Danish Ministry of the Environment
Environmental Protection Agency

Survey of 1,6-hexanediol diglycidyl ether in Building Materials for Consumers and in Toys

A LOUS 2012-2015 follow-up project

Environmental Project No. 1582, 2014

Title:

Survey of 1,6-hexanediol diglycidyl ether in Building Materials for Consumers and in Toys

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Foreword

This project ”Survey of 1,6-hexanediol diglycidyl ether in Building Materials for Consumers and in Toys” was carried out from September 2013 till December 2013. The project is a part of the Danish Environmental Protection Agency’s (EPA’s) LOUS project 2012-2015.

The List of Undesirable Substances (LOUS) was established by the Danish EPA as a guide for enterprises. It indicates substances of concern, based on their use tonnage and their dangerous properties. The latest version of LOUS from 2009 includes 40 chemical substances and groups of substances [DEPA 2011].

During the period 2012-2015, all substances listed on LOUS will be surveyed and further need for risk management measures will be evaluated. In certain cases, implementation projects will be launched to achieve the goals laid down in the strategies for these substances.

This report describes the procedure and the results of the survey of 1,6-hexanediol diglycidyl ether in consumer products including do-it-yourself (DIY) building materials and toys in Denmark. The project was financed by the Danish EPA.

The project was carried by the Danish Technological Institute (DTI). Participants from DTI were Eva Jacobsen (project manager), Karen Krzywkowski, Inge Bondgaard Nielsen and Ulla Christensen. Quality assurance was carried out by Eva Jacobsen.

The progress, development and results of the project were assessed by an advisory group consisting of the following persons:

Lea Stine Tobiassen, Danish EPA
Jette Heltved Larsen, Danish EPA
Eva Jacobsen, DTI

Summary and Conclusion

The substance 1,6-hexanediol diglycidyl ether is included on the List of Undesirable Substances (LOUS) from 2009 established by the Danish EPA, due to QSAR data indicating its potential as a carcinogen.

This project "Survey of 1,6-hexanediol diglycidyl ether in Building Materials for Consumers and in Toys" was initiated by the Danish EPA as a follow-up on a previous LOUS 2012-2015 project "Survey of 1,6-hexanediol diglycidyl ether" [DEPA 2013a]. Here, the dominant function of 1,6-hexanediol diglycidyl ether was reported to be as a reactive diluent in epoxy systems. The survey indicated that the substance may be found in do-it-yourself (DIY) building materials, such as adhesives and paints, and in modelling clay.

For the present survey, data/information was obtained from contact to sector-specific associations within the areas of building materials and toys/hobby materials as well as to relevant manufactures, importers and retailers. Information was also retrieved from databases and home pages of regulatory authorities and internet searches for e.g. literature, products and MSDSs. Furthermore, access to REACH registration reports was obtained via the Danish EPA (no confidential information is included in this report). Finally, 15 consumer products were selected and analysed for content of 1,6-hexanediol diglycidyl ether.

The use of 1,6-hexanediol diglycidyl ether as a reactive diluent in epoxy systems, typically epoxy coatings and adhesives, was confirmed by a representative of the Danish Coatings and Adhesives Association (DFL). Only one of the responding DFL members confirmed the use of 1,6-hexanediol diglycidyl ether and only in industrial products. Similarly, some members of the European Council of producers and importers of paints, printing inks and artists' colours (CEPE) responded that the substance may be present only in some professional products.

Enquiries regarding the content of 1,6-hexanediol diglycidyl ether in consumer products were also directed to 17 manufacturers, importers or retailers of various marine/building materials and specifically of epoxy products. One retailer of various DIY products reported that a single product within their product range, a two-component epoxy floor coating, contains 1,6-hexanediol diglycidyl ether. The remaining responders stated that they do not sell epoxy products, that their products do not contain reactive diluents, that a number of brands do not include the reactive diluent 1,6-hexanediol diglycidyl ether or that their products are intended solely for professionals. Only one retailer did not respond to the enquiry.

Fifteen different two-component epoxy products (16 epoxy resins in total) intended for the private consumer were purchased for chemical analysis for content of 1,6-hexanediol diglycidyl ether. In this process, an additional three products were identified to contain the substance according to the declaration from an available MSDS or from the product label: an additional epoxy floor coating, a coating/filler for yachts, and a primer for treatment of concrete/masonry prior to epoxy treatment.

Six of the 16 analysed resins were found to contain 1,6-hexanediol diglycidyl ether and the concentration ranges between 0.3-17.7% (w/w). The chemical analysis confirmed the content of 1,6-hexanediol diglycidyl ether in the four products that were declared to contain the substance. The concentrations (in the epoxy resin) were determined to be 10.3% and 1.4% (w/w) in the two floor coatings, 17.7% (w/w) in the marine coating/filler and 11.3% (w/w) in the concrete primer. An

additional marine filler was found to contain 4.4% (w/w) of 1,6-hexanediol diglycidyl ether, and 0.3% (w/w) of 1,6-hexanediol diglycidyl ether was detected in a laminating epoxy. The remaining ten epoxy resins were not found to contain 1,6-hexanediol diglycidyl ether in detectable amounts.

In relation to modelling clay, a total of seven members of two associations for toys and hobby materials responded to our enquiry and stated that their products do not contain 1,6-hexanediol diglycidyl ether. The Danish Toy Association (LF) also provided the information that 1,6-hexanediol diglycidyl ether is not a substance expected to be found in toys. Furthermore, the substance is not declared in a number of safety data sheets for modelling clay or similar toys that were retrieved from the internet.

Seven chemical safety reports (CSRs) concerning 1,6-hexanediol diglycidyl ether were looked through for exposure scenarios relating to children's exposure, however, none were found. The reports were also searched for the words "child", "toy" and "modelling clay". Only the latter term was found and only once in each report, in a description of a general product category: "PC 9b: Fillers, putties, plasters, modelling clay". In this context, the term "modelling clay" seems to be a material for model making rather than play dough for children.

In conclusion, the prevalence of the use of the reactive diluent 1,6-hexanediol diglycidyl ether in DIY building materials on the Danish market appears to be limited. The substance seems to be used mainly in some two-component epoxy systems such as floor coatings and fibreglass repair products. Because of their function the identified products are evaluated probably not to be used at a high frequency by private consumers in Denmark. Contents of 1,6-hexanediol diglycidyl ether in the concentration range 0.3-17.7% (w/w) was identified through analysis of six out of 15 building materials accessible also to consumers. The identified products are of a type that is not expected to be used with a high frequency by private consumers in Denmark.

The term "modelling clay" is ambiguous and it appears from the results of this survey that the substance 1,6-hexanediol diglycidyl ether is not used in modelling clay (play dough) intended as a toy for children.

Sammenfatning og konklusion

Stoffet 1,6-hexanedioldiglycidylether er optaget på Miljøstyrelsens Liste over Uønskede Stoffer (LOUS) fra 2009 på baggrund af QSAR-data, der indikerer potentielt kræftfremkaldende egenskaber ved stoffet.

Dette projekt "Survey of 1,6-hexanediol diglycidyl ether in Building Materials for Consumers and in Toys" blev igangsat af Miljøstyrelsen som opfølgning på et tidligere projekt under LOUS 2012-2015 "Survey of 1,6-hexanediol diglycidyl ether" [DEPA 2013a]. Her blev hovedfunktionen af 1,6-hexanedioldiglycidylether rapporteret at være som reaktiv fortynder i epoxysystemer. Kortlægningen pegede på, at stoffet muligvis findes i gør-det-selv byggevarer såsom lim og maling samt i modellervoks.

Data/information til denne kortlægning blev indhentet gennem kontakt til brancheorganisationer inden for bygge-/byggevareområdet og legetøj/hobbymaterialer samt til relevante producenter, importører og forhandlere. Informationer blev også indhentet fra databaser og hjemmesider for regulatoriske myndigheder samt fra internetsøgninger efter bl.a. litteratur, produkter og sikkerhedsdatablade. Desuden opnåedes adgang til REACH registreringsrapporter gennem Miljøstyrelsen (denne rapport indeholder ingen konfidentiel information). Endelig blev 15 forbrugerprodukter udvalgt og analyseret for indhold af 1,6-hexanedioldiglycidylether.

Anvendelsen af 1,6-hexanedioldiglycidylether som reaktiv fortynder i epoxysystemer, typisk epoxy-malinger og lime, blev bekræftet af en repræsentant for brancheforeningen Danmarks Farve- og Limindustri (DFL). Kun et enkelt af de responderende DFL-medlemmer bekræftede brugen af 1,6-hexanedioldiglycidylether og det kun i industrielle produkter. Tilsvarende oplyste nogle af medlemmerne af "The European Council of producers and importers of paints, printing inks and artists' colours" (CEPE), at stoffet kan indgå i visse produkter til professionelle.

Forespørgsler vedrørende indhold af 1,6-hexanedioldiglycidylether i forbrugerprodukter blev også rettet til 17 producenter, importører eller forhandlere af forskellige byggevarer/maritime produkter og af epoxyprodukter specifikt. En forhandler af forskellige gør-det-selv produkter svarede, at et enkelt af produkterne i deres sortiment, en tokomponent epoxygulvmaling, indeholder 1,6-hexanedioldiglycidylether. De øvrige, der svarede, oplyste, at de enten ikke forhandler epoxyprodukter, at deres produkter ikke indeholder reaktive fortyndere, at et antal varemærker ikke indeholder den reaktive fortynder 1,6-hexanedioldiglycidylether eller at deres produkter alene henvender sig til professionelle. Kun en enkelt forhandler svarede ikke på henvendelsen.

Femten forskellige tokomponent epoxyprodukter (16 epoxy-resiner i alt) beregnet for private forbrugere blev indkøbt med henblik på kemisk analyse for indhold af 1,6-hexanedioldiglycidylether. I denne forbindelse blev yderligere tre produkter identificeret med indhold af stoffet iht. deklarationen fra tilgængelige sikkerhedsdatablade eller fra produktets mærkat: endnu en epoxygulvmaling, en maling/spartel til sejlbåde og en grunder til behandling af beton/murværk forud for epoxybehandling.

Seks af de 16 analyserede resiner viste sig at indeholde 1,6-hexanedioldiglycidylether og koncentrationen ligger i intervallet 0,3-17,7 % (w/w). Den kemiske analyse bekræftede indholdet af 1,6-hexanedioldiglycidylether i de fire produkter, der ifølge deklarationen indeholder stoffet. Koncentrationerne (i epoxy-resinet) blev bestemt til 10,3 % and 1,4 % (w/w) i de to gulvmalinger,

17,7 % (w/w) i skibsmalingen/-spartlen og 11,3 % (w/w) i betongrunderen. Endnu en marin spartel blev fundet at indeholde 4,4 % (w/w) af 1,6-hexanedioldiglycidylether, og 0,3 % (w/w) af 1,6-hexanedioldiglycidylether blev detekteret i en lamineringsepoxy. De resterende ti epoxy-resiner indeholder ikke målbare mængder af 1,6-hexanedioldiglycidylether.

I relation til modellervoks svarede i alt syv medlemmer fra to brancheorganisationer for legetøj og hobbymaterialer på forespørgslen og oplyste, at deres produkter ikke indeholder 1,6-hexanedioldiglycidylether. Legetøjsbranchens Fællesråd (LF) oplyste også, at 1,6-hexanedioldiglycidylether ikke er et stof, som man ville forvente at finde i legetøj. Stoffet er desuden ikke deklareret i et større antal sikkerhedsdatablade for modellervoks og tilsvarende legetøj, der blev fundet via internettet.

Syv kemiske sikkerhedsrapporter (CSR-rapporter) vedrørende 1,6-hexanedioldiglycidylether blev screenet for eksponeringsscenarier, der relaterede til eksponering af børn, men sådanne blev ikke fundet. En søgning i rapporterne efter ordene ”child” (”barn”), ”toy” (”legetøj”) og ”modelling clay” (”modellervoks”) blev også foretaget. Kun sidstnævnte udtryk blev fundet, og det kun én gang i hver af rapporterne, i en angivelse af en generel produktkategori: “ PC 9b: Fyldstoffer, kit, puds, modellervoks”. I denne sammenhæng synes udtrykket ”modellervoks” at angive et materiale, der anvendes til at lave modeller snarere end at være modellervoks til børns leg.

Sammenfattende synes udbredelsen af brugen af den reaktive fortynder 1,6-hexanedioldiglycidyl-ether i gør-det-selv byggevarer på det danske marked at være begrænset. Stoffet anvendes hovedsageligt i visse tokomponent epoxysystemer, såsom gulvmalinger og produkter til reparation af glasfiber. Der blev påvist indhold af 1,6-hexanediol diglycidyl ether i 6 ud af 15 bygningsprodukter, der også er tilgængelige for den private forbruger, i koncentrationer på 0,3 til 17,7 % (w/w). De identificerede produkter forventes af pba deres funktion ikke at blive anvendt med stor hyppighed af de private forbrugere i Danmark.

Udtrykket ”modelling clay” (”modellervoks”) er tvetydigt, og ud fra resultaterne af denne kortlægning vurderes det, at stoffet 1,6-hexanedioldiglycidylether ikke anvendes i modellervoks, der er påtænkt som legetøj for børn.

1. Background

The List of Undesirable Substances (LOUS) was established by the Danish Environmental Protection Agency (EPA) as a guide for enterprises. It indicates substances of concern, based on their dangerous properties and their use of more than 100 tonnes per year in Denmark.

The substance 1,6-hexanediol diglycidyl ether (HDDGE), CAS no. 16096-31-4, was included on the LOUS 2009 list[1] due to its potential carcinogenic properties according to QSAR[2] data [DEPA 2011].

As a part of the Danish EPA's LOUS 2012-2015 project, a project "Survey of 1,6-hexanediol diglycidyl ether" was performed [DEPA 2013a]. The conclusion of this survey was that the available knowledge on 1,6-hexanediol diglycidyl ether is limited. Identified data gaps include detailed knowledge on application of 1,6-hexanediol diglycidyl ether and consumption by application area. The dominant function of the substance was reported to be as a reactive diluent, in particular in relation to epoxy systems. The survey indicated that the substance may be found in do-it-yourself (DIY) building products, such as adhesives and paints, and in modelling clay. However, no information on the availability of such products on the Danish market was retrieved [DEPA 2013a].

From the publicly available REACH[3] registration [ECHA 2013a], it appeared that 1,6-hexanediol diglycidyl ether may be used in modelling clay for consumers, although it was not clear what the term covered. Due to the linguistic ambiguity, the Danish EPA decided to investigate whether the potential use in modelling clay also covered the modelling clay used as a toy for children.

Based on the results of the initial survey, this project "Survey of 1,6-hexanediol diglycidyl ether in building materials for consumers and in toys" was initiated by the Danish EPA in 2013 as a LOUS follow-up project.

1.1 Objective of the Survey

The objective of this survey is to identify consumer products on the Danish market that contain the substance 1,6-hexanediol diglycidyl ether in the product groups of DIY building materials and in toys such as modelling clay. For both product groups, specific products containing 1,6-hexanediol diglycidyl ether should be identified. If possible, the concentration levels of the substance in the products should be established.

If, in consultation with the Danish EPA, it is judged relevant, selected products within building materials and toys will be purchased for analytical determination of the content of 1,6-hexanediol diglycidyl ether.

[1] LOUS 2009 is based on tonnage registrations to the Danish Product Registry in 2007-08

[2] Quantitative structure–activity relationship. Mathematical models used to estimate chemical properties by grouping structurally related chemicals into categories and thus fill gaps in e.g. toxicity data needed for assessing the hazard of chemicals.

[3] Registration, Evaluation, Authorisation and Restriction of Chemical substances. REACH is an EU regulation on chemicals that entered into force on 1st June 2007 (Regulation (EC) No 1907/2006 of the European Parliament and of the council) http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2006:396:0001:0849:EN:PDF

1.2 Delimitation of the Survey

The survey of 1,6-hexanediol diglycidyl ether published by the Danish EPA in 2013 [DEPA 2013a] is used as a starting point for this follow-up project as this report identified epoxy systems as a major category in which the substance is used. The potential use of 1,6-hexanediol diglycidyl ether in modelling clay for consumers is mentioned in that report based on publicly available information from the REACH registration [ECHA 2013a].

This survey focuses on two-component epoxy-based building materials including boatbuilding materials and home improvement and repair products (paints, adhesives, fillers, and binders). In addition, certain toys such as modelling clay and other viscous products, e.g. slime, are included.

This survey is limited to include products containing only uncured epoxy systems as the level of unreacted material remaining in the final (fully cured) product is negligible and would therefore not present a health risk [DOW 2012; Hathaway and Proctor 2004; CDC 1978]. Full curing, however, may take several days at room temperature [Hathaway and Proctor 2004]. Issues in relation to unreacted residual monomers of 1,6-hexanediol diglycidyl ether in the final product are not covered by this report.

1.3 Description of 1,6-hexanediol diglycidyl ether

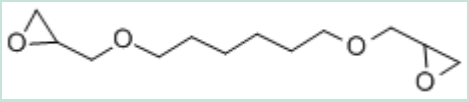
1,6-hexanediol diglycidyl ether is an aliphatic ether compound with epoxide/oxirane groups at each end, see Fact box 1.

Fact box 1: 1,6-hexanediol diglycidyl ether

CAS no: 16096-31-4 EC no: 240-260-4 EC name: 1,6-bis(2,3-epoxypropoxy)hexane

Molecular formula: $C_{12}H_{22}O_4$

Structural formula [Chemical Book 2013]:



The substance 1,6-hexanediol diglycidyl ether does not have a harmonised classification and it is therefore not included in Annex VI of the CLP[4] regulation (Regulation (EC) No 1272/2008). Most notifiers under REACH have classified 1,6-hexanediol diglycidyl ether as a skin and an eye irritant as well as a skin sensitizer according to the European Chemicals Agency's (ECHA's) self-classification list (C&L[5] Inventory). Furthermore, the substance is self-classified by most manufacturers/importers as an aquatic chronic toxicant. Classification for the end-point of carcinogenicity is not included in the C&L Inventory. 95 (22%) of 427 notifiers do not assign any hazard statement codes [ECHA 2013b].

1.4 Usage of 1,6-hexanediol diglycidyl ether

The substance 1,6-hexanediol diglycidyl ether is used as a reactive diluent. Reactive diluents are generally used in epoxy systems to reduce the viscosity of the base resin for improved handling or

[4] Classification, Labelling and Packaging
[5] Classification & Labelling

ease of processing. The epoxy groups of reactive diluents can react with the curing agents to become part of the cross-linked epoxy system. Reactive diluents are used for formulating solvent free paint and coating compounds. They can also be used to improve performance properties such as impact strength, adhesion, flexibility, filler-loading and solvent resistance of the epoxy system [epotec 2013]. The areas of application include civil engineering[6] projects, structural composites[7], adhesives, marine and protective coatings, and potting and encapsulation of electronic components [DOW 2012; Spolchemie 2013].

The di-functional reactive diluent 1,6-hexanediol diglycidyl ether, i.e. containing two reactive groups per molecule (see Fact box 1), is particularly used as a reactive diluent for high viscosity epoxy resins. The di-functionality of 1,6-hexanediol diglycidyl ether entails improved reactivity, and it also helps to produce formulations with improved toughness and to retain to a large extent the chemical resistance characteristics of the system [epotec 2011; DOW 2013].

The substance 1,6-hexanediol diglycidyl ether is registered to ECHA within a tonnage band of 1,000-10,000 tonnes per year [ECHA 2013a]. It is registered with identified "Consumer uses" within three product categories (PCs):

PC 1: Adhesives, sealants
PC 9a: Coatings and paints, thinners, paint removers
PC 9b: Fillers, putties, plasters, modelling clay

DIY consumer applications are specified as "Adhesives and Paints".

The database, Substances in Preparations in Nordic Countries (SPIN), contains non-confidential information on substances from the Product Registries of Norway, Sweden, Finland and Denmark [SPIN2000.net 2013]. From these data, a graphical illustration of the amounts of 1,6-hexanediol diglycidyl ether used per year in Denmark and the other Nordic countries is generated, see Figure 1. It appears that the use of the substance peaked in 2006 and 2007 in Denmark at more than 500 tonnes, after which it was reduced to approximately one tenth and reached a steady level.

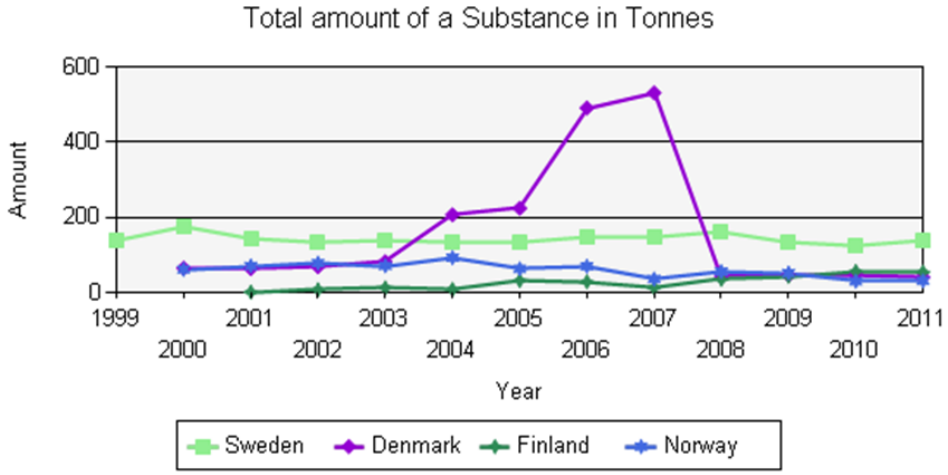


FIGURE 1
THE TOTAL AMOUNT OF 1,6-HEXANEDIOL DIGLYCIDYL ETHER USED IN DENMARK AND OTHER NORDIC COUNTRIES ACCORDING TO DATA FROM THE SPIN DATABASE [SPIN2000.NET 2013]

[6] Building of infrastructure, e.g. roads, bridges, canals, schools and harbours
[7] Complex materials, such as wood or fiberglass, in which two or more distinct, structurally complementary substances, especially metals, ceramics, glasses and polymers combine to produce structural or functional properties not present in any individual component

However, scrutiny of the registration data in the Danish Product Registry has revealed that the apparent peak in 2006 and 2007 was due to a registration error. Also, tonnage data prior to 2006 are less reliable [DEPA 2013b]. Therefore, the use of 1,6-hexanediol diglycidyl ether may not have surpassed 100 tonnes.

The total number of preparations registered per year range from 80 to 120 in the years 2000-2011. In 2011, the use of 1,6-hexanediol diglycidyl ether in Denmark of 41 tonnes (84 preparations) was registered in five use categories [SPIN2000.net 2013]:

- Adhesives, binding agents (19.6 tonnes/21 preparations)
- Paints, lacquers and varnishes (13.3 tonnes/14 preparations)
- Construction materials (7.1 tonnes/27 preparations)
- Surface treatment (0.9 tonnes/7 preparations)
- Fillers (0.2 tonnes/8 preparations)

It should be noted that the Danish Product Registry is intended for registration of substances and mixtures manufactured or imported for occupational use in amounts ≥100 kg/year, which contain at least one substance classified as dangerous in a concentration of at least 0.1% or 1% (depending on the classification of the substance). As 1,6-hexandiol diglycidyl ether does not have a harmonised classification, its registration must only occur based on self-classification or if the substance is a constituent of products, which are classified as dangerous due to the presence of other constituents. There is no obligation to register consumer products in the Danish Product Registry [WEA 2013]. Furthermore, the SPIN database only shows aggregated, non-confidential information. This means that each category must contain at least four products from at least three different companies in order to be included. If this criterion is not fulfilled, the data will not be available. Consequently, the data obtained from the Product Registry/SPIN do not provide a complete picture of the presence of 1,6-hexanediol diglycidyl ether in mixtures placed on the Danish market [DEPA 2013a].

The previous survey of 1,6-hexanediol diglycidyl ether obtained the following information from two sector-specific associations:

The European Council of producers and importers of paints, printing inks and artists' colours (CEPE) informed that 1,6-hexanediol diglycidyl ether is widely used as a reactive diluent in epoxy coatings produced by the paint industry. It is incorporated into paint formulations in order to reduce their content of volatile organic compounds (VOCs). The epoxy coatings in question may be used e.g. for coating tanks for drinking water [DEPA 2013a].

In addition, the Association of the European Adhesive and Sealant Industry (FEICA) provided information from their members on the use of 1,6-hexanediol diglycidyl ether. Some adhesive companies indicated that the substance is used as a reactive diluent in epoxy systems for buildings (two-component, epoxy-based adhesives, floorings and coatings). The reactive diluent constitutes 5-40% of an individual component and the concentration of the substance in the end product will be less than 10% [DEPA 2013a].

2. Data Collection

Data for this survey was collected in the period from mid-September till December 2013.

2.1 Methodology

In order to obtain as much information as possible about relevant product types, specific product names and level of concentration of 1,6-hexanediol diglycidyl ether, several different strategies for the survey were employed:

- Internet search for background information, products, manufacturers, MSDSs[8], patents etc.
- Contact to the sector-specific associations both in Denmark and abroad
- Contact to manufacturers/importers/retailers of e.g. epoxy systems and paints
- Contact to manufacturers/importers/retailers of toys
- Contact to do-it-yourself (DIY) centres
- Visit to DIY centres/marine shop
- Contact to relevant interest groups/knowledge centres
- Non-confidential information from REACH and the SPIN database
- Information from the Danish Product Registry[9]
- Information from REACH registration reports[9]

Relevant parties were contacted by telephone and/or by e-mail and when relevant, a questionnaire was sent (see list of contacts in Appendix 1). The procedure for the information search is described in detail below.

2.1.1 Enquiries to Sector-specific Associations

Nine sector-specific associations were contacted by telephone and/or by e-mail. Six of them were Danish or European associations within the area of building materials and the remaining three were Danish or Nordic associations covering toys and hobby materials (see Appendix 1).

In relation to DIY building materials, the Confederation of Danish Industry (Dansk Industri, DI) was contacted, specifically, the Federation of Danish Building Industries (DI-Byg) and the Danish Coatings and Adhesives Association (Danmarks Farve- og Limindustri, DFL). Enquiries were also made to European associations such as the European Council of producers and importers of paints, printing inks and artists' colours (CEPE), the Association of the European Adhesive and Sealant Industry (FEICA) and the European Federation for Construction Chemicals (EFCC). In addition to these, Danboat, the Danish Water Sports Trade Association (Søsportens Brancheforening) was also contacted, due to initial information that indicated the use of various epoxy products by e.g. yacht owners for fibreglass boat repair.

Enquiries regarding toys, with a special focus on modelling clay and other viscous products, were directed to three sector-specific associations: the Nordic Association of Toy Manufacturers

[8] Material Safety Data Sheet
[9] Confidentiality agreements have been signed and no confidential information is included in this report.

(Nordictoys), the Danish Toy Association (Legetøjsbranchens Fællesråd, LF), and the Joint Council of Creative & Hobby Materials (Fællesrådet for Formnings- & Hobbymaterialer, FFFH).

A number of these associations kindly forwarded our enquiries to their members in order to help in the identification of products containing 1,6-hexanediol diglycidyl ether that may be used by private consumers.

2.1.2 Enquiries to Manufacturers/Importers/Retailers

In addition to the above-mentioned associations, 17 manufacturers, importers and retailors of various DIY building products were also directly approached (see Appendix 1). Some of these may also have been contacted via a sector-specific association.

2.1.3 Enquiries to Interest Groups/Knowledge Centres

Enquiries were also directed to two interest groups/knowledge centres in Denmark with a focus on health and the environment: Asthma-Allergy Denmark (Astma-Allergi Danmark) and Information Centre for Environment and Health (Informationscenter for Miljø og Sundhed). They were asked for any information that they might have regarding 1,6-hexanediol diglycidyl ether and its possible content in consumer products.

2.1.4 Additional Approaches for Information Search

In addition to the direct contact to relevant parties, information from the database SPIN and from ECHA's website regarding REACH registrations were retrieved. Also, other approaches were employed in order to gain information on the use of 1,6-hexanediol diglycidyl ether such as internet searches for relevant information, literature, patents, MSDSs and more. A thorough internet search was made for 1,6-hexanediol diglycidyl ether or its CAS number in combination with e.g. search terms relating to various DIY products, specifically epoxy products and paints. Furthermore, the Danish EPA provided information from the Danish Product Registry as well as access to seven Chemical Safety Reports (CSRs) under REACH concerning 1,6-hexanediol diglycidyl ether[9].

3. Results of Data Collection

3.1 Results of Enquiries to Interest Groups/Knowledge Centres

The two contacted interest groups/knowledge centres working within health and the environment, Asthma-Allergy Denmark (Astma-Allergi Danmark) and the Information Centre for Environment and Health (Informationscenter for Miljø og Sundhed), could not provide us with information regarding consumer products containing 1,6-hexanediol diglycidyl ether or other information pertaining to the substance.

3.2 Results Relating to DIY Building Materials

Responses were obtained from four out of six sector-specific associations as well as from 16 out of 17 manufacturers, importers or retailers of epoxy products.

3.2.1 Results of Enquiries to Sector-specific Associations

The Danish Coatings and Adhesives Association (DFL) confirmed that 1,6-hexanediol diglycidyl ether is used in epoxy systems as a diluent and mentioned typical uses of epoxy systems in coatings of e.g. pipelines or storage tanks for drinking water or chemicals. In addition, the reactive diluent may also be used in adhesives. Only one enterprise confirmed the use of 1,6-hexanediol diglycidyl ether in their products (around 800 kg per year) with a range of industrial applications [DFL 2013a]. The members of DFL account for around 90% of the Danish market within paints, adhesives, varnishes, sealants and wood impregnation [DFL 2013b].

The Federation of Danish Building Industries (DI-Byg) and DFL are both part of the Confederation of Danish Industry, and DI-Byg referred to DFL as they represent the same relevant manufacturers. DI-Byg represents around 430 members with a direct or indirect connection to the building sector and covers a broad range of enterprises throughout the value chain [DI-Byg 2013].

The European Council of producers and importers of paints, printing inks and artists' colours (CEPE) forwarded our enquiry to their members of which 16 responded. The members of CEPE are 25 national associations, six suppliers plus a number of companies that are also member of one of the national associations affiliated with CEPE [CEPE 2013a]. None of the responders are using 1,6-hexanediol diglycidyl ether in products that can be purchased by a private consumer. However, some responders replied that the substance may be present is some professional products. According to their website [CEPE 2013a], CEPE brings together approximately 85% of the European industry in its membership and the responses obtained were judged by the technical director of the organization to be representative of the CEPE market [CEPE 2013b].

The Association of the European Adhesive and Sealant Industry (FEICA) and the European Federation for Construction Chemicals (EFCC) did not respond to our enquiry. FEICA was also contacted during the previous survey of 1,6-hexanediol diglycidyl ether and the information provided by FEICA on that occasion is given in section 1.4.

The chairman of the Danish Water Sports Trade Association, Danboat, was not able to provide specific information on the use of 1,6-hexanediol diglycidyl ether in marine products for the private consumer, but kindly informed about the major manufacturers and Danish importers of marine

products [Danboat 2013]. This information was used as a starting point for contacting relevant players within the area of epoxy-based marine materials.

3.2.2 Results of Enquiries to Manufacturers/Importers/Retailers

Requests to six major manufacturers, importers or retailers with a specific focus on marine supplies, in particular two-component epoxy products (see Appendix 1), did not identify any products containing the substance 1,6-hexanediol diglycidyl ether intended for the private consumer in Denmark. One retailer replied that a number of named epoxy brands from his supplier of epoxy products did not contain the enquired substance (confidential source).

Enquiries were also directed to 11 manufacturers, importers or retailers of more general building materials and specifically of two-component epoxy products (see Appendix 1). All except for one retailer of epoxy products responded to the enquiry. One retailer of epoxy products responded that their products do not contain reactive diluents, and another replied that their products are intended solely for professionals. Three major manufacturers of paints also indicated that 1,6-hexanediol diglycidyl ether is not contained in their products for the private consumer. Likewise, an importer/supplier of epoxy products also informed that a number of the major brands do not contain 1,6-hexanediol diglycidyl ether. Two major DIY centres replied that they do not sell epoxy products, whereas three other DIY centres forwarded our enquiry to their suppliers. One retailer replied that one of their DIY products contains the reactive diluent: a two-component epoxy floor coating with a content of 5-10% of 1,6-hexanediol diglycidyl ether (confidential source). All other suppliers replied that 1,6-hexanediol diglycidyl ether is not used in their products; one of the DIY centres specified that 1,6-hexanediol diglycidyl ether is not used in their indoor or outdoor paints, adhesives, sealants, putties or mortar/cement (confidential source).

3.2.3 Results Based on Additional Approaches for Information Search

In an additional attempt to identify building materials for the private consumer containing 1,6-hexanediol diglycidyl ether, the Danish EPA contacted three manufacturers who had registered products containing the substance in the Danish Product Registry. The manufacturers were asked if specific products (eight products in total) containing 1,6-hexanediol diglycidyl ether could be purchased by private consumers. All three manufacturers responded that the eight enquired products would be used solely by professionals. One of these manufacturers specified that their products are mainly targeted at the maritime sector (ships and offshore rigs) and - to a lesser extent - also to the industry (e.g. the petrochemical industry), and that their products are used solely for repair and maintenance of equipment. This manufacturer also stated that more than 90% of their products are exported (confidential source).

A number of MSDSs retrieved from the internet were also studied in order to identify potential consumer products containing the substance. However, most of the MSDSs pointed towards a professional use of the identified products containing 1,6-hexanediol diglycidyl ether.

From a review of seven CSR reports, it appears as if two-component epoxy paints and adhesives are the main consumer product categories containing 1,6-hexanediol diglycidyl ether within the EU.

3.3 Conclusion of the Data Collection Relating to DIY Building Materials

The sector-specific associations in relation to building materials confirmed the use of 1,6-hexanediol diglycidyl ether as a reactive diluent in epoxy systems used in coatings and adhesives. Furthermore, from their responses it appears as if the substance is rarely used in products on the Danish market, and when it is used it is mostly in products for professional use.

This impression was confirmed by direct contact to 17 manufacturers, importers or retailers of epoxy products that resulted in the identification of a single consumer product containing 1,6-hexanediol diglycidyl ether: an epoxy floor coating. The remaining responders replied that they either do not use this particular reactive diluent, do not use reactive diluents in their products at all or that their products are not intended for private consumers. Some of the contacted DIY centres responded that they do not sell epoxy products.

Therefore, from our enquiries it appears as if the reactive diluent 1,6-hexanediol diglycidyl ether is used to a very limited extent in building products accessible for the Danish consumer.

From the CSR reports it appears as if two-component epoxy paints and adhesives are the main consumer product categories containing 1,6-hexanediol diglycidyl ether within the EU.

3.4 Results Relating to Toys

Responses were obtained from all three contacted sector-specific associations within toys and hobby materials.

3.4.1 Results of Enquiries to Sector-specific Associations

The sector-specific associations the Nordic Association of Toy Manufacturers (Nordictoys) and the Joint Council of Creative & Hobby Materials (FFFH) kindly forwarded our enquiry to their members. Nordictoys is an association of 10 toy manufacturers [Nordictoys 2013a] and FFFH is an association of 17 manufacturers, importers and distributors of creative and hobby materials in Denmark [FFFH 2013a]. Two members of Nordictoys [Nordictoys 2013b] and five members of FFFH [FFFH 2013b] responded to our enquiry; at least two of these had products such as modelling clay and glue in their product range. None of the responders could confirm the use of the substance 1,6-hexanediol diglycidyl ether in toys such as modelling clay or glue or any of their other products.

The Danish Toy Association (LF) also provided the information that 1,6- hexanediol diglycidyl ether is not a substance expected to be found in toys, based on a request within the association [LF 2013].

3.4.2 Results Based on Additional Approaches for Information Search

An internet search for safety data sheets for modelling clay was also performed and 1,6-hexanediol diglycidyl ether was not declared in any of approximately 25 examined MSDSs.

In a further attempt to clarify whether the reactive diluent is used in toys such as modelling clay, seven CSR reports were looked through for exposure scenarios relating to children's exposure, however, none were found. All seven CSR reports were also searched for the words "child", "toy" and "modelling clay". Only the latter term was found and only once in each of the reports in relation to descriptors of product categories (PCs): "PC 9b: Fillers, putties, plasters, modelling clay". In this context, the term "modelling clay" seems to be a polymeric building material for making models.

Therefore, it appears that the ambiguous term "modelling clay" used in the reports submitted for REACH registration of 1,6-hexanediol diglycidyl ether relates solely to a product used as a building material and not to the toy used by children.

3.5 Conclusion of the Data Collection Relating to Toys

Based on the review of the CSR reports, responses obtained from seven manufacturers, importers or retailers of toys and the information provided by the Danish Toy Association (LF), it is evaluated

that the substance 1,6-hexanediol diglycidyl ether is not used in modelling clay for children. Thus, the ambiguous term “modelling clay” from the REACH registration reports concerning 1,6-hexanediol diglycidyl ether is used solely to describe a building material. Therefore, there appears to be no concern for children being exposed to 1,6-hexanediol diglycidyl ether via toys.

4. Selection of Products for Analysis

In consultation with the Danish EPA, it was decided to analyse selected building materials for content of 1,6-hexanediol diglycidyl ether. It was also decided not to analyse modelling clay (as a toy for children) as the reactive diluent appears not to be used in this type of product.

4.1 Criteria for Purchase of Products

The following criteria were used in the selection of consumer products within building materials to be analysed for the content of 1,6-hexanediol diglycidyl ether:

- Products identified from the survey to contain the substance (i.e. an epoxy floor coating)
- Two-component floor coatings with an unknown composition
- Two-component epoxy products with an unknown composition
- Products used by different consumer groups (e.g. boat owners, DYI people laying floor)
- Products from different manufacturers
- Manufacturers from different countries

From our enquiries to manufacturers, importers and retailers of various epoxy systems, a single epoxy floor coating was identified to contain 1,6-hexanediol diglycidyl ether. Therefore, a search was performed for similar two-component epoxy floor coatings available for the Danish consumer. Also, identification of other DIY epoxy systems for use in e.g. home or ship maintenance was initiated, in particular from brands besides those (typically major brands) reported by manufacturers, importers or suppliers not to contain the reactive diluent 1,6-hexanediol diglycidyl ether. Thus, a strong effort was made and the niche market was searched in order to identify a number of two-component epoxy systems that might contain the substance. Products were identified from catalogues and shops and from online searches.

For all potentially relevant products, an investigation of the product labels or an online search for MSDSs was performed in order to obtain information on the product composition. An additional floor coating and a marine coating/filler containing 1,6-hexanediol diglycidyl ether were identified using this approach (with a concentration of 1,6-hexanediol diglycidyl ether in the range 1-5% and 10-25%, respectively, according to the MSDSs). In most cases, products that according to their label or MSDS do not contain 1,6-hexanediol diglycidyl ether were not selected for analysis. An estimated number of 100 MSDSs were studied. Therefore, the majority of products selected for analysis had an unknown composition, three products were known to contain 1,6-hexanediol diglycidyl ether and finally, a few products that appeared not to contain the substance were also selected for analysis.

4.2 Outline of Purchased Products

Information on the 15 purchased products appears from Table 4.1. One of each of the products listed in the table was purchased in November 2013. Products from 12 manufacturers (one Danish, a total of 9 from the EU or EEA countries and one outside of EU) were purchased from 10 different shops within general DIY shops, specialised DIY shops, DIY building shops and marine shops

(purchases took place at two physical shops and from eight different online shops of which two also have a physical shop).

TABLE 4.1 OUTLINE OF TWO-COMPONENT CONSUMER PRODUCTS PURCHASED FOR DETERMINATION OF CONTENT OF 1,6-HEXANEDIOL DIGLYCIDYL ETHER BY CHEMICAL ANALYSIS.

Product no.	Manufacturer	Product description	Type of shop
1	A	Two-component epoxy floor coating	DIY shop
2	B	Two-component epoxy floor coating (only one component purchased)	Online (from physical paint shop)
3	C	Two-component epoxy floor coating	Online (building products)
4	D	Two-component epoxy filler	Online (marine shop)
5	E	Two-component epoxy filler	Marine shop
6	F	Two-component epoxy filler	Online (marine shop)
7	F	Two-component epoxy primer	Online (marine shop)
8	G	Two-component epoxy repair kit	Online (also physical DIY shop)
9	G	Two-component epoxy (laminating and casting)	Online (also physical DIY shop)
10	H	Two-component epoxy (laminating)	Online (via physical marine shop)
11	I	Two-component epoxy kit with two resins and one curing agent (laminating, casting, adhesion, coating)	Online (via physical marine shop)
12	J	Two-component epoxy adhesive	Online (broad-spectrum consumer products)
13	Not disclosed on the product	Two-component epoxy (laminating)	Online (DIY composite materials)
14	Not disclosed on the product	Two-component epoxy (laminating)	Online (DIY composite materials)
15	K	Two-component epoxy primer	Online (DIY composite materials)

5. Chemical Analysis

Fifteen DIY two-component epoxy products were selected and purchased for analysis (see Table 4.1). A revision of the labels of the purchased products revealed some products with labelling issues (e.g. a lack of labelling or mislabelling of the two components) that did not allow a certain identification of the component containing the epoxy system, and therefore potentially also the reactive diluent 1,6-hexanediol diglycidyl ether. This finding led to the decision to analyse both components of the purchased products, i.e. the resin and the curing agent, in order to be certain to analyse the part with a potential content of 1,6-hexanediol diglycidyl ether. One of the purchased products was a kit containing two resins and one curing agent (#11). For one product (#2), which was declared to contain 1,6-hexanediol diglycidyl ether, the two components could be purchased individually and only the part declared to contain the substance was purchased. Therefore, a total of 30 components were analysed.

5.1 Description of the Analytical Method

The content of 1,6-hexanediol diglycidyl ether in the products was determined in duplicate analyses by gas chromatography with a mass selective detector (GC-MS). Internal standards of bromobenzene and o-terphenyle were added to the product samples that were then extracted with solvent and analysed.

TABLE 5.1 GC-MS CONDITIONS.

Equipment	Agilent GC (7890A) with MSD (5975C)
Column	Agilent 19091S-733 HP-1MS, 30 m x 0.25 mm x 1.0 µm
Injector	Splitless, 225°C
Oven settings	37-320°C, 20°C per min.
Mass spectrometer	Scan mode

5.2 Validation of the GC-MS Quantitative Method

A validation of the applied method for quantification was carried out.

A reference standard for 1,6-hexanediol diglycidyl ether was analysed in order to carry out identification by retention time and mass spectra in addition to comparison of the mass spectrum with the MS library of NIST[10]. The reference standard was prepared on the basis of a chemical purchased from Carbone Scientific.

Bromobenzene and o-terphenyl were added as internal standards to compensate for possible variations in the GC-MS analysis.
The accuracy of the analysis was determined from six repeated measurements of a control sample.

[10] National Institute of Standards and Technology

Linearity of the measurement range was investigated by analysing the reference standard at five different concentration levels on two different days. The linearity of the reference standard on both days was acceptable as $R^2>0.99$, where R is the correlation factor. The closer R^2 is to 1 the better the quality of the predictions made from the standard curve.

The uncertainty of the method was calculated to be 8% (relative standard deviation, RSD) based on the determination of the accuracy and the standard deviation of the recovery investigation. A recovery investigation was carried out by spiking a sample with 1,6-hexanediol diglycidyl ether. The average recovery was calculated to 106% which is acceptable as the uncertainty of the method was determined to be 8% (RSD).

Blank specimens were included in all analyses and no interference with 1,6-hexanediol diglycidyl ether was detected.

The detection limit was investigated and calculated to 50mg/kg.

5.3 Results of the Chemical Analysis

For nine of the analysed products, 1,6-hexanediol diglycidyl ether was not detected in either of the two product components, i.e. in the pair of resin and curing agent. In the remaining six products, 1,6-hexanediol diglycidyl ether was found in one of the two components (the suspected epoxy resin), see Table 5.2.

TABLE 5.2 RESULTS OF THE CHEMICAL ANALYSIS.
DATA IN THE TABLE REFER TO THE COMPONENT CONTAINING THE EPOXY RESIN.

Sample	Total content 1,6-hexandiol diglycidyl ether			
	g/kg	g/kg (mean)	Standard deviation	% (w/w) (mean)
1	101	103	3.0	10.3
	106			
2	13	14	1.5	1.4
	15			
3	<	-	-	-
	<			
4	170	177	8.8	17.7
	183			
5	<	-	-	-
	<			
6	43	44	1.4	4.4
	45			
7	<	-	-	-
	<			
8	<	-	-	-
	<			
9	2.5	2.6	0.2	0.3
	2.7			
10	<	-	-	-
	<			
11-I	<	-	-	-
	<			
11-II	<	-	-	-
	<			

Sample	Total content 1,6-hexandiol diglycidyl ether			
	g/kg	g/kg (mean)	Standard deviation	% (w/w) (mean)
12	< <<	-	-	-
13	< <<	-	-	-
14	< <<	-	-	-
15	109 117	113	5.1	11.3

<: less than the limit of detection (50mg/kg)
- : not relevant

The concentration of 1,6-hexanediol diglycidyl ether in the epoxy resins ranged from 0.3-17.7% (w/w).

1,6-hexanediol diglycidyl ether was detected in all four products that were declared to contain the substance. The two floor coatings (samples 1 and 2) were found to contain 10.3% and 1.4%, respectively, which is in agreement with the ranges stated by the manufacturer/importer (5-10% and 1-5%, respectively). The concentration of 1,6-hexanediol diglycidyl ether in the yacht coating/filler (sample 4) was determined to 17.7%. This is within the range of 10-25% as stated by the MSDS. The concrete primer (sample 15) was found to contain 11.3% of 1,6-hexanediol diglycidyl ether. A specification of the concentration range of 1,6-hexanediol diglycidyl ether in this product was not disclosed.

The chemical analysis identified two additional products containing 1,6-hexanediol diglycidyl ether: a yacht filler (sample 6) and a laminating epoxy (sample 9) with a content of 4.4% and 0.3%, respectively. The label of the former product only states a content of ”glycidyl ether” without any further specification, while the latter is declared to contain 25-50% of another reactive diluent, 4-tert-butylphenyl glycidyl ether, according to the MSDS.

5.4 Conclusion of the Chemical Analysis

The chemical analysis detected the reactive diluent 1,6-hexanediol diglycidyl ether in six (38%) of the 16 tested epoxy resins. These resins contain the substance in the range 0.3-17.7% (w/w). 1,6-hexanediol diglycidyl ether was not found in detectable amounts in the remaining 24 samples (detection limit of 50mg/kg).

6. Conclusion

This project “Survey of 1,6-hexanediol diglycidyl ether in Building Materials for Consumers and in Toys” focused on the identification of the reactive diluent 1,6-hexanediol diglycidyl ether in two-component epoxy systems and in toys based on the findings of a previous survey on the substance [DEPA 2013a].

Sector-specific associations in relation to building materials confirmed the use of 1,6-hexanediol diglycidyl ether as a reactive diluent in epoxy-based coatings and adhesives. From their responses it appears as if the substance is rarely used in products on the Danish market and when it is used, it is mostly in products for professional use. This impression was confirmed by direct contact to 17 manufacturers, importers or retailers of various epoxy products that resulted in the identification of a single consumer product containing 1,6-hexanediol diglycidyl ether: a two-component epoxy floor coating. A few DIY centres replied that they do not sell epoxy products, whereas the remaining contacts replied that they either do not use this particular reactive diluent, do not use reactive diluents in their products at all or that their products are not intended for private consumers. Only one retailer did not respond to the enquiry.

In consultation with the Danish EPA, it was decided to purchase 15 DIY two-component epoxy products for chemical analysis of the content of 1,6-hexanediol diglycidyl ether. One of the purchased products was a kit containing two resins, therefore a total of 16 resins were purchased. Two additional epoxy coatings (a floor coating and a yacht coating/filler) containing 1,6-hexanediol diglycidyl ether according to their MSDS were identified in this process. Furthermore, a product purchased online, an epoxy primer, was found upon its arrival to contain the substance according to its label.

The chemical analysis confirmed the presence of 1,6-hexanediol diglycidyl ether in the four products that are declared to contain 1,6-hexanediol diglycidyl ether. In addition, the chemical analysis identified two additional products, a yacht filler and a laminating epoxy, containing the substance. The concentration of 1,6-hexanediol diglycidyl ether in the six epoxy resins were found to be in the range 0.3-17.7% (w/w). Thus, this survey identified a total of six DIY building materials (two-component epoxy systems) containing 1,6-hexanediol diglycidyl ether that are accessible to the general public on the Danish market: two floor coatings, two specific marine products (fillers/protective coating), a laminating epoxy product and a primer to be used prior to epoxy treatment of concrete and masonry.

The potential use of 1,6-hexanediol diglycidyl ether in toys was also investigated due to the appearance of the term “modelling clay” under “consumer use” in the publicly available REACH registration. Therefore, seven CSR reports under REACH were reviewed for exposure scenarios relating to children, however, none were found. All seven CSR reports were also searched for the words “child”, “toy” and “modelling clay”. Only the latter was found and only once in each of the reports in relation to a product category descriptor: “PC 9b: Fillers, putties, plasters, modelling clay”. In this context, the term “modelling clay” seems to be a polymeric building material for making models, and therefore the substance 1,6-hexanediol diglycidyl ether does not appear to be used for products intended for children.

This notion was also confirmed from the responses to enquiries directed towards toy and hobby material associations. Seven manufacturers, importers or retailers of toys that received our enquiry via a toy association responded that 1,6-hexanediol diglycidyl ether is not a constituent of their toys. Based on a request within their association, the Danish Toy Association (LF) also provided the information that 1,6-hexanediol diglycidyl ether is not a substance expected to be found in toys.

From these strong indications that 1,6-hexanediol diglycidyl ether is not used in toys, it was decided not to proceed with chemical analysis of this product group.

In conclusion, the information that was obtained in the course of this survey strongly suggests that the substance 1,6-hexanediol diglycidyl ether is not used in the manufacturing of toys.

Furthermore, it appears as if the reactive diluent 1,6-hexanediol diglycidyl ether is used to a limited extent in building products accessible for the Danish consumer. Building materials containing 1,6-hexanediol diglycidyl ether available to the general public were found mainly within two-component epoxy systems that are used for home maintenance/repair and recreational activities e.g. within water sports. 1,6-hexanediol diglycidyl ether was identified in six out of 15 building materials accessible also for the consumer in the concentration range 0.3-17.7% (w/w). The identified products containing 1,6-hexanediol diglycidyl ether are due to their function probably not used with a high frequency by the private consumers.

Abbreviations and Acronyms

CAS	Chemical Abstracts Service
CEPE	The European Council of producers and importers of paints, printing inks and artists' colours
C&L	Classification & Labelling
CLP	Classification, Labelling and Packaging
CSR	Chemical Safety Report
DEPA	Danish Environmental Protection Agency
DFL	Danmarks Farve- og Limindustri (Danish Coatings and Adhesives Association)
DI	Dansk Industri (Danish Industry)
DI-Byg	Federation of Danish Building Industries
DIY	Do-it-yourself
ECHA	European Chemicals Agency
EFCC	European Federation for Construction Chemicals
EPA	Environmental Protection Agency
FEICA	Association of the European Adhesive and Sealant Industry
FFFH	Fællesrådet for Formnings- & Hobbymaterialer (the Joint Council of Creative & Hobby Materials)
GC-MS	Gas chromatography-mass spectrometry
HDDGE	1,6-hexanediol diglycidyl ether
LF	Legetøjsbranchens Fællesråd (the Danish Toy Association)
LOUS	List of Undesirable Substances
MSDS	Material safety data sheet
PC	Product category
QSAR	Quantitative Structure–Activity Relationship
REACH	Registration, Evaluation, Authorisation and Restriction of Chemical substances
RSD	Relative standard deviation
SPIN	Substances in Preparations in Nordic Countries
VOC	Volatile organic compound
w/w	Weight by weight

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FFFH 2013b: Responses were obtained *via* Chairman of the board, Jan Frandsen, who forwarded the enquiry to all FFFH members. Responses were obtained from five members (av form, Creativ Company, Dana Lim, PQX 102 and Schjerning Farver) (e-mails dated 29 September 2013, 3 October 2013, 8 October 2013 and 19 December 2013)

Hathaway and Proctor 2004: Gloria J. Hathaway and Nick H. Proctor, Chemical Hazards of the Workplace, 5th Edition, Wiley 2004, p. 300

LF 2013: Personal communication (e-mail dated 8 October, 2013)

Nordictoys 2013a: Information about Nordictoys. Available from:
http://www.nordictoys.org/members.html [27 November 2013]

Nordictoys 2013b: Chairman of the board, David Hartz, was our contact. The chairman of the board forwarded the enquiry to all members of Nordictoys. Responses were obtained from two members (LEGO Group and Malte Haaning Plastic) (e-mails dated 1 October 2013, 9 October 2013 and 19 December 2013)

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Appendix 1: List of Contacts

Associations:

Building materials:

- European Council of producers and importers of paints, printing inks and artists' colours (CEPE)
- Association of the European Adhesive and Sealant Industry (FEICA)
- European Federation for Construction Chemicals (EFCC)
- Federation of Danish Building Industries (DI-Byg)
- Danish Coatings and Adhesives Association (Danmarks Farve- og Limindustri, DFL)
- The Danish Water Sports Trade Association (Danboat, Søsportens Brancheforening)

Toys:

- The Joint Council of Creative & Hobby Materials (Fællesrådet for Formnings- & Hobbymaterialer, FFFH)
- The Danish Toy Association (Legetøjsbranchens Fællesråd, LF)
- The Nordic Association of Toy Manufacturers (Nordictoys)

Manufacturers/Importers/Retailers of Building Materials:

- Members of the above listed associations
- Akzo Nobel DECO
- Akzo Nobel Performance Coatings
- Bauhaus
- Biltema
- Bodotex Composites
- Bygma
- Ekomposit.dk
- Flügger
- Hempel
- Henkel
- HF Marine
- jem & fix
- Jotun
- LKR Epoxy
- Meripol Glasfiberservice
- Silvan
- Watski

Interest Groups/Knowledge Centres

- Asthma-Allergy Denmark (Astma-Allergi Danmark)
- The Information Centre for Environment and Health (Informationscenter for Miljø og Sundhed)

Survey of 1,6-hexanediol diglycidyl ether in building materials for consumers and in toys
This project is a survey of 1,6-hexanediol diglycidyl ether (HDDGE) in building materials for consumers and in toys on the Danish market. It is part of the Danish Environmental Protection Agency's (EPA's) LOUS project 2012-2015. The background for choosing these use categories were the results from a previous survey from the Danish EPA under the LOUS-review (Environmental Project no. 1472).

The survey concludes that the use of the reactive diluent 1,6-hexanediol diglycidyl ether in DIY building materials on the Danish market appears to be limited. Analysis revealed contents of 1,6-hexanediol diglycidyl ether of 0.3-17.7% in 6 out of 15 products. It is evaluated that the identified consumer products, used as floor coating and fibreglass repair products, due to their function will probably not be used often by private consumers in Denmark. Furthermore, the survey concludes that the substance 1,6-hexanediol diglycidyl ether is not used in modelling clay (play dough) intended as a toy for children.

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