could also be used for lashes.

A breakdown of the products purchased is presented in TABLE 14 below. As mentioned, based on the user study, the focus was on purchasing adhesives in Denmark and on what appeared to be Danish websites. (That is, websites with Danish-language text and URLs ending in ".dk".) However, in six cases, the websites were ultimately found to be either Swedish or Polish, as the products were shipped from these countries. Two products were purchased outside of the EU (on SHEIN, which was mentioned the most times in the user study). However, one of them turned out to be coloured pink and was therefore not included in the chemical analyses.

TABLE 14. The distribution of the 32 transparent adhesives purchased

Product type	Purchased in DK	Purchased in the EU	Purchased outside the EU	Total
Nail adhesive	12	1		13
Lash adhesive	7	5	1	13
Skin adhesive	5			5
Skin adhesive and lash adhesive	1			1
Total	**25**	**6**	**1**	**32**

TABLE 15 below contains information about the 32 purchased products in terms of product type, where the products were shipped from (DK, EU or non-EU), product volume/size, and price. The products are labelled using the following information:

- Numbering from 01-37 - note that there are gaps in the numbering, as more than 32 products were purchased to ensure a total of 32 colourless adhesives for the chemical analyses.
- Product type (F for ‘face’ adhesive, E for 'eye' (lash) adhesive, N for ‘nail’ adhesive and A for 'all' or multi-purpose adhesive).

TABLE 15. Overview of the 32 products purchased and information about product type, volume/size, price, etc. Note that there are gaps in the numbering, as not all products purchased proved to be transparent adhesives; these are therefore not a part of the survey. For this reason, more than 32 products were initially purchased.

Lab no.	Product type	Location shipped from	Volume/size	Price per unit
01-N	Adhesive for nails	Denmark	10 ml	40 DKK
02-E	Adhesive for lashes	EU, but not DK	7 ml	70 DKK
05-E	Adhesive for lashes	EU, but not DK	14 g	29 DKK
06-E	Adhesive for lashes	Denmark	14 g	90 DKK
07-A	Adhesive for face and lashes	Denmark	*Not specified*	69 DKK
08-F	Adhesive for face	Denmark	10 ml	12 DKK
09-E	Adhesive for lashes	Denmark	7 ml	49 DKK
11-N	Adhesive for nails	Denmark	8 g	21 DKK
12-E	Adhesive for lashes	EU, but not DK	5 ml	26 DKK
13-N	Adhesive for nails	Denmark	7.5 ml	99 DKK
15-E	Adhesive for lashes	Denmark	4.5 ml	50 DKK
16-N	Adhesive for nails	Denmark	7.5 g	21 DKK
17-F	Adhesive for face	Denmark	6.8 ml	20 DKK
18-N	Adhesive for nails	EU, but not DK	10 g	21 DKK
19-N	Adhesive for nails	Denmark	5 ml	35 DKK
20-N	Adhesive for nails	Denmark	8 ml	29 DKK
21-F	Adhesive for face	Denmark	10 ml	29 DKK
22-F	Adhesive for face	Denmark	7 ml	50 DKK
23-E	Adhesive for lashes	Denmark	4.7 g	25 DKK
24-E	Adhesive for lashes	Denmark	5 ml	149 DKK
25-N	Adhesive for nails	Denmark	3 g	30 DKK
26-E	Adhesive for lashes	EU, but not DK	5 ml	75 DKK
27-N	Nail adhesive, set with nails	Denmark	2 g	50 DKK
28-N	Adhesive for nails	Denmark	*Not specified*	26 DKK
29-E	Adhesive for lashes	Denmark	*Not specified*	32 DKK
30-N	Adhesive for nails	Denmark	*Not specified*	19 DKK
31-F	Adhesive for face	Denmark	5 ml	30 DKK
33-E	Adhesive for lashes	Outside the EU	5 ml	14 DKK
34-N	Adhesive for nails	Denmark	3 g	30 DKK
35-E	Adhesive for lashes	Denmark	5 g	85 DKK
36-E	Adhesive for lashes	EU, but not DK	7 g	61 DKK
37-N	Adhesive for nails	Denmark	3 g	40 DKK

As indicated in TABLE 15, one product was purchased from outside the EU. The remaining products were purchased on what appeared to be Danish websites, but it turned out that six products were shipped from other European countries instead.

The products are generally relatively inexpensive, with an average price of DKK 45, but the price varies from DKK 12 to DKK 149. The average price of adhesive for artificial nails was DKK 35; the average price of lash adhesive was DKK 58; and skin adhesive is the cheapest

category, with an average price of DKK 28. The product volume/size varied from 2 to 14 g, but there is not much difference across the three different types of adhesives (nail adhesive, lash adhesive and skin adhesive). No calculation has been made of the average price for the products for DK, EU and outside of EU, respectively.

8. Initial chemical analyses

By agreement with the Danish EPA, the following preliminary chemical analyses were performed on the 32 purchased beauty product adhesives:

- pH measurements
- Semi-quantitative analyses for formaldehyde (by CA method)
- GC-MS screening

The Danish EPA requested measurements of the adhesives' pH values to investigate possible irritation effects of the adhesives based on products' pH values alone.

Based on the results of the literature search, where an American study showed that several lash adhesives containing acrylates released formaldehyde even though formaldehyde was not declared, it was decided that a semi-quantitative analysis of the content of free formaldehyde in the purchased beauty product adhesives should also be performed in this project.

GC-MS screening was carried out to investigate whether the purchased adhesives for beauty products contain problematic substances other than the substances declared for some products, such as acrylates. The GC-MS screening also served to provide input on which substances to perform a risk assessment for and thus perform quantitative analyses of the purchased adhesives.

The initial analyses and results are described in greater detail below.

8.1 pH measurements

pH is defined as the inverse logarithm of the activity of protons (H^+ ions) in an aqueous solution (IUPAC, 2025). Therefore, it generally makes no sense to measure the pH value of non-aqueous solutions. Some adhesives contain water, but others do not. An attempt was made to measure the pH value of all purchased adhesives, despite the fact that not all adhesives are aqueous solutions and that the water content in some adhesives is not particularly high. These pH measurements should therefore be seen strictly as a guide for both the aqueous and non-aqueous adhesives, and the results are not used for classification purposes.

It was not possible to use a pH electrode, as a pH electrode must be dipped into an aqueous solution in order to take a proper pH measurement. The adhesives are viscous, so they are liable to harden directly on the electrode and destroy it. Therefore, an alternative method in the form of wet pH paper was used to determine the pH value. This method is imprecise in the sense that the resulting pH value is only an approximation of the true pH, and is rather an expression of the pH effect the adhesive exerts on the pH paper. However, comparing pH values between different products is possible, which is why the pH value was determined by this method nonetheless. That said, the precise values are more uncertain compared to hypothetical measurements taken directly in the adhesive. The pH measured on pH paper corresponds approximately to the pH to which (moist) skin is exposed when applying a product such as artificial eyelashes.

Initially, pH paper was dipped in pure water (Milli-Q water) and adhesive was applied to the pH paper in a thin layer. After a few minutes, the pH value was read from a colour scale with different colours for each pH unit and recorded. This initial pH value was used to determine which more specific pH paper to use (pH paper with a range from 0-6, 5.0-10.0 or 7.5-14, all

with 0.5 pH units per colour combination). The pH measurement was then repeated with the more specific pH paper (dipped in Milli-Q water and coated with a thin layer of adhesive). A reading was taken after a few minutes, and the pH value was recorded.

The measured pH values on pH paper with intervals of 0.5 pH units are shown in TABLE 16 below. The pH values have been read from a colour scale. In some cases where the exact colour could not be identified, the pH value is given as a range.

TABLE 16. pH values determined using wet pH paper for the 32 adhesives. The adhesives are sorted by adhesive type, so all nail adhesives are listed first, followed by all lash adhesives and finally skin adhesives.

Lab no.	Adhesive type	pH value read	Contains water (yes/no)
01-N	Nail adhesive	4.0	No
11-N	Nail adhesive	4.0	No
13-N	Nail adhesive	1.5	No
16-N	Nail adhesive	3.0	No
18-N	Nail adhesive	2.0	No
19-N	Nail adhesive	3.5	No
20-N	Nail adhesive	3.5	No
25-N	Nail adhesive	2.5	Yes
27-N	Nail adhesive	2.5	Yes
28-N	Nail adhesive	3.0	No
30-N	Nail adhesive	2.5	No
34-N	Nail adhesive	3.5	No
37-N	Nail adhesive	4.0	No
02-E	Lash adhesive	7.0-7.5	No
05-E	Lash adhesive	7.5	Yes
06-E	Lash adhesive	7.5-8.0	Yes
07-A	Adhesive for face and lashes	8.0	Yes
09-E	Lash adhesive	7.5-8.0	No ingredient list
12-E	Lash adhesive	8.0	Yes
15-E	Lash adhesive	8.0	Yes
23-E	Lash adhesive	8.0	Yes
24-E	Lash adhesive	2.5	No
26-E	Lash adhesive	8.0	Yes
29-E	Lash adhesive	7.0	Yes
33-E	Lash adhesive	6.5	Yes
35-E	Lash adhesive	8.0	No
36-E	Lash adhesive	4.0	Yes
08-F	Skin adhesive	5.0	Yes
17-F	Skin adhesive	3.0	No
21-F	Skin adhesive	3.5	Yes
22-F	Skin adhesive	4.5	Yes
31-F	Skin adhesive	4.0	No

It can be seen from TABLE 16 the majority of nail adhesives do not contain water (two of 13 products contain water; the rest do not), whereas lash and skin adhesives do (10 of 13 lash adhesives with ingredient lists contain water, and three of five skin adhesives contain water).

The results show that nail adhesives generally have a relatively acidic pH value between pH 1.5 and 4.0. Two nail adhesives stand out with acidic pH values of 1.5 and 2.0. The remaining 11 nail adhesives all have pH values between 2.5 and 4.0. According to the rules for the classification of chemical mixtures, section 3.2 "Skin corrosion/irritation" of the CLP Regulation (EU Regulation 1272/2008) states that "in the absence of other information, a mixture is considered to be skin corrosive (skin corrosion, category 1) if it has a pH ≤ 2 or a pH ≥ 11.5". This means that products 13-N and 18-N can be considered to be corrosive unless there is other data to the contrary.

Lash adhesives have a more neutral pH, generally between 6.5 and 8.0. However, there are two lash adhesives that stand out with much more acidic pH values of 2.5 (24-E) and 4.0 (36-E), respectively. Tears have a neutral pH of about 7[4], and the majority of the pH values of lash adhesives are generally in the neutral range, around the pH of tears.

The five skin adhesives all have pH values of 3.0 to 5.0. Note, however, that most of these pH values correspond to the skin's pH of approximately 4.5-5.5[5]. The one product that can be used as both skin adhesive and lash adhesive has a pH value of 8.0.

That said, it should be noted that these results are uncertain, partly because determination with pH paper is generally less accurate than determination with a pH electrode and partly because, as mentioned earlier, pH is defined exclusively for aqueous fluids, which not all adhesives are. Even so, these results may still give an indication of possible irritation when using the adhesives. This is especially true for the two nail adhesives with very low pH values. Here, the levels suggest that there may be a risk of irritation or corrosion if the adhesive comes into contact with the skin.

8.2 Semi-quantitative analyses for formaldehyde

A semi-quantitative analysis for formaldehyde release was performed using the so-called CA (chromotropic acid) method. This method is used by the Danish Allergy Research Centre in its own laboratory, as the method provides sufficient data to make a statement about the risk of allergy to formaldehyde. The same screening method was also used in the Danish EPA's "Survey and risk assessment of free formaldehyde in cosmetic products" (Poulsen et al., 2023), which showed a good correlation between the results of the semi-quantitative and quantitative analyses of formaldehyde in selected cosmetic products.

The CA method is a semi-quantitative method that can indicate the result in ranges based on a colour reaction. It was originally described in Contact Dermatitis, 5th edition (2011).

The original CA method outlines a method for identifying formaldehyde concentrations in ranges up to 40 ppm and at a level above 40 ppm. In the analysis conducted in this report, a range of 40-100 ppm is also included. For more precise concentrations or identification of high concentration levels, it is recommended to use a quantitative method to determine the actual concentration of free formaldehyde.

[4] The reference for tears comes from Abelson et al. (1981).

[5] The reference for skin pH is found on this website: Goldwell PH Value

This semi-quantitative method uses a colour reaction to determine if a cosmetic product contains free formaldehyde. If the concentration of free formaldehyde is above 2.5 ppm in the sample, formaldehyde evaporates from the cosmetic product and dissolves in the reagent solution, which is kept separate from the cosmetic product. When formaldehyde reacts with the reagent, a pink colour appears in the reagent liquid. The greater the concentration of formaldehyde in the sample, the more intense the colour of the reagent solution. The colour can range from pink to dark violet.

This screening method is very sensitive to formaldehyde, but other aldehydes can cause cross-reactions that can be observed as a change in colour (discolouration from the pink/violet colour). The intensity of the colour of the reagent liquid is compared with the colours of reference solutions with known formaldehyde content (2.5, 10, 20, 40, and 100 ppm), whereby a semi-quantitative concentration (estimated content based on colour comparison) of formaldehyde in the product can be given in terms of intervals. The reference solutions are prepared from formaldehyde standards whose concentration of formaldehyde is known. A so-called standard addition was performed by adding a known amount of formaldehyde to a selected sample to verify that the method is working.

When using the CA method, it is important to be mindful of the possibility of the introduction of formaldehyde via the ambient laboratory air. For this reason, a laboratory blank was used to ensure that no formaldehyde was drawn in from the environment. The blank was negative, which means that the colour ranges indicate formaldehyde release exclusively from the samples.

For the semi-quantitative analyses of the 32 adhesives for beauty products, the CA method was modified, whereby a reference solution with 100 ppm free formaldehyde was also prepared. This means that the results for free formaldehyde content for the 32 adhesives can be stated in the following intervals:

- < 2.5 ppm
- $2.5 \leq x < 5$ ppm
- $5 \leq x < 10$ ppm
- $10 \leq x < 20$ ppm
- $20 \leq x < 40$ ppm
- $40 \leq x < 100$ ppm
- ≥ 100 ppm

The analysis was carried out by placing a specific weighed amount of an adhesive in a small glass container, which was placed at the bottom of a closed glass flask. A test tube containing the reagent liquid was also placed in the flask. The reagent liquid changed colour by reacting with free formaldehyde as it evaporated from the adhesive. The more intense the colour, the greater the concentration of free formaldehyde.

In this case, the colour of the individual products was read after 48 hours, as the method prescribes, by comparing the colour of each sample with the colours of the prepared reference solutions with known concentrations of formaldehyde. The colour – and thus, the resulting concentration range of free formaldehyde – was assessed by two people. FIGURE 2 shows an image of the prepared reference solutions for the laboratory blank and samples containing < 2.5 ppm to ≥ 100 ppm formaldehyde, as well as five of the samples' colours after 48 hours.

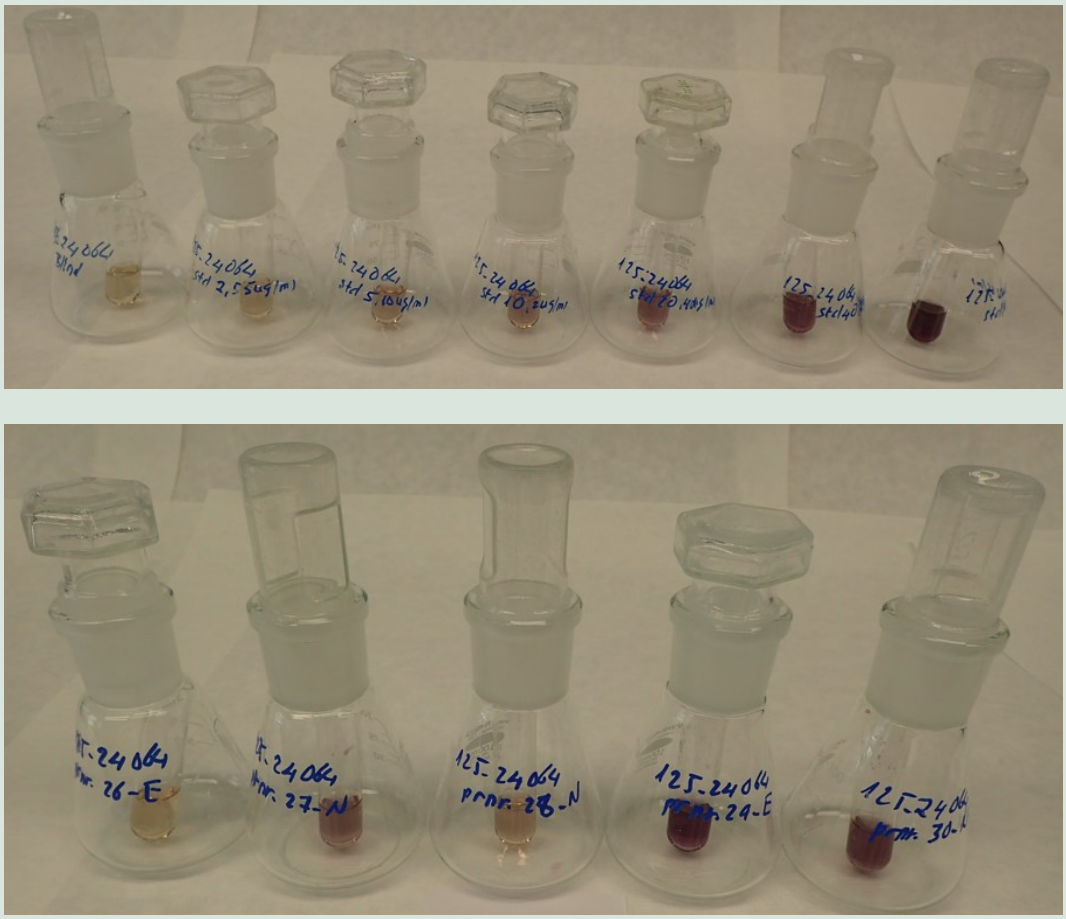

FIGURE 2. Top: An image of the purple colour of the prepared reference solutions for the lab blank and < 2.5 ppm to ≥ 100 ppm formaldehyde after 48 hours. Bottom: An image of five samples after 48 hours. The concentration of formaldehyde can be read by comparing the colour of the samples with that of the prepared reference solutions.

The results of the semi-quantitative analyses for release of formaldehyde using the CA method are given below in TABLE 17. It should be noted that essentially the same amounts of all adhesives were weighed for the CA method, except for the two samples 26-E and 29-E, where approximately 10% and 20% less was weighed, respectively. For these two samples, the estimated amount of formaldehyde released may therefore be underestimated.

TABLE 17. Results for release of formaldehyde by the CA method (semi-quantitative analysis)

Lab no.	Type of adhesive	Estimated amount of formaldehyde released (ppm)
01-N	Nail adhesive	5 ≤ x < 10
02-E	Lash adhesive	< 2.5
05-E	Lash adhesive	< 2.5
06-E	Lash adhesive	10 ≤ x < 20
07-A	Adhesive for face and lashes	< 2.5
08-F	Skin adhesive	< 2.5
09-E	Lash adhesive	< 2.5 (light yellow colour)

Lab no.	Type of adhesive	Estimated amount of formaldehyde released (ppm)
11-N	Nail adhesive	20 ≤ x < 40
12-E	Lash adhesive	< 2.5
13-N	Nail adhesive	< 2.5
15-E	Lash adhesive	< 2.5
16-N	Nail adhesive	20 ≤ x < 40
17-F	Skin adhesive	Discolouration; formaldehyde not reportable due to different colour
18-N	Nail adhesive	> 100
19-N	Nail adhesive	5 ≤ x < 10
20-N	Nail adhesive	40 ≤ x < 100
21-F	Skin adhesive	Discolouration; formaldehyde not reportable due to different colour
22-F	Skin adhesive	< 2.5
23-E	Lash adhesive	< 2.5
24-E	Lash adhesive	40 ≤ x < 100
25-N	Nail adhesive	10 ≤ x < 20
26-E*	Lash adhesive	< 2.5
27-N	Nail adhesive	10 ≤ x < 20
28-N	Nail adhesive	< 2.5
29-E*	Lash adhesive	40 ≤ x < 100
30-N	Nail adhesive	40 ≤ x < 100
31-F	Skin adhesive	Discolouration; formaldehyde not reportable due to different colour
33-E	Lash adhesive	< 2.5
34-N	Nail adhesive	>100
35-E	Lash adhesive	< 2.5
36-E	Lash adhesive	10 ≤ x < 20
37-N	Nail adhesive	40 ≤ x < 100

* It should be noted that for these two samples, approximately 10 and 20% less adhesive was weighed out than for the other products. For these two samples, the amount of formaldehyde released may therefore be underestimated.

Of the 32 adhesives, 13 products released formaldehyde in concentrations above 10 ppm, which is the limit value for labelling cosmetic products with the warning "releases formaldehyde" (cf. Annex V of the Cosmetics Regulation (EU Regulation 1223/2009)). However, the warning "releases formaldehyde" used in the Cosmetics Regulation, only apply for preservatives that releases formaldehyde. It should be noted that product 06-E, for which our reading showed formaldehyde release in the range 10-20 ppm, declares the presence of formaldehyde in its ingredient list. If this adhesive was subject to the Cosmetics Regulation, the use of formaldehyde as an ingredient would not be permitted.

In addition, two out of 32 adhesives released formaldehyde at concentrations above the detection limit (the visible purple colour) of 2.5 ppm, but below 10 ppm.

For three products, all of which are skin adhesives, it was not possible to assess the release of formaldehyde due to discolouration. This was likely caused by the presence of other

aldehydes that reacted with the liquid, resulting in discolouration. All three of these skin adhesives contain some form of resin instead of acrylates.

8.3 Headspace GC-MS screening

A GC-MS screening of all 32 adhesives was carried out to identify volatile chemical substances in the purchased adhesives. The survey of the adhesives based on ingredient lists provided some information about the content of the adhesives, but GC-MS screening was also carried out to investigate whether the purchased adhesives for beauty products contain problematic substances other than (e.g.) acrylates. The GC-MS screening also served to provide input on which substances to perform a risk assessment for in the project.

The GC-MS screening was initially attempted on an extract of the adhesives; that is, different solvents were tested and then analysed via GC-MS. However, it turned out that the high content of some substances in the samples interfered with the analysis to such an extent that there was either insufficient usable data or it was not possible to perform the analysis at all. For that reason, instead of analysing solutions/extracts of these adhesives, headspace analysis was performed. This is a screening of the substances that are released from the adhesive when the sample is heated. Headspace GC-MS is performed by heating a sample in a closed container and analysing the air in the container above the sample (i.e., the headspace). The GC-MS screening is thus an expression of which volatile substances are released from the adhesive when heated slightly to 60°C. Under these conditions, low-volatility substances are likely to be released in only small amounts, if at all.

The choice of how the sample is introduced into the instrument affects which substances are measured and how intense the signals are. Therefore, there is a difference between performing a GC-MS screening on the extract of the adhesives and on what is released from the adhesives when heated slightly. Among other effects, this will likely result in underestimation of low-volatility substances in the headspace analysis (i.e., they will be seen less clearly), as they are likely to be released only in small amounts. Nevertheless, it was decided that the headspace analysis would produce the best picture of the various constituents of the adhesives.

8.3.1 Sample preparation for GC-MS screening

A specific weighed amount of each adhesive was placed in a vial and immediately sealed with a lid. The weighings were within ±10% of the average, except for one sample (29-E) where approximately half the average was weighed out. For this sample, the amount of the different substances, as indicated in + signs, has therefore been adjusted accordingly.

8.3.2 Results of the headspace GC-MS screening

For the GC-MS screening, single determinations were generally made, as this is a screening analysis (a semi-quantitative method of analysis) that only provides information about the presence of the substances, not their exact concentrations. Broadly, we have attempted to identify at least the five largest peaks in the chromatograms for each sample with the help of the NIST (National Institute of Standards and Technology) library and the experience of our specialists. If a substance was identified in one sample, the same substance was searched for in the other samples to the extent that this was possible, resulting in the identification of more than five substances for some samples.

A clear carry-over (i.e., contamination from one sample to another) of acrylates was observed between the individual samples, and therefore blank samples containing no chemical substances were analysed between the individual screening analyses.

Appendix 2 lists the volatile organic compounds identified in the total of 32 analysed adhesives at the product level. In addition, the same appendix (Appendix 2) contains a table listing the

individual substances identified and the samples in which they were identified by headspace GC-MS analysis. The tables indicate with one to four + signs the amount of the substances in the headspace relative to the content of the internal standard in the sample's headspace. For example, four + signs are indicated for the identified acrylates, representing the highest amount found in the headspace of the analysed adhesives. In the tables in Appendix 2, the maximum estimated released "amount", in + signs, is given across the samples from which the substance was released.

With respect to the above, the indication of + signs should not be seen as a direct expression of the concentration of the substance released from the sample, but at best an estimate that makes it possible to compare the amount of the same substance across several samples.

+ corresponds approximately to an estimated concentration released from the sample of < 1/10 of the area of the internal standard
++ corresponds approximately to an estimated concentration released from the sample of between 0.1 and 1 times the area of the internal standard
+++ corresponds approximately to an estimated concentration released from the sample of between 1 and 10 times the area of the internal standard
++++ approximately corresponds to an estimated concentration released from the sample of between 10 and 100 times the area of the internal standard

During the GC-MS screening, a total of 115 unique peaks were seen in the chromatograms of the 32 samples, where each peak in a chromatogram represents an organic substance. Of these 115 substances, 85 were identified by CAS number. Between 2 and 36 substances were measured as emitted from each of the 32 adhesives. For seven of the adhesives, only two substances were measured as released from the adhesive. This is consistent with the fact that most of these adhesives only contained two or three ingredients according to their ingredient lists – and in five cases, two acrylates. For 14 of the adhesives, all substances in the chromatogram were identified; for 17 of the adhesives, there were generally 2–4 substances in each chromatogram that were not identified, but only one of the substances was in the second highest tier (+++) and none of these substances were in the highest tier (++++). In one product (13-N), 36 unique substances were measured in the chromatogram, of which 18 were identified.

In general, it is particularly the lash and nail adhesives, as opposed to the skin adhesives, that release acrylates. This also matches the ingredient lists, as described in section 5.5. Five of the adhesives release a number of substances (fragrances), including limonene, but only two of these adhesives (05-E and 06-E) declared the presence of fragrances.

8.4 Initial hazard assessment of substances from the screening

An initial hazard assessment was performed for the total of 85 substances identified in the GC-MS screening. For these substances, the classification (harmonised and notified classification) was looked up in the ECHA's C&L database. In addition, it was indicated whether each substance:

- is a Seveso substance; that is, whether it is a particularly hazardous substance for which special rules have been adopted regarding the handling of these substances in industrial installations in the EU to prevent accidents
- is on the candidate list (is an SVHC / Substance of Very High Concern)
- or if there are special conditions for the substance listed in the ECHA database

In addition, there were five substances with problematic properties that were declared on the products but were not identified by the GC-MS screening. This may be because the

substances were so volatile or reactive that they evaporated/reacted before measurement, that they are present in too small concentrations relative to how readily they evaporate, or because these substances were not suitable for measurement by means of headspace GC-MS. These five substances were:

- Methanol, declared in one product (22-F)
- BHA, declared in two products (20-N and 27-N)
- Ethyltrimethylbenzoyl phenylphosphinate, declared in one product (13-N)
- Boron trifluoride, declared in one product (18-N)
- Methylparaben, declared in one product (08-F)

TABLE 18 presents a list of selected identified substances with their CAS numbers and how many of the 32 products they were found in. Only substances identified in three or more of the 32 products are listed. In addition, the classifications of the substances are given. The full list of all substances identified in the headspace of the 32 products, along with their classifications and presence on relevant lists, are given in Appendix 2.2.

TABLE 18. Overview of the substances identified via headspace GC-MS screening emitted from the greatest number of the 32 adhesive products. The number of products in which each is present, and the classification of each substance is listed. Substances are listed in descending order of number of products that released them.

CAS no.	Name of substance	Released from no. of prods.	Comment (e.g., info from ECHA)	Harmonised classification	CLH notified classification (majority)
80-62-6	Methyl methacrylate	18	Properties of concern: Skin sensitising	Flam. Liq. 2 (H225) Skin Irrit. 2 (H315) Skin Sens. 1 (H317) STOT SE 3 (H335)	-
7085-85-0	ethyl-2-cyanoacrylate	16		Skin Irrit. 2 (H315), Eye Irrit. 2 (H319), STOT SE 3 (H335): STOT SE 3; H335: C ≥ 10%	-
104-76-7	2-Ethyl-1-hexanol	11		Not classified	Skin Irrit. 2 (H315), Eye Irrit. 2 H319, Acute Tox. 4 H332, STOT SE 3 H335, Aquatic Chronic 3 H412 (44+479 notifiers) Skin Irrit. 2 H315, Eye Irrit. 2 H319, Acute Tox. 4 H332, STOT SE 3 H335 (1106 notifiers) *Other hazards notified: STOT SE 3 H336 (7+4++3 notifiers), Aquatic Chronic 2 (H411) (1 notifier)*
103-09-3	2-Ethyl-1-hexyl acetate	11	Substance included in the Community Rolling Action Plan (CoRAP).	Not classified	Skin Irrit. 2 H315 (1802 notifiers) Not classified (386 notifiers) *Other hazards notified: Eye Irrit. 2 H319 (3 notifiers)*

CAS no.	Name of substance	Released from no. of prods.	Comment (e.g., info from ECHA)	Harmonised classification	CLH notified classification (majority)
71-36-3	1-Butanol	9		Flam. Liq. 3 (H226) Acute Tox. 4 (H302) Skin Irrit. 2 (H315) Eye Dam. 1 (H318) STOT SE 3 (H335) STOT SE 3 (H336)	-
123-05-7	2-Ethylhexanal	8	Properties of concern: A majority of data submitters agree this substance is skin sensitising	Not classified	Flam. Liq. 3 (H226), Skin Sens. 1B (H317), Repr. 2 (H361) (1289 notifiers) Flam. Liq. 3 (H226), Skin Irrit. 2 (H315), Eye Irrit. 2 (H319) (201 notifiers) Flam. Liq. 3 (H226), Skin Sens. 1B (H317), Repr. 2 (H361) (140 notifiers) *Other hazards notified: STOT SE 3 (H335) (57+24 notifiers).*
142-96-1	n-Butyl ether	8	(Dibutyl ether)	Flam. Liq. 3 (H226) Skin Irrit. 2 (H315) Eye Irrit. 2 (H319) STOT SE 3 (H335) Aquatic Chronic 3 (H412)	-
590-01-2	n-Butyl propionate	8		Flam. Liq. 3 (H226)	H226 (>1000 notifiers) H226, H315, H318 (38 notifiers)
103-11-7	2-Ethylhexyl acrylate	7	Properties of concern: Skin sensitising	Skin Irrit. 2 H315, Skin Sens. 1 H317, STOT SE 3 H335	-
547-63-7	Methyl isobutyrate	6	Properties of concern: A majority of data submitters agree this substance is skin sensitising	Not classified	Flam. Liq. 2 (H225) (1709 notifiers) Flam. Liq. 2 (H225), Acute Tox. 4 (H332) (39+4 notifiers) Flam. Liq 3 (H226), Acute Tox. 4 (H302), Skin Irrit. 2 (H315), Skin Sens. 1 (H317) (1 notifier)
15726-15-5	3-Methyl-4-heptanone	5		Not classified	Flam. Liq. 3 (H226) (1 notifier) Flam. Liq. 3 (H226), Skin Irrit. 2 (H315), Eye Irrit. 2a (H319), STOT SE 3 (H335) (1 notifier)

CAS no.	Name of substance	Released from no. of prods.	Comment (e.g., info from ECHA)	Harmonised classification	CLH notified classification (majority)
1632-16-2	2-Ethyl-1-hexene	4		Not classified	Flam. Liq. 3 H226, Skin Irrit. 2 H315, Aquatic Chronic 2 H411, (116 notifiers) Flam. Liq. 2 H225, Asp. Tox. 1 H304, Skin Irrit. 2 H315, Eye Irrit. 2 H319, Aquatic Chronic 2 H411. (1 notifier) *Other hazards notified: STOT SE 3 H335.*
79-92-5	Camphene	4		Not classified	Flam. Sol. 2 H228, Eye Irrit. 2 H319, Aquatic Chronic 1 (H410) (135+13 notifiers) Flam. Sol. 1 H228, Asp. Tox. 1 H304, Eye Irrit. 2 H319, Aquatic Acute 1 H400, Aquatic Chronic 1 (H410) (1288 notifiers) Flam. Sol. 2, Eye Irrit. 2 H319, Aquatic Acute 1 H400, Aquatic Chronic 1 (H410) (404 notifiers)
5989-27-5	D-Limonene	4	Registered under (R)-p-mentha-1,8-diene Properties of concern: Skin sensitising	H410, Flam. Liq. 3 H226, Skin Irrit. 2 H315, Skin Sens. 1B H317, Asp. Tox. 1 H304, Aquatic Acute 1 H400, Aquatic Chronic 3 H412	-
108-88-3	Toluene	4	Properties of concern: Some data submitters indicate they consider this substance as Carcinogenic Some data submitters indicate they consider this substance as Mutagenic Suspected to be Toxic to Reproduction Substance included in the Community Rolling Action Plan (CoRAP). Some uses of this substance are restricted under Annex XVII of REACH.	Flam. Liq. 2 (H225) Skin Irrit. 2 (H315) Asp. Tox. 1 (H304) STOT SE 3 (H336) STOT RE 2 * (H373 **) Repr. 2 (H361d ***)	-

CAS no.	Name of substance	Released from no. of prods.	Comment (e.g., info from ECHA)	Harmonised classification	CLH notified classification (majority)
80-56-8	α-Pinene	4	Properties of Concern: A majority of data submitters agree this substance is Skin sensitising	Not classified	Flam. Liq. 3 (H226), Acute Tox. 4 (H302), Asp. Tox. 1 (H304), Skin Irrit. 2(H315), Skin Sens. 1B(H317), Aquatic Acute 1 (H400), Aquatic Chronic 1 (H410) (137 notifiers) Flam. Liq. 3 (H226), Skin Irrit. 2 (H315), Eye Dam. 1 (H318) (474 notifiers) Flam. Liq. 3 (H226), Asp. Tox. 1 (H304), Skin Irrit. 2 (H315), Skin Sens. 1 (H317), Aquatic Acute 1 (H400), Aquatic Chronic 1 (H410) (392 notifiers) H226, H304, H315, H317 (247 notifiers) *Other hazards notified: H319.*
123-86-4	n-Butyl acetate	3		Flam. Liq. 3 (H226) STOT SE 3 (H336)	-
109-21-7	n-Butyl butanoate	3	Registered as Butyl butyrate	Flam. Liq. 3 H226	-
527-84-4	o-Cymene	3		Not classified	Flam. Liq. 3 (H226) (67 notifiers). Flam. Liq. 3 (H226), Aquatic Chronic 2 H411 (28 notifiers) *Other hazards notified: Acute Tox. 4 H302 (6 notifiers) Skin Irrit. 2 H315 (1 notifier), Eye Irrit. 2 H319 (1 notifier)*
508-32-7	Tricyclene	3	Registered in ECHA as 1,7,7-trimethyltricyclo[2.2.1.02,6]heptane	Not classified	Not Classified (79 notifiers) Aquatic Acute 1 H400, Aquatic Chronic 1 H410 (39 notifiers) Asp. Tox. 1 (H304) (18 notifiers)
1120-21-4	Undecane	3		Not classified	Asp. Tox 1. H304 (1749+286 notifiers) *Other notified hazards: Flam. Liq. 3 H226, Skin Irrit. 2, Aquatic Chronic 4 H413 (13 notifiers), Eye Irrit 2 H319 STOT SE 3 (6 notifiers), Aquatic Acute 1 H400 Aquatic Chronic 1 (1 notifier)*

CAS no.	Name of substance	Released from no. of prods.	Comment (e.g., info from ECHA)	Harmonised classification	CLH notified classification (majority)
127-91-3	β-Pinene	3	Registered in ECHA as Pin-2(10)-ene Properties of concern: A majority of data submitters agree this substance is skin sensitising	Not classified	Flam. Liq. 3 H226, Asp. Tox. 1 H304, Skin Irrit. 2 H315, Skin Sens. 1 H317 (1563 notifiers) Flam. Liq. 3 H226, Asp. Tox. 1 H304, Skin Sens. 1 H317, Aquatic Acute 1 H400, Aquatic Chronic 1 H410 (285 notifiers)

8.5 Selection of substances for risk assessment and quantitative analyses

Based on the initial hazard assessment, three substances were selected for the subsequent quantitative analyses and risk assessment. The three substances were selected from those identified based on the criteria below.

- The substances must be present in many of the analysed products (or released from many products)
- The substances must be classified as skin irritants, eye irritants and/or sensitisers
- Or, the substances must be suspected of sensitising or endocrine-disrupting effects
- Finally, the amount of substance released (as indicated by + signs) was considered; substances which, in the screening, were seen to be released in the greatest amount (++++) were judged to be more significant than substances released in lesser amounts (+).

Based on the GC-MS screening and the results in Appendix 2 and TABLE 18 above, it was assessed that the substances below were the most relevant, as they were released from the most products and in the largest quantities. Their classifications are given in parentheses:

- CAS 71-36-3; 1-Butanol (Skin Irrit. 2) - released from 9 products
- CAS 7085-85-0; ethyl-2-cyanoacrylate (Skin Irrit. 2, Eye Irrit. 2) - released from 16 products
- CAS 104-76-7; 2-Ethyl-1-hexanol (Skin Irrit. 2, Eye Irrit. 2, not yet harmonised) - released from 11 products
- CAS 103-09-3; 2-Ethyl-1-hexyl acetate (Skin Irrit. 2, not harmonised) - released from 11 products
- CAS 123-05-7; 2-Ethylhexanal (not harmonised, but most classify the substance as Skin Sens. 1B and Repr. 2) - released from 8 products
- CAS 103-11-7; 2-Ethylhexyl acrylate (Skin Irrit. 2, Skin Sens. 1) - released from 7 products
- CAS 15726-15-5; 3-Methyl-4-heptanone (most registrants: Skin Sens. 1B) - released from 5 products
- CAS 547-63-7; Methyl isobutyrate (only 1 out of almost 2000 registrants have classified the substance as Skin Sens. 1. ECHA notes "A majority of data submitters agree this substance is Skin sensitising", which must be an error. This substance is not an immediate sensitiser) - released from 6 products
- CAS 80-62-6; Methyl methacrylate (Skin Irrit. 2, Skin Sens. 1) - released from 18 products
- CAS 590-01-2; n-Butyl propionate (flammable classification only, no other classification) - released from 8 products

The substance 2-ethylhexanal (CAS 123-05-7) was excluded despite its notified classification as Skin Sens. 1B and Repr. 2, as the identification of the substance via the NIST library in the GC-MS screening was uncertain, and the substance only appears as a single + in the 8 products from which it was detected. In addition, the substances of concern declared on the products (methanol, BHA, ethyltrimethylbenzoyl phenylphosphinate, boron trifluoride and

methylparaben) were excluded, as they were only declared in one or two of the adhesives each, and were not identified or cannot be identified in the GC-MS screening (see their classifications in TABLE 28 in Appendix 2).

Given the above list of substances present in the greatest numbers of products, it was decided in collaboration with the Danish EPA to focus on a risk assessment of acrylates, as the majority of these are classified as allergenic, and as the other identified substances either do not have equally worrying classifications or were identified in much smaller quantities (fewer + signs) in the GC-MS screening.

It was decided to focus on the three acrylates that were identified partly via the ingredient list on most of the adhesives (ethyl-2-cyanoacrylate) and those identified as released from the greatest number of adhesives (also including ethyl-2-cyanoacrylate); that is, the following three acrylates:

- CAS 80-62-6; Methyl methacrylate (Skin Irit. 2, Skin Sens. 1) - released from 18 products
- CAS 7085-85-0; ethyl-2-cyanoacrylate (Skin Irrit. 2, Eye Irrit. 2) - released from 16 products
- CAS 103-11-7; 2-Ethylhexyl acrylate (Skin Irrit. 2, Skin Sens. 1) - released from 7 products

It was decided to perform quantitative analyses of all three acrylates in all lash adhesives and nail adhesives, 27 products in total. Skin adhesives were excluded, as they contain ingredients other than acrylates according to the survey.

It was furthermore decided in collaboration with the Danish EPA to perform a risk assessment for formaldehyde based on the levels determined by the semi-quantitative CA analysis for formaldehyde. A quantitative analysis of formaldehyde in adhesives for beauty products was deliberately not carried out, partly due to budgetary reasons and partly because it was considered that the semi-quantitative results for formaldehyde release are sufficient to illustrate the problems associated with the release of formaldehyde from adhesives for beauty products.

Finally, it was decided that quantitative analyses of the acrylates should be performed, rather than migration analyses, as the adhesive for beauty products is applied directly to the skin or nails. Thus, in a risk assessment it is the concentration of acrylates in the adhesive that is of interest in relation to the amount of adhesive applied.

9. Quantitative analyses

In collaboration with the Danish EPA, it was decided to perform quantitative analyses on the following three acrylates in all nail adhesives and lash adhesives, representing 27 of the purchased products. Skin adhesives were not included because they do not contain acrylates according to the ingredient lists.

- CAS 80-62-6; Methyl methacrylate
- CAS 7085-85-0; ethyl-2-cyanoacrylate
- CAS 103-11-7; 2-Ethylhexyl acrylate

9.1 Method of analysis and sample preparation

The analytical method used for the quantitative determination of the three acrylates in the adhesives is based on a method described by American Laboratory (2014), which determines various methacrylates in dental filling materials using techniques including GC-MS.

Acrylates are light-sensitive, which is why dark glass (vials) and other shielding from light was used wherever possible. A known quantity of the adhesives was weighed out, and then dichloromethane with internal standard was added. The solvent was added and the lid was closed as quickly as possible to minimise the effect of the adhesive polymerising/curing or the volatile components evaporating. The sample was then placed in an ultrasonic bath for 30 minutes at 30°C, cooled and filtered, and then analysed via GC-MS. Several samples were diluted multiple times before analysis due to high acrylate content, and for several samples, several different amounts were weighed due to low content of some acrylates and high content of others. Due to the consistency of the adhesives, their content, and their tendency to harden, a relatively large amount of solvent was required in relation to the amount of sample weighed. Despite low detection limits for the three acrylates in solution, the high degree of dilution gives us high detection limits in the samples (see below).

The analytical method determines the amount of acrylates dissolved/extracted from the sample when dichloromethane is added directly after weighing the sample. During sample preparation, it can be seen that the adhesive swells or the solution becomes cloudy for most adhesives. The fact that the adhesives partially harden or do not fully dissolve means that for some of the samples, there may be a relatively large difference between the duplicate determinations. It is not known whether any hardened adhesive could encapsulate some of the measured acrylates, which then would not be extracted in dichloromethane, but from the results in TABLE 19 below, it can be seen that in several cases it must be all or almost all ethyl-2-cyanoacrylate that is measured in the sample.

At a minimum, true duplicate determinations were performed for the quantitative analyses. In addition, two times five duplicate determinations were performed for the control with known acrylate content (i.e., 10 low-level controls and 10 high-level controls), and we investigated possible degradation of the substances, evaluated the linearity of the curve in the measurement range, measured detection limits, used blanks, and performed standard addition of a known quantity of acrylates to selected samples. The detection limit for the three acrylates – methyl methacrylate, ethyl-2-cyanoacrylate and 2-ethylhexyl acrylate – was determined to be 130, 235 and 30 mg/kg, respectively, for the minimum weighed sample amount. Due to expected low content of either methyl methacrylate or 2-ethylhexyl acrylate, some samples were weighed out at up to 5x larger sample quantities to ensure the content was within the measuring range. The detection limits for the three substances at the maximum weighed amounts

were determined to be 25, 45 and 5 mg/kg, respectively. As the maximum amount was not weighed for all samples, the stated detection limits and quantification limits vary in TABLE 19. The uncertainty of the analyses was 19%, 33% and 15% at low concentrations and 33%, 34% and 24% at high concentrations of the three acrylates. These uncertainties are increased by the carry-over seen during the analysis (see section below). It should be noted that uncertainties of between 20 and 30% are common in chemical analyses, and so the measured uncertainties are considered satisfactory, especially in light of the measurement challenges.

Due to clear carry-over of acrylates and some other interfering substances between individual chromatograms, some samples were analysed several times, and several solvent samples were analysed between samples to minimise the effect of this carry-over. Where the carryover could not be sufficiently mitigated, the detection limit is therefore higher for some samples.

In general, the recovery of the controls was too high (between 188% and 207%). This means that the content of the added acrylate in the control samples was generally overestimated. A similar situation holds for the standard addition performed. The reason for this is unclear. Despite repeated attempts and investigations, this could not be resolved. As the recovery results were consistent, the results listed TABLE 19 below were therefore adjusted for the increased recovery (i.e., approximately halved). It is therefore possible that the actual content of the samples is higher than indicated.

9.2 Results of the quantitative analyses for acrylates

The results of the quantitative analyses for the three acrylates are listed in TABLE 19 below. The results are an average of the determinations performed.

TABLE 19. Results of the quantitative analyses of the three acrylates in nail adhesives and lash adhesives. Note that the content of ethyl-2-cyanoacrylate in some cases is given in % (in bold) and not in mg/kg, like the other two acrylates, due to much higher content. Nail adhesives are listed first, followed by lash adhesives.

Lab no.	Product type	Content of methyl methacrylate (mg/kg)	Content of ethyl-2-cyanoacrylate (mg/kg unless otherwise stated)	Content of 2-ethylhexyl acrylate (mg/kg)
01-N	Nail adhesive	666	**63%**	< 15
11-N	Nail adhesive	2230	**77%**	< 30
13-N	Nail adhesive	< 130	< 235	94
16-N	Nail adhesive	788	**77%**	< 45 (b)
18-N	Nail adhesive	1500	**69%**	< 30 (b)
19-N	Nail adhesive	1090	**57%**	< 30
20-N	Nail adhesive	1290	**74%**	< 30
25-N	Nail adhesive	994	**85%**	< 15
27-N	Nail adhesive, set with nails	1870	**93%**	< 30
28-N	Nail adhesive	1350	**87%**	< 15
30-N	Nail adhesive	1380	**83%**	< 15 (b)
34-N	Nail adhesive	1210	**74%**	< 30
37-N	Nail adhesive	738	**100%**	< 30
02-E	Adhesive for lashes	< 65	< 120	220
05-E	Adhesive for lashes	< 130	< 235	< 30

Lab no.	Product type	Content of methyl methacrylate (mg/kg)	Content of ethyl-2-cyanoacrylate (mg/kg unless otherwise stated)	Content of 2-ethylhexyl acrylate (mg/kg)
06-E	Adhesive for lashes	< 130	< 235	< 30
07-A	Adhesive for face and lashes	< 130	< 235	238 (a)
09-E	Adhesive for lashes	< 65	< 120	204
12-E	Adhesive for lashes	< 25 (c)	< 45	26
15-E	Adhesive for lashes	25-75	< 45	345
23-E	Adhesive for lashes	25-75	< 45	24
24-E	Adhesive for lashes	3200	**90%**	< 15 (b)
26-E	Adhesive for lashes	130-385	< 235	30-85
29-E	Adhesive for lashes	25-75	< 45	91 (a)
33-E	Adhesive for lashes	< 25	< 45	5-15
35-E	Adhesive for lashes	< 25 (c)	< 45	38
36-E	Adhesive for lashes	< 130 (c)	< 235	305 (a)

(a) This is a possible false positive identification. It is unclear from the screening whether this is the actual substance or another very similar compound with almost the same retention time and ions.

(b) The detection limit is elevated due to disturbances in the chromatogram.

(c) A small signal is visible, but below the detection limit.

It can be seen from TABLE 19 that ethyl-2-cyanoacrylate is identified in by far the highest concentrations. This is consistent with the fact that it is the only one of the three acrylates listed on the products' ingredient lists. The ingredient lists have been reviewed in relation to the results of the quantitative analyses, and in all cases where ethyl-2-cyanoacrylate is listed on the ingredient list (often simply as 'ethyl cyanoacrylate), the substance is identified in large quantities (percentage level) in the quantitative analysis. Here, there is 100% agreement between the quantitative analyses and the information on the ingredient lists of the products. ethyl-2-cyanoacrylate was identified in 13 of the 27 nail and lash adhesives, and in amounts ranging from 57.0% to 100%. In the remaining 14 products, ethyl-2-cyanoacrylate was not identified in amounts above the detection limits for those products.

The identified amounts of ethyl-2-cyanoacrylate between 57% and 100% are consistent with the safety data sheets identified in the survey for both nail and lash adhesives containing ethyl-2-cyanoacrylate (see TABLE 7), where examples of content of this acrylate between 60% and 100% were found.

As indicated in TABLE 18, ethyl-2-cyanoacrylate has a harmonised classification as Skin Irrit. 2 (H315), Eye Irrit. 2 (H319) and STOT SE 3 (H335) at concentrations ≥ 10%. As the lowest concentration of ethyl-2-cyanoacrylate was 57% in the adhesives in which the substance was identified, these adhesives should be hazard-labelled, given that transparent adhesives, as stated in section 2.3 "CLP", are subject to the CLP Regulation. Of the 13 adhesives with a content of ethyl-2-cyanoacrylate identified by the quantitative analyses, 12 of them were labelled with the "warning" hazard symbol (exclamation mark). Product 24-E was not hazard-labelled, but it was labelled as "hypoallergenic" and it contains approximately 90% ethyl-2-cyanoacrylate. In addition, product 18-N did not have a hazard label on the product itself, but a hazard label was affixed to the outer packaging.

The acrylate methyl methacrylate was identified above the detection limit in 17 of the 27 adhesives in concentrations between 25 and 3200 mg/kg (corresponding to up to 0.3%). In eight of

the adhesives, polymethyl methacrylate was listed as an ingredient. In these cases, methyl methacrylate was identified at levels above 700 mg/kg. However, methyl methacrylate has also been identified in ten products where polymethyl methacrylate is not on the ingredient list (01-N, 11-N, 15-E, 18-N, 19-N, 23-E, 26-E, 29-E and 34-N). That said, there is no clear pattern regarding the listed acrylate on the ingredient lists of these ten products and the presence of methyl methacrylate.

2-ethylhexyl acrylate was identified in 12 of the 27 adhesives above the detection limit. 2-ethylhexyl acrylate was the acrylate identified in the lowest amounts, between 5 and 345 mg/kg.

Altogether, there were only two adhesives out of 27 (05-E and 06-E) in which the three acrylates tested for were not identified above the respective limits of detection. This is consistent with the fact that these two particular adhesives did not contain acrylates according to their ingredient lists. These two lash adhesives both contain the ingredients 'rubber latex' and 'cellulose gum', among others.

However, despite challenges with the quantitative analysis of the acrylates, the results are consistent with the substances listed on the ingredient lists of the analysed products.

10. Adhesive weighing tests

For the risk assessment and exposure scenarios, weighing tests were carried out with individual adhesives to obtain data on how much a drop of adhesive weighs. The weighing tests were carried out on a total of five different adhesives, for both artificial nails and lashes. Because a variety of adhesives were chosen, some adhesives were more viscous than others.

A total of ten weighing trials were performed for each of the five adhesives due to expected large fluctuations in the measurements. The results of all weighings, as well as averages of all 10 measurements, are given in TABLE 20 below. The weighings were performed on an analytical balance with a precision of 0.1 mg.

TABLE 20. Weighing tests for one drop of adhesive performed with five different adhesives for artificial nails and lashes. Ten weighings were performed per adhesive.

Lab no.	**15-E***	**12-E**	**30-N**	**34-N**	**18-N**
Comments	Transferred via glass pipette	Transferred via glass pipette	Thin liquid, dripped from packaging	Thin liquid, dripped from packaging	Viscous, blob deposited with spatula
Unit of measurement	**mg**	**mg**	**mg**	**mg**	**mg**
Measurement no. 1	13.7	21.3	15	19	3.5
Measurement no. 2	17.7	18.1	15.7	24.7	4
Measurement no. 3	16.9	20.6	15.9	21.2	4.2
Measurement no. 4	16	22.6	15.4	20	4.6
Measurement no. 5	16.4	18.7	14.5	20.1	4.5
Measurement no. 6	17.1	19.5	15.7	19.8	5.7
Measurement no. 7	17.2	19.8	16.1	19.7	4.4
Measurement no. 8	17.9	19.2	15.6	20	4.5
Measurement no. 9	16.7	19.6	15.6	19.8	3.9
Measurement no. 10	17	20.1	12.6	19.5	3.5
Average	**16.7**	**20.0**	**15.2**	**20.4**	**4.3**
Minimum value	**13.7**	**18.1**	**12.6**	**19**	**3.5**
Highest value	**17.9**	**22.6**	**16.1**	**24.7**	**5.7**

* The product is applied with a brush, which is why a glass pipette was used to weigh out the adhesive

As shown in TABLE 20, for the five different adhesives, one drop of adhesive weighs between 3.5 mg and 24.7 mg. There is varying uncertainty within the ten measurements of each

adhesive. The viscous adhesive does not form drops; it was deposited using a spatula, resulting in greater uncertainty for the measurement result. The uncertainty of the ten measurements for each type of adhesive is between 15% and 35%. However, the uncertainty between the individual adhesives is greatest. This is because there are major differences in the viscosity of the adhesives and how it was possible to get the adhesives out of their packaging. We found that for some adhesives, a drop could easily be deposited via the tube or supplied applicator, while other adhesives could hardly be squeezed out of the tube. The fact that the adhesives had to be deposited in different ways thus had a major impact on the droplet sizes.

If worst-case considerations are to be used for the risk assessment, it would be relevant to use the highest measured value for the five adhesives, which was 25 mg for one drop of adhesive. However, it should be noted that the weighings above used laboratory equipment available for weighing experiments, such as a pipette and spatula, which consumers do not necessarily have on hand. It is therefore not inconceivable that some consumers may use much larger amounts of adhesive in situations where the adhesive is both thin (runny) or viscous (must be squeezed out, and comes out suddenly in large quantities).

Conversely, for nail adhesives, it is primarily the nail edge that is exposed to the adhesive, as the nail itself acts as a barrier for the adhesive against the skin. This means that a larger amount of adhesive is needed on the nail for the nail edge to be exposed.

In the experience of the project group and their immediate family members, far more nail adhesive is typically used to fix artificial nails in place compared to the amount of lash adhesive needed to fix artificial lashes in place. There is no information from the survey to confirm this, and this was not asked in the user survey as it was not expected that users would be able to state quantities used in a consistent manner. The amount of adhesive used is discussed further in the next chapter (chapter 11, "Exposure scenarios").

11. Exposure scenarios

These exposure scenarios are realistic worst-case usage scenarios that take into account the expected uses of the products. Here, we have chosen to focus on the most frequent uses of the adhesives, namely in connection with the application of artificial eyelashes, nails and nail tips. That said, these adhesives can also be used to apply decorative items directly to the skin, including on the face and other parts of the body.

The exposure scenarios focus only on private, individual users, not professionals.

11.1 Application of adhesive to artificial eyelashes

As indicated in FIGURE 3, adhesive is applied to artificial lashes by dipping them into a small amount of adhesive. After dipping, the artificial lashes are applied along the margin of the eyelid. The method of dipping into a small dab of adhesive applied to the back of the hand is also recommended for use by private individuals applying individual lashes[6].

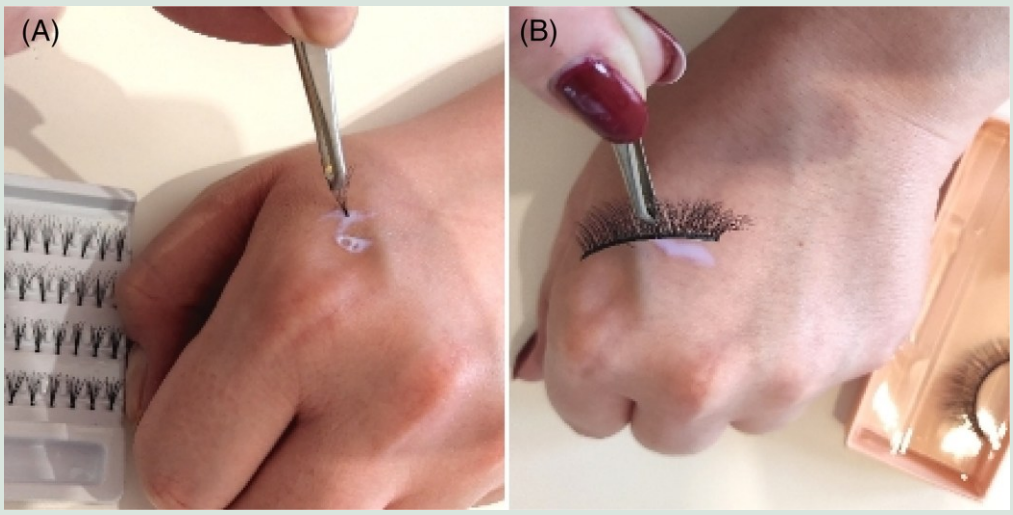

FIGURE 3. A shows the application of "cluster" eyelash extensions, while B shows eyelash bands. The adhesive is squeezed out onto the back of the hand, and tweezers are then used to dip the lashes in the adhesive. In the case of nail and hair technicians, adhesive may be left on the hand all day long. If gloves are used, the breakthrough time for the type of gloves typically used is less than 10 minutes (Symanzik et al., 2022).

You can also find instructions for private individuals on the internet that recommend applying a thin line of adhesive to the lash line, then placing artificial lashes as close to one's own as possible. Finally, an "eyelash applicator" is used to apply pressure and fix the artificial lashes in place, in contact with the natural lashes.

In doing so, the adhesive may come into contact with the edge of the upper eyelid. However, the adhesive is not meant to be in contact with the skin, only with the user's natural lashes,

[6] https://www.matas.dk/stories-falske-oejenvipper

according to some instructions. Some sites on the internet specify a distance of 0.2-0.5 mm away from the skin. Others state that the false eyelashes should be in contact with the skin to avoid the risk of pulling out one's natural eyelashes when removing the artificial ones. Regardless, we can assume that in many cases, the adhesive will come into contact with the skin. The area is estimated to be a maximum of 0.9 cm^2 per eyelid based on previous measurements of false eyelashes (3.5 cm × 0.25 cm) (Poulsen et al., 2025).

The eyelash scenario assumes that 2 drops of adhesive are used per eye. Based on the results of the weighing experiments in chapter 10, a drop of adhesive is assumed to weigh approximately 25 mg, which means that in an eyelash context, 50 mg of adhesive is used per eyelid contact surface, measuring 0.9 cm^2. This corresponds to 55 mg adhesive/cm^2.

11.2 Applying artificial nails and nail tips

There are various tutorials on the internet in video and text form alike, intended for both professionals and private individuals.

Typically, one drop of adhesive is applied to the centre of one's own nail, and one more is applied to the underside of the artificial nail or tip. Some instructions recommend applying a thin layer of nail adhesive to one's natural nails before attaching an artificial nail. When applying tips, some tutorial recommend applying adhesive to the transition between the tip and the nail to make the transition less visible. Readers are warned against using too much adhesive. Doing so can cause the adhesive to spread onto the skin surrounding the nail. The area of skin surrounding a fingernail is estimated to be 1 mm^2. In the case of an inexperienced user, the adhesive could cover as much as a 0.5 mm radius all the way around the nail, with a perimeter of about 36 mm (assuming nails of about 9 mm in length on all four sides; i.e., an area of 36 mm^2).

Based on this information, for our nail scenario, we assume that too much adhesive – 4 drops – will be used. If we assume that half that amount (i.e., 2 drops) will come into contact with the skin, rather than the nail alone, this results in exposure of 2 drops per 36 mm^2.

Based on the results of the weighing experiments in chapter 10, a drop of adhesive is assumed to weigh about 25 mg, so in our nail scenario, we have 50 mg / 36 mm^2. This corresponds to 1.4 mg/mm^2 or 140 mg/cm^2.

11.3 Inhalation

For the inhalation scenario, we assume exposure to 20 drops of adhesive distributed in the air near the breathing zone, approx. 1 m^3. 20 drops of adhesive weigh approx. 500 mg, based on the weighing experiments. This is a worst-case scenario as specified in the SCCS Notes of Guidance (SCCS, 2023) for the assessment of the breathing zone.

12. Hazard assessment

The hazard assessments aim to clarify whether there are toxicological effects relevant to the exposure scenarios. Data obtained from oral exposure are also included, as this data provides insight into what happens if a substance is absorbed into the body through the skin or lungs.

The goal of a hazard assessment is to find a measure of tolerable exposure to the substance based on the critical effect, which is the toxicological effect observed at the lowest dose at which the respective effects occur.

Either a NOAEL/NOAEC value or a Tolerable Daily Intake, DNEL or similar is specified.

The hazard assessments will be used in risk assessments for hazard characterisation – an assessment of whether the critical hazard can be expected to occur under the conditions described in the exposure scenarios.

The following four substances have been selected for hazard and risk assessment:

- CAS no. 50-00-0 Formaldehyde
- CAS no. 80-62-6 Methyl methacrylate (released by 18 products)
- CAS no. 103-11-7 2-Ethylhexyl acrylate (released by 7 products)
- CAS no. 7085-85-0 Ethyl 2-cyanoacrylate (released by 15 products)

For descriptive and hazard assessment purposes, data on these four substances were sourced from:

1. Substance assessments from EU scientific committees, such as SCHEER, SCCS, RAC, EFSA, etc.
2. Substance assessments by other international and national expert committees, such as the WHO, IPCS, IARC, US EPA, RIVM, BfR, etc.
3. ECHA data for the substances, including data from REACH registrations of the substances
4. Previous assessments in the Danish EPA's project reports, if any
5. Any available US FDA or EMA (European Medicines Agency) data on the substances in relation to their use in medical devices
6. Web-based searches on Google / Google Scholar and PubMed, PubChem and the CIR (Cosmetic Ingredient Review) database

12.1 Hazard assessment for formaldehyde

This hazard assessment is based on previous assessments of formaldehyde, including EFSA's assessment of formaldehyde as a preservative in food (EFSA, 2006), the Danish EPA's LOUS report on formaldehyde (Andersen et al., 2014), the SCCS' opinion on formaldehyde in nail hardeners (SCCS/1538/14, 2014) and a number of other sources. The most recent hazard assessment of formaldehyde, carried out as part of the Danish EPA's survey of free formaldehyde in cosmetic products, serves as a basis for this hazard assessment. The primary endpoints in this case are sensitisation and allergic reactions (elicitation) (Poulsen et al., 2023).

12.1.1 Identification, classification and physicochemical parameters

Formaldehyde is a small molecule with the simple molecular formula CH_2O. Formaldehyde is a gas at room temperature, and in air it photooxidises into carbon dioxide. The half-life is

estimated to be approximately one hour (WHO, 2010). The physicochemical parameters of formaldehyde are described in TABLE 21 below.

TABLE 21. The physico-chemical parameters for formaldehyde (ECHA, 2021)

Chemical name	Formaldehyde
Synonyms	Methyl aldehyde, formalin, methanal
CAS no. / EC no.	50-00-0 / 200-001-8
Molecular formula	CH_2O
Molecular mass	30.031 g/mol
Physical state (at 20°C)	Colourless gas
Density	0.815 - 1.12 g/cm³ @ -80 – 20°C
Melting point	-118.3°C
Boiling point (at 1013 hPa)	-21°C
Steam pressure (at 20°C)	2.6 hPa
Octanol-water partition coefficient (log KOW) (at 25°C)	0.35
Water solubility (at 20 °C)	High water solubility, 550 g/litre
Solubility in ethanol (at 30°C)	Is soluble

Formaldehyde has the following harmonised classification (ECHA C&L, 2025):

- Acute Tox 4; H302 "Harmful if swallowed"
- Skin. Corr. 1B; H314 "Causes severe skin burns and eye damage"
- Skin Sens. 1A; H317 (for concentrations "C" ≥ 0.2%) "May cause an allergic skin reaction"
- Acute Tox 2; H330 "Fatal if inhaled"
- Muta. 2; H341 "Suspected of causing genetic defects"
- Carc. 1B; H350 "May cause cancer"

The occupational exposure limit for formaldehyde is 0.3 ppm or 0.37 mg/m^3 (8 hours). The short-term limit value is 0.6 ppm or 0.74 mg/m^3. Formaldehyde has the annotation EK, meaning that for occupational contexts, the substance has an EU-established limit value (E) and is carcinogenic (K). The substance also has a skin sensitisation annotation (Statutory Order 1356, 2025).

According to the Cosmetic Products Regulation (1223/2009), formaldehyde per se is not authorised for use in cosmetic products, but certain formaldehyde releasers are allowed on the condition that the maximum theoretical release is less than 0.1% (1000 ppm). There is also a provision that cosmetic products must be labelled with the warning "releases formaldehyde" if the total concentration of formaldehyde released by the finished product exceeds 0.001% (10 ppm) and if the product contains preservatives (formaldehyde releasers) listed on Annex V of the Cosmetic products Regulation. According to the REACH (1907/2006) and CLP (1272/2008) regulations, no carcinogenic substances above a given concentration limit (established per substance) may be added to chemical mixtures marketed for consumer use. For formaldehyde, according to entry 28 of Annex XVII of REACH, a maximum concentration of 0.1% (1000 ppm) of formaldehyde may be added to mixtures marketed to consumers. This applies to formaldehyde, but not to formaldehyde releasers.

12.1.2 Absorption and distribution

Formaldehyde is a so-called endogenous metabolite; that is, formaldehyde is formed naturally in the body. Formaldehyde is thus present in considerable concentrations within the body. EFSA (2014) estimated the endogenous turnover of formaldehyde to be approximately 0.61-0.91 mg/kg bw per minute and 878-1310 mg/kg bw/day assuming a half-life of 1-1.5 min.

Compared to formaldehyde metabolism and background levels of formaldehyde from food sources (1.4-1.7 mg/kg BW/day for a 60-70 kg person), the relative contribution of exogenous formaldehyde from consumption of animal products (milk and meat) - from animals exposed to formaldehyde-treated feed - is negligible (< 0.001 %). Upon exposure, formaldehyde reacts with the contact site, and so systemic absorption is not expected through dermal exposure, oral exposure or inhalation. There is no evidence of systemic toxicity or a systemic target organ following long-term exposure to formaldehyde (WHO, 2010). The classifications of formaldehyde as Carc. 1B and Muta. 2 are due to changes at the actual point of contact by inhalation, where there is a risk of nasal cancer.

12.1.3 Acute and chronic effects

Skin contact

In case of skin contact, the allergenic effect of formaldehyde is considered to be the critical effect (Larsen et al., 2021). The critical effect is the effect seen at the lowest concentration.

Eye contact

Eye irritation is the critical effect of exposure to formaldehyde in the air, as it is the effect seen at the lowest concentrations of formaldehyde. Therefore, occurrences of eye irritation are assumed to provide a margin of safety in relation to irritation-induced cytotoxicity (toxicity to cells) and cell proliferation (cell division), which occur only at higher formaldehyde concentrations. According to the WHO (2010), sensory irritation (increased frequency of eye blinking) is observed at levels of 0.38 mg/m^3, listed as a NOAEC value – although it is effectively a LOAEC value, as the differences between unobserved (NOAEC) and lowest observed adverse effects (LOAEC) were negligible.

Ingestion

Based on animal experimental data, the WHO (2005) and EFSA (2006) established a NOAEL of 15 mg/kg BW/day based on a long-term rat study with dosing via drinking water, as higher exposure levels resulted in effects on the mucous membrane of the stomach. Based on this, the WHO (2005) and EFSA (2006) established a Tolerable Daily Intake (TDI) value of 0.15 mg/kg BW/day using an uncertainty factor of 100 for intraspecies and interspecies variation.

Inhalation

The SCCS assesses formaldehyde's respiratory irritant and carcinogenic effects as the most important inhalation effects (SCCS/1538/14, 2014). ECHA (2019) states in their substance evaluation report for formaldehyde that the substance is shown to be carcinogenic in inhalation when exposure exceeds a certain threshold value. Here, 0.1 mg/m^3 is set as a tolerable exposure level for humans without risk of a carcinogenic effect and irritation of the eyes and respiratory tract. This value was originally set by WHO in 2010 as an indicative limit value for indoor air, as indicated above. ECHA (2019) also states that the value of 0.1 mg/m^3 covers long-term local effects in the form of respiratory irritation, sensory irritation and cancer.

Sensitive persons may smell formaldehyde at concentrations down to 0.03 mg/m^3 (WHO, 2000). The NOAEC (No Observed Adverse Effect Concentration) for eye and nose irritation (collectively termed "sensory irritation") is set at 0.38 mg/m^3 (WHO, 2010). Based on this NOAEC value, the WHO has set a guideline limit value of 0.1 mg/m^3 for the maximum 30-minute average exposure in indoor air (WHO, 2000).

Levels for sensory irritation of the respiratory tract are somewhat higher than for the eyes. No systemic absorption of formaldehyde has been reported, and systemic effects such as cancer from dermal exposure are considered unlikely, as formaldehyde rapidly reacts with the mucosal surface upon exposure and is thus no longer available for systemic intake (Andersen et al., 2014; ECHA, 2020).

According to ECHA (2020), long-term animal studies (subchronic studies with rats and mice) have shown nasal tumours when exposed to formaldehyde at concentrations of 7.45 mg/m^3 and above for six hours per day for five days per week. The RAC (Committee for Risk Assessment) has concluded that the formation of tumours in the nose is concentration-dependent and that a concentration of 2.5 mg/m^3 should be considered the lowest value (LOAEC) at which the first signs of tumour formation are seen. A formaldehyde concentration of 1.24 mg/m^3 can be considered as NOAEC for cell division leading to the formation of tumours in the nose (nasal cancer). While the value of 0.1 mg/m^3 has been proposed for a reduction by the ECHA in 2020 in the context of an updated assessment (ECHA, 2020), the RAC concludes that the original studies on which this value is based contain too few observations and too much variation in the data. Thus, the RAC suggests using other studies, leading to a proposed limit value of 0.05 mg/m^3 instead of basing it on a NOAEL value set at 0.37 mg/m^3 for sensory irritation (ECHA, 2020).

12.1.4 Critical effect and exposure limit

Allergy is the critical effect of formaldehyde by dermal exposure.

Most cases of formaldehyde allergy detected in persons where contact dermatitis is suspected can be associated with the use of cosmetics (DeGroot, 2010). Thus, as a rule, this allergic reaction may be considered to be caused by the levels of free formaldehyde present in cosmetic products.

After a longer investigation and use of two models, Poulsen et al. (2023) conclude that overall, the calculated sensitisation levels in leave-on products applied to the face and/or body with the hands are in the range of 110-165 ppm by use of the so-called QRA method for risk assessment. However, the QRA method requires a daily use. Once sensitised, a lower dose is usually sufficient to induce an attack, known as elicitation. After reviewing the data, Poulsen et al. (2023) concluded that the lowest reported elicitation level for formaldehyde in a cream is between 130 and 200 ppm when used for a short time (1-2 weeks) on normal skin, and 2.5-10 ppm formaldehyde when used on eczematous (pre-irritated) skin for up to four weeks. Due to the uncertainties associated with the use of formulated products, the values in µg/cm^2 of skin have been omitted. However, the elicitation from exposure to formaldehyde releasers in face creams is calculated to be 0.05-0.57 µg/cm^2.

For diagnostic patch testing, a concentration of 2% in water is used (Mose et al., 2025).

For inhalation, the NOAEC value of 0.37 mg/m^3 can be used for sensory irritation (more frequent eye blinking), and the NOAEC value of 7.45 mg/m^3 for development of nasal cancer (Poulsen et al., 2023).

In the ECHA summary (ECHA, 2025) the following limit values are given for exposure of the general population:

- Inhalation, systemic effects, long-term: (DNEL) 3.2 mg/m^3
- Inhalation, local effects, long-term: (DNEL) 100 µg/m^3
- Dermal exposure, systemic effects, long-term: (DNEL) 102 mg/kg bw/day
- Skin exposure, local effects, long-term (72 timer): (DNEL) 12 µg/cm^2 (critical effect: skin sensitisation)
- Oral exposure, systemic effects, long term: (DNEL) 4.1 mg/kg bw/day

No short-term hazards have been identified. These limit values would have to be used if a risk assessment of these products were to be conducted under the general chemicals legislation, rather than the cosmetics legislation.

12.2 Hazard assessment for methyl methacrylate

Methyl methacrylate (MMA) is a monomer used to make polyacrylate, a type of plastic. Besides nail and lash adhesives, MMA is used in other adhesives and sealants, inks and toners, car care products, air fresheners, paints, coatings and perfumes. MMA is used in some dental products, such as dentures and mouth guards.

In 2002, the EU conducted a comprehensive risk assessment of MMA with Germany as the reporting country (EU, 2002). This risk assessment has been used as a starting point.

12.2.1 Identification, classification and physicochemical parameters

TABLE 22. Physical and chemical parameters of methyl methacrylate (MMA), (EU, 2002)

Chemical name	Methyl methacrylate
Synonyms	methyl 2-methylprop-2-enoate; Methyl methacrylate; methacrylic acid, methyl ester; MMA
CAS no. / EC no.	80-62-6 / 201-297-1
Density	0.944 g/cm³ @ 20°C
Molecular formula	$C_5H_8O_2$
Molecular mass	100.12 g/mol
Physical state (at 20°C)	Liquid
Melting point	–48°C @ 101.3 kPa
Boiling point	100.36°C @ 101.325 kPa
Vapour pressure	30–100 hPa @ 16.67–39.4°C
Octanol/water partition coefficient (log KOW)	1.32–1.38 @ 20°C and pH 7
Water solubility	15.3 g/L @ 20°C and pH 7
Solubility in ethanol (at 30°C)	Mixable
Odour threshold	0.208–1.4 mg/m3 (0.05–0.34 ppm) (EU, 2002)

MMA has the following harmonised classification (ECHA C&L, 2025):

- Flam. Liq. 2; H225 "Highly flammable liquid and vapour"
- STOT SE 3; H335 "May cause respiratory irritation"
- Skin Irrit. 2; H315 "Causes skin irritation"
- Skin Sens. 1B; H317 "May cause an allergic skin reaction"

12.2.2 Absorption, distribution, metabolism and excretion

Experience from dermal exposure among dental technicians shows that MMA can be absorbed through the skin and excreted in the urine (Rajanemi et al. 1989).

No data have been found on the absorption of MMA by inhalation among animals or humans. It is thought that MMA is distributed and metabolised like other aliphatic esters; that is, they are hydrolysed in the nasal epithelium to the corresponding acid and alcohol, in this case methacrylic acid and methanol. These metabolites are further oxidised to CO_2, which is excreted in exhaled air. Only small amounts of MMA are excreted in the urine (Voss JU, 2017).

12.2.3 Acute and chronic effects

Skin contact

As early as 1957, Fisher et al. reported four cases of dermatitis and inflammation of the nail folds and skin around the nails in patients with artificial nails. A fifth case had a severe reaction

to MMA, which included swelling, redness, pain, paraesthesia (numbness, etc.) in the fingers, and loss of the fingernails. After 6 years, the nails had still not grown back and the patient was still suffering from swelling and **paraesthesia** in the fingertips. In view of these cases, occupational cases, tests on animals, and other data, MMA is considered a skin sensitiser – in other words, it is possible to develop an allergy to MMA (EU, 2002).

The sensitising effects of MMA have been found in a local lymph node assay (LLNA) in mice according to OECD 429 (ECHA, 2025a).

Skin allergy cross-reactions have been observed with glycidyl methacrylate, ethyl methacrylate, hydroxyethyl methacrylate, and (iso)propyl methacrylate (EU, 2002). It is unknown whether patients with acrylate allergy have an increased risk of developing contact reactions in the oral cavity during dental work where acrylate is typically used. One patient with a severe acrylate allergy had seven fillings replaced without a reaction (Danish Allergy Centre, 2016). In a study from 2023, a total of 360 patients with discomfort in and around the mouth were examined, and ten (2.8%) were found to have a reaction to MMA. Of these ten, eight were found to have clinical relevance in relation to dental treatment. Tests for numerous other methacrylates were also found to be clinically relevant (Al-Gawahiri et al., 2023). Forkel et al. (2024) state that allergic contact dermatitis to MMA is significantly more frequent amongst patient with already experienced contact allergic reactions in the mouth cavity in relation to dental treatments compared to patients without. We can thus conclude that sensitisation to methacrylates may imply some risk of reaction to dental treatments using methacrylate-based polymers.

In a Spanish study (Roche et al., 2008) of 15 patients (14 cosmetologists and one client) with symptoms of contact dermatitis on the fingertips and hands, five (33.3%) were diagnosed with contact allergy to MMA. The remaining cases were attributable to other methacrylates.

In a Swedish population of 131 dental technicians with contact dermatitis, 15% were found to react to MMA (Wrangsjö, 2001).

There are sufficient relevant studies showing no evidence of mutagenic or carcinogenic effects (EU, 2002).

Inhalation

Acute occupational exposure to high concentrations in the air tends to result in respiratory irritation in a proportion of those exposed. Late-onset asthmatic cases have also been observed (EU, 2002).

12.2.4 Critical effect and exposure limit

Destruction of the olfactory epithelium in the nose of rats is considered the critical effect. In a rat study, a NOAEC of 104 mg/m^3 was found (Lomax, 1992; Lomax et al., 1997; U.S. EPA, 1998). However, the odour threshold of 0.208–1.4 mg/m^3 (0.05–0.34 ppm) should serve as a warning against reaching such high concentrations. MMA has a strong and characteristic fruity odour (EU, 2002).

From a 2-year inhalation study on rats with six hours of exposure a day for five days a week, a NOAEC of 25 ppm (100 mg/m^3) was found for local effects on the respiratory tract, while the NOAEC for systemic effects was 100 ppm (400 mg/m^3) (EU, 2002).

When ingested through drinking water in a 2-year study with rats, a NOAEL of 2000 ppm was found in drinking water (equivalent to 200 mg/kg bw/day) (EU, 2002).

In ECHA's summary (ECHA, 2025a) the following limit values for exposure of the general population are given:

- Inhalation, systemic effects, long-term: (DNEL) 74.3 mg/m^3
- Inhalation, local effects, long term: (DNEL) 104 mg/m^3; short-term: 208 mg/m^3
- Dermal exposure, systemic effects, long-term: (DNEL) 8.2 mg/kg bw/day
- Dermal exposure, local effects, long- and short-term: (DNEL 1.5 mg/cm^2 (critical effect: skin sensitisation)
- Oral exposure, systemic effects, long-term: (DNEL) 8.2 mg/kg bw/day

12.3 Hazard assessment for 2-ethylhexyl acrylate

This substance is a monomer typically used in the manufacture of polymers, including plastics, paints and adhesives.

12.3.1 Identification, classification and physicochemical parameters

TABLE 23. Physical and chemical parameters of 2-ethylhexyl acrylate (ECHA, 2025b)

Chemical name	2-Ethylhexyl acrylate
Synonyms	2-ethylhexyl prop-2-enoate (IUPAC); Acrylic acid, 2-ethylhexyl ester
CAS no. / EC no.	103-11-7 / 203-080-7
Density	0.88 @ 20°C
Molecular formula	$C_{11}H_{20}O_2$
Molecular mass	184.27 g/mol
Physical state (at 20°C)	Liquid
Melting point	-90°C
Boiling point	215°C @ 101.3 kPa
Vapour pressure	24 Pa @ 25°C
Octanol/water partition coefficient (log KOW)	4 @ 20°C
Water solubility	9.6 mg/L @ 25°C
Odour threshold	0.02 mg/L (PubChem)

Ethylhexyl acrylate has the following harmonised classification (ECHA C&L, 2025):
- STOT SE 3; May cause respiratory irritation
- Skin irrit. 2; Causes skin irritation
- Skin sens. 1; May cause an allergic skin reaction

12.3.2 Absorption, distribution, metabolism and excretion

ECHA (2025b) assumes an oral and inhalation absorption of 100%, while dermal absorption is set at 10%.

12.3.3 Acute and chronic effects

2-ethylhexyl acrylate (2-EHA) is not considered genotoxic or carcinogenic. Subacute and sub-chronic studies in rats and rabbits have not shown effects on fertility (ECHA, 2025b).

However, skin tumours have been observed in experiments on C3H/HeJ mice after treatment with high and highly irritating concentrations of 2-EHA. This suggests that 2-EHA may be carcinogenic by a non-genotoxic mechanism, whereby persistent irritation leads to inflammation, tissue damage and possibly wound repair, the latter of which is inhibited in the mouse strain used. At doses below the maximum tolerated dose, no tumour development was observed (Murphy et al., 2018).

2-EHA has shown weak to moderate dermal sensitising potential in the LLNA test in mice (EC3 = 9.7%–18.96%; 2425–4740 µg/cm^2). In various earlier tests in guinea pigs, 2-EHA also showed sensitising potential both with and without adjuvant. 2-EHA could also be predicted to be a skin sensitiser from a battery of in vitro tests clarifying the mechanism of action (ECHA, 2025b).

A PubMed search for examples of human sensitisation involving 2-EHA yielded few results. 2-EHA is thus associated with two cases of allergy to medical devices: one in the form of patches for transdermal drug administration (Navarro-Trivino and Ruiz-Villaverde, 2020) and one in the form of adhesive in tape for holding a wig against the scalp (Torchia et al., 2008).

12.3.4 Critical effect and exposure limit

The ECHA (2025b) lists 'no hazard identified' in the summary of DN(M)ELs for the general population for 2-ethylhexyl acrylate. For occupational use, the DNEL for local effects is 38 mg/m^3, where the critical effect is respiratory irritation, both short- and long-term.
In a subchronic oral study in rats, a NOAEL of 357 mg/kg bw/day was found.
In a subchronic study of dermal exposure in mice, a NOAEL of 4.5 mg/cm^2 was found, with local skin effects as the critical effect (ECHA, 2025b).

Skin sensitisation is considered a 'medium hazard' according to the ECHA's REACH guidance with no derived threshold value provided. The LLNA studies in mice gave an EC3 value of at least 2425 µg/cm^2 – a moderately potent allergen (ECHA, 2025b), and this is the value used for risk categorisation.

12.3.5 Other

Under 'additional information' in the registration dossier, the following text appears: "*The monomer 2-Ethylhexyl acrylate is not intended to be used as such or in a mixture in consumer products*."

12.4 Hazard assessment for ethyl 2-cyanoacrylate

Cyanoacrylates are found in adhesives that need to cure quickly, including products marketed as "instant glues". Cyanoacrylate adhesives are used for bonding a wide variety of materials, including wood, metal, and plastic – as well as artificial eyelashes and nails. In addition, there are cyanoacrylate adhesives for wound edges and adhesives for attaching medical sensors.

12.4.1 Identification, classification and physicochemical parameters

TABLE 24. Physical and chemical parameters of ethyl 2-cyanoacrylate (ECHA, 2025c)

Chemical name	Ethyl 2-cyanoacrylate
Synonyms	Ethyl 2-cyanoacrylate (IUPAC) ethyl 2-cyanoprop-2-enoate; 2-Propenoic acid, 2-cyano-, ethyl ester; Cyanoacrylate; ethyl cyanoacrylate
CAS no. / EC no.	7085-85-0 / 230-391-5
Density	1.043 g/cm3
Molecular formula	$C_6H_7NO_2$
Molecular mass	125.13 g/mol
Physical state (at 20°C)	Liquid
Melting point	-31°C
Boiling point	214°C @ 100.3 kPa
Vapour pressure	21 Pa @ 20°C
Octanol/water partition coefficient (log KOW)	0.776 @ 22°C and pH 6.3

Water solubility	24 µg/L @ 20°C and pH 6.6
Odour threshold	0.31 ppm (PubChem)

Ethyl 2-cyanoacrylate has the following harmonised classification (ECHA C&L, 2025):

- STOT SE 3; H335 (C≥10%) "May cause respiratory irritation"
- Skin Irrit. 2; H315 "Causes skin irritation"
- Eye Irrit. 2; H319 "Causes serious eye irritation"

12.4.2 Absorption, distribution, metabolism and excretion

Ethyl 2-cyanoacrylate polymerises rapidly in contact with water and is therefore not expected to be absorbed through the skin or gastrointestinal tract.

12.4.3 Acute and chronic effects

Cyanoacrylates have been identified as skin sensitisers in a number of cases reported in the literature (PubChem, 2025). For example, Constandt et al. (2005) found that out of 27 patients in contact with artificial nails, including 16 nail technicians and 11 customers, all had eczema of varying degrees on different parts of the body, such as around the nails and on the face. One of seven who were tested with ethyl cyanoacrylate reacted to the substance.

Out of 16 patients with suspected contact dermatitis induced by a wound adhesive, 81% reacted to ethyl cyanoacrylate. Eight of the patients reacted exclusively to ethyl cyanoacrylate. Cross-reactions and simultaneous reactions to methacrylates and acrylates have been observed (Bianchetti et al., 2025).

Using a patch test, a 48-year-old woman with itchy, red and swollen eyelids was found to be allergic to ethyl 2-cyanoacrylate and a number of methacrylates. The allergy was traced to the adhesive for her artificial eyelashes, which contained ethyl 2-cyanoacrylate (Shanmugam and Wilkinson, 2012).

12.4.4 Critical effect and exposure limit

The ECHA (2025c) lists a DNEL for both occupational users and the general population at 9.25 mg/m^3 by inhalation, with respiratory irritation being the critical effect.

No threshold value for induction or elicitation of contact allergy to ethyl 2-cyanoacrylate has been found. For diagnostic patch testing, a concentration of 10% in petroleum jelly is used (Shanmugam and Wilkinson, 2012).

13. Risk assessment

In this chapter, the calculated exposure for each of the four selected substances is compared to their DNEL values. As skin exposure will be greatest in the nail scenario, we consider it first. Given that there may be cross-allergy between the three hazard-assessed acrylates, the risk of reaction to these is calculated both individually and collectively.

The calculation for the risk characterisation ratio, RCR, is

$$\text{RCR} = \frac{\text{calculated exposure (substance A)}}{DNEL\ (substance\ A)}$$

13.1 Risk characterisation for formaldehyde

13 of the 32 adhesives release formaldehyde in amounts corresponding to more than 10 ppm (i.e., 10 mg/kg or 0.01 µg/mg).

The DNEL is 12 µg/cm^2 (critical effect: skin sensitisation, local effects, 72 timer) (ECHA, 2025). Inhalation, local effects, long-term: (DNEL) 100 µg/m^3 (ECHA, 2025).

It should be noted that the used DNEL-values from ECHA (2025) for formaldehyde are valid for long term exposure (72 hours), whereas exposure to formaldehyde by use of beauty product adhesives will be for a shorter exposure time.

Nail edges

In the nail scenario, the exposure to adhesive is 140 mg/cm^2. Thus, the exposure to formaldehyde is 1.4 µg/cm^2.

$$\text{RCR} = \frac{1{,}4\ \mu g/cm^2}{12\ \mu g/cm^2} = 0.1$$

As the RCR is below 1, there is no immediate risk of sensitisation posed by formaldehyde in the adhesives that release amounts corresponding to 10–85 ppm.

18-N and 34-N release formaldehyde at concentrations above 100 ppm (i.e., 0.1 µg/mg). The exposure from these is 14 µg/cm^2.

For these two adhesives, the RCR is greater than 1 and there is a risk of sensitisation.

For all adhesives with concentrations above 10 ppm, there is a risk of elicitation of an already acquired formaldehyde allergy. The higher the formaldehyde content, the higher the risk that people who have already developed an allergy to formaldehyde will have an allergic reaction (Poulsen et al., 2023).

Inhalation

Inhalation from 20 drops of adhesive, totalling 500 mg, can be calculated at 50 µg/m^3 given a concentration of 100 ppm formaldehyde (0.1 µg/mg) and an inhalation zone of 1 m^3.

$$\text{RCR} = \frac{50\ \mu g/m^3}{100\ \mu g/m^3} = 0.5$$

This means that the concentration of formaldehyde in the adhesive must reach at least 200 ppm before irritation of the respiratory tract is possible. Since the exposure is also short-term and the frequency is less than daily, the risk of respiratory irritation associated with formaldehyde from the adhesive is considered low.

Eyelids

For the eyelash scenario, an RCR can be calculated as follows for exposure to adhesive containing more than 100 ppm formaldehyde (0.1 µg/mg): 55 mg adhesive/cm^2 releases 5.5 µg formaldehyde/cm^2.

$$\text{RCR} = \frac{5{,}5\ \mu g/cm^2}{12\ \mu g/cm^2} = 0.5$$

This means that the risk of sensitisation is low, although there is a risk of eliciting an already existing formaldehyde allergy.

13.2 Risk characterisation for methyl methacrylate

18 of the 32 adhesives released methyl methacrylate (MMA).

The DNEL is 1.5 mg/cm^2 (critical effect: skin sensitisation).

Nail edges

In the nail scenario, the exposure to adhesive is 140 mg/cm^2. The highest concentration of MMA found in a nail adhesive is 2230 mg/kg in product 11-N. This corresponds to 2230/10^6 = 0.00223 mg MMA/mg adhesive. In 140 mg of adhesive, there are thus 140 × 2.23 µg = 312.2 µg MMA/cm^2

$$\text{RCR} = \frac{312{,}2\ \mu g/cm^2}{1500\ \mu g/cm^2} = 0.2$$

This means that the greatest concentration of MMA found in a nail adhesive does not pose any risk of sensitisation. In an already sensitised person, exposure to this concentration could elicit an allergic reaction with skin symptoms.

Eyelids

In the eyelash scenario, the exposure is 55 mg adhesive/cm^2. Adhesive no. 24-E, intended for eyelashes, has the greatest measured content of MMA at 3200 mg/kg adhesive. This corresponds to 3200/10^3 = 3.2 µg MMA/mg adhesive. In 55 mg adhesive/cm^2, there are thus 176 µg MMA/cm^2.

$$\text{RCR} = \frac{176\ \mu g/cm2}{1500\ \mu g/cm2} = 0.1$$

As the RCR is one-tenth of 1, there is no risk of sensitisation with MMA in the eyelash scenario, even if using the eyelash adhesive with the highest concentration recorded.

Inhalation

Inhalation from 20 drops of adhesive, totalling 500 mg, can be calculated at 1.6 mg MMA/m^3 at the highest concentration recorded of 3200 mg MMA/kg adhesive and an inhalation zone of 1

m^3. As this is far below the DNEL (inhalation, systemic effects, long-term) of 74.3 mg/m^3 for MMA, no health risk in terms of systemic effects can be expected, even with daily use.

13.3 Risk characterisation for 2-ethylhexyl acrylate

No DNEL for sensitisation has been derived. However, the LLNA study in mice gave an EC3 value of 2425 µg/cm^2 – in other words, a moderately potent allergen (ECHA, 2025b). This value (2 mg/cm^2) will be taken as a DNEL in the absence of other usable data.

Nail edges

In the nail scenario, the exposure to adhesive is 140 mg/cm^2. The highest concentration of ethylhexyl acrylate found in a nail adhesive is in product 13-N, with a concentration of 94 mg/kg adhesive. This yields a dose of 13 µg ethylhexyl acrylate/cm^2.

$$\text{RCR} = \frac{13\ \mu g/cm^2}{2425\ \mu g/cm^2} = 0.005$$

With an RCR far below 1, the risk of sensitisation to ethylhexyl acrylate can be expected to be extremely small. In an already sensitised person, exposure to this concentration could elicit an allergic reaction with skin symptoms.

Eyelids

In the eyelash scenario, the exposure is 55 mg adhesive/cm^2. The highest concentration of 2-ethylhexyl acrylate found in an eyelash adhesive is in product 15-E, which contains 345 mg of 2-ethylhexyl acrylate/kg adhesive. This yields a dose of 19 µg/cm^2.

$$\text{RCR} = \frac{19\ \mu g/cm^2}{2425\ \mu g/cm^2} = 0.007$$

Thus, even in the eyelash scenario, the risk is extremely low. Once again, in an already sensitised person, exposure to this concentration could elicit an allergic reaction with skin symptoms.

Inhalation

Inhalation from 20 drops of adhesive, totalling 500 mg, can be calculated at 0.1725 mg 2-ethylhexyl acrylate/m^3 at the highest concentration recorded, 345 mg/kg, with an inhalation zone of 1 m^3.

For occupational use, the DNEL for local effects is 38 mg/m^3, where the critical effect is respiratory irritation, both short- and long-term. This level, as the calculation indicates, is one that private consumers cannot achieve.

13.4 Risk characterisation for ethyl-2-cyanoacrylate

No threshold value for induction or elicitation of contact allergy to ethyl 2-cyanoacrylate has been found. In diagnostic patch testing, a concentration of 10% in petroleum jelly is used.

This means that all adhesives containing 10% or more will trigger reactions in already sensitised individuals. The quantity sufficient to sensitise a person is unknown.

Inhalation

The DNEL for both occupational users and the general population is 9.25 mg/m^3 by inhalation, with respiratory irritation being the critical effect.

A single nail adhesive, product 37-N, consists of 100% ethyl-2-cyanoacrylate. Inhalation of 20 drops of adhesive, totalling 500 mg, in an inhalation zone of 1 m^3 could theoretically lead to an inhalation air concentration of 500 mg/m^3. This could result in respiratory irritation. To get below 9.25 mg/m^3, the concentration of ethyl-2-cyanoacrylate must be below 1.8% (18,000 mg/kg). As the concentration is much higher in all 13 products for which this substance was measured, all of these products may cause respiratory irritation. This is especially true if, for example, several people are together in a poorly ventilated space, such as friends in a single room.

13.5 Overall risk characterisation for the three acrylates

Since the hazard assessments of the three acrylates indicate that it is likely that cross-reactions are possible to some extent in those already sensitised to one type of acrylate, we calculate here whether the RCR exceeds 1 for sensitisation with combined exposure. For example, this could occur when using a nail adhesive and an eyelash adhesive on the same day. However, it can easily be seen that the RCR for MMA (methyl methacrylate) and 2-ethylhexyl acrylate cannot reach 1, even if the RCRs for nail exposure and eyelid exposure are added together.

Another possibility is that adhesives with a combined composition of the three considered acrylates could lead to an overall exceedance of the sensitisation risk level. However, since the DNEL for sensitisation for cyanoacrylate is unknown, this calculation can only be performed for adhesives containing both MMA and 2-ethylhexyl acrylate.

The combined RCR can be calculated as a weighted sum of the two, as follows:

$$RCR_{comb} = \frac{\text{calculated nail exposure (subst. A)}}{DNEL\ (subst.\ A)} + \frac{\text{calculated nail exposure (subst. B)}}{DNEL\ (subst.\ B)}$$

$$+ \frac{\text{calculated eye exposure (subst. A)}}{DNEL\ (subst.\ A)} + \frac{\text{calculated eye exposure (subst. B)}}{DNEL\ (subst.\ B)}$$

For example, one might choose a combination of products 13-N (nail adhesive) and 15-E (lash adhesive).

TABLE 25. Content of methyl methacrylate (MMA) and 2-ethylhexyl acrylate in 13-N and 15-E

	Content of methyl methacrylate (A) (mg/kg)	Content of 2-ethylhexyl acrylate (B) (mg/kg)
13-N	<130	94
15-E	75	345

$$RCR_{comb} = \frac{18{,}2\ \mu g/cm^2}{1500\ \mu g/cm^2} + \frac{13{,}2\ \mu g/cm^2}{2425\ \mu g/cm^2} + \frac{4{,}1\ \mu g/cm^2}{1500\ \mu g/cm^2} + \frac{19\ \mu g/cm^2}{2425\ \mu g/cm^2} = 0.03$$

It can be seen from the calculation above that the combined RCR is still far below 1, and that the risk of sensitisation is therefore also very low.

13.6 Discussion of the risk assessment

Two adhesives, 18-N and 34-N, release formaldehyde at a concentration above 100 ppm (i.e., 0.1 µg/mg). For these two adhesives, the RCR is greater than 1 and there is a risk of

sensitisation. For these two adhesives, no risk of irritation of the respiratory tract has been demonstrated at an inhalation zone of 1 m^3. However, if the user has their nose close to the adhesive in a non-ventilated room, respiratory irritation may still occur. This is especially true if several people are receiving nail services at the same time.

Considering realistic worst-case scenarios with exposure of eyelids and nail edges, no risk of sensitisation to either formaldehyde or the three acrylates was noted for adhesives other than 18-N and 34-N, even when the acrylates are combined in individual products or when it is assumed that adhesive is used on both the nail edges and the eyelids. Even so, this does not exclude the possibility that people who are already sensitised may react to the adhesives. Such sensitisation could be caused by inappropriate use of products (e.g. use on large areas of the skin), exemplified by the application of adhesive to the back of the hand.

It should also be noted that the REACH registration for the substance 2-ethylhexyl acrylate does not foresee the use of the substance in direct-to-consumer products. Consequently, the registrant did not prioritise providing data that could be used to calculate a limit value for sensitisation of individual consumers. For cyanoacrylate, there is also a lack of data for a consumer sensitisation threshold, though this project shows that it could be relevant to compute one.

Some adhesives contain high concentrations of cyanoacrylate. These adhesives may irritate the respiratory tract in environments without point extraction ventilation, such as typical private usage environments. Although cyanoacrylates can cause contact allergies, no threshold value for sensitisation has been found to which the levels in question here can be compared.

However, recent literature indicates that the incidence of allergic reactions when using artificial nails is on the rise, especially in the wake of the development of UV-curing gels and polishes. Do-it-yourself kits are contributing to this rise due to a lack of experience among their users. Contact allergy occurs mainly due to the continuous release of unpolymerised and allergenic monomers of (meth)acrylates in the artificial nails and dust produced during filing. Symptoms occur between two and four months, or even up to 16 months, after the first applications. Cyanoacrylates can cause eczema on the fingertips and eyelids. Toxic reactions in the form of severe paraesthesia (numbness, etc.), white fingers (pseudo-Raynaud's syndrome) and permanent nail loss have been observed. This is thought to be due to the toxic effect of acrylates on nerve fibres (Scheers et al., 2024).

Thus, although this project cannot demonstrate a risk of sensitisation associated with the individual acrylates in the analysed products, this problem still exists. The problem could be due to consumption patterns other than those assumed in the exposure scenarios, misuse of the products, careless application, application alongside many other users of a product, etc. There is also the possibility that sensitisation and/or irritation caused by formaldehyde or cyanoacrylate results in sensitisation to the other acrylates one may be exposed to when using these adhesives.

14. Discussion and conclusion

The conclusions of this report are based on the results of the survey, the purchased transparent adhesives and the chemical analyses performed in this project. The overall results of the project, and its uncertainties and limitations, are discussed further in this chapter.

14.1 Selection of adhesives purchased for the study

The adhesives purchased for chemical analyses in this project were selected based on the survey conducted in the project and input from a user survey.

The user survey conducted was a small-scale, questionnaire-based user survey on the use of beauty product adhesives among consumers (primarily young people under the age of 25), for which a total of 161 complete responses were received. Only this small-scale user survey was conducted, partly for budgetary reasons, but also out of consideration for the project's timeline, as the results of the survey were to be used to decide which products to purchase for the chemical analyses.

As the user survey was both small-scale and targeted to users of beauty product adhesives, it does not provide a representative sample of the population, but rather illustrates some trends for consumers who use beauty product adhesives. The survey was disseminated via FORCE Technology's intranet to FORCE Technology employees and their friends and family, and via social media from the accounts of the Danish EPA, the Danish Consumer Council (Forbrugerrådet TÆNK) and FORCE Technology. The user survey is thus also influenced by the nature of followers of these accounts.

Despite the limitations of the user survey, some of the trends from the survey responses were still used in relation to where beauty product adhesives are purchased (primarily in Danish stores and on Danish websites), which types of adhesives are most commonly used (nail and lash adhesives), and which brands and products are typically purchased. These trends of actual purchases by users were backed up by the survey of adhesives available on the market. For instance, many of the products/brands identified in the user survey had already been identified in the market survey. The results of the user survey were used to assess which specific brands and types of products to purchase. The Danish Consumer Council's Kemiluppen app served as a source of supplementary data on which adhesives are scanned the most by consumers in the app. This input from the market survey, combined with results of the questionnaire-based user survey, provided an overview of the adhesives that seem to be used the most – both in terms of specific brands and the distribution between nail, lash and skin adhesives.

The focus was primarily on beauty product adhesives on the Danish market – partly due to the results of the user survey, but also because it was assessed that this is a relatively cheap class of products in which consumers cannot save much money by shopping on foreign websites. As a result, only a few products were purchased in the EU, and only one from outside the EU; the rest were products from Danish websites or Danish stores.

A more comprehensive survey of the general Danish population's use of adhesives for beauty products could very well have produced a different picture, but it is believed that the smaller user survey in combination with the results of the market survey gave a good overview of the products purchased by Danish consumers.

14.2 Discomfort and irritation when using adhesives

A literature search was conducted, which showed that several instances of discomfort and allergic reactions have been reported from both lash adhesive and nail adhesive; meanwhile, it was not possible to identify studies on discomfort when using skin adhesive. However, it should be noted that it was generally not stated in the literature whether the adhesives in question were transparent or coloured.

The occurrence of discomfort when using beauty product adhesives was confirmed by the small-scale user survey. A total of 15% of the respondents in the user survey reported experiencing discomfort on one or more occasions when using beauty product adhesives. In addition, 17% of the respondents knew someone who had experienced discomfort or an allergic reaction when using beauty product adhesives. It should be noted that a relatively large proportion of respondents reported either experiencing discomfort when using beauty product adhesives or knowing someone who has experienced it, but it is conceivable that consumers who have experienced discomfort may have been more inclined to complete the questionnaire than consumers who have not had such an experience.

That said, the results of the user survey are supported by information from the Danish Allergy Centre and Asthma-Allergy Denmark, which were contacted in connection with the project. These institutes reported receiving inquiries from consumers with allergic reactions to adhesives for artificial nails.

The pH value of the purchased adhesives was measured on moistened pH paper, despite the fact that not all adhesives are aqueous solutions and the water content in some of the adhesives is not particularly high. These pH measurements should therefore be treated only as a guide, but they may still give an indication of the possibility of irritation when using the adhesives. The pH measured on moist pH paper corresponds approximately to the pH to which (moist) skin is exposed when applying a product such as artificial eyelashes.

The fact that some adhesives had a very acidic pH value of 1.5, 2.0 or 2.5 (both nail and lash adhesives) means that there may be a risk of irritation when using these adhesives. According to the rules for the classification of chemical mixtures, mixtures with a pH value ≤ 2 are considered to be corrosive to skin. This means that two nail adhesives, 13-N and 18-N, can be considered potentially corrosive, and that there may be a risk of skin irritation or burns when using these two nail adhesives. It is also important to note that exposure to sensitising substances such as acrylates, formaldehyde and methacrylates on irritated skin can lead to a higher risk of sensitisation and allergic reactions.

14.3 Ingredients in transparent adhesives

The survey showed that acrylates are the main ingredient in most nail and lash adhesives. Skin adhesives, on the other hand, contain other ingredients with adhesive film-forming properties, such as various resins. The absence of acrylates may be related to the lack of reports of discomfort associated with the use of skin adhesives. Water or an alcohol is typically used as a solvent. In water-based adhesives, a preservative is often used. In most cases, this is phenoxyethanol, but other preservatives are also used. A few of the adhesives contain fragrances, but this is not typical.

This report has focused primarily on acrylates due to their allergenic properties. Although some preservatives and fragrances may also be allergenic, this was not investigated further in the report. This is partly because, as the chemical analyses show, acrylates are present at much higher concentrations than any possible preservatives and fragrances.

Information from industry associations and safety data sheets confirmed the resulting overview of ingredients in adhesives identified in the survey of products on the market. The overall impression of the contents of transparent adhesives was thus confirmed by several sources, reinforcing the validity of the study's results.

In the course of the survey, several ingredients of concern were observed in some adhesives, including toluene, BHA and boron trifluoride:

Toluene (CAS 108-88-3) was released by a few (four) of the adhesives in the chemical analyses (headspace GC-MS screening): two nail adhesives, one skin adhesive and one lash adhesive. These were very low levels (below approximately 10 ppm) released from heated samples. Toluene is classified as toxic to reproduction (Repr. 2; H361d (Suspected of damaging the unborn child)). According to the Cosmetic Products Regulation (EU Regulation 1223/2009), toluene is restricted in cosmetic products due to its classification as Repr. 2[7], but may be used in nail products at concentrations up to 25% according to Annex III of the Cosmetic Products Regulation. This means that skin adhesives and lash adhesives containing toluene are not allowed according to the Cosmetic Products Regulation, but nail adhesives containing it are allowed due to the exception mentioned. For transparent adhesives, which fall under the REACH Regulation, toluene is not permitted in adhesive substances (presumably including the adhesives in the study) in chemical mixtures for consumer use at concentrations above 0.1% (1000 ppm) (EU Regulation 1907/2006, Annex XVII No. 48).
In this particular case, the REACH Regulation provides better consumer protection than the Cosmetic Products Regulation – but only for nail adhesives. For skin adhesives and lash adhesives, the Cosmetic Products Regulation offers better consumer protection. Nonetheless, it should be noted that toluene was only identified as being released from a few of the adhesives, and only in very small amounts, at levels far below 0.1%.

BHA (butylhydroxyanisole, CAS 25013-16-5) was identified as an ingredient via ingredient lists in two different nail adhesives. BHA has a notified classification as Carc. 2; H351 (Suspected of causing cancer) and Repr. 2; H361 (Suspected of damaging fertility or the unborn child). BHA is also listed on list III on EDlist.org[8]; that is, it is considered to have endocrine-disrupting properties by one of the national authorities behind EDlist.org. BHA is not prohibited by the Cosmetic Products Regulation, as it has only notified classifications as Carc. 2 and Repr. 2. The SCCS has assessed the use of the substance in cosmetics, but has not proposed any ban or restriction. Similarly, BHA is not restricted via the REACH Regulation in transparent adhesives.

Boron trifluoride (CAS no. 7637-07-2) has a harmonised classification as corrosive (Skin Corr. 1A; H314 (Causes severe skin burns and eye damage) and Acute Tox. 2; H330 (Fatal if inhaled). Boron trifluoride was observed in one nail adhesive. It should be noted that according to the Cosmetic Products Regulation, Annex II, entry 191, "hydrogen fluoride, its normal salts, its complex compounds and hydrofluorides" may not be used in cosmetic products. However, boron trifluoride is not restricted in transparent adhesives by the REACH Regulation. For this substance, consumers would be better protected if the adhesive was covered by the Cosmetic Products Regulation.

[7] The prohibition applies to intentional addition; the substance is allowed if present unintentionally, in the form of impurities and the like (Article 17 of the Cosmetic Products Regulation).

[8] EDClist.org is a website launched by Belgium, Denmark, France, the Netherlands and Sweden in 2020 with the aim of providing information about the current status of substances identified as or suspected to be endocrine disruptors in the EU.

The screening analyses performed for formaldehyde release confirm what is also described in the literature: namely, that nail adhesives may release formaldehyde. Formaldehyde is both classified (harmonised classification) as carcinogenic (Carc. 1B, H350 (May cause cancer)) and allergenic (Skin Sens. 1, H317 (May cause an allergic skin reaction)). In this project, formaldehyde release above 10 ppm was detected in four lash adhesives and nine nail adhesives using a semi-quantitative analysis method, which in a previous project on formaldehyde release from cosmetic products showed good agreement with the levels determined by quantitative analyses. In the semi-quantitative analysis method, a colour reaction is possible in the presence of aldehydes other than formaldehyde, but this results in a discolouration (to a different colour entirely), which also occurred for three of the analysed products. It is expected that a positive result in this screening analysis for the release of formaldehyde means that the product actually releases formaldehyde at a concentration close to the indicated concentration range.

This means that there may be a risk of elicitation (i.e., allergic reaction) amongst consumers who have already developed an allergy towards the substance when using these adhesives. In addition, two nail adhesives released formaldehyde at concentrations above 100 ppm, which entails a risk of sensitisation (i.e., the development of an allergy) to formaldehyde. According to the Cosmetic Products Regulation, formaldehyde release must be declared on a product if it occurs at a concentration above 10 ppm and if it contains a formaldehyde releaser (listed on Annex V), whereas the limit value for transparent adhesives is 0.1%, corresponding to 1000 ppm (the generic limit for carcinogenic substances) under the REACH Regulation, as formaldehyde is listed in Appendix 2 (see section 2.2 on the "REACH Regulation

14.4 Allergy risk of selected ingredients

The exposure scenarios used in this report are based on data obtained from the user survey and various tutorials and instructions on the internet in the form of videos, adverts, and text. In general, realistic worst-case exposures have been assumed, taking into account that these products are used by private consumers and not professionals. However, there is potential for large variations in exposure when consumers use these products, especially amongst novice users.

The exposure scenarios presented focused on the most common uses of the adhesives, namely for artificial eyelashes and/or artificial nails. However, there may also be cases where larger amounts of adhesive and larger areas of skin are used if the adhesives are used to attach decorations to the body.

With the exception of two adhesives, no risk of sensitisation was found with either formaldehyde or the assessed acrylates, even when the acrylates are combined in single products, or when it is assumed that adhesive is applied to both the nail edges and the eyelids. However, it should be noted that ethyl-2-cyanoacrylate could not be assessed for sensitisation potential due to a lack of data. Even so, this does not exclude the possibility that people who are already sensitised may react to the adhesives. Such sensitisation could have been caused by inappropriate use of products (e.g., use on large areas of the skin).

Two nail adhesives released formaldehyde at concentrations above 100 ppm, which poses a risk of sensitisation (i.e., development of an allergy) to formaldehyde.

However, it should be noted that for 2-ethylhexyl acrylate and ethyl 2-cyanoacrylate, there is insufficient data to establish a limit value for sensitisation and that the risk assessment is therefore somewhat uncertain. In addition, two of the nail adhesives were observed to have a very low pH value (as shown by the effect of the adhesive on moistened pH paper), which means that they would have to be classified as corrosive if they were aqueous mixtures. This

could increase the risk of sensitisation in the case of simultaneous exposure to sensitising substances. Although there is no quantitative measure for it, corrosivity may serve as a kind of adjuvant, increasing the immune system's response to exposure to allergens.

Furthermore, the registrant of 2-ethylhexyl acrylate states that the substance is not intended for use in products marketed to general consumers, which may explain why more studies have not been conducted to provide insight into the risk of sensitisation.

There is a possibility of cross-reaction between the different methacrylates and acrylates. Consequently, once a person has been sensitised to one type, that person may also have a reaction to other types.

14.5 Discussion of legislation the products are subject to

Transparent adhesives for beauty products, as previously stated, are not covered by the Cosmetic Products Regulation, as they are not intended to cleanse, perfume, alter appearance, correct body odour, or protect the surface of the human body, even though they come into direct contact with the skin and nails. Rather, it is the artificial nails, eyelashes and facial decorations these adhesives are intended to fix in place that have the purpose of altering one's appearance (Working Group on Cosmetic Products, 2023).

Therefore, adhesives for beauty products – when transparent – are not covered by the Cosmetic Products Regulation, but instead by the REACH and CLP Regulations. This means that transparent adhesives for beauty products must be labelled if an adhesive contains substances classified as hazardous, such as acrylates or solvents, at a concentration that results in an overall classification for the mixture. The levels of hazard-classified ethyl 2-cyanoacrylate detected by the quantitative analyses in this project mean that adhesives containing this substance must be hazard-labelled.

Under the current rules for transparent adhesives covered by the REACH and CLP Regulations, rather than the Cosmetic Products Regulation, consumers are protected by the presence of a hazard symbol on products. The hazard labelling takes the form of an exclamation mark that stands for "health warning", but the hazard labelling is the same regardless of whether the hazard involves skin irritation, respiratory irritation, skin sensitisation or acute toxicity. The hazard labelling on transparent adhesives for beauty products is thus the same as it might be on the washing-up liquid a consumer has at home. The hazard labelling warns the consumer about the existence of a hazard, but not necessarily its nature, unless the consumer reads the label closely.

However, it should be noted that both REACH/CLP and the Cosmetic Products Regulation provide options to restrict or prohibit the use of certain substances in consumer products, as well as to restrict them to professional use. For example, under REACH, hazardous substances may be subject to authorisation or restrictions in Annex XVII, which applies across many product types, including consumer adhesives. The CLP Regulation also ensures the uniform classification and communication of chemical hazards via hazard symbols and the H and P phrases. The Cosmetic Products Regulation, on the other hand, is product-specific and requires that a product undergo a safety assessment, that a Cosmetic Product Safety Report and a product information file be prepared for a cosmetic product, and that a responsible person be appointed who must be able to document that a product is safe under normal and reasonably foreseeable use.

In addition, the Cosmetic Products Regulation contains special rules on the declaration of a wide range of specific allergenic fragrances in the list of ingredients, even when these are not necessarily classified as dangerous chemical substances according to CLP. For consumers

with known allergies, or for health authorities following up on reported events, this provides a level of information that is not automatically available for chemical mixtures that are covered solely by REACH/CLP.

For transparent adhesives, which are currently only regulated as chemical mixtures under REACH/CLP, there is no legal requirement for them to provide a list of ingredients. Although the majority of the transparent adhesives in this project did have an ingredient list on their packaging and thus provided information about their ingredients, this is not required by law. In practice, this means that consumers may not always have access to information about ingredients and, by extension, they may be deprived of the opportunity to make informed choices based on factors including allergy risks and particularly problematic substances. This lack of an obligation to declare ingredients can have several practical consequences. For example, it can make it more difficult for authorities to carry out market surveillance, and it can also make it difficult to follow up on reported events and health incidents if there is no access to full information about the contents of a product.

This also means that transparent adhesives are not subject to the same safety requirements as cosmetic products. For example, the Cosmetic Products Regulation prohibits and restricts a number of substances based on known health risks. These prohibitions and restrictions may not apply to similar products classified as chemical mixtures. As a result, there is a risk that consumers – including particularly vulnerable groups, such as children and young people – will be exposed to harmful substances. As discussed earlier, this is particularly evident for products containing boron trifluoride. In the survey identified adhesives containing boron trifluoride, which is classified as corrosive and fatal if inhaled. Boron trifluoride is banned by the Cosmetic products Regulation, but not restricted in consumer products by the REACH Regulation.

The argument that transparent adhesives should not be covered by cosmetics legislation (Working Group on Cosmetic Products, 2023) seems to be at odds with the purpose of the legislation, as this deprives consumers of the opportunity to receive appropriate warnings and instructions for use. Furthermore, adhesives are sold as essential accessory products for products which are covered by cosmetics legislation, so it would be reasonable to also consider the adhesives as cosmetic products. These products could additionally be restricted to professional use under the Cosmetic Products Regulation or, alternatively, at least be supplied with clearer warnings about the allergenic risks associated with the use of nail and lash adhesives with such high concentrations of allergenic acrylates.

The intentions of the Cosmetic Products Regulation are stated in the preamble, including point 9, which states that "cosmetic products should be safe under normal or reasonably foreseeable conditions of use. In particular, a risk-benefit reasoning should not justify a risk to human health".

Overall, this review shows that regulation of transparent adhesives for beauty products as chemical mixtures under REACH/CLP primarily protects consumers through overall hazard classifications and general hazard labelling of products. If, on the other hand, adhesives were covered by the Cosmetic Products Regulation, there would be a requirement for a product safety assessment, detailed list of ingredients, declaration of relevant allergens and targeted warnings adapted to each product's particular application. For products marketed directly to consumers that may contain highly sensitising or corrosive substances, these differences mean that requirements in the Cosmetic Products Regulation would generally result in a greater level of information and more specific protections of consumer health than the requirements for chemical mixtures under REACH/CLP.

14.6 Discussion of the consequences of early sensitisation to acrylates

Sensitisation to methacrylates may create some risk for reactions during dental treatment using methacrylate-based polymers. Allergies to acrylates have also been observed to be provoked by medical devices, such as patches for transdermal administration of drugs, as well as adhesives in tapes for securing wigs to the scalp.

Such allergies can restrict the application of commonplace healthcare treatments, leaving a sensitised individual to seek less advantageous options in order to receive appropriate treatment.

14.7 Conclusion

This study of transparent adhesives for beauty products used by Danish consumers shows that nail adhesive and lash adhesive may contain the allergen ethyl-2-cyanoacrylate as a main ingredient. In addition, other allergenic acrylates were identified at lower concentrations. The small user survey conducted showed that 15% of the respondents had personally experienced discomfort one or more times when using beauty product adhesives. In addition, 17% of the respondents knew someone who had experienced discomfort or an allergic reaction when using beauty product adhesives. A literature search confirmed that allergic reactions and chemical burns are particularly common when using nail or lash adhesives. Conversely, the same problems have not been identified when using skin adhesives, which also do not appear to contain acrylates according to the market survey.

Risk assessments of three substances – a methacrylate, an acrylate and a cyanoacrylate – did not reveal a risk of sensitisation to the extent that these substances occur in the analysed adhesives. However, the previously mentioned experiences of discomfort reported in the literature and by the Danish consumers surveyed show that there are users who have been sensitised.

The chemical analyses carried out show that several of the analysed nail and lash adhesives release formaldehyde, which is allergenic. A risk of sensitisation to formaldehyde has been demonstrated with normal, foreseeable use of two nail adhesives.

Nail adhesives containing more than 1.8% cyanoacrylate can cause respiratory irritation during foreseeable use. All analysed adhesives with cyanoacrylate content had a cyanoacrylate content well above 1.8%. This means that a risk of respiratory irritation is to be expected when using nail adhesive.

A person who is already sensitised to either acrylates or formaldehyde could have a reaction to a large majority of these adhesives. In addition, adhesives that have a very low pH value when applied to (moist) skin will increase the risk of sensitisation when users are simultaneously exposed to sensitising substances.

Although this study cannot demonstrate a risk of sensitisation with the risk-assessed acrylates at the concentrations observed, it should be emphasised that the problem of sensitisation to these adhesives seems to be increasing, judging from our user study and the literature.

As transparent adhesives are not currently covered by the Cosmetic Products Regulation, but by the REACH and CLP Regulations on chemical mixtures, consumers are fundamentally not guaranteed a list of ingredients, but only hazard labelling, which does not necessarily tell the consumer much or prompt the consumer to read the label closely. Even so, a majority of the transparent adhesives analysed in this project provided ingredient lists.

A review of the differences in legislation and identified problematic substances in transparent adhesives shows that consumers are generally disadvantaged, as transparent adhesives are covered by the REACH and CLP Regulations rather than the Cosmetic Products Regulation. In particular, the labelling rules regarding the release of known sensitising ingredients allow consumers with a known allergy, or consumers who want to avoid developing an allergy, to reject these products, but the Cosmetic Products Regulation sets stricter requirements than does the REACH Regulation for certain other problematic substances in chemical mixtures for consumer use.

Given that these adhesives are sold as essential accessories for products covered by cosmetics legislation, it would make sense for these adhesives to also be considered cosmetic products. Transparent adhesives could additionally be restricted to professional use under the Cosmetic Products Regulation or, alternatively, at least be supplied with clearer warnings about the allergenic risks associated with the use of nail and lash adhesives with such high concentrations of allergenic acrylates.

15. References

Abelson et al. 1981. Normal human tear pH by direct measurement. Abelson MB, Udell IJ, Weston JH. Arch Ophthalmol. 1981 Feb; 99(2):301. Normal human tear pH by direct measurement - PubMed

Aggarwal et al., 2021. Pediatric full-thickness burns by cyanoacrylate nail glue: A case report. Aggarwal S, Aggarwal S, Aggarwal R. Burns Open, Volume 5, Issue 4, October 2021, pp. 10-12. Pediatric full-thickness burns by cyanoacrylate nail glue: A case report - ScienceDirect

Alhumsi & Mardan, 2021. Burn Injury Due to Cyanoacrylate-Based Nail Glue: A Case Report and Literature Review. Cureus. 2021 Mar 14;13(3):e13878. Alhumsi TR, Martan QNS. Burn Injury Due to Cyanoacrylate-Based Nail Glue: A Case Report and Literature Review - PubMed

Al-Gawahiri, M et al, 2023. Frequency and clinical relevance of contact allergy in dental patients. Contact Dermatitis, 90, 1, 66-73. https://onlinelibrary.wiley.com/doi/10.1111/cod.14440

Andersen et al., 2014. Survey of Formaldehyde. Part of the LOUS review Environmental project No 1618, 2014. Andersen DN, Slothuus T, Larsen PB. DHI. Danish EPA. https://www2.mst.dk/Udgiv/publications/2014/11/978-87-93283-23-7.pdf

Amano et al., 2012. Ocular Disordes Due to Eyelash Extensions. Cornea, Vol. 31. No. 2, February 2012. Amano Y, Sguimot Y, Sugita M.

American Laboratory, 2014. Qualitative and quantitative determination of methacrylates in dental filling materials. March 3, 2014.

Astma-Allergi Danmark, 2025a. Description of acrylates on the website of Astma-Allergi Danmark ('Asthma-Allergy Denmark'). Akrylater og allergisk kontakteksem - Astma-Allergi Danmark

Astma-Allergi Danmark, 2025b. Description of contact eczema on the website of Astma-Allergi Danmark ('Asthma-Allergy Denmark'): Kontakteksem - Astma-Allergi Danmark

Baek & Adler, 2024. Allergic contact dermatitis to isobornyl acrylate in a home nail glue. Contact Dermatitis, vol. 91. Issue 1, July 2024. Baek P, Adler BL. Allergic contact dermatitis to isobornyl acrylate in a home nail glue - Baek - 2024 - Contact Dermatitis - Wiley Online Library

Bhargava et al., 2012. Eyelid allergic contact dermatitis caused by ethyl cyanoacrylate-containing eyelash adhesive. Contact Dermatitis (01051873), 2012, Vol 67, Issue 5, p306. Bhargava K, White JM., White IR.

Bianchetti et al., 2025. Sensitization Patterns to Cyanoacrylate-Based Surgical Glues. Contact Dermatititis., 93, 4, 328-335. doi: 10.1111/cod.14838. Epub 2025 Jul 7.

Brambilla et al., 2020. Exposure to Nail and False Eyelash Glue: A Case Series Study. Int J Environ Res Public Health. 2020 Jun 15;17(12):4283. Brambilla E, Crevani M, Petrolini VM, Scaravaggi G, Di Primo M, Roda E, Locatelli CA. Exposure to Nail and False Eyelash Glue: A Case Series Study - PubMed

Coles et al., 2016. Paediatric burns secondary to nail adhesives: a case series. Burns Trauma. 2016 Sep 5;4(1):17. Coles C, Javed MU, Gorse SH, Nguyen D. Paediatric burns secondary to nail adhesives: a case series - PMC

Constandt et al., 2005. Screening for contact allergy to artificial nails. Contact Dermatitis, 52, 2, 73-77. https://doi.org/10.1111/j.0105-1873.2005.00496.x

Danish Allergy Centre, 2016. How should we advise patients with allergic contact dermatitis caused by (meth-)acrylates about future dental work? https://www.videncenterforallergi.dk/how-should-we-advise-patients-with-allergic-contact-dermatitis-caused-by-meth-acrylates-about-future-dental-work-2/

Danish Allergy Centre, 2025a. Description of contact allergy & eczema on their website (*In Danish)*: Om kontaktallergi & eksem – Videncenter For Allergi

Danish Allergy Centre, 2025b. Description of artificial nails and gel based nail varnish on their website: Kunstige negle og gelneglelak – Videncenter For Allergi

de Groot et al., 2010. Formaldehyde-releasers in cosmetics: relationship to formaldehyde contact allergy. Part 2. Patch test relationship to formaldehyde contact allergy, experimental provocation tests, amount of formaldehyde released, and assessment of risk to consumers allergic to formal-dehyde. De Groot A, White IR, Flyvholm M-A, Lensen G, Coenraads P-J. Contact Dermatitis 2010: 62: 18–31.

ECHA, 2020. RAC, SEAC Opinion on an Annex XV dossier proposing restrictions on Formalde-hyde and formaldehyde releasers. Compiled version prepared by the ECHA Secretariat of RAC's opinion (adopted 13 March 2020) and SEAC's opinion (adopted 17 September 2020). https://echa.europa.eu/documents/10162/f10b57af-6075-bb34-2b30-4e0651d0b52f

ECHA, 2021. Formaldehyde Registration Dossier ECHA. https://echa.europa.eu/da/registration-dossier/-/registered-dossier/15858

ECHA C&L, 2025. ECHAs Classification & Labelling database, accessed 2025. https://echa.europa.eu/en/information-on-chemicals/cl-inventory-database

ECHA, 2025. Formaldehyde. Brief profile. Scientific properties. Toxicological information. Last updated 06/08/2025. https://echa.europa.eu/da/brief-profile/-/briefprofile/100.000.002

ECHA, 2025a. Methyl methacrylate. Brief profile. Scientific properties. Toxicological information. Last updated 26/08/2025. https://echa.europa.eu/da/brief-profile/-/briefprofile/100.001.180

ECHA, 2025b. 2-ethylhexyl acrylate. Brief profile. Scientific properties. Toxicological information. Last updated 19/07/2025. https://echa.europa.eu/da/brief-profile/-/briefprofile/100.002.801

ECHA, 2025c. Ethyl 2-cyanoacrylate. Brief profile. Scientific properties. Toxicological information. Last updated 01/09/2025. https://echa.europa.eu/da/brief-profile/-/briefprofile/100.027.628

EFSA, 2006. Use of formaldehyde as a preservative during the manufacture and preparation of food additives. Opinion of the Scientific Panel on food additives, flavorings, processing aids and materials in contact with food (AFC). The EFSA Journal (2006) 415, 1-10. https://efsa.onlinelibrary.wiley.com/doi/epdf/10.2903/j.efsa.2007.415

EFSA, 2014. Endogenous formaldehyde turnover in humans compared with exogenous contribution from food sources EFSA Journal 2014;12(2):3550

EU, 2002. European Union Risk Assessment Report. CAS 80-62-6. EINECS 201-297-1. Methyla methacrylate. European Chemicals Bureau. 1st priority list, volume 22. European Union Risk Assessment Report: Methyl Methacrylate | Policy Commons.

EU Regulation 1907, 2006. 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).

EU Regulation 1272, 2008. 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.

EU Regulation 1223, 2009. Regulation (EC) No 1223/2009 of the European Parliament and of the Council of 30 November 2009 on cosmetic products.

Goncalo et al., 2017. Allergic contact dermatitis caused by nail acrylates in Europe. An EECDRG study. Contact Dermatitis, vol. 78, Issue 4, April 2018. pp. 254-260. Allergic contact dermatitis caused by nail acrylates in Europe. An EECDRG study - Gonçalo - 2018 - Contact Dermatitis - Wiley Online Library

Forkel et al., 2024. Contact allergies to dental materials in patients. Br J Dermatol. https://doi.org/10.1093/bjd/ljad525

Goncalo et al., 2017. Allergic contact dermatitis caused by nail acrylates in Europe. An EECDRG study. Contact Dermatitis, vol. 78, Issue 4, April 2018. pp. 254-260. Allergic contact dermatitis caused by nail acrylates in Europe. An EECDRG study - Gonçalo - 2018 - Contact Dermatitis - Wiley Online Library

Havmose et al., 2022. Artificial Nails and Long-lasting Nail Polish in Danish Hairdressers: Self-use, Occupational Exposure and Related Eczema. Acta Derm Venereol. 2022 Nov 23;102:4524. Havmose M, Thyssen JP, Zacharie C, Johansen JD. Artificial Nails and Long-lasting Nail Polish in Danish Hairdressers: Self-use, Occupational Exposure and Related Eczema - PMC

HPT, 2024. SDS for the product Clear Bond, eye lash glue. MSDS_for_CLEAR_BOND.pdf

IUPAC, 2025. IUPAC Compendium of Chemical Terminology, 5th ed. International Union of Pure and Applied Chemistry; 2025. Online version 5.0.0, 2025. https://doi.org/10.1351/goldbook.P04524. https://goldbook.iupac.org/terms/view/P04524

Kandii, 2024. SDS for Gel Tip Glue. GEL TIP GLUE - DK - SDS.pdf

Kandii, 2025a. SDS for Clear Bond IT. Clear adhesive for eye lashes. CLEAR BOND IT! DIY-VIPPER - DK - SDS.pdf

Kandii, 2025b. SDS for Gem Stone Gel & Gem Stone Glue. GEM STONE GEL & GEM STONE GLUE - DK - SDS.pdf

Kepiro, 2016. Allergic Contact Dermatitis to Artificial Fingernails. J Clin Case Stu 1(3). Képíró L, Kinyó A, Altmayer A, Kemény L, Bata-Csörgő Z. Allergic Contact Dermatitis to ArtificialFingernails

Kiara Sky, 2025. SDS for Stick It Nail Glue. SDS is accessed online in May 2025; the SDS is not dated. SDS_Stick it nail glue

Kim & Chung, 2014. Bilateral Eyelid Contact Dermatitis and Toxic Conjunctivitis due to Acrylate-Containing Glue. Ann Dermatol. 2014 Aug;26(4):543-544. Kim YJ, Chung JK. Annals of Dermatology - Eyelid Contact Dermatitis

Larsen et al., 2021. Survey and risk assessment of chemicals in knitting yarn. Survey of chemical substances in consumer products No. 184, March 2021. Danish EPA. Larsen PB, Semark ID, Andersen ES, Andersen DN, DHI. Kolarik B, Jensen A, Eriksen JV, Medico Kemiske Laboratorium. Rapport

Lash Shop, 2025a. SDS for Clarity Clear Lash Extension Adhesive. SDS_Clarity Clear Lash Adhesive

Lash Shop, 2025b. SDS for Ultra Lash lift Adhesive. SDS-ultra-lift-adhesive

Lindström et al., 2013. Occupational asthma and rhinitis caused by cyanoacrylate-based eyelash extension glues. Occupational Medicine, Volume 63, Issue 4, June 2013, Pages 294–297. Lindström I, Suojalehto H, Henricks-Eckerman ML, Suuronen K. Occupational asthma and rhinitis caused by cyanoacrylate-based eyelash extension glues | Occupational Medicine | Oxford Academic

Lomax LG, 1992. Histopathologic evaluation of the nasal cavities from Fisher 344 rats exposed to methyl methacrylate vapor for two years. Rohm and Haas Company SH, PA. Cited in US EPA (1998).

Lomax LG, Krivanek ND, Frame SR, 1997. Chronic inhalation toxicity and oncogenicity of methyl methacrylate in rats and hamsters. Food Chem Toxicol 35:393-407.

Mahajan & Ma-hajan, 2024. Greenish discoloration due to gel nail extensions mimicking Pseudomonas aeruginosa infection: Is beauty really worth the risk: A case report. CosmoDerma. 2024;4:121. Mahajan M, Mahajan BB. Greenish discoloration due to gel nail extensions mimicking Pseudomonas aeruginosa infection: Is beauty really worth the risk: A case report - Cosmoderma

Mose et al. 2025. Kontaktallergener. Statusartikel. Ugeskrift for Læger. 187:V11240778. doi: 10.61409/V11240778. *Danish article, title in English: Contact allergens, status article. Weekly Journal for Doctors.*

Murphy, S et al., 2018. Critical evaluation of 2-ethylhexyl acrylate dermal carcinogenicity studies using contemporary criteria. Toxicology Letters, 294, 205-11. DOI: 10.1016/j.toxlet.2018.05.016.

Nail Superstore, 2006. SDS for Artisan Nail Glue. SDS_Artisan Nail Glue - Nail Superstore

Nailster, 2024. SDS for Gel Glue Neglelim from Nailster. Gel_Glue_-_DK_-_SDS.pdf

Nardeosingh & Tung, 2020. Thermal injury and false eye lashes. Eye News, April/May 2020, Vol. 26, No. 6. Nardosingh S, Tung ASW.

Navarro-Trivino og Ruiz-Villaverde, 2020. Allergic contact dermatitis caused by 2-ethylhexyl acrylate in a rivastigmine transdermal therapeutic system. Contact Dermatitis, 83, 2, 143-45. https://onlinelibrary.wiley.com/doi/10.1111/cod.13551

Poulsen et al., 2023. Survey and risk assessment of free formaldehyde in cosmetic products. Survey of chemical substances in consumer products, No. 194, September 2023. Danish IPA, ISBN: 978-87-7038-557-2. Rapport

Poulsen et al., 2025. Survey and risk assessment of eyelash and eyebrow serums. Survey of chemical substances in consumer products, No. 202, May 2025. Danish EPA. Survey and risk assessment of eyelash and eyebrow serums

Purenails, 2025. SDS for Nail Glue. Safety data sheet was assessed online in May 2025. No date on the SDS. SDS_NailGlue_SDS

PubChem, 2025. Ethyl cyanoacrylate. Hazardous substances databank, annotation record. https://pubchem.ncbi.nlm.nih.gov/source/hsdb/7910

Quaade & Simonsen, 2023. The bitter side of nail art: A teenage girl's encounter with (meth)acrylate-induced allergic contact dermatitis from nail glue. Quaade AS & Simonsen AB, Contact Dermatitis Vol. 89, Issue 4, October 2023, p. 299-301. Quaade & Simonsen, Contact Dermatitis Vol. 89, 4, 2023

Rajanemi, R et al., 1989. Percutaneous absorption of methyl methacrylate by dental technicians. British J Ind Medicine, 46: 356-357. https://oem.bmj.com/content/46/5/356

Raposo et al., 2017. Allergic contact dermatitis caused by (meth)acrylates in nail cosmetic products in users and nail technicians – a 5-year study. Contact Dermatitis, Vol. 77, Issue 6, 2017, pp. 356-359. Allergic contact dermatitis caused by (meth)acrylates in nail cosmetic products in users and nail technicians – a 5-year study - Raposo - 2017 - Contact Dermatitis - Wiley Online Library

Roche, 2008. Sensibilización a acrilatos por uñas artificiales acrílicas. Revisión de 15 casosSen-sitization to acrylates caused by artificial acrylic nails: review of 15 cases. Actas Dermo-Sifiliográficas, 99, 10, 788-94. https://www.sciencedirect.com/science/article/pii/S0001731008749597?via%3Dihub

Scheers et al., 2024. Nail cosmetology. Hand Surgery and Rehabilitation, 43, Supplement, April 2024, 101657. https://doi.org/10.1016/j.hansur.2024.101657

SCCS, 2023. Notes of Guidance of the testing of cosmetic ingredients and their safety evaluation, 12th revision. Final Opinion. December 22, 2023. SCCS Notes of guidance for the testing of cosmetic ingredients and their safety evaluation - 12th revision - Public Health

Shanmugam & Wilkinson, 2012. Allergic contact dermatitis caused by a cyanoacrylate-containing false eyelash glue. Contact Dermatitis, Vol. 67, pp. 306-320, 2012. Shanmugam S & Wilkinson M.

Statutory Order 1356, 2025. Statutory order on occupational threshold limit values for substances and materials (chemical agents). The Ministry of Employment, Denmark, November 19., 2025. Bekendtgørelse om grænseværdier for stoffer og materialer (kemiske agenser) i arbejdsmiljøet

Symanzik et al., 2022. Allergic contact dermatitis caused by 2-hydroxyethyl methacrylate and ethyl cyanoacrylate contained in cosmetic glues among hairdressers and beauticians who perform nail treatments and eyelash extension as well as hair extension applications: A systematic review. Contact Dermatitis, Volume: 86, Issue: 6, Pages: 480-492, First published: 28 January 2022, DOI: (10.1111/cod.14056). Allergic contact dermatitis caused by 2-hydroxyethyl methacrylate and ethyl cyanoacrylate contained in cosmetic glues among hairdressers and beauticians who perform nail treatments and eyelash extension as well as hair extension applications: A systematic review - Symanzik - 2022 - Contact Dermatitis - Wiley Online Library

Søgaard et al., 2025. Søgaard, R., Schwensen, J.F.B., Nielsen, M.B. and Elberling, J. (2025), Isolated Periorbital Edema Linked to Artificial Nails: A Case of Allergic Contact Dermatitis. Int J Dermatol, 64: 1886-1887. https://doi.org/10.1111/ijd.17787

Torchia, D et al., 2008. Allergic contact dermatitis from 2-ethylhexyl acrylate contained in a wig-fixing adhesive tape and its 'incidental' therapeutic effect on alopecia areata. Contact Dermatitis, 58, 3, 170-171. https://onlinelibrary.wiley.com/doi/10.1111/j.1600-0536.2007.01212.x

U.S.EPA (1998) Chemical Assessment Summary: Methyl methacrylate; CASRN 80-62-6. Agency USEP Washington, D.C. http://cfpub.epa.gov/ncea/iris/iris_documents/documents/subst/1000_summary.pdf

Voss JU, 2017. Toxikologische Basisdaten und Textentwurf für die Ableitung von EU-LCI-Werten für Triethylamin (CAS Nr. 121-44-8), Tributylphosphat (CAS Nr. 126-73-8), Triethylphosphat (CAS Nr. 78-40-0), Methylmethacrylat (CAS Nr. 80-62-6) und Ethylmethylketon (CAS Nr. 78-93-3). UBA Texte 42/2017. https://www.umweltbundesamt.de/publikationen/toxikologische-basisdaten-textentwurf-fuer-die

Wella, 2023. SDS for OPI Mach 5 High-Velocity Nail Adhesive. _SDS for OPI_Mach_5_High-Velocity_Nail_Adhesive_(US)

WHO, 2000. Air Quality Guidelines for Europe. Second edition. WHO regional publications, Eu-ropean Series, No 91. https://www.euro.who.int/__data/assets/pdf_file/0005/74732/E7
WHO, 2010. World Health Organization. WHO Guidelines for indoor air quality: Selected Pollutants. https://www.euro.who.int/__data/assets/pdf_file/0009/128169/e94535.pdf

WHO, 2005. Formaldehyde in Drinking-water. Background document for development of WHO Guidelines for Drinking-water Quality. WHO/SDE/WSH/05.08/48. https://www.who.int/water_sanitation_health/dwq/chemicals/formaldehyde130605.pdf

Working group on cosmetic products, 2023. Manual of the Working Group on Cosmetic Products (Sub-Group on Borderline Products) on the Scope of Application of the Cosmetics Regulation (EC) NO 1223/2009 (ART. 2(1)(A)) Version 5.3 (November 2023). Working group on cosmetic products, borderline products.

Wrangsjø, K et al. 2001. Occupational dermatitis in dental personnel: contact dermatitis with special reference to (meth)acrylates in 174 patients. Contact Dermatitiis, 45,3, 158-163. https://onlinelibrary.wiley.com/doi/10.1034/j.1600-0536.2001.045003158.x

Xiang et al., 2022. Formaldehyde Release From Eyelash Glues: Analysis Using the Chromotropic Acid Method. Dermatitis. Vol. 33, No. 6. December 2022. Xiang M, Shaik JA, Hylwa S. https://www.liebertpub.com/doi/abs/10.1097/DER.0000000000000910?journalCode=der
Analysis Using the Chromotropic Acid Method, Dermatitis.

Appendix 1. Questions from the user study

This appendix contains the exact wording of the 14 questions asked in the small-scale user study conducted in the project. Questions and response options are listed below. Questions marked with an * allowed multiple response options to be selected. The questionnaire was prepared in Danish. This is the direct translation of the Danish questions.

Question 1: How old are you?
- Under 15 years
- 15-20 years
- 21-25 years
- 26-30 years
- Over 30 years

Question 2*: What type(s) of adhesive do you use? Adhesive to apply artificial lashes, artificial nails, or facial decorations? (select all that apply)
- Artificial lashes
- Artificial nails
- Facial decorations (e.g., rhinestones, stickers, glitter)
- Other
- No adhesives of any kind

Question 3: Can you name which ones?
Open-ended question

Question 4: How do you use the adhesive?
- Only for the purpose stated on the packaging
- Also for other purposes (e.g., nail adhesive on lashes or teeth)
- If for another purpose, what is it? *Open-ended question*

Question 5: How often do you use nail adhesive?
- Daily
- Weekly
- Monthly
- Less often
- I do not use this type of adhesive

Question 6: How often do you use lash adhesive?
- Daily
- Weekly
- Monthly
- Less often
- I do not use this type of adhesive

Question 7: How often do you use adhesive for purposes other than nails and lashes?
- Daily
- Weekly
- Monthly

- Less often
- I do not use this type of adhesive

Question 8: How long does a tube/tub of adhesive last?
- For a few uses only
- Approx. 10 uses
- More than 10 uses
- It often hardens before I finish it, so I have to buy a new one

Question 9*: What type of adhesive do you typically use? (select all that apply)
- Transparent adhesive
- Coloured adhesive
- Don't know

Question 10: Where do you primarily get your nails and lashes done?
- At home (DIY/friend/acquaintance)
- Professionally at a salon
- I do not use adhesive for these purposes

Question 11*: Where do you buy the adhesive? (select all that apply)
- At a physical store (e.g., Matas, Normal)
- At a beauty salon
- On social media (e.g., Instagram, TikTok Shops)
- From a Danish online shop (e.g., Nicehair, Matas)
- From an EU-based online shop (e.g., Sephora, amazon.de)
- From an online shop outside of Europe (e.g., SHEIN)
- Other

Question 12: Do you remember where (which store or online shop)?
Open-ended question

Question 13: Do you know the name or brand of the adhesive product you use most often?
- Yes
- No
- If yes: Type its name here: *Open-ended question*

Question 14: Have you or anyone you know experienced discomfort or irritation, such as a rash, itching or redness when using adhesive for artificial nails, artificial lashes or facial decorations?
- Yes, I've experienced it several times myself
- Yes, I've experienced it once myself
- Yes, I know someone who has experienced discomfort or allergic reactions
- No
- If yes: Please specify what kind of discomfort or irritation: *Open-ended question*

Appendix 2. GC-MS screening

This appendix contains results from the GC-MS screening performed for the 32 different adhesives.

A total of two tables are provided in separate subsections below. One table shows substances identified in each individual sample, and one table shows the individual substances identified, as well as information on how many of the 32 samples each substance was identified in and how the substances are classified.

In total, approximately 85 unique substances were identified. Only substances that have been identified or whose identification is slightly uncertain are listed.

In the tables, one to four + signs indicate the amount of the identified substances released in relation to the content of the internal standard in the sample. For example, four + signs are given for the identified acrylates, where the content is several percent. In the tables below, the maximum estimated "amount" released, in the form of + signs, is given across the samples from which each substance was released.

With respect to the above, the indication of + signs should not be seen as a direct expression of the concentration of the substance released from the sample, but at best an estimate that makes it possible to compare the amount released of the same substance across multiple samples.

+ corresponds approximately to an estimated concentration released from the sample of < 1/10 of the area of the internal standard
++ corresponds approximately to an estimated concentration released from the sample of between 0.1 and 1 times the area of the internal standard
+++ corresponds approximately to an estimated concentration released from the sample of between 1 and 10 times the area of the internal standard
++++ approximately corresponds to an estimated concentration released from the sample of between 10 and 100 times the area of the internal standard

Appendix 2.1 GC-MS screening results: Substances released from individual samples

The substances released from each of the 32 adhesives are listed in TABLE 26 on the following pages.

TABLE 26. Results of GC-MS headspace screening. Identified substances released from the adhesives.

Lab. no.	CAS no.	Substance	Amount	Subst. in total	Substances not identified
01-N	75-09-2	Dichloromethan	+++	5	None
	80-62-6	Methyl methacrylate	++		
	79-34-5	1,1,2,2-Tetrachlorethane	+		
	7085-85-0	2-Cyanoethyl acrylat	++++		
	1120-21-4	Undecane	+		

Lab. no.	CAS no.	Substance	Amount	Subst. in total	Substances not identified
02-E	71-36-3	1-Butanol	+++	12	+ (3)
	1632-16-2	2-Ethyl-1-hexene	++		++ (1)
	142-96-1	n-Butyl ether	+++		
	590-01-2	n-Butyl propionat	+		
	123-05-7	2-Ethylhexanal	+		
	104-76-7	2-Ethyl-1-hexanol	+++		
	103-09-3	2-Ethyl-1-hexylacetat	++		
	103-11-7	2-Ethylhexyl acrylat	++		
05-E	71-36-3	1-Butanol	++++	9	None
	123-86-4	n-Butyl acetat	++++		
	142-96-1	n-Butyl ether	++++		
	141-32-2	n-Butyl acrylat	+++		
	590-01-2	n-Butyl propionat	+++		
	15726-15-5	3-Methyl-4-heptanon	++		
	97-87-0	n-Butyl isobutyrat	++		
	7085-85-0	2-Cyanoethyl acrylat	+++		
	109-21-7	n-Butyl butanoat	+++		
06-E	110-62-3	Pentanal	+	10	None
	80-56-8	α-Pinen	+		
	79-92-5	Camphen	+		
	127-91-3	β-Pinen	++		
	123-35-3	β-Myrcen	+		
	527-84-4	o-Cymen	+		
	5989-27-5	D-Limonen	+++		
	78-70-6	Linalool	+		
	76-22-2	Camphor	+		
	98-55-5	α-Terpineol	+		
07-A	110-19-0	Isobutyl acetate	+	10	+ (2)
	1632-16-2	2-Ethyl-1-hexene	+		++ (1)
	123-05-7	2-Ethylhexanal	+		
	104-76-7	2-Ethyl-1-hexanol	+++		
	103-09-3	2-Ethyl-1-hexylacetat	++		
	62625-25-6	1-Butoxy-2-ethylhexane	+		
	102-25-0?	1,3,5-Triethylbenzene eller lign.	+		
08-F	2043-43-8	lactamid (2-Hydroxypropanamid)	++	2	+ (1)
09-E	71-36-3	1-Butanol	++++	15	+ (4)
	108-88-3	Toluen	++		
	123-86-4	n-Butyl acetat	+++		
	142-96-1	n-Butyl ether	++		
	590-01-2	n-Butyl propionat	++		
	123-05-7	2-Ethylhexanal	+		
	109-21-7	n-Butyl butanoat	++		
	104-76-7	2-Ethyl-1-hexanol	+++		
	103-09-3	2-Ethyl-1-hexylacetat	++		
	62625-25-6	1-Butoxy-2-ethylhexane	+		
	103-11-7	2-Ethylhexyl acrylat	++		
11-N	547-63-7	Methyl isobutyrat	+	3	None
	80-62-6	Methyl methacrylat	+++		
	7085-85-0	2-Cyanoethyl acrylat	++++		

Lab. no.	CAS no.	Substance	Amount	Subst. in total	Substances not identified
12-E	71-36-3	1-Butanol	++	13	+ (3)
	547-63-7	Methyl isobutyrat	++		
	80-62-6	Methyl methacrylat	+		
	142-96-1	n-Butyl ether	++		
	590-01-2	n-Butyl propionat	+		
	15726-15-5	3-Methyl-4-heptanon	+		
	123-05-7	2-Ethylhexanal	+		
	104-76-7	2-Ethyl-1-hexanol	++		
	103-09-3	2-Ethyl-1-hexylacetat	++		
	103-11-7	2-Ethylhexyl acrylat	+		
13-N	142-68-7	Tetrahydropyran	++	36	+ (16)
	79-41-4	2-Methylacrylsyre	++		++ (2)
	62960-76-3	(4E)-2,6-Dimethyl-4-octene el. lign.	++		
	508-32-7	Tricyclen	++		
	53252-21-4	3,4-Dimethyl-3-hexen-2-one	++		
	497-32-5	β-Fenchene (2,2-dimethyl-5-methylene-norbornan)	++		
	79-92-5	Camphen	+++		
	7085-85-0	2-Cyanoethyl acrylat	+++		
	473-19-8	Isocamphane (muligvis)	++		
	1124-27-2	menthene, 1-methyl-4-(1-methylethylidene)-cyclohexan	++		
	556-67-2	Octamethyltetrasiloxane (D4)	++		
	868-77-9	2-Hydroxyethyl methacrylate	++++		
	95-50-1/ 541-73-1/ 106-46-7	o-Dichlorobenzene, eller m- eller p-	++		
	1120-21-4	Undecane	++		
	97-90-5	Ethylene glycol dimethacrylate	++		
	5888-33-5	Isobornyl acrylate	+		
	7534-94-3	iso-Bornyl methacrylate	+++		
	128-37-0	BHT, 3,5-Di-tert-butyl-4-hydroxytoluene	+		
15-E	2043-43-8	lactamid (2-Hydroxypropanamid)	++	12	+ (2)
	71-36-3	1-Butanol	++		
	547-63-7	Methyl isobutyrat	++		
	80-62-6	Methyl methacrylat	++		
	541-05-9	Hexamethylcyclotrisiloxane	++		
	590-01-2	n-Butyl propionat	+		
	123-05-7	2-Ethylhexanal	+		
	104-76-7	2-Ethyl-1-hexanol	++		
	103-09-3	2-Ethyl-1-hexylacetat	++		
	103-11-7	2-Ethylhexyl acrylat	+		
16-N	80-62-6	Methyl methacrylat	++	2	None
	7085-85-0	2-Cyanoethyl acrylat	++++		

Lab. no.	CAS no.	Substance	Amount	Subst. in total	Substances not identified
17-F	67-63-0	isopropanol	++	19	+ (3)
	108-21-4	isopropylacetat	++++		
	508-32-7	Tricyclen	++		
	99-83-2/ 2867-05-2	α-Phellandrene/3-Thujene	++		
	80-56-8	α-Pinen	++++		
	79-92-5	Camphen	++		
	1572-99-2	Ethyl 2-cyanopropionate	++		
	127-91-3	β-Pinen	++		
	99-83-2	α-Phellandrene eller lignende	+		
	527-84-4	o-Cymen	++		
	5989-27-5	D-Limonen	++++		
	99-85-4	γ-Terpinen	+		
	586-62-9	terpinolen	+		
	1195-32-0	p-Cymenene	+		
	3856-25-5	Copaene	+		
	554-61-0/ 586-62-9	2-Carene? Eller måske terpinolen	+		
18-N	67-66-3	Chloroform	++++	5	None
	80-62-6	Methyl methacrylat	+		
	80-56-8	α-Pinen	+		
	7085-85-0	2-Cyanoethyl acrylat	++++		
	5989-27-5	D-Limonen	+		
19-N	75-09-2	Dichloromethan	++++	5	+ (1)
	80-62-6	Methyl methacrylat	+++		
	79-34-5	1,1,2,2-Tetrachlorethane	++		
	7085-85-0	2-Cyanoethyl acrylat	++++		
20-N	80-62-6	Methyl methacrylat	+++	2	None
	7085-85-0	2-Cyanoethyl acrylat	++++		
21-F	626-93-7	2-Hexanol	+++	5	None
	108-88-3	Toluen	+		
	80-56-8	α-Pinen	+		
	1572-99-2	Ethyl 2-cyanopropionate	++		
	5989-27-5	D-Limonen	+		
22-F	122-99-6	2-Phenoxyethanol	++	2	+ (1)
23-E	71-36-3	1-Butanol	++	14	+ (2)
	547-63-7	Methyl isobutyrat	++		
	80-62-6	Methyl methacrylat	+		
	142-96-1	n-Butyl ether	++		
	590-01-2	n-Butyl propionat	+		
	15726-15-5	3-Methyl-4-heptanon	+		
	123-05-7	2-Ethylhexanal	+		
	104-76-7	2-Ethyl-1-hexanol	++		
	103-09-3	2-Ethyl-1-hexylacetat	++		
	122-99-6	2-Phenoxyethanol	+		
	103-11-7	2-Ethylhexyl acrylat	++		
	7085-85-0	2-Cyanoethyl acrylat	++		
24-E	80-62-6	Methyl methacrylat	++	2	None
	7085-85-0	2-Cyanoethyl acrylat	++++		

Lab. no.	CAS no.	Substance	Amount	Subst. in total	Substances not identified
25-N	80-62-6	Methyl methacrylat	++	2	None
	7085-85-0	2-Cyanoethyl acrylat	++++		
26-E	71-36-3	1-Butanol	+++	8	+ (2)
	105-57-7	Acetal	+		
	97-62-1	ethylisobutyrat	+++		
	142-96-1	n-Butyl ether	++		
	13475-82-6	2,2,4,6,6-Pentamethylheptane	++		
	78-67-1	2,2'-Azobis-(2-methylpropanenitrile)	++		
27-N	80-62-6	Methyl methacrylat	++	4	None
	108-88-3	Toluen	++		
	7085-85-0	2-Cyanoethyl acrylat	+++		
	78-67-1	2,2'-Azobis-(2-methylpropanenitrile)	+		
28-N	80-62-6	Methyl methacrylat	++	3	None
	7085-85-0	2-Cyanoethyl acrylat	++++		
	1120-21-4	Undecane	+		
29-E	547-63-7	Methyl isobutyrat	+	11	+ (1)
	80-62-6	Methyl methacrylat	++		++ (2)
	1632-16-2	2-Ethyl-1-hexene	++		+++ (1)
	104-76-7	2-Ethyl-1-hexanol	+++		
	103-09-3	2-Ethyl-1-hexylacetat	+		
	541-02-6	Decamethylcyclopentasiloxane	++		
	540-97-6	Dodecamethylcyclohexasiloxane	+		
30-N	542-58-5	2-Chlorethylacetat	++	4	None
	80-62-6	Methyl methacrylat	++		
	108-88-3	Toluen	++		
	7085-85-0	2-Cyanoethyl acrylat	++++		
31-F	67-63-0	isopropanol	++	20	+ (1)
	108-21-4	isopropylacetat	+++		++ (2)
	108-38-3	m-xylen	++		
	106-42-3	p-xylen	+++		
	95-47-6	o-xylen	++		
	508-32-7	Tricyclen	++		
	99-83-2/ 2867-05-2	α-Phellandrene/3-Thujene	++		
	80-56-8	α-Pinen	+++		
	79-92-5	Camphen	++		
	127-91-3	β-Pinen	++		
	99-83-2	α-Phellandrene eller lignende	+		
	554-61-0/ 586-62-9	2-Carene? Eller måske terpinolen	+		
	527-84-4	o-Cymen	++		
	5989-27-5	D-Limonen	++++		
	586-62-9	terpinolen	++		
	673-84-7	Allo-Ocimene	+		
	3856-25-5	Copaene	+		

Lab. no.	CAS no.	Substance	Amount	Subst. in total	Substances not identified
33-E	141-78-6 71-36-3 105-37-3 123-86-4 7452-79-1 142-96-1 590-01-2 15726-15-5 109-21-7 104-76-7 103-09-3 103-11-7 32210-23-4	ethylacetat 1-Butanol Ethyl propanoate n-Butyl acetat Ethyl 2-methylbutyrate n-Butyl ether n-Butyl propionat 3-Methyl-4-heptanon n-Butyl butanoat 2-Ethyl-1-hexanol 2-Ethyl-1-hexylacetat 2-Ethylhexyl acrylat 4-tert-Butylcyclohexyl acetate	++ +++ ++ +++ + ++++ ++ + ++ +++ ++ + ++	15	+ (2)
34-N	80-62-6 7085-85-0 104-76-7 103-09-3 32210-23-4	Methyl methacrylat 2-Cyanoethyl acrylat 2-Ethyl-1-hexanol 2-Ethyl-1-hexylacetat 4-tert-Butylcyclohexyl acetate	+++ ++++ ++ + +	5	None
35-E	71-36-3 547-63-7 80-62-6 142-96-1 590-01-2 15726-15-5 123-05-7 104-76-7 103-09-3 103-11-7	1-Butanol Methyl isobutyrat Methyl methacrylat n-Butyl ether n-Butyl propionat 3-Methyl-4-heptanon 2-Ethylhexanal 2-Ethyl-1-hexanol 2-Ethyl-1-hexylacetat 2-Ethylhexyl acrylat	++ ++ ++ ++ + + + ++ ++ +	12	+ (2)
36-E	592-84-7 1632-16-2 ? 123-05-7 104-76-7 103-09-3 10534-44-8	n-Butyl formate 2-Ethyl-1-hexene 2-Propyl-1,3-dioxonan 2-Ethylhexanal 2-Ethyl-1-hexanol 2-Ethyl-1-hexylacetat 3-Dehydroquinic acid (1,3,4-Trihydroxy-5-oxocyclohexanecarboxylic acid)	++ ++ ++ + +++ +++ ++	9	+ (2)
37-N	80-62-6 7085-85-0	Methyl methacrylat 2-Cyanoethyl acrylat	+++ ++++	2	None

Appendix 2.2 Results of GC-MS screening: Substances identified and their classifications

The individual substances identified as emitted from the 32 different adhesives are listed in TABLE 27 on the following pages. The table is sorted alphabetically by substance name. In total, approximately 85 substances were identified.

TABLE 27. Overview of the substances identified via headspace GC-MS screening which are emitted from the highest numbers of the 32 adhesive products. The number of products in which each is present, as well as the classification of each substance is listed. An * means that the content may be due to water in the sample.

CAS no.	Substance	Released from no. of prod.	Comment, e.g. information from ECHA	Harmonised classification	CLH notified classification (most of the listed)	Seveso subst.	SHVC
62960-76-3	(4E)-2,6-Dimethyl-4-octene eller lignende	1	Not registered in ECHA	-	-	-	-
79-34-5	1,1,2,2-Tetrachlorethane	2	Some uses of this substance are restricted under Annex XVII of REACH.	Acute Tox. 1 (H310) Acute Tox. 2 * (H330) Aquatic Chronic 2 (H411)		yes	-
102-25-0 ?	1,3,5-Triethylbenzene eller lignende	1	-	Not classified	Skin Irrit. 2 (H315), Eye Irrit. 2 (H319), Aquatic Chronic 4 (H413) (39 notifiers). Skin Irrit. 2 (H315), Eye Irrit. 2 (H319), STOT SE 3H335 (other:Respirato...), (Respiratory tra...) (6 notifiers) Skin Irrit. 2 (H315), Eye Irrit. 2 (H319), Aquatic Chronic 2 (H411) (1 notifier)	-	-
71-36-3	1-Butanol	9		Flam. Liq. 3 (H226) Acute Tox. 4 (H302) Skin Irrit. 2 (H315) Eye Dam. 1 (H318) STOT SE 3 (H335) STOT SE 3 (H336)	-	yes	-
62625-25-6	1-Butoxy-2-ethylhexane	2	Not registered in ECHA	-	-	-	-

CAS no.	Substance	Released from no. of prod.	Comment, e.g. information from ECHA	Harmonised classification	CLH notified classification (most of the listed)	Seveso subst.	SHVC
13475-82-6	2,2,4,6,6-Pentamethylheptane	1		Not classified	Flam. Liq. 3 (H226), Asp. Tox. 1 (H304), Aquatic Chronic 4 (H413) (137 +107 +40 notifiers) *Other hazards notified: STOT SE 3 (H336), (24 notifiers), Eye irrit. 2 (H319) (7 notifiers). Aquatic Acute 1 (H400), Aquatic Chronic 1(H410) (7 notifiers).*	-	-
78-67-1	2,2'-Azobis-(2-methylpropanenitrile)	2	Fundet under 2,2'-dimethyl-2,2'-azodipropiononitrile	Self-react. C (H242) Acute Tox. 4 * (H302) Acute Tox. 4 *(H332) Aquatic Chronic 3 (H412)	-	yes	-

CAS no.	Substance	Released from no. of prod.	Comment, e.g. information from ECHA	Harmonised classification	CLH notified classification (most of the listed)	Seveso subst.	SHVC
554-61-0 /586-62-9	2-Carene? Or perhaps terpinolen	2	DELTA - 2 -CARENE registered under: Reaction mass of (1S,6R)-3,7,7-trimethylbicyclo[4.1.0]hept-2-ene and (1R,6S)-3,7,7-trimethylbicyclo[4.1.0]hept-2-ene CAS number: 554-61-0 Terpinolene registered under: p-mentha-1,4(8)-diene . CAS: 586-62-9 Properties of concern: A majority of data submitters agree these substance are Skin sensitising	Not classified Not classified	Flam. Liq. 3 (H226), Asp. Tox. 1 (H304), Skin Irrit. 2 (H315), Skin Sens. 1B (H317), Aquatic Acute 1 (H400), Aquatic Chronic 2 (H411) (2 notifierts) Asp. Tox. 1 (H304), Skin Sens. 1B (H317), Aquatic Acute 1 (H400), Aquatic Chronic 1 (H410) (90 +161 notifiers) Flam. Liq. 3 (H226), Asp. Tox. 1 (H304), Skin Irrit. 2 (H315), Skin Sens. 1 (H317), Aquatic Chronic 2 (H411) (1289 notifiers) Flam. Liq. 3 (H226), Asp. Tox. 1 (H304),, Aquatic Chronic 2 (H411) (350 notifiers) *Other hazards notified: Eye Irrit. 2 (38 notifiers) and STOT SE 3 (1 notifier)*	- -	- -
542-58-5	2-Chlorethylacetat	1		Not classified	Flam. Liq. 3 (H226,) Acute Tox. 2 (H300), Acute Tox. 2 (H310), Acute Tox. 2 (H330) (39 +1 notifiers) Flam. Liq. 3 (H226,) Acute Tox. 2 (H300) (1 notifier)	-	-
7085-85-0	2-Cyanoethyl acrylat	16		Skin Irrit. 2 (H315), Eye Irrit. 2 (H319), STOT SE 3 (H335): STOT SE 3; H335: C ≥ 10 %	-	No	-

CAS no.	Substance	Released from no. of prod.	Comment, e.g. information from ECHA	Harmonised classification	CLH notified classification (most of the listed)	Seveso subst.	SHVC
104-76-7	2-Ethyl-1-hexanol	11		Not classified	Skin Irrit. 2 (H315), Eye Irrit. 2 H319, Acute Tox. 4 H332, STOT SE 3 H335, Aquatic Chronic 3 H412 (44+479 notfiers) Skin Irrit. 2 H315, Eye Irrit. 2 H319, Acute Tox. 4 H332, STOT SE 3 H335 (1106 notfiers) *Other hazards notified: STOT SE 3 H336 (7+4++3 notfier), Aquatic Chronic 2 (H411) (1 notifier)*	-	-
1632-16-2	2-Ethyl-1-hexene	4		Not classified	Flam. Liq. 3 H226, Skin Irrit. 2 H315, Aquatic Chronic 2 H411, (116 notifiers) Flam. Liq. 2 H225, Asp. Tox. 1 H304, Skin Irrit. 2 H315, Eye Irrit. 2 H319, Aquatic Chronic 2 H411. (1 notifier) *Other hazards notified: STOT SE 3 H335.*	-	-
103-09-3	2-Ethyl-1-hexylacetat	11	Substance included in the Community Rolling Action Plan (CoRAP).	Not classified	Skin Irrit. 2 H315 (1802 notifiers) Not classified (386 notifiers) *Other hazards notified: Eye irrit 2 H319 (3 notifiers)*	-	-

CAS no.	Substance	Released from no. of prod.	Comment, e.g. information from ECHA	Harmonised classification	CLH notified classification (most of the listed)	Seveso subst.	SHVC
123-05-7	2-Ethylhexanal	8	Properties of concern: A majority of data submitters agree this substance is Skin sensitising	Not classified	Flam. Liq. 3 (H226), Skin Sens. 1B (H317), Repr. 2 (H361) (1289 notifiers) Flam. Liq. 3 (H226), Skin Irrit. 2 (H315), Eye Irrit. 2 (H319) (201 Notifiers) Flam. Liq. 3 (H226), Skin Sens. 1B (H317), Repr. 2 (H361) (140 notifiers) *Other hazards notified: STOT SE 3 (H335). (57+24 notifiers).*	-	-
103-11-7	2-Ethylhexyl acrylat	7	Properties of concern: Skin sensitising	Skin Irrit. 2 H315, Skin Sens. 1 H317, STOT SE 3 H335	-	No	-
626-93-7	2-Hexanol	1		Not classified	Flam. Liq. 3 H226, Acute Tox. 4 H302, Acute Tox. 4 H312, Eye Irrit. 2 H319 (104 notifiers) Flam. Liq. 3 H226, Skin Irrit. 2 H315, Eye Irrit. 2 H319, STOT SE 3 H335. (66 + 38 + 36notifiers) *Other hazards notified: Acute tox. 4 (H302) (5 notifiers)*	-	-
868-77-9	2-Hydroxyethyl methacrylate	1	Properties of concern: Skin sensitising Substance included in the Community Rolling Action Plan (CoRAP).	Skin Irrit. 2 H315, Eye Irrit. 2 H319, Skin Sens. 1 H317	-	No	-

CAS no.	Substance	Released from no. of prod.	Comment, e.g. information from ECHA	Harmonised classification	CLH notified classification (most of the listed)	Seveso subst.	SHVC
79-41-4	2-Methylacrylsyre	1		Acute Tox. 4 * H302, Acute Tox. 4 *H312, Skin Corr. 1A H314 (STOT SE 3; H335: C ≥ 1 %)	-	No	-
122-99-6	2-Phenoxyethanol	2		Acute Tox. 4. H302, Eye. Dam. 1 H318, STOT SE 3 H335.	-	No	-
kan ikke finde	2-Propyl-1,3-dioxonan	1	Not registered in ECHA	-	-	-	-
53252-21-4	3,4-Dimethyl-3-hexen-2-one	1	Not registered in ECHA				
10534-44-8	3-Dehydroquinic acid (1,3,4-Trihydroxy-5-oxocyclohexanecarboxylic acid)	1	Not registered in ECHA				
15726-15-5	3-Methyl-4-heptanon	5		Not classified	Flam. Liq. 3 (H226) (1 notifier) Flam. Liq. 3 (H226), Skin Irrit.2 (H315), Eye Irrit.2a (H319), STOT SE3 (H335) (1 notifier)	-	-
32210-23-4	4-tert-Butylcyclohexyl acetate	2	Properties of concern: Some data submitters indicate they consider this substance as Skin sensitising	Not classified	Skin Sens. 1B H317 (2021 notifiers). Aquatic chronic 2 H411 (285 +92 notfiers) Skin Sens. 1 H317 , Aquatic chronic 2 H411 (72 notfiers) Skin Irrit. 2H315, Eye Irrit. 2 H319, STOT SE 3 H335 (38 notifiers).	-	-

CAS no.	Substance	Released from no. of prod.	Comment, e.g. information from ECHA	Harmonised classification	CLH notified classification (most of the listed)	Seveso subst.	SHVC
105-57-7	Acetal	1	Registered under 1,1-diethoxyethane Properties of concern: Some data submitters indicate they consider this substance as Skin sensitising	Flam. Liq 2 H225, Skin Irrit. 2 H315, Eye Irrit. 2 H319.	-	yes	-
673-84-7	Allo-Ocimene	1	Registered under 2,6-dimethylocta-2,4,6-triene Properties of concern: A majority of data submitters agree this substance is Skin sensitising	Not classified	Flam. Liq. 3 H226, Acute Tox. 4 H302, Asp. Tox. 1 H304, Skin Irrit. 2 H315, Skin Sens. 1 H317, Eye Irrit. 2 H319, Aquatic Chronic 2 H411 (1290 notifiers) Acute Tox. 4 H302, Asp. Tox. 1 H304, Skin Irrit. 2 H315, Eye Irrit. 2 H319, (241 notifiers) *Other hazards notified: Aquatic Acute 1 H400 (27 notifiers)*	-	-
128-37-0	BHT, 3,5-Di-tert-butyl-4-hydroxytoluene	1	CAS number for 2,6-di-tert-butyl-p-cresol (BHT) Properties of concern: Under assessment as Endocrine Disrupting	Not classified	Aquatic Chronic 1 H410 (2292 +476 notifiers) Aquatic Acute 1 H400, Aquatic Chronic 1 H410 (1737 +333 notifiers) *Other hazards notfied: Acute tox 4 (around 300 notifiers, STOT SE 3 (around 130 notifiers), STOT SE 1 (around 35 notifiers), STOT RE 2 (around 90 notifiers), Skin irrit 2 (around 200 notifiers), Skin sens 1 H317 (around 30 notifiers), Eye irrit. 2 H319 (around 250 notifiers´) and more*	-	-

CAS no.	Substance	Released from no. of prod.	Comment, e.g. information from ECHA	Harmonised classification	CLH notified classification (most of the listed)	Seveso subst.	SHVC
79-92-5	Camphen	4		Not classified	Flam. Sol. 2 H228, Eye Irrit. 2 H319, Aquatic Chronic 1 (H410) (135+13 notifiers) Flam. Sol. 1 H228, Asp. Tox. 1 H304, Eye Irrit. 2 H319, Aquatic Acute 1 H400, Aquatic Chronic 1 (H410) (1288 notifiers) Flam. Sol. 2 , Eye Irrit. 2 H319, Aquatic Acute 1 H400, Aquatic Chronic 1 (H410) (404notifiers)	-	-
76-22-2	Camphor	1			Flam. Sol. 2 H228'Skin Irrit. 2 H315, Eye Dam. 1 H318, Acute Tox. 4 H332, STOT SE 2 H371 (16 joint notifiers) Flam. Sol. 2 H228, Acute Tox. 4 H332, STOT SE 2 H371 (897 notifiers) Flam. Sol. 2 H228, Acute Tox. 4 H332, STOT RE 2 H373 (389 notifiers) *Other hazards notified: Aquatic Chronic 2 H411 (104 notifiers), Muta 2 (H341 1 notifier)*	-	-

CAS no.	Substance	Released from no. of prod.	Comment, e.g. information from ECHA	Harmonised classification	CLH notified classification (most of the listed)	Seveso subst.	SHVC
67-66-3	Chloroform	1	Properties of concern: Suspected to be Carcinogenic Suspected to be Toxic to Reproduction Some uses of this substance are restricted under Annex XVII of REACH.	Acute Tox. 4H302, Skin Irrit. 2 H315, Eye Irrit. 2 H319, Acute Tox. 3 H331, Carc. 2 H351, STOT RE 1 H372, Repr. 2 H361d	-	yes	-
3856-25-5	Copaene	2	CAS number for 8-isopropyl-1,3-dimethyltricyclo[4.4.0.02,7]dec-3-ene	Not classified	Asp. Tox. 1 H304 (1 notifier) Flam. Liq. 3 H226, Skin Irrit. 2 H315 (1 notifier)	-	-
541-02-6	Decamethylcyclopentasiloxane*	1	Properties of concern Persistent, Bioaccumulative and Toxic Under assessment as Persistent Organic Pollutant Substance of very high concern (SVHC) and included in the candidate list for authorisation. Some uses of this substance are restricted under Annex XVII of REACH.	Not classified	Not classified (4425 notifiers) Aquatic Chronic 4 (H413), (66 notifiers) Skin. Irrit. 2 (H315), 43 notifiers. Eye Irrit. 2 H319, Acute Tox. 3 H331, Aquatic Chronic 4 H413 (22 notifiers) *Other hazards notified: H304, H335, H361 (around 5 notifiers for each)*	-	Yes

CAS no.	Substance	Released from no. of prod.	Comment, e.g. information from ECHA	Harmonised classification	CLH notified classification (most of the listed)	Seveso subst.	SHVC
75-09-2	Dichloromethan	2	Properties of concern: Suspected to be Carcinogenic Under assessment as Endocrine Disrupting Substance included in the Community Rolling Action Plan (CoRAP). Some uses of this substance are restricted under Annex XVII of REACH.	Carc. 2 (H351)	-	no	-
5989-27-5	D-Limonen	4	Registered under (R)-p-mentha-1,8-diene Properties of concern: Skin sensitising	H410, Flam. Liq. 3 H226, Skin Irrit. 2 H315, Skin Sens. 1B H317, Asp. Tox. 1 H304, Aquatic Acute 1 H400, Aquatic Chronic 3 H412	-	no	-
540-97-6	Dodecamethylcyclohexasiloxane*	1	Properties of concern: Persistent, Bioaccumulative and Toxic, Under assessment as Persistent Organic Pollutant. Substance of very high concern (SVHC) and included in the candidate list for authorisation.	Not classified	Not classified (365 notifiers) Aquatic Chronic 4 H413 (72 notifiers) Eye Irrit.2 H319 (22 notifers) *Other hazards notified: Flam liq 3 (226 (1 notifier), Acute tox 3 (H331 (1 notifier) H304 (1 notifier).*	-	Yes
1572-99-2	Ethyl 2-cyanopropionate	2		Not classified	Acute Tox. 3 H301, Skin Irrit. 2 H315, Eye Irrit. 2 H319 (3 notifiers) Acute Tox. 3 H301, Skin Irrit. 2 H315, Eye Irrit. 2A H319 (1 notifiers)	-	-

CAS no.	Substance	Released from no. of prod.	Comment, e.g. information from ECHA	Harmonised classification	CLH notified classification (most of the listed)	Seveso subst.	SHVC
7452-79-1	Ethyl 2-methylbutyrate	1		Not classified	Flam. Liq. 3 H226 (1874 notifiers) *Other hazards notifed: Acute Tox 4 H302, Aquatic Chronic 2, H411, Skin. Irrit. 2 H315, Eye Irrit. 2 H319, STOS Se 3 H335 (all 1 notifier)*	-	-
105-37-3	Ethyl propanoate	1		Flam. Liq. 2 H225	-	yes	-
141-78-6	Ethylacetat	1		Flam. Liq. 2 H225, Eye Irrit. 2 H319, STOT SE 3, H336	-	yes	-
97-90-5	Ethylene glycol dimethacrylate	1	Properties of concern: Skin sensitizing	Skin Sens. 1H317, STOT SE 3; H335: C ≥ 10 %	-	no	-
97-62-1	ethylisobutyrat	1		Not classified	Flam. Liq. 2 H225, Skin Irrit. 2 H315, Eye Irrit. 2 H319 (29+4 notifiers) Flam. Liq. 2 H225 (1626 noptifiers) Flam. Liq. 2 H225, Skin Irrit. 2 H315, Eye Irrit. 2 H319, STOT SE 3 H335 (38 notifiers) *Other hazards notified: Aquatic Chronic 2 H411, 1 notifer)*	-	-

CAS no.	Substance	Released from no. of prod.	Comment, e.g. information from ECHA	Harmonised classification	CLH notified classification (most of the listed)	Seveso subst.	SHVC
541-05-9	Hexamethylcyclotrisiloxane*	1		Not classified	Flam. Sol. 1 H228 (336 notifiers) Not classified (479 notfiers) Other hazards notified: Skin. Irrit. 2 H315, Eye Irrit.2 .H319 STOT SE 3 H335 (11 notfiers for all) Flam. Sol. 2 (2 notifers)	-	-
5888-33-5	Isobornyl acrylate	1	Registered under Exo-1,7,7-trimethylbicyclo[2.2.1]hept-2-yl acrylate Properties of concern: Skin sensitising	Skin Sens. 1A H317	-	No	-
7534-94-3	iso-Bornyl methacrylate	1	Registered under Exo-1,7,7-trimethylbicyclo[2.2.1]hept-2-yl methacrylate	Not classfied	Aquatic Chronic 3 H412 (89 joint notifiers)	-	-
110-19-0	Isobutyl acetate	1		Flam. Liq. 2 H225	-	yes	-
473-19-8	Isocamphane, muligvis	1	Not registered in ECHA	-	-	-	-
67-63-0	Isopropanol	2		Flam. Liq. 2 H225. Eye Irrit. 2 H319, STOT SE 3 H336	-	yes	-
108-21-4	Isopropylacetat	2		Flam. Liq. 2 H225. Eye Irrit. 2 H319, STOT SE 3 H336	-	yes	-
2043-43-8	lactamid (2-Hydroxypropanamid)	2		Not classified	Skin Irrit. 2 H315. Eye Irrit. 2A H319, STOT SE 3 H336 (1 notifier)	-	-
78-70-6	Linalool	1	Properties of concern: Skin sensitising	Skin Sens. 1B H317	-	no	-
1124-27-2	menthene, 1-methyl-4-(1-methylethylidene)-cyclohexan	1	Findable in ECHA but with no data	-	-	-	-

CAS no.	Substance	Released from no. of prod.	Comment, e.g. information from ECHA	Harmonised classification	CLH notified classification (most of the listed)	Seveso subst.	SHVC
547-63-7	Methyl isobutyrate	6	Properties of concern: A majority of data submitters agree this substance is Skin sensitising	Not classified	Flam. Liq. 2 (H225) (1709 notifiers) Flam. Liq. 2 (H225), Acut tox 4 (H332) (39+4 notifiers) Flam. Liq 3 (H226), Acute Tox. 4 (H302), Skin Irrit. 2 (H315),Skin Sens. 1 (H317) (1 notifier)	-	-
80-62-6	Methyl methacrylate	18	Properties of concern: Skin sensitising	Flam. Liq. 2 (H225) Skin Irrit. 2 (H315) Skin Sens. 1 (H317) STOT SE 3 (H335)	-	yes	-
108-38-3	m-xylene	1	Substance included in the Community Rolling Action Plan (CoRAP).	Flam. Liq. 3 (H226) Acute Tox. 4 H312 Skin Irrit. 2 (H315) Acute Toc. 4 H332	-	yes	-
123-86-4	n-Butyl acetate	3		Flam. Liq. 3 (H226) STOT SE 3 (H336)	-	yes	-
141-32-2	n-Butyl acrylate	1	Properties of concern: Skin sensitising Substance included in the Community Rolling Action Plan (CoRAP).	Flam. Liq. 3 (H226) Skin Irrit. 2 (H315) Eye Irrit. 2 (H319) Skin Sens. 1 (H317) STOT SE 3 (H335)	-	yes	-
109-21-7	n-Butyl butanoate	3	Registered as Butyl butyrate	Flam. Liq. 3 H226	-	yes	-
142-96-1	n-Butyl ether	8	(Dibutyl ether)	Flam. Liq. 3 (H226) Skin Irrit. 2 (H315) Eye Irrit. 2 (H319) STOT SE 3 (H335) Aquatic Chronic 3 (H412)	-	yes	-
592-84-7	n-Butyl formate	1		Flam. Liq. 2 (H225) Eye Irrit. 2 (H319) STOT SE 3 (H335)	-	yes	-

CAS no.	Substance	Released from no. of prod.	Comment, e.g. information from ECHA	Harmonised classification	CLH notified classification (most of the listed)	Seveso subst.	SHVC
97-87-0	n-Butyl isobutyrate	1		Not classified	Flam. Liq. 3 (H226) (1604 notifiers). Flam. Liq. 3(H226) Skin Irrit. 2 (H315), Eye Irrit. 2 (H319), STOT SE 3 (H335) (38 notifiers)	-	-
590-01-2	n-Butyl propionat	8		Flam. Liq. 3 (H226)	H226(>1000notifiers) H226, H315, H318(38 notifiers)	yes	-
556-67-2	Octamethyltetrasiloxane (D4)*	1		Aquatic Chronic 1 H410, Repr. 2 H361f***	-	no	yes
527-84-4	o-Cymene	3		Not classified	Flam. Liq. 3 (H226) (67 notifiers). Flam. Liq. 3(H226), Aquatic Chronic 2 H 411(28 notifiers) *Other hazards notified: Acute tox. 4 H302 (6 notifiers) Skin Irrit. 2 H315 (1 notifier), Eye Irrit. 2 H319 (1 notifier)*	-	-
95-50-1/ 541-73-1/ 106-46-7	o-Dichlorobenzene, eller m- eller p-	1	1,2 Dichlorobenzene (CAS 95-50-1) 1,3-dichlorbenzene (CAS: 541-73-1) 1,4-Dichlorbenzene (CAS 106-46-7)	Acute Tox. 4 *H302, Skin Irrit. 2 H315 Eye Irrit. 2 H319 STOT SE 3 H335 Aquatic Acute 1 H400 Aquatic Chronic 1 H410 Acute Tox. 4 *H302, Aquatic Chronic 2 H411 Eye Irrit. 2 H319 Carc. 2 H351 Aquatic Acute 1 H400 Aquatic Chronic 1 H410	- - -	yes yes yes	- - -

CAS no.	Substance	Released from no. of prod.	Comment, e.g. information from ECHA	Harmonised classification	CLH notified classification (most of the listed)	Seveso subst.	SHVC
95-47-6	o-xylene	1	Substance included in the Community Rolling Action Plan (CoRAP).	Flam. Liq. 3 H226 Acute Tox. 4 * H312 Skin Irrit. 2 H315 Acute Tox. 4 * H332	-	yes	-
1195-32-0	p-Cymenene	1	Registered as p,α-dimethylstyrene	Not classified	Asp. Tox. 1 H304 (1286 notifiers) Not classified (104 notifiers) *Other hazards notified:Skin irrit. 2 H315 , Eye Irrit. 2 H319, STOT SE 3 H335 (38 notified. Aquatic Chronic 2H411 (29 notified)*	-	-
110-62-3	Pentanal	1	Registered as valeraldehyde Properties of concern: A majority of data submitters agree this substance is Skin sensitizing	Not classified	Flam. Liq. 2 H225, Skin Sens. 1 H317, Eye Irrit. 2 H319, Acute Tox. 4 H332, STOT SE 3 H335 (57+1287 notifiers) Flam. Liq. 2 H225, Skin Irrit. 2 H315, Eye Irrit. 2 H319, Acute Tox. 4 H332 (259 notifiers) *Other reported hazards: Eye dam 1 H318 (38 notifiers)*	-	-
106-42-3	p-xylene	1	Substance included in the Community Rolling Action Plan (CoRAP).	Flam. Liq. 3 H226 Acute Tox. 4 * H312 Skin Irrit. 2 H315 Acute Tox. 4 * H332	-	yes	-

CAS no.	Substance	Released from no. of prod.	Comment, e.g. information from ECHA	Harmonised classification	CLH notified classification (most of the listed)	Seveso subst.	SHVC
586-62-9	terpinolen	2	Registered under p-mentha-1,4(8)-diene Properties of concern: A majority of data submitters agree this substance is Skin sensitising	Not classified	Asp. Tox. 1 H304, Skin Sens. 1B H317, Aquatic Acute 1 H400, Aquatic Chronic 1 H410 (97 notifiers) Flam. Liq. 3 H226, Asp. Tox. 1 H304, Skin Irrit. 2. H315, Skin Sens. 1 H317, Aquatic Chronic 2 H411 (1289 notifiers) *Other reported hazards: Eye Irrit. 2 H319*	-	-
142-68-7	Tetrahydropyran	1		Not classified	Flam. Liq. 2 H225, , Skin Irrit. 2. H315, Eye Irrit. 2 H319,STOT SE 3 H335 (38 notifiers)	-	-
108-88-3	Toluene	4	Properties of concern: Some data submitters indicate they consider this substance as Carcinogenic Some data submitters indicate they consider this substance as Mutagenic Suspected to be Toxic to Reproduction Substance included in the Community Rolling Action Plan (CoRAP). Some uses of this substance are restricted under Annex XVII of REACH.	Flam. Liq. 2 (H225) Skin Irrit. 2 (H315) Asp. Tox. 1 (H304) STOT SE 3 (H336) STOT RE 2 * (H373 **) Repr. 2 (H361d ***)	-	yes	-
508-32-7	Tricyclen	3	Registered in ECHA as 1,7,7-trimethyltricyclo[2.2.1.02,6]heptane	Not classified	Not Classified (79 notifiers) Aquatic Acute 1 H400 ,Aquatic Chronic 1 H410 (39 notifiers) ASP. Tox. 1 (H304) (18 notifiers)	-	-

CAS no.	Substance	Released from no. of prod.	Comment, e.g. information from ECHA	Harmonised classification	CLH notified classification (most of the listed)	Seveso subst.	SHVC
1120-21-4	Undecane	3		Not classified	Asp. Tox 1. H304 (1749+286 notifiers) *Other notified hazards: Flam. Liq. 3 H226, Skin Irrit. 2, Aquatic Chronic 4 H413 (13 notifiers), Ey irrit .2 H319 STOT SE 3 (6 notifiers), Aquatic Acute 1H400 Aquatic Chronic 1 (1 notifier)*	-	-
99-83-2	α-Phellandrene or similar	2	Registered in ECHA as p-mentha-1,5-diene	Not classified	Flam. Liq. 3 (H226) , Asp. Tox 1. H304 (1573 notifiers) Flam. Liq. 3 H226, Acute Tox. 4 H302, Skin Irrit. 2 H315,Eye Irrit. 2 H319, Resp. Sens. 1 H334, STOT SE 3 H335 (38 notifiers) *Other notified hazards:L Aquatic Acute 1 H400, Aquatic Chronic 1 H410, (29 notifiers)*	-	-
99-83-2/2867-05-2	α-Phellandrene/3-Thujene	2	For CAS 99-83-2, see above. 3-Thujene registered as 5-isopropyl-2-methylbicyclo[3.1.0]hex-2-ene with CAS: 2867-05-2 Properties of concern: A majority of data submitters agree this substance is Skin sensitising	Not classified	Flam. Liq. 3 (H226) , Skin sens. 1 H317 (2 joint notifiers) Flam. Liq. 3 (H226) (14 notifiers) *Other hazards reported: Acute Tox. 4 H403, Asp. Tox.4 H304, Skin Irrit. 2 H317, Aquatic Chronic 2 H411, Acuatic Chronig 2 H411 (2 notifiers for al)*	-	-

CAS no.	Substance	Released from no. of prod.	Comment, e.g. information from ECHA	Harmonised classification	CLH notified classification (most of the listed)	Seveso subst.	SHVC
80-56-8	α-Pinene	4	Properties of Concern: A majority of data submitters agree this substance is Skin sensitising	Not classified	Flam. Liq. 3 (H226), Acute Tox. 4 (H302), Asp. Tox. 1 (H304), Skin Irrit. 2(H315), Skin Sens. 1B(H317), Aquatic Acute 1 (H400), Aquatic Chronic 1 (H410) (137 notifiers) Flam. Liq. 3 (H226) , Skin Irrit. 2 (H315), Eye dam. 1 (H318) (474 notifiers) Flam. Liq. 3 (H226), Asp. Tox. 1 (H304), Skin Irrit. 2(H315), Skin Sens. 1 (H317), Aquatic Acute 1 (H400), Aquatic Chronic 1 (H410) (392 notifiers) H226, H304, H315, H317 (247 notifiers) *Other hazards notified: H319.*	-	-
98-55-5	α-Terpineol	1	Registered as p-menth-1-en-8-ol	Not classified	Skin Irrit. 2 H315, Eye Irrit. 2 H319 (2240 notifiers) Skin Irrit. 2 H315, Eye Irrit.2 H319 , STOT SE 3H335 (38notifiers)	-	-
497-32-5	β-Fenchene (2,2-dimethyl-5-methylene-norbornan)	1	Not registered in ECHa under the given CAS	-	-	-	-

CAS no.	Substance	Released from no. of prod.	Comment, e.g. information from ECHA	Harmonised classification	CLH notified classification (most of the listed)	Seveso subst.	SHVC
123-35-3	β-Myrcene	1	Registerd in ECHA as 7-methyl-3-methyleneocta-1,6-diene Properties of concern: Some data submitters indicate they consider this substance as Skin sensitising	Not classified	Flam. Liq. 3 H226,Asp. Tox. 1 H304,Skin Irrit. 2 H315,Skin Sens. 1B H317,Eye Irrit. 2 H319,Aquatic Acute 1 H400, Aquatic Chronic 2 H411 (73 joint notifiers) Flam. Liq. 3 H226,Asp. Tox. 1 H304,Skin Irrit. 2 H315 ,Eye Irrit. 2 H319,Aquatic Acute 1 H400,Aquatic Chronic 2 H411 (43 joint notifiers) Flam. Liq. 3 H226,Asp. Tox. 1 H304,Skin Irrit. 2 H315,Eye Irrit. 2 H319,(1527 joint notifiers)	-	-
127-91-3	β-Pinene	3	Registered in ECHA as Pin-2(10)-ene Properties of concern: A majority of data submitters agree this substance is Skin sensitising	Not classified	Flam. Liq. 3 H226,Asp. Tox. 1 H304, Skin Irrit. 2 H315,Skin Sens. 1 H317 (1563 notifiers) Flam. Liq. 3 H226,Asp. Tox. 1 H304, Skin Sens. 1 H317, Aquatic Acute 1 H400, Aquatic Chronic 1 H410 (285 notifiers)	-	-
99-85-4	γ-Terpinene	1	Registered in ECHA as p-mentha-1,4-diene	Not classified	Flam. Liq. 3 H226, Repr. 2 H361, Aquatic Chronic 2 H411(91 joint notifiers) Flam. Liq. 3 H226,Asp. Tox. 1 H304, (1758 notifiers) *Other reported hazards: Skin. Irrit. 2 H315, Eye Irrit. 2. H319, STOT SE 3 H335. (38 notifiers)*	-	-

TABLE 28. Overview of the declared substances, which were on the packaging of the purchased adhesives, but not identified by the headspace GC-MS screening. The number of products in which they are present, as well as the classification of the substances, are listed.

CAS nr.	Substance	Declared in no. of products	Comment, e.g. information from ECHA	Harmonised classification	CLH notified classification (most of the listed)	Seveso subst.	SHVC
67-56-1	Methanol	1	Substance included in the Community Rolling Action Plan (CoRAP). Some uses of this substance are restricted under Annex XVII of REACH.	Flam. Liq. 2 H225 Acute Tox. 3 * H301 Acute Tox. 3 * H311 Acute Tox. 3 * H331 STOT SE 1; H370: C ≥ 10 % STOT SE 2; H371: 3 % ≤ C < 10 %	-	yes	-
25013-16-5	BHA Butylated hydroxyanisole (tert-butyl-4-methoxyphenol)	2		-	Eye Irrit. 2 H319, Carc. 2 H351 (226 notifiers) Skin Irrit. 2 H315, Eye Irrit. 2 H319, Carc. 2 H351, Repr. 2 H361f (104 notifiers) *Other reported hazards: Eye Dam. 1 H318 (38 notifiers)*	-	-
7637-07-2	Boron trifluoride	1	Not allowed in cosmetic products	Press. Gas Skin Corr. 1A H314 Acute Tox. 2 *H330	-	yes	-
99-76-3	Methylparaben	1	Methyl 4-hydroxybenzoate Substance included in the Community Rolling Action Plan (CoRAP). Properties of concern: Under assessment as Endocrine Disrupting	Not classified	Aquatic Chronic 2 H411 (255 joint entries) Skin Irrit. 2H315, Eye Irrit. 2 H319, STOT SE 3 (H335) (1355 notifiers) Not classified (1038 notifiers) *Other reported hazards: Aquatic Chronic 3 H412 (221 notifiers)*	-	-

CAS nr.	Substance	Declared in no. of products	Comment, e.g. information from ECHA	Harmonised classification	CLH notified classification (most of the listed)	Seveso subst.	SHVC
84434-11-7	Ethyltrimethylbenzoyl Phenylphosphinate	1	Ethyl phenyl(2,4,6-trimethylbenzoyl)phosphinate Properties of concern: A majority of data submitters agree this substance is Skin sensitizing	-	Skin Sens 1B H317, Aquatic Chronic 2 H411 (2324 joint entries) Aquatic Chronic 3 (78 notifiers)	-	-

Survey and risk assessment of beauty product adhesives

This project sought to survey the use of adhesives for beauty products – specifically, adhesives for artificial nails, artificial eyelashes and facial decorations (e.g., to apply stones or glitter to the skin). It focused on transparent adhesives, as from a regulatory perspective, only coloured adhesives fall under the Cosmetic Products Regulation. Transparent adhesives are instead covered by legislation for chemical mixtures (i.e., the REACH and CLP regulations).

A small user survey was conducted among primarily young people under the age of 25 regarding their use of adhesives for beauty products and discomfort experienced when using them. Ingredients in adhesives for beauty products were investigated through a market survey, literature search and chemical analyses of selected purchased adhesives.

The user survey conducted showed that 15% of the respondents had experienced discomfort on one or more occasions when using beauty product adhesives. In addition, 17% of respondents knew someone who had experienced discomfort or allergic reactions when using beauty product adhesives. A literature search confirmed that allergic reactions and chemical burns are particularly common when using nail or lash adhesives. The survey of ingredients in the different types of beauty product adhesives showed that nail and lash adhesives contain acrylates and at large concentrations, whereas skin adhesives typically do not contain acrylates at all.

The chemical analyses carried out showed that several of the nail and lash adhesives tested release formaldehyde, which is allergenic. Some adhesives have such a low pH that they may be corrosive or irritating. There is a demonstrated risk of sensitisation (i.e., the development of an allergy) to formaldehyde with normal, foreseeable use of two of the tested nail adhesives. A person who is already sensitised to either acrylates or formaldehyde could have a reaction to a large majority of these adhesives. A low pH could also promote the sensitising effect.

A review of the differences in legislation and identified problematic substances in transparent adhesives shows that consumers are generally disadvantaged, as transparent adhesives are covered by the REACH and CLP Regulations rather than the Cosmetic Products Regulation. As adhesives are sold as indispensable accessories for cosmetic products, it would therefore make sense for these adhesives to also be considered cosmetic products.

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