



Low Carbon Intelligent Operations for Textile Industry in APEC Economies

PROJECT MIDTERM REPORT

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Low Carbon Intelligent Operations for Textile Industry in APEC Economies

Project Midterm Report

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PREFACE

The term "sustainable development" is first used by the World Commission on Environment and Development (United Nations, 1987). The term is then defined by the Brundtland Commission as "the development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Smith & Rees, 1998).

This challenge (i.e., achieving consumption sustainability while reducing ecological impacts and resource intensity) is the key to corporate sustainable competitiveness. In order to overcome this challenge, companies need to maintain their competitiveness advantages through innovation and creativity. As shown in Figure 1, sustainable development ties together environmental sustainability, economic sustainability, and sociopolitical sustainability. Sustainable development has therefore become both a challenge and an opportunity to worldwide corporations--especially in the time of facing continuous and rapid changes in climate change, resources, and economic conditions.

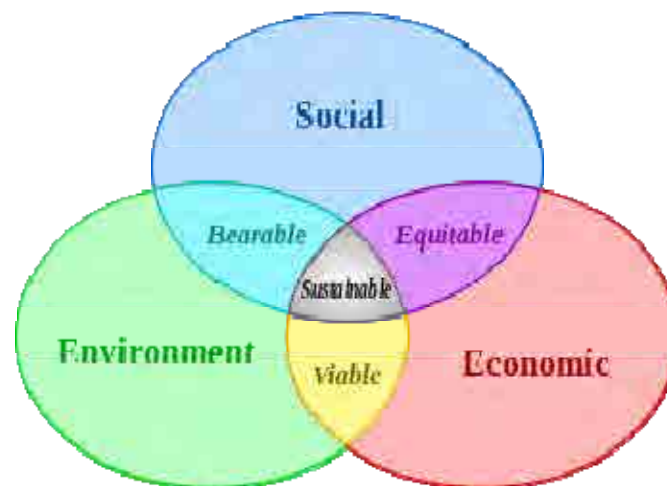


Figure1. Constituent parts of sustainable development

Source: Samuel Mann (2009)

Moreover, both the 2005 Kyoto Protocol and the 2009 Copenhagen Summit are attempts of the United Nations to set binding obligations on industrialized countries to reduce emissions of greenhouse gases. The objectives are to maintain a stabilization of greenhouse gas concentrations at 450 ppm CO₂-equivalent and to achieve a climate target of 2°C by the year 2100 (Niven Huang, 2012). In order to achieve these objectives, industrialized nations have initiated policies and regulations. How to reduce greenhouse gas emissions has become a global focal point. The 2009 Copenhagen Summit has set up a framework for climate change mitigation beyond 2012. Such framework helps to explore the concept of "low-carbon" development.

The textile industry is one of the biggest GHG emitters on Earth, owing to its huge size and scope. Many processes and products that go into the making of fibers, textiles and apparel products consume significant quantities of fossil fuel. Apparel and textiles account for approximately 10 percent of the total carbon impact. The estimated consumption for an annual global production of 60 billion kilograms of fabrics boggles the mind: 1 trillion kilowatt hours of electricity and up to 9 trillion liters of water (Valerio Zaffalon, 2010).

As a result, the ethical agenda of multinational retail companies has been dominated by environmental issues. Marks & Spencer and Walmart are the two companies that have been setting the pace for the whole textile industry. Along with investments in corporate social responsibility and projects to improve the general living conditions of workers, retail companies are offering environmentally responsible products to their customers by taking the necessary steps to ask their suppliers to reduce carbon emissions from production. Such an action offers a way for companies and individuals to contribute to climate change.

For example, the fashion retail market in the United Kingdom is the first market worldwide to use a carbon footprint label for clothing. This label is issued by a third independent party-the Carbon Trust. Originally, it is estimated that the carbon footprint of a basic men's large 155 gram (g) white T-shirt which is produced in a traditional way without using renewable energy is 6.574 kilogram (kg) of CO₂. But, the same T-shirt made of 100% renewable energy and organic cotton has a footprint of only 671 gram. Accordingly, all relevant stakeholders who produce and sell and buy a basic men's large 155 gram white T-shirt in the UK's fashion retail market contribute to a 90% reduction in CO₂ emissions.

The direct carbon footprint contribution of manufacturing plants from yarn to customer including spinning, knitting, dyeing, finishing, cutting and sewing, plus transportation to the distribution center could reach up to 12.5 kg of CO₂ per kg of fabric. The carbon emissions of T-shirt manufacturing in CO₂ equivalents could be more than 12 times the product weight. Considering that the carbon footprint of steel is about 2 kg of CO₂ equivalents per kg of steel, the pressure coming down from the supply chain to the full industry is understandable: The elephants are among us.

APEC textile manufacturers produce mostly of the textile and clothing. The purchase and use of clothing leads to the release of over 850 Mt CO₂ per year (around 3% of global production CO₂ emissions), including both embodied emissions in the clothing, and emissions arising from clothing use (washing, drying, ironing). Global consumption of clothing results in around 330Mt CO₂ of emissions, with emissions from the use of clothing resulting in an additional 530Mt CO₂ per year (The Carbon Trust, 2011). In 2009, APEC economics exported \$118 billion textiles (53.2% of worldwide exports of textile) and \$167.8 billion clothing (55.7% of clothing). In 2010, APEC economics exported \$158 billion textiles (63% of worldwide exports of textile) and \$221.7 billion clothing (63% of clothing). Global warming is more likely to increase the sale of

athletic clothes by 3% and maintain a retail margin of 42% (Chen, 2012).

Among APEC economies, Chinese Taipei has strong manufacturing capacities, including textile manufacturing. In order to minimize the impact of the Kyoto Protocol on its industries and to work together with industrialized countries on the global warming issue, the Chinese Taipei government has recently initiated a number of programs which aims to promote carbon footprint labeling. For example, the government announced algorithm specifications for the assessment of the life cycle greenhouse gas emissions of goods and services in March 2010. As of March 2013, there are 77 final products and services which are adopted the algorithm specification and passed the carbon footprint verification. The government has also initiated a carbon footprint management plan since 2010. Under this plan, a carbon-neutral platform is constructed in order to balance a measured amount of carbon released with an equivalent amount offset or to buy enough carbon credits to make up the difference. At the time of the current work, there are 6 products and services which are recorded in the platform's database.

With this in mind, the Taiwan Textile Research Institute (TTRI) has recently started to help the textile manufacturer in Chinese Taipei to tackle high carbon emission in production. Under this project, a Chinese Taipei textile manufacturer, Formosa Taffeta Co., Ltd. (FTC) participates in the case study. (Please refer to Appendices A and B for a brief introduction of TTRI and FTC, respectively). The TTRI conducts an environmental footprint evaluation on the FTC's 24 types of functional textiles. To be more specific, the project team first identifies the needed raw materials as well as calculates both the energy consumption and wastes (in terms of CO₂ emissions being released) in the manufacturing process. Next, the project team locates carbon hotspots and explores optimal solutions based on the amount of CO₂ emissions associated with raw materials, energy consumption, and wastes. In order to facilitate the evaluation process, a tool titled "Life Cycle Inventory Questionnaire (LCIQ)" is designed and used in the project. This tool helps not on the project team to compile a carbon footprint inventory but also the FTC to continuously manage its environmental footprint after the closure of this project. Finally, the experience and lessens gained from the case study are shared to APEC member economies in a workshop.

This project will not be completed without gratitude help from the following individuals and institutions. I express my deep appreciation to the Asia Pacific Economic Cooperation (APEC) and the Chinese Taipei's Ministry of Foreign Affairs for financially support this project.

Special thanks also go to the FORMOSA TAFFETA CO., LTD. for participating in the case study. In particular, Young-Chin CHEN, Bruce H.N. CHUNG, John M.C. LIAG, and Adam F.Y. WANG were kind and helpful in drawing a product's life-cycle map, collecting MSDS information and supporting to offer every activity data. Finally, I wish to acknowledge the support professionals that I worked with on an almost daily basis. Tony Yang Ping SHIH who is project overseer gives me the chance to implement this project, and leads team to take place the upcoming APEC workshop. Tian-pao LIN, and

Huan-yun TU took time to check the integrity of the collected data, analyze the data, and conduct the LCIQ calculation. I couldn't design out the LCIQ Tool without their supports. Wei-chia CHU was great helpers in the workshop preparations and handling. Su-hui CHEN provided visual design of all document's templates. It is hard to imagine that the project would have ever come to completion without the decision and hard work of this fine team of professionals. Furthermore, I wish to thank Kitty WU of ENG-edit Consulting Service provided expert help in turning page after page of words and symbols written in red ink into beautiful copy.

To these individuals, and all the others too numerous to mention, I wish to express my warm thanks and appreciation.

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SUMMARY

This project entitled “Low Carbon Intelligent Operations for Textile Industry in APEC Economics” aims to assist textile manufacturers in creating a low-carbon materials processing procedure according to the publicly available specification of carbon footprint verification (PAS 2050) in APEC economics. This project has two main goals: (1) conduct a case study, and (2) share the experience and lessons learned from the case study in an international workshop. The case study is designed to first identify the needed raw materials and calculate GHG emissions associated with raw materials. Next, it calculates both the energy consumption and the wastes (in terms of carbon emissions being released) during the production process. It then locates carbon hotspots and explores optimal solutions. Finally, the footprint evaluation is verified by a third independent party. Thus, the case study establishes a baseline for low carbon evaluation systems scientifically and credibly.

This midterm report reports only the case study result. It contains Chapters on the introductions of carbon footprint and PAS 2050 Specification, the framework of this project, and the methodologies for measuring textile carbon footprint inventory. In particular, Chapter 5 reports on the case study result. The procedure, methodologies, and results of carbon footprint inventory are delineated in the chapter.

CHAPTER 1.

THE CONCEPT OF CARBON FOOTPRINT

In recent years, the rise of an environmental awareness to save the planet has taken a strong hold across the world. Although, the footprint concept may be very new to textiles manufacturers and consumers, it will not be long before everyone starts to talk about reducing footprint to ward off global warming, save the water, and the natural resources for the future generation. Therefore, it is important to understand the concept of “Footprint”. It may come as a surprise to some that, for a dress, its footprint is certainly not the fabric tracks it consumes the energy from the sewing process.

Carbon footprint is the measure of the total greenhouse gas (GHG) emissions caused by product, organization, event, or person. GHGs have been known to cause global warming effects. GHGs are emitted mainly from manufacturing, transportation, heating and electricity generation, as well as agricultural practices. Since there are many types of greenhouse gases, such as carbon dioxide, methane, nitrous oxide, chlorofluorocarbon (CFC), sulfur hexafluoride; carbon footprint is reported in terms of carbon dioxide equivalent. It is calculated by using the Global Warming Potential (GWP) factor of each gas, where GWP of carbon dioxide, the most common gas, is considered to be 1. For example, the GWP of methane is 25, meaning it can cause 25 times more warming than carbon dioxide; the GWP for nitrous oxide is 298 meaning it can cause 298 times more warming than carbon dioxide.

The term “product carbon footprint” refers to using life cycle assessment (LCA) to focus specifically on the quantification of greenhouse gas emissions throughout the product’s life cycle. The results of a product carbon footprint are usually presented as a total absolute value of life-cycle carbon dioxide-equivalent (CO₂ e) emissions measured in kilograms or metric tons. Product carbon footprint is based on LCA, which is a method of analysis that seeks to quantify the environmental and human-health impacts associated with products and services. That is, the boundaries of LCA evaluations can encompass a “cradle-to-grave” approach and broadly include the extraction and processing of raw materials, production, consumer-use, and end-of-life scenarios, which may include recycling of materials.

The LCA evaluation result can be used to identify significant impacts on the environment and human health and can inform actions to reduce these impacts. Data and intelligence gathered through this process can also be used to inform strategy and identify design considerations that reduce product cost while also yielding environmental benefits and providing the opportunity to enhance brand value. Many organizations have recognized that carbon footprint provides the ability to evaluate the efficiency with which they produce goods and services using a different set of metrics. The process has enabled companies to improve the environmental performance of their business

activities as well as to reduce both manufacturing and supply-chain costs. The process has also enabled companies to identify environmental risks in the supply chain and to position themselves to compete in a carbon-constrained economy.

Accordingly, the result of a carbon footprint can inform important business decisions and should be used as one of several indicators of product environmental performance. The key to effectively using carbon footprint as a business tool is to balance the complexities of such an analysis with meaningful results that can be applied in a commercial context. Carbon footprint may be considered as a subset of ecological footprint, where only carbon equivalent emission is reported. But, more importantly, carbon footprint focuses on a specific product. For companies, the result of product carbon footprint can help to

- (1) reduce costs associated with manufacturing, energy use, waste, and packaging
- (2) inform design using a lifecycle approach (Design for Environment)
- (3) manage their supply chain to drive greater environmental improvements
- (4) quantify the business value of their sustainability initiatives, which can yield immediate returns on investment.

CHAPTER 2.

THE PAS 2050 SPECIFICATION

The international standard which is used in the LCA evaluation for this project is the so-called "PAS 2050 specification." The specification is developed in response to broad community and industry desire for a consistent method for assessing the life cycle GHG emissions of goods and services (see Figure 2). It can be used by organizations of all sizes and types, in any location, to assess the climate change impact of the products they offer. It therefore offers organizations a method to deliver improved understanding of the GHG emissions arising from their supply chains, and to provide a common basis for GHG emission quantification that will inform and enable meaningful GHG emission reduction program.



Figure 2. PAS 2050 (2011 specification)
Source: BSI (2011)

The PAS 2050 specification moreover builds on existing methods established through BS EN ISO 14040 and BS EN ISO 14044 by specifying requirements for the assessment of the life cycle GHG emissions of products. Accordingly, for organizations that supply goods and services, the specification:

- permits an internal assessment of the existing life cycle GHG emissions of goods and services
- facilitates the evaluation of alternative product configurations, sourcing and manufacturing methods, raw material choices, and supplier selection on the basis of the life cycle GHG emissions associated with goods and services

- provides a benchmark for ongoing programs aimed at reducing GHG emissions
- allows for a comparison of goods or services using a common, recognized, and standardized approach to life cycle GHG emissions assessment
- supports reporting on corporate responsibility.

On the other hand, for consumers who purchase goods and services, the PAS 2050 specification:

- provides a common basis from which the results of life cycle GHG emissions assessments can be reported and communicated
- offers an opportunity for greater understanding of life cycle GHG emissions when making purchasing decisions and using goods and services.

CHAPTER 3.

RESEARCH FRAMEWORK

This project aims to address the issues of capacity building enhancing and to experience sharing for low carbon intelligent operations. The project invites one Chinese Taipei manufacturer to participate in the case study in order to measure GHG emissions generated from the whole lifecycle of functional textile products. Based on the publicly available carbon footprint verification specification (PAS 2050), the case study conducts a footprint on 24 types of textile products. In the end of this case study, these products all received the verification statement issued by an independent third party. Under this project, an international workshop is held in Chinese Taipei to share the experience and lessons gained from the case study.

The project's research framework is divided into four phases and is shown schematically in Figure 3.

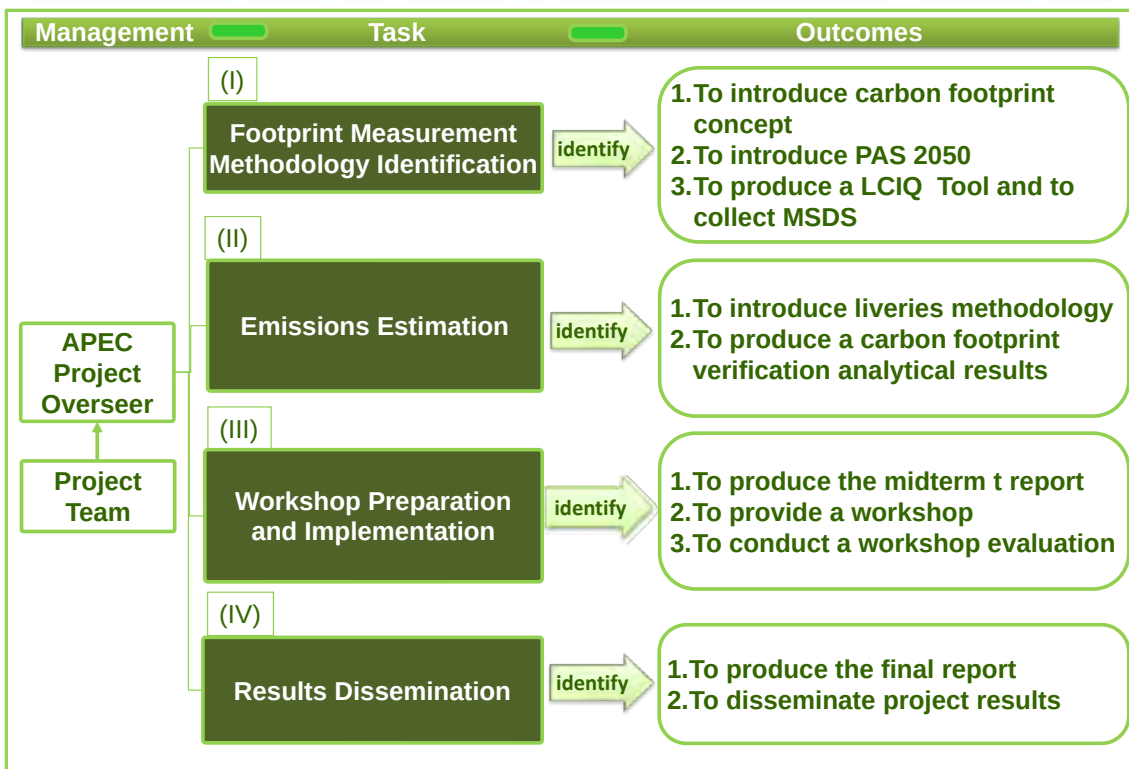


Figure 3. Research Framework

Phase I : Footprint Measurement Methodology Identification

Phase I aims to identify a feasible methodology for conducting the LCA evaluation, i.e., compiling a carbon footprint inventory. This task was carried out between June and August, 2012. The activities conducted by the project team under this phase are described as follows :

1. To design a form for the so-called "product lifecycle inventory method" based on the publicly available specification of carbon footprint verification (PAS 2050). (Please see Chapter 2 for a brief introduction of the PAS 2050 specification.)
2. To construct a methodology for compiling a carbon footprint inventory. This methodology is named "Life Cycle Inventory Questionnaire (LCIQ)." This methodology is designed by the TTRI to calculate all the required data in the PAS 2050 Specification. (Please see Chapter 4 for an introduction of the LCIQ tool.)
3. In order to verify the feasibility of the LCIQ tool, the project team invites a highly qualified Chinese Taipei textile manufacturer (FTC) to participate in the case study.
4. Based on FTC's manufacturing activities, the project team gathers the Materials Safety Data Sheet (MSDS) information for each product under consideration. A total of ten sets of MSDS for functional textile products are completed for the case study. The MSDS is introduced in Chapter 4 while the ten sets of MSDS are reported in Appendix C.

Phase II : Emissions Estimation

After identifying the method for compiling the carbon footprint inventory and locate a textile manufacturer to participate in the case study, the Phase II then estimates the GHG emissions from production processes. This phase was carried out between September and October, 2012. The activities conducted by the project team under this phase are described as follows :

1. To establish a baseline for the LCA evaluation. The project team first reviews previous studies that analyze carbon hotspots in the manufacturing process for functional textiles. Based on the literature review result, the team then establishes a baseline for calculating the GHG emissions from production processes.
2. To estimate the amount of emissions generated from producing functional textiles. The project team first applies the LCIQ tool to calculate production emissions. The team then identifies optimal solutions for reducing emissions.

3. To receive the carbon footprint verification. A carbon footprint report, which delineates the process of measuring, calculating, and declaring the participated manufacturer's direct and indirect GHG emissions, is verified by an independent third party (British Standards Institution). A carbon footprint statement (the highest level for verification) is then issued only under the following two conditions:

- (1) When the carbon footprint report makes the best use of the data available and uses consistent, reasonable practices to apportion data
- (2) The manner in which the carbon footprint is calculated is practical and robust (to the extent it can be given the data available)

In the case study, FTC's 24 types of functional textile products all received the carbon footprint statement. The case study's results are reported in the Chapter 5 of this project midterm report.

Phase III : Workshop Preparation and Implementation

One of this project's goals is to share the experience and lessen gained from the case study. Accordingly, an international workshop titled "2013 Workshop on Low Carbon Intelligent Operations for Textile Industry" is scheduled to be held in Chinese Taipei during April 23-24, 2013. Also, the project team believes that an international workshop will help to raise awareness and interests among workshop participants in how the green benefits can be gained from the use of a low carbon materials processing procedure, and to encourage wider application as well as trade and investment in low carbon intelligent operations for the textile industry in APEC economies.

The target audience for the workshop are - APEC economies' presenters, including professors and experienced manufacturers delivering specific low carbon textile operation workshop to government officials of Chinese Taipei, academic scholars, industry experts as well as PPSTI members and experts, government officials of the APEC economies, including the policymakers in the area of environmental protection, employees of the Environmental Affairs' office and (patent) law enforcement bodies. It is expected that more than 30 delegates from APEC economies, academia, and industries will participate in the workshop.

The preparation work for the workshop has begun since October 2012. The preparation work contains the following activities:

1. To invite highly qualified experts and textile manufactures to be workshop presenters.
2. To distribute invitation letters by e-mail to the expected participants of the workshop;
3. To ensure visa support;
4. To create the arrive-departure schedule of workshop participants;

5. Support in determination of location and dates for the workshop, working out of proposals on the accommodation, catering and transportation services for the workshop participants;
6. To distribute circular information (Administrative Circular) on organizational issues of holding workshop for participants and APEC Secretariat;
7. Support in organization of workshop mock-up design development, fabrication and/or purchase of equipment and materials;
8. Fitting-out of rooms for holding workshop (furniture, equipment and materials, including sound amplifying systems (mikes, consoles, amplifiers, acoustic systems) and a set of video projection equipment (screens, video projectors, notebooks), required for workshop;
9. To ensure technical support throughout the workshop according to APEC standards and rules;
10. To work out scenario of the official opening ceremony;
11. To organize photo session and audio record of all presentations and reports;
12. To develop a workshop participant input form, which will be distributed to participants during the workshop
13. Finally, after the workshop, an analysis of participants' experiences about low carbon textile operations and their feedback regarding the workshop will be prepared by the project team.

Phase III effort, that is, all tasks in the preparation and the implementation of workshop, will be shown in both the workshop proceedings and the workshop evaluation report.

Phase IV : Results Dissemination

In order to communicate to the widest possible audience, all project deliverables—the project midterm report (the case study result), the workshop proceedings, and the workshop evaluation report—will be distributed on CD-ROM and electronically. It is expected that 30 copies workshop proceedings CD-ROM will be sent to APEC Secretariat.

The project deliverables will also be disseminated to the non-APEC economies, whose assistance was received within project implementation.

CHAPTER 4.

METHODS FOR CARBON INVENTORY ESTIMATION

All activities along the full life cycle of individual fabric, from raw material acquisition through disposal, use energy in the manufacturing process. Carbon emissions result from energy use. But we haven't seen a study discussing a feasible methodology or tool for compiling a carbon footprint inventory. This chapter introduces the tool for compiling a carbon footprint inventory.

The process of carrying out a carbon footprint inventory requires evaluation of product lifecycles, estimation of required main raw materials, auxiliary materials and packaging materials, and quantities of greenhouse gas emissions created during manufacturing and shipping of output products. The process thus requires a great deal of information and calculation.

Before we conduct the footprint inventory calculation, we need to decide which product carbon footprint standard to choose because the footprint standard provides requirements and guidelines on the decisions to be made when conducting a carbon footprint study. In response to the need for transparency in the greenhouse gas (GHG) emissions of products, several standards have been developed or are still under development. There are three main Product Carbon Footprint standards that are or will be applied worldwide: PAS 2050, GHG Protocol and ISO 14067. In addition to these three standards, also numerous other initiatives were initiated by either public or private organizations at the regional and local level. So how can a company decide which carbon footprint standard best supports its sustainability strategy? This study uses PAS 2050 because it has already been applied by many companies worldwide, including Chinese Taipei. Also the ISO DS 14067, which is derived from PAS 2050, is under development.

As shown in Figure 4, PAS 2050 allows for two standard types of assessment: Cradle-to-Gate and Cradle-to-Grave assessments. These two types of assessments are often used for different purposes. Cradle-to-Gate assessments are commonly used where a buyer has asked a supplier to provide information on the carbon footprint of the product they supply. In this kind of case, it makes sense to report emissions that occur only up to the point at which the product is transferred to the buyer. It also enables footprints to be incrementally calculated and reported across a supply chain. For cradle-to-gate carbon footprints it is particularly important that adequate records on removals of carbon and carbon content are provided to downstream companies using cradle-to-gate information in their carbon footprint assessments.

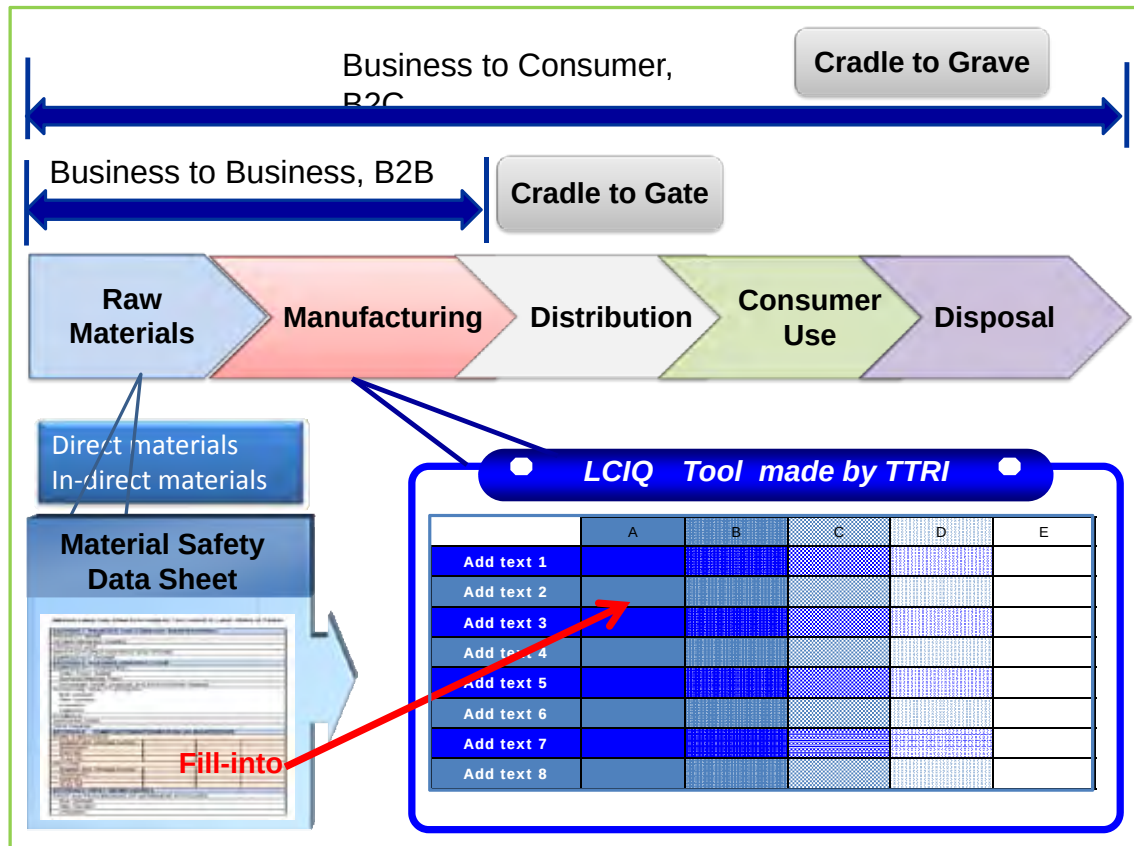


Figure 4. The assessment phase of the product life cycle

In our case study, FTC purchases raw materials (e.g., yarns, dyes, chemicals, and package materials) from its upstream suppliers and converts them into fabrics. FTC then sells fabrics to its downstream firms (e.g., large multinational retail companies). Finally, clothing are made of fabrics by retail companies. Accordingly, we carry out a cradle-to-gate assessment in the case study. And, such an assessment includes the following two main calculation processes:

- (1) to calculate the amount of carbon emissions generated from raw materials
- (2) to calculate the amount of emissions generated from the energy used in converting raw materials to a fabric

FTC purchases raw materials (e.g., yarns, dyes, chemicals, and package materials) from its upstream suppliers and converts raw materials into fabrics. FTC then sells fabrics to its downstream firms (e.g., large multinational retail companies). These firms turn fabrics into clothing. Accordingly, FTC asked their up-stream suppliers to provide information on the carbon footprint of the product they supply. This provided information is such as Materials Safety Data Sheet (MSDS) of chemicals, Energy Consumption etc. MSDS goes to page 30 for details. The PAS 2050 Guide suggests four footprint process steps (See Figure 5). Among four steps, the Step 2 is perhaps the most difficult step. It requires collecting primary activity data (e.g., the amounts and types of raw material consumed in manufacturing a fabric) for a period of 12 months. Thus, the project team needs to collect such data from electricity billing statement or account.

Also, in order to compile the carbon footprint inventory, the project team designs a method called "Life Cycle Inventory Questionnaire (LCIQ)". Based on the concept of cradle-to-gate and uses the materials safety data sheet (MSDS), the LCIQ method can be applied to collect the necessary data required in Step 2. The LCIQ method not only can be applied to the cradle-to-gate assessment but also can be expanded to the cradle-to-cradle assessment (a full product life cycle assessment).

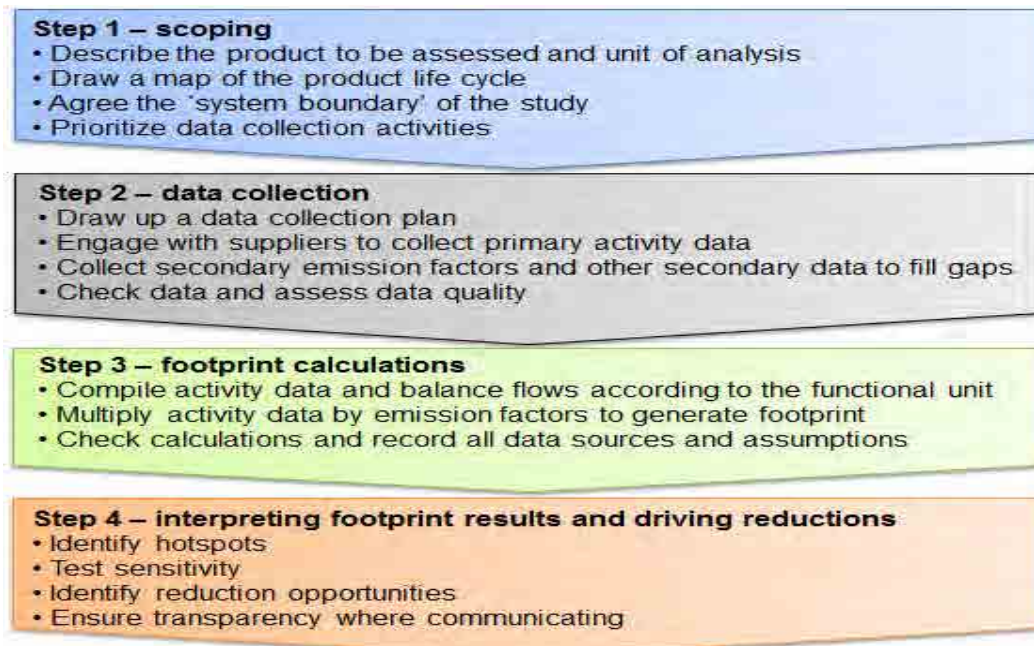


Figure 5. The stepwise footprint process

Source: The Guide to PAS 2050:2011, (BSI, 2011), p4

The following sub-sections briefly introduce the four stepwise footprint processes, MSDS, and LCIQ.

4.1 The Four Stepwise Footprint Process

The PAS 2050 is a publicly available specification that provides a method for assessing the life cycle greenhouse gas (GHG) emissions of products. It can be used by organizations of all sizes and types, in any location, to assess the climate change impact of the products they offer. For businesses, carbon footprint information that has been calculated in accordance with PAS 2050 provides a common basis for understanding the life cycle GHG emissions of products.

While PAS 2050 continues to drive consistency through greater prescription, there are instances in which the one-size-fits-all approach has limitations for some sectors or products. An important addition to PAS 2050 was the introduction of principles promoting the development and use of 'supplementary requirements' for different products or sectors. Supplementary requirements could provide further clarification on only one, or a small number, of aspects of the calculation process. The concept of supplementary

requirements is akin to 'Product Category Rules', PCR (i.e. developed through ISO 14025¹) and 'Product rules' (GHG Protocol Product Standard) and may include either of these (if consistent with PAS 2050). Before begin to carry out the assessment, look to see if there are supplementary requirements that may help to assess the emissions associated with product. Where they exist they should always be used. If there are no supplementary requirements for your sector, check to see whether other rules or guidance may be applicable².) If not, may even want to consider starting to develop supplementary requirements within the industry.

A provision of this part (i.e., supplementary requirements) of PAS 2050 moreover derives a four stepwise footprint process. The process starts from scoping, data collection, emission calculation, emission result reduction (see Figure 5). These steps are sequential and cannot be carried out in isolation.

4.1.1 Step 1-Scoping

Scoping is the most important step when undertaking any product carbon footprint inventory. It ensures that the right amount of effort is spent in getting the right data from the right places to achieve robust results in the most efficient manner possible. There are four main stages to scoping, and they are best undertaken sequentially.

- **Describe the product to be assessed and the unit of analysis**

It is vital that the product to be assessed is clearly defined at the outset. For its carbon footprint, the product must be defined in terms of a 'functional unit'. The functional unit defines the function of the product that will be assessed and the quantity of product to which all of the data collected will relate. By defining the product to be assessed as a quantified functional unit, it provides a reference to which all of the studied inputs and outputs across a product system are related, which helps to ensure the consistency and comparability of results.

- **Draw a map of the product life-cycle**

The process-mapping stage is an initial brainstorm exercise to map all of the 'flows' of materials and energy in and out of the product system as they are used to make and distribute the product. Since an assessment should focus on the most important aspects and avoid unnecessary detail, a process map can be as simple or as detailed as is deemed necessary or as time permits. Additionally, even if only a cradle-to-gate assessment is performed, it is always useful for the map to include the assessed product's whole life cycle in order to make sure that the 'downstream' of all activities, such as recyclability at end-of-life or potential to influence use phase emissions, are not overlooked.

¹ ISO 14025:2006 *Environmental labels and declarations – Type III environmental declarations – Principles and procedures*.

² For example, see the PCR library at <http://pcr-library.edf.org.tw/about/index.asp>.

● **Agree and record the system boundary of the study**

Once the process map is complete, it can be used to help identify which parts of the overall system will, and will not, be included in the assessment. As an output from this scoping stage, It should clearly document and record the 'system boundary' in terms of:

- ✧ a list of all included life cycle stages (e.g. raw materials, production, use, end-of-life)
- ✧ a list of all included activities and processes within each life cycle stage
- ✧ a list of all excluded activities and processes, and the steps taken to determine their exclusion.

● **Prioritize data collection activities**

Having defined a system boundary, the next step in the scoping stage is to prioritize data collection activities. Data collection is the most time-consuming and resource intensive step in a carbon footprint assessment. It is usually not worth spending significant time and effort getting precise and accurate data for a life cycle stage that have very little impact on the overall footprint. Efforts should focus on important purposes of assessment.

4.1.2 Step 2-Data collection

The data needed to carry out a product carbon footprint calculation fall into two categories: activity data and emission factors. Collecting primary activity data for specific activities across the supply chain can be time consuming, and so often dictates the amount of resource needed for a footprint study. But the use of primary data generally increases the accuracy of the carbon footprint calculated, as the numbers used in the calculation relate directly to the real-life production or provision of the product or service assessed. Secondary data are usually less accurate, as they will relate to processes only similar to the one that actually takes place, or an industry average for that process.

● **Draw up a data collection plan**

Having prioritized the needed data in the scoping step, the next stage is to develop a plan of collecting data. Such a plan is used in order to focus efforts as well as provide a reference for the inventory estimation. The data collection plan should outline top targets for primary data collection, and highlight areas where secondary data will be sought instead, recognizing where primary data collection may not be feasible. It does not have to be too detailed, or formal, but should cover all of the data you will need for the carbon footprint assessment.

● **Engaging suppliers to collect primary data**

Engaging suppliers in the carbon footprint process helps to collect specific primary activity data and to gain greater insights into emission sources in the supply chain. It can also encourage future cooperation in reducing emissions for the supply chain. Nonetheless, it is a difficult task for up-stream suppliers, especially chemical producers, to provide specific information about their products. Suppliers can also be reluctant to provide carbon footprint data or their product information.

● **Collecting and using secondary data**

Secondary data are typically used in footprint studies as a source of:

- ✧ emission factors – which convert primary activity data (material/energy/process inputs and outputs) into GHG emissions (in kg CO₂e)
- ✧ information to fill gaps in primary activity data
- ✧ information to calculate the impact of ‘downstream’ life cycle stages.

● **Collecting data for downstream’ activities**

Downstream activities refer to activities which occur during the product distribution process, in retail operations, in use, and at the end-of-life. Generally only the primary activity data for distribution is needed for performing inventory estimation. But if the retail operation is part of business activities, the estimation will require including data from both distribution activities and retail operations.

● **Assessing and recording data quality**

The accuracy or ‘quality’ of product carbon footprint result is ultimately dependent on the quality of the data used to calculate it. It is critical that we consider the quality of the primary and secondary data we have used, and demonstrate that they appropriately represent the footprint product. The best-quality data should always be sought in an assessment, but is of particular importance where external communication is an ultimate goal of the study.

4.1.3 Step 3-Footprint calculations

● **General calculation process**

The first task in the calculation process is to map all of the ‘flows’ occurring and calculate the quantities associated with each flow. Flows should be able to show all of the inputs, outputs, distances, and other activities at each stage of production. Because these activity data are often collected in many different formats and relating to different units, the next task is to balance the production process flows so that all inputs and outputs reflect the provision of the functional unit/reference flow defined in Step 1. This is an important task, and perhaps the most difficult part of the calculation process. Nonetheless, there are three golden rules to follow when balancing flows and they are:

- ✧ always consider waste in the process
- ✧ make calculations as transparent as possible, so they can be traced backwards
- ✧ record all assumptions and data concerns.

Once all production process flows are balanced to reflect the functional unit, the remaining work in the footprint calculation process stage is simple. A footprint is calculated simply by multiplying the activity data by the emission factor for each production process flow. The formula is provided in the following. The footprint of each flow is then summed to give total footprint against each life cycle stage, and for the total system.

Carbon footprint = activity data (kg/litres/kWh/tkm, etc.) × emission factor (kg CO₂e per kg/litre/kWh/tkm, etc.)

● Calculations for specific aspects of the footprint

The 2011 version of PAS 2050 contains a number of revised clauses with regard to the accounting procedures for biogenic carbon emissions/removals/potential storage within a product system. New provisions require that emissions resulting from all energy use, both energy produced off-site and energy produced on site, must be taken into account in the calculation of a carbon footprint. And, based on publicly available secondary emissions factors, one can account for the most common types of energy using. This is because emission factors for fuel and electricity are normally well-described and available country-by-country. For example, in Chinese Taipei, emissions factors for grid electricity and common fuel types are provided by Taiwan Power Company and can be accessed on the internet (<http://www.taipower.com.tw/quickLink/co2.htm>)

Refrigeration/ Sulfur hexafluoride (SF₆)

Refrigeration and climate control systems commonly contain substances such as hydrochloro fluorocarbons (HCFCs, e.g. R-22) and hydrofluorocarbons (HFCs, e.g. R-134a). These are highly intensive to produce, and when emitted to the atmosphere have a global warming potential often in excess of 1,000 times that of carbon dioxide. This is why, even in very small quantities, refrigerant leakages can be an important source of emissions.

In calculating the footprint, we need to identify the type of refrigerant used to produce a product. We also need to figure out the annual level of gas replacement (system top-ups) from maintenance records. These data are system inputs and are assumed to reflect the amount of refrigerant that has leaked from the system over the studied period. Thus, we need an emission factor for both the production of the refrigerant and for the release of the gas.

Transportation emissions

Transportation plays an important role in production and distribution. On the one hand, it carries raw materials and labor to the place where they are needed. On the other hand, it transports intermediate products to other producers for subsequent use in their production process or ships finished goods to customers. Thus it is always necessary to calculate the amount of emissions from transportation. Emission factors for transportation are widely available, and the most common unit used for measuring transportation emissions is: tonne-kilometre (tkm).

1 tkm refers to transporting 1 tonne of material a distance of 1 km.

4.1.4 Step 4-Interpreting footprint results and driving reductions

● Understanding carbon footprint results

The footprint calculation result is a 'total' footprint value for the agreed

functional unit. The result is broken down according to the contributions in each material, process, and life cycle stage. Footprint results contain powerful information because they can be used to identify emission hotspot areas where implementing change would have the most impact. In addition, the granularity of the footprint result is affected by the amount and type of inventory data used. To identify the main contributors in each process or activity, we can only dig down into the result as far as the data will allow.

● **How certain can be about the footprint and hotspots?**

When we apply the PAS 2050 specification to conduct a product carbon footprint, we can only regard the footprint result as an estimate. So, the process to compile a carbon footprint inventory is an estimation process. Inevitably, there are some inaccuracies in standardized emission factors and in data collection. There are also some knowledge gaps and misconceptions that are filled by assumptions and global warming potentials used to calculate the CO₂ equivalence of GHG. It is therefore important for analysts and users to understand uncertainties associated with the footprint result as well as to identify which aspects of the assessment leading to these uncertainties. By doing so, we can ensure that the resulting estimation is as accurate as possible. This is important when making decisions on carbon hotspot prioritization, raw material acquisition, etc.

● **Footprint verification**

The final stage in the step 4 is to verify the footprint result by an independent third party. By gaining third-party assurance, footprint claims can be bullet proofed. Such an assurance provides stakeholders with the confidence that claims are robust and well founded. Typically, assurance involves the following:

- ✧ reviewing and testing data collection and calculation procedures to confirm these are sound and that activity data are of the appropriate quality
- ✧ reviewing the reported footprint claims to ensure that these reflect what has been undertaken and delivered in the given reporting period.

Moreover, there are three different levels of assurance (self-verification, other third-party verification, independent third-party certification) issued by the third party. And, the PAS 250 specification requires that claims of conformity state the level of assurance.

By gaining third-party assurance, footprint claims can be 'bullet-proofed', and provide stakeholders with the confidence that claims are robust and well founded. Typically, assurance involves:

- ✧ reviewing and testing data collection and calculation procedures to confirm these are sound and that activity data are of the appropriate quality
- ✧ reviewing the reported footprint claims to ensure that these reflect what has been undertaken and delivered in the given reporting period.

It is important to remember that there are different levels of assurance (i.e.

self-verification, other third-party verification or independent third-party certification), and it is a requirement of PAS 2050 that claims of conformity state the level of assurance.

4.2. Materials Safety Data Sheet (MSDS)

The United Nations Environment Programmer (UNEP) has actively promoted hazardous chemical use reduction. According to a newest report, there are over 140,000 chemicals on the marketing, but only a few has been studied if they are hazard to both human and environmental health. The OECD also points out that both chemical compounds (e.g., ammonia, hydrogen sulfide and sulfuric acid) and organic chemical compounds (e.g., phenyl ethylene and methanol) generate the most emissions to the air when they are used in the production process. In order to reduce the use of hazardous chemicals, it urgently needs a good collaboration between governments and businesses on the regulation of chemical use.

With this in mind, material safety data sheet (MSDS) is an important component of product stewardship and occupational safety and health. MSDS is designed to provide workers and emergency personnel with procedures for handling or working with that substance in a safe manner. MSDS includes information such as physical data (melting point, boiling point, flash point, etc.), toxicity, health effects, first aid, reactivity, storage, disposal, protective equipment, and spill-handling procedures. It is widely used for cataloging information on chemicals, chemical compounds, and chemical mixtures. According to ISO 11014-1, there are four categories of information that must be presented on an MSDS, and they are:

- A. Information for Emergency Response
 - Product and company identification (Sec. 1)
 - Hazards identification (Sec. 2)
 - Composition/Information on ingredients (Sec. 3)
- B. Standard Operation Procedure for Emergency
 - First and measures (Sec. 4)
 - Fire fighting measures (Sec. 5)
 - Accidental release measures (Sec. 6)
- C. Hazard-Prevention Information
 - Handling and storage (Sec. 7)
 - Exposure controls/Personal protection (Sec. 8)
 - Physical and chemical properties (Sec. 9)
 - Stability and reactivity (Sec. 10)

D. Other information

- Toxicological information (Sec. 11)
- Ecological information (Sec. 12)
- Disposal considerations (Sec. 13)
- Transportation information (Sec. 14)
- Regulatory information (Sec. 15)
- Other information (Sec. 16)

Moreover, the Chinese Taipei government agencies (i.e. Environmental Protection Agency, Council of Labor Affairs, Ministry of Transportation and Communications) have implemented Regulations Respecting Controlled Products. These regulations mandate the MSDS information to be made public available. The MSDS format used in Chinese Taipei is provided in Table 1.

Table 1: Material Safety Data Sheet form made by The Council of Labor Affairs of Taiwan

Material Safety Data Sheet

SECTION 1: PRODUCT AND COMPANY IDENTIFICATION			
PRODUCT NAME			
OTHER/GENERIC NAMES			
PRODUCT USE			
MANUFACTURER ADDRESS AND PHONE			
EMERGENCY PHONE			
SECTION 2: HAZARDS IDENTIFICATION			
EMERGENCY OVERVIEW			
Odor, Color, Grade			
General Physical Form			
Immediate health, physical, and environmental hazards			
POTENTIAL HEALTH EFFECTS			
Eye Contact			
Skin Contact			
Inhalation			
Ingestion			
SYMBOLS			
WARNING SIGN			
Other hazards			
SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS			
PURE SUBSTANCE			
English and Chinese names			
Synonyms			
CAS No			
% by Wt			
MIXTURE			
English and Chinese names			
Synonyms			
CAS No.			
% by Wt			
SECTION 4: FIRST AID MEASURES			
FIRST AID PROCEDURES OF DIFFERENT EXPOSURE			
Eye Contact			
Skin Contact			
Inhalation			
Ingestion			
The most important symptoms and hazardous effects			

Advice to physician			
SECTION 5: FIRE FIGHTING MEASURES			
EXTINGUISHING MEDIA			
Special hazards that may be encountered when extinguishing			
Unusual Fire and Explosion Hazards			
Special protective equipment for fire-fighters			
SECTION 6: ACCIDENTAL RELEASE MEASURES			
ENVIRONMENTAL CONSIDERATION			
METHODS FOR CLEANING UP			
SECTION 7: HANDLING AND STORAGE			
HANDLING			
STORAGE			
SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION			
ENGINEERING CONTROLS			
CONTROL PARAMETERS			
TWA	STEL	CEILING	BEIs
PERSONAL PROTECTIVE EQUIPMENT (PPE)			
Prevention of Swallowing			
Respiratory Protection			
Eye/Face Protection			
Skin Protection			
EXPOSURE GUIDELINES			
SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES			
General Physical Form		Odor, Color, Grade	
Olfactory threshold		Melting point	
pH		Boiling point	
Flammable Limits - LEL		Flash Point	
Flammable Limits - UEL			
Auto ignition temperature		Evaporation rate	
Vapor Pressure		Vapor Density	
Density		solubility in Water	
Specific Gravity		Viscosity	
SECTION 10: STABILITY AND REACTIVITY			
STABILITY			
HAZARDOUS POLYMERIZATION			
INCOMPATIBILITIES			
MATERIALS AND CONDITIONS TO AVOID			
HAZARDOUS DECOMPOSITION			
SECTION 11: TOXICOLOGICAL INFORMATION			
IMMEDIATE(ACUTE) EFFECT			

SYMPTOMS		
ACUTE TOXICITY		
LD50		
CHRONIC OR LONG-TERM TOXICITY		
ROUTE OF EXPOSURE		
SECTION 12: ECOLOGICAL INFORMATION		
ECOTOXICOLOGICAL INFORMATION		
SECTION 13: DISPOSAL CONSIDERATIONS		
Waste Disposal Method		
SECTION 14: TRANSPORT INFORMATION		
US DOT HAZARD CLASS		
US DOT ID NUMBER		
HAZARD CLASS OF TRANSPORT		
PACKAGING CATEGORY		
MARINE POLLUTANT (Y/N)		
SPECIAL DELIVERY METHODS AND PRECAUTIONS		
SECTION 15: REGULATORY INFORMATION		
APPLICABLE REGULATIONS		
SECTION 16: OTHER INFORMATION		
REFERENCES		
MSDS-MAKER'S COMPANY	Company Name	
	Address / Phone	
MAKER	Titles	Name (Signature)
DATE		
NOTE		

Globally, Material Safety data sheets (MSDS) should provide comprehensive information about a substance or mixture for use in workplace chemical control regulatory frameworks (ECHA, 2011). Both employers and workers use it as a source of information about hazards, including environmental hazards, and to obtain advice on safety precautions. The information acts as a reference source for the management of hazardous chemicals in the workplace (OSHA, 2004).

An MSDS should be produced for all substances and mixtures which meet the harmonized criteria for physical, health or environmental hazards under the GHS and for all mixtures which contain ingredients that meet the criteria for carcinogenic, toxic to reproduction or specific target organ toxicity in concentrations exceeding the cut-off limits for MSDS specified by the criteria for mixtures.

The Globally Harmonized System of Classification and Labeling of Chemicals (GHS) are a globally harmonized hazard classification and compatible labeling system, including material safety data sheets and easily understandable

symbols. The GHS covers all hazardous chemicals. The mode of application of the hazard communication elements of the GHS (e.g. labels, safety data sheets) may vary by product category or stage in the life cycle. Target audiences for the GHS include consumers, workers, transport workers, and emergency responders. The GHS is designed to permit self-classification (UNECE, 2011).

Material Safety Data Sheets and Labeling are provided as a convenience to general users. The 2009 Chemical Dialogue (CD) meeting agreed that the Council of Labor Affairs of Chinese Taipei would help to set up a website which provides information on GHS:

- GHS Reference Exchange and Tool (G.R.E.A.T.) - a Standard Element Clearinghouse

The goal of this GHS clearinghouse website (named the “GHS Reference Exchange and Tool, G.R.E.A.T.”) is to collect and provide GHS information by collaboration with focal point(s) of member economies. This “G.R.E.A.T.” website covers the GHS labeling elements in local languages including (1) hazard class and category, (2) pictogram (Symbol), (3) signal word, (4) hazard statement, and (5) precautionary Statement. Chinese Taipei encourages member economies GHS focal point(s) to provide the GHS labeling elements in different languages or update status (APEC, 2009).

In order to calculate the carbon emissions generated from producing and to conduct carbon footprint inventory, we obtain MSDS information from FTC's upstream suppliers. In particular, the information on the column of hazard compounds (in %) in the MSDS helps us to obtain secondary data from the LCA software. Once we have the MSDS information, they are incorporated into the LCIQ calculate in order to obtain the carbon emissions generated from producing raw materials.

In this chapter, we introduce MSDS and discuss what kind of information should be included in the MSDS. Due to the large size of MSDS, we attached some copies of MSDS conducted for the case study in the Appendix C.

4.3 Life Cycle Inventory Questionnaire (LCIQ Tool)

In the case study, the project team designs a tool (the LCIQ tool) for compiling a carbon footprint inventory. This chapter introduces this tool. We first collect information on company and evaluated products. We draw a product life-cycle map and set the inventory boundary. We also calculate the carbon emissions generated from producing both direct and in-direct raw materials. Based on the obtained raw material emissions, we calculate the emissions from suing SF6 gas/refrigerant/ energy in the production process. Finally, we calculate the waste emissions to the air, water, and the land. When we perform the LCIQ calculation, we perform the Step 3 in Figure 5. After this step, we will be able to locate carbon hotspots and find emission reduction policies.

Each step in the LCIQ calculation is introduced in the following:

(1) LCIQ Introduction

This is an introduction of the LCIQ tool, which include architecture description, purpose, instruction, and recommended attachment. These are the inventory list.



Life cycle inventory questionnaire (LCIQ) version: 1.0

Created by : Taiwan Textile Research Institute

Architecture Description:

1. This life cycle inventory questionnaire is established according to ISO14040: 2006 and ISO14044: 2006 standard; comply the spirit and procedures of life cycle inventory and assessment which could assist industry doing life cycle inventory of products.
2. Term explained:
 - a. ISO14040:2006—Environmental management/Life cycle assessment-Principles and framework
 - b. ISO14044:2006—Environmental management/Life cycle assessment-Requirements and guidelines

Purpose:

(Article 11 (Requirements for components and sub-assemblies) of EuP Directive mentions that implementing measures may require manufacturers or their authorised representatives placing components and subassemblies on the market and/or putting them into service to provide the manufacturer of an EuP covered by implementing measures with relevant information on the material composition and the consumption of energy, materials and/or resources of the components or sub-assemblies. For the purpose of making the Eco-profile of the products, please assist in filling this LCI questionnaire.

2. Application of LCI/LCA:

- a. Identification of significant environment issues
- b. Environmental information disclosure, such as Environmental product declaration(EPD), Ecological profile, carbon footprint, and European Union Eco-labeling program, etc.
- c. Decide the environmental performance indicators and their measurement technology selection.

Instruction:

1. The questionnaire contains 11 sheets: profile, flowchart, the make-up of the component, auxiliary material, energy & resource consumption, electricity consumption by equipments, emission to the air, emission to the water and wastes. Please fill out the sheets from left to right.
2. DQI(Data Quality Indicator) mentioned in the questionnaire includes three types of value:
 - a. Measurement: can be obtained by measure equipment directly.
 - b. Calculation: can be obtained by calculating via using standard formula, such as energy consumption of equipment.

(2) Company Profile

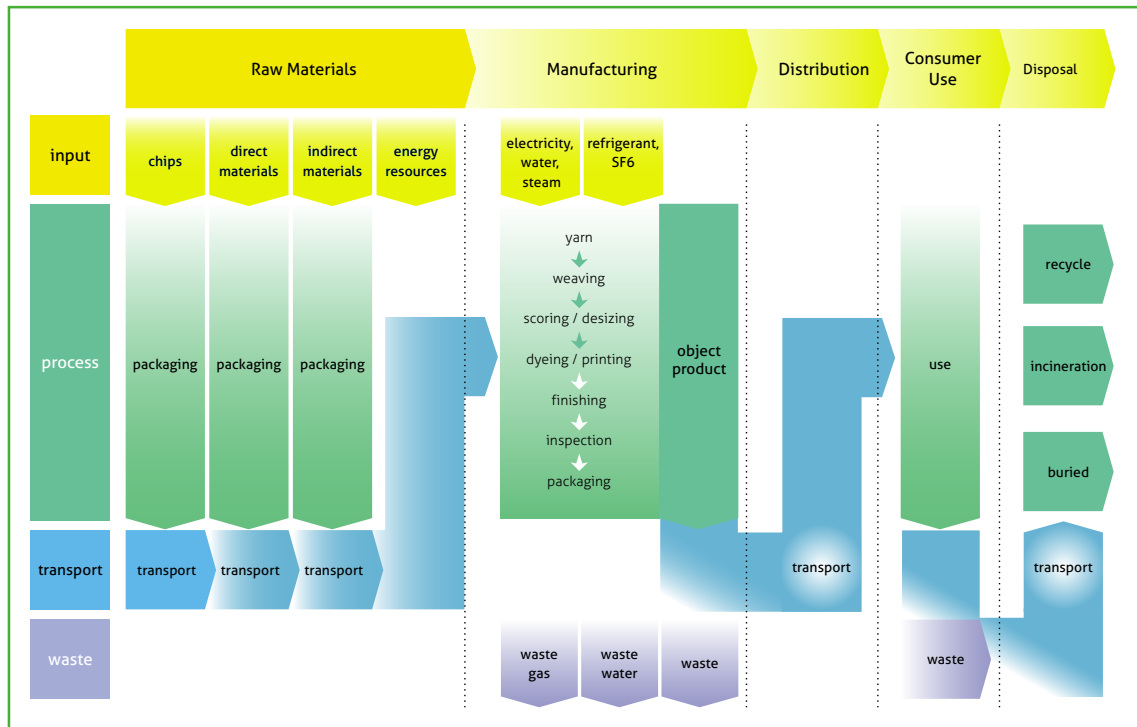
This requires information on company profile, including company name, company address, capital of plant, employee number, contact person, contact person title, phone number, fax number, e-mail address, company homepage, company introduction, product name & model, product picture, product specification, function unit of product, environmental regulation compliance, and inventory period. Since this information must be written into the inventory report for the third party verification, it is good to know or identify correctly from the beginning.

④ Company profile	
Company name	
Factory Address	
Capital of plant	
Employee no.	
Contact person	
Title	
Phone no.	
Fax No.	
E-mail	
Company website	
Company introduction	
Product name & model	
Product Picture	
Product specification	
Function unit of product	Kg /yard
Environmental regulation complied	
④ Investigation information	
Filling date	
Inventory period	20XX/ 1/1~20XX/12/31

(3) Draw a product life-cycle Map

As we mentioned earlier, the PAS 2050 Guide suggests four footprint process steps. The first step is to draw a product life-cycle process map. And, the important thing about drawing the map is to help us to set the inventorying boundary and list out each production stage.

In the case study, as shown in this step, we first identify inputs and outputs (i.e. from raw materials to disposal, including transportation) according to the concept of a product's life-cycle. In our case, the whole manufacturing process of converting raw materials to a fabric takes place in one single factory. This simplifies the emission calculation process. We then set both raw materials and manufacturing as the boundaries for conducting carbon footprint inventorying.



(4) Emissions of Direct Materials

After we draw the map, we start to apply the LCIQ tool to calculate carbon emissions from production processes. We first calculate the amount of carbon emissions generated from producing raw materials. And, as in the production process map, we identify the types of raw materials that are used in the production process. These raw materials are considered as direct materials in the production process.

In order to perform the LCIQ calculation process, we obtain the MSDS information for each raw material from suppliers and incorporate the information (i.e. components and percentages) into the calculation process. We also incorporate the database in the LCA software into the calculation to obtain the amount of carbon emissions generated from producing each raw material. And, our calculation includes emissions for shipping of each raw material.

Processing Stage	Raw Material Items			Raw Material Consumption (Annual)	Chemical Characteristics (Raw Materials)		Data Quality Attributes
	No.	Supplier	Name	Quantity	Composition		
					Name	Ratio	
Gray Fabric	N9999	A	Nylon or Polyester fabric	100541.000 kg	nylon	100.0%	Measurement
Desizing	AA112	B	Desizing agent	195.000 g	Sodium persulfate	>98.0%	Measurement
Dyeing	AB225	C	Scouring agent	720.800 kg	Naphthalenes ulfonic acid	3.0%	Measurement
					Sodium sulfate	47.0%	
					Thiourea dioxide	50.0%	

Note: Data for chemical characteristics are taken directly from the Material Safety Data Sheet (MSDS).

(5) Emissions of In-direct Materials

We then continue to calculate the amount of emissions generated from producing in-direct materials. The calculation process is the same as that of direct materials.

If suppliers are not able to provide the needed MSDS information for some of the in-direct materials, we ask them to give us the amount of energy used in producing these indirect materials. We then estimate emissions from energy use.

Processing Stage	Raw Material Items			Raw Material Consumption (Annual)	Chemical Characteristics (Raw Materials)		Data Quality Attributes
	No.	Supplier	Name	Quantity	Composition		
					Name	Ratio	
Gray Fabric	P50010	C	Industrial SP sewing thread (white)	100.000 kg	polyester	100.0%	Measurement
Packaging	T60010	E	1.25"*2.2*45" paper tube	720.800 kg	fiber	90.0%	Measurement
					polyvinyl acetate	5.0%	
					water	5.0%	

Note: Data for chemical characteristics are taken directly from the Material Safety Data Sheet (MSDS).

(6) Emissions of SF6 gas Consumption

In order to obtain the amount of Sulfur Hexafluoride (SF6) gas used in producing a product, we first estimate the total amount of gas consumed from its servicing equipments. We then estimate the total amount of gas consumed according to the ratio of gas escape or the proportion of filling material(s). With

these information, we can calculate the amount of Sulfur Hexafluoride (SF6) gas used in producing a product.

Location	Power Circuit Breaker	Brand Name	Type	Equipment No.	Production Year	Last Filling Date	SF6 Filling Volume (kg)	SF6 Annual Added Volume (kg)	Allocated Amount (kg)
Q	GCB	FUJI	HU 1220N-06MF-C	FM67076/1.3	1992	2010/1/6	1.96	4.52	
S	VCB	Mitsubishi	C-Mitsubishi VCB	FK68499/1-10	1994	2007/6/8	2.56		

(7) Emissions of Refrigerants Consumption

The way to calculate the amount of each refrigerant (R11, R12, R134, R134a, R22 etc) used in producing a product is the same as that of SF6 gas.

Location	Refrigerant	Type	Quantity	R11, R12, R123, R134a, R22	Original Filling (tone)	Quantity * Original Filling (tone)	Refrigerant Emission Factor (kg/kg)	Annual Emissions (tone)	Total Emissions (kg)	Allocated Amount (kg)
S	TRANE	440_RT	2	R11	0.4631	0.9262	20%	0.19524	0.96704	
IO	CARRIER	800RT	5	R123	0.6810	3.4050	20%	0.6810		
U	MC_QUAY	650_RT	1	R134a	0.4540	0.4540	20%	0.09080		

(8) Energy Emissions

In order to calculate the amount of carbon emissions generated from the energy used in converting raw materials to a fabric, we first identify all types of energy (electricity, coal, fuel oils, etc.) used in the production process. We then collect the amount of energy used each month for a period of 12 months. Finally, we calculate energy emissions based on the portions of the individuals consumed in production.

With the calculated energy emissions, companies can establish a new baseline or correct existing baseline for energy consumption in the production process.

	Purchased Electricity					Coal		Fuel Oil	LPG	Nature Gas	Diesel	Bio-diesel	Underground Water	Tap Water	Steam		Nitrogen	Sold Electricity		Own Generating Electricity Capacity
	Peak	Half Peak	Off Peak	Half Peak on Sat.	Total	Calorific Value	Amount								Purchased	Sold		Peak Time	Half Peak Time	
	kWh					kcal/kg	ton	kL	kg	m3	L	L	ton	ton	ton	kg	kWh			
Last Dec.																				
1																				
2																				
Σ																				
11																				
12																				
Next Jan.																				
Total																				

(9) Waste Emissions to the Air

In Chinese Taipei, hazardous wastes released in the air, water or on land are regulated by governments. Information on facility compliance with water, air, and hazardous waste requirements provides a good source for calculating waste emissions.

So, we first collected the needed data from the emission control database and checked the data quality. From the data, we then calculated the amount of volatile organic compounds (VOCs) and methane consumed from production processes.

Location	Monthly or Quarterly	SO _x	NO _x	VOC	Allocated Amount of This Product	Data Quality Attributes
		kg				
Finishing 1	Last Dec.					I: Measurement
	Q1					II: Calculation
	Q2					III: Estimation
	Q3					
	Q4					
	Next Jan.					
Total						

Note: Data are taken directly from the air pollution fee declaration

(10) Waste Emissions to the Water

From the government's emission control database, we collect the amount of water used each month for a period of 12 months. We then calculate wastewater emissions released into the environment.

Location	Quarterly or Monthly	Waste Water	COD	SS	Total COD	Total SS	Output	Allocation Proportion	Allocated Amount	Data Quality Attributes
		m ³ /month	mg/L	mg/L	kg	kg	kg	%	kg	
Q	Last Dec.									I: Measurement
	1									I: Measurement
	2									I: Measurement
	Σ									
	12									I: Measurement
	Next Jan.									I: Measurement
Total										II: Calculation

Note: Data are taken directly from daily or monthly operation records, and are checked with the waste water treatment fee declaration.

(11) Waste Emissions to the Soil

From the government's emission control database, we collect the amount of wastes (other than air and wastewater) generated each month for a period of 12 months. We then calculate waste emissions released into the soil. With the calculated waste emissions, companies can establish a new baseline or correct existing baseline for wastes released from production process.

Location		No.	Item Name	Official Code	Output	Allocation Proportion	Allocated Amount	Data Quality Attributes
					kg	%	kg	
	Last Dec.	1	Plastic Buckets	D-0299				I: Measurement
		2	Drum					I: Measurement
		3	Paper Tube					I: Measurement
		4	Waste Fabric					I: Measurement
		5	Garbage					I: Measurement
		6	Textile Sludge					I: Measurement
	Σ							
Total								II: Calculation

Notes: 1. Data are taken directly from daily or monthly operation records, and are checked with the Waste pollution declaration.

2. The "Total" amount is calculated by Last Dec. Q1, Q2, Q3, Q4 and next Jan.

When we conduct environmental footprint using the LCIQ tool, we need to apply the following equation, which is the equation used to calculate emissions in the PAS 2050.

Before we perform the calculation using the equation, we need to calculate activity data. And we can calculate activity data when we complete the aforementioned 11 data sheets. Also, we can obtain emission factors from LCA database or other references. After we obtain both activity data and

emission factors, we incorporate them into the equation and calculate carbon emissions for environmental footprint.

$$A = B \times C$$

where

A : Carbon footprint of a given activity

B : Activity data (mass/volume/kWh/km)

C : Emission factor (CO₂e per unit)

CHAPTER 5

THE CASE STUDY

The most famous and biggest textile manufacturing company in Chinese Taipei -FORMOSA TAFFETA CO., LTD. (FTC) participated in the case study. We performed environmental footprint for their 24 types of functional textile products. FTC would like to understand the carbon emissions generated from producing a functional textile. With such information, FTC will be able to set baselines for both energy consumption and carbon emissions in the production process. Such baselines help FTC not only to reduce energy consumption (and hence production costs) but also to find emission reduction plans. Moreover, "environmental impact reduction" is becoming a marketing tool. Carbon footprint labeling (like the Nutrition labeling) provides information on product's environmental performance. This is definitely an extra buying selection criteria to customers, and also helps FTC's downstream firms to evaluation information on their own. With these in mind, FCT forms a taskforce for carrying out this environmental footprint study.

In the case study, we perform the environmental footprint on FTC's 24 types of functional textile products. The profile of these products is provided as follows:

Item	Function	Use purpose
-Nylon /polyester dyeing & setting process for woven fabrics	Dyeing & setting	lining, cloth cover
-Nylon /polyester dyeing & wicking finishing process for woven fabrics	Moisture absorbing & quick drying	athletic clothes, jackets, golf clothing
-Nylon/polyester dyeing & water repellent process for woven fabrics	Antifouling, waterproof	Cloth cover, tent, athletic clothes, jackets
-Nylon/polyester dyeing & water repellent & calendaring process for woven fabrics	waterproof, handling soft	Tank top, trench coat, down jacket, athletic jacket, fashion clothing
-Nylon/polyester dyeing & PU coating process for woven fabrics	Waterproof, windproof, coloring	trench coat, rain coat, athletic jacket, fashion clothing, anorak
-Nylon dyeing & acrylic coating process for woven fabrics	Waterproof, windproof	umbrella, tent, athletic jacket, fashion clothing
-Nylon/polyester dyeing & laminating process for woven fabrics	Breathable and waterproof, warm & windproof	trench coat, rain coat, athletic jacket, fashion clothing, anorak
-Nylon/polyester printing & water repellent process for woven fabrics	Printing, Antifouling, Breathable and waterproof	umbrella, cloth cover, athletic jacket, fashion clothing, beach shorts
-Nylon/polyester printing & water repellent & calendaring process for woven fabrics	waterproof, handling soft	lining, cloth cover, trench coat, anorak, athletic jacket, fashion clothing
-Nylon/polyester printing & PU coating process for woven fabrics	breathable and waterproof, windproof, coloring	trench coat, rain coat, athletic jacket, fashion clothing, anorak

-Nylon printing & acrylic coating process for woven fabrics	breathable and waterproof, windproof	umbrella, tent, athletic jacket, fashion clothing
-Nylon/polyester printing & laminating process for woven fabrics	breathable and waterproof, warm & windproof	trench coat, rain coat, athletic jacket, fashion clothing, anorak

This chapter reports the case study results according to both the 4 stepwise processes in Section 4.1 and the LCIQ calculation process.

In short, we will need to check it complies with the principles in clause 4.3 of PAS 2050. In particular, we should check that it (as follows) in order to know whether if a supplementary requirement or other product rules/PCR is applicable:

- ✧ does not conflict with the provisions of PAS 2050 unless this has been explicitly allowed for within a PAS 2050 provision (e.g. if justified, the time period for assessment may be different in supplementary requirements to the 100 year period identified in PAS 2050)
- ✧ has been developed through a consensus-based process and well recognized (i.e. within our sector and/or internationally)
- ✧ has a scope that is applicable to our industry/ stakeholders and it is comprehensive.

Because there is no available document of supplementary requirement or PCR worldwide to be able to use in the report of assessment, the system boundary for the assessment is defined in PCF inventory report. In the following sub-sections, we will details how the project team proceeds the environmental footprint process according to the 4 stepwise footprint process in Figure 5.

5.1 Step 1-Scoping

FTC first identifies which textile products they would like to do environmental footprint. The company identifies a total of 24 types of functional textiles including polyester and nylon, and they are listed as follows :

- Dyeing & setting process for woven fabrics
- Dyeing & wicking finishing process for woven fabrics
- Dyeing & water repellent process for woven fabrics
- Dyeing & water repellent & calendaring process for woven fabrics
- Dyeing & PU coating process for woven fabrics
- Dyeing & acrylic coating process for woven fabrics
- Dyeing & laminating process for woven fabrics
- Printing & water repellent process for woven fabrics
- Printing & water repellent & calendaring process for woven fabrics
- Printing & PU coating process for woven fabrics
- Printing & acrylic coating process for woven fabrics
- Printing & laminating process for woven fabrics

- **Describe the product to be assessed and the unit of analysis**

In general, the weaving and dyeing segment is the most important product processes of functional textile business unit. In the textile supply chain operations, the weaving and dyeing processes produce fabrics differently in thickness and lengths. Therefore, fabrics are generally cut and sold by the yard. But, in order to uniform the unit measurement in the emission calculation process, we use "1kg of woven fabric" as the declared unit. The appropriate functional unit is then driven by how the product is typically consumed, therefore, the functional unit of FTC products are defined such as 1kg Nylon dyeing & setting process for woven fabrics, 1kg Polyester dyeing & wicking finishing process for woven fabrics, 1kg Polyester printing & laminating process for woven fabrics etc.

- **Draw a product life-cycle map**

In the case study, the LCIQ tool is applied to conduct the cradle-to-gate assessment. We need to calculate:

- (1) the amount of carbon emissions generated from producing raw materials (yarns, dyes, chemicals, and package materials), and
- (2) the amount of emissions generated from the energy used in converting raw materials to a fabric.

So, we need to first draw a product life cycle map and set the inventory boundary. As shown in Figure 6, we first identify inputs and outputs (i.e. from raw materials to disposal, including transportation) according to the concept of a product's life-cycle. In our case, the whole manufacturing process of converting raw materials to a fabric takes place in one single factory. This simplifies the emission calculation process. We then set both raw materials and manufacturing as the boundaries for conducting carbon footprint inventorying.

After we draw the map, we start to apply the LCIQ tool to calculate carbon emissions from production processes. We first calculate the amount of carbon emissions generated from producing raw materials. And, as in the production process map, we identify the type of raw materials that are used in the production process. These raw materials are considered as direct materials in the production process.

In order to perform the LCIQ calculation process, we obtain the MSDS information for each raw material from suppliers and incorporate the information (i.e. components and percentages) into the calculation process. We also incorporate the database in the LCA software into the calculation to obtain the amount of carbon emissions generated from producing each raw material. And, our calculation includes emissions for shipping of each raw material.

We then continue to calculate the amount of emissions generated from producing in-direct materials. The calculation process is the same as that of

direct materials. If suppliers are not able to provide the needed MSDS information for some of the in-direct materials, we ask them to give us the amount of energy used in producing these indirect materials. We then estimate emissions from energy use.

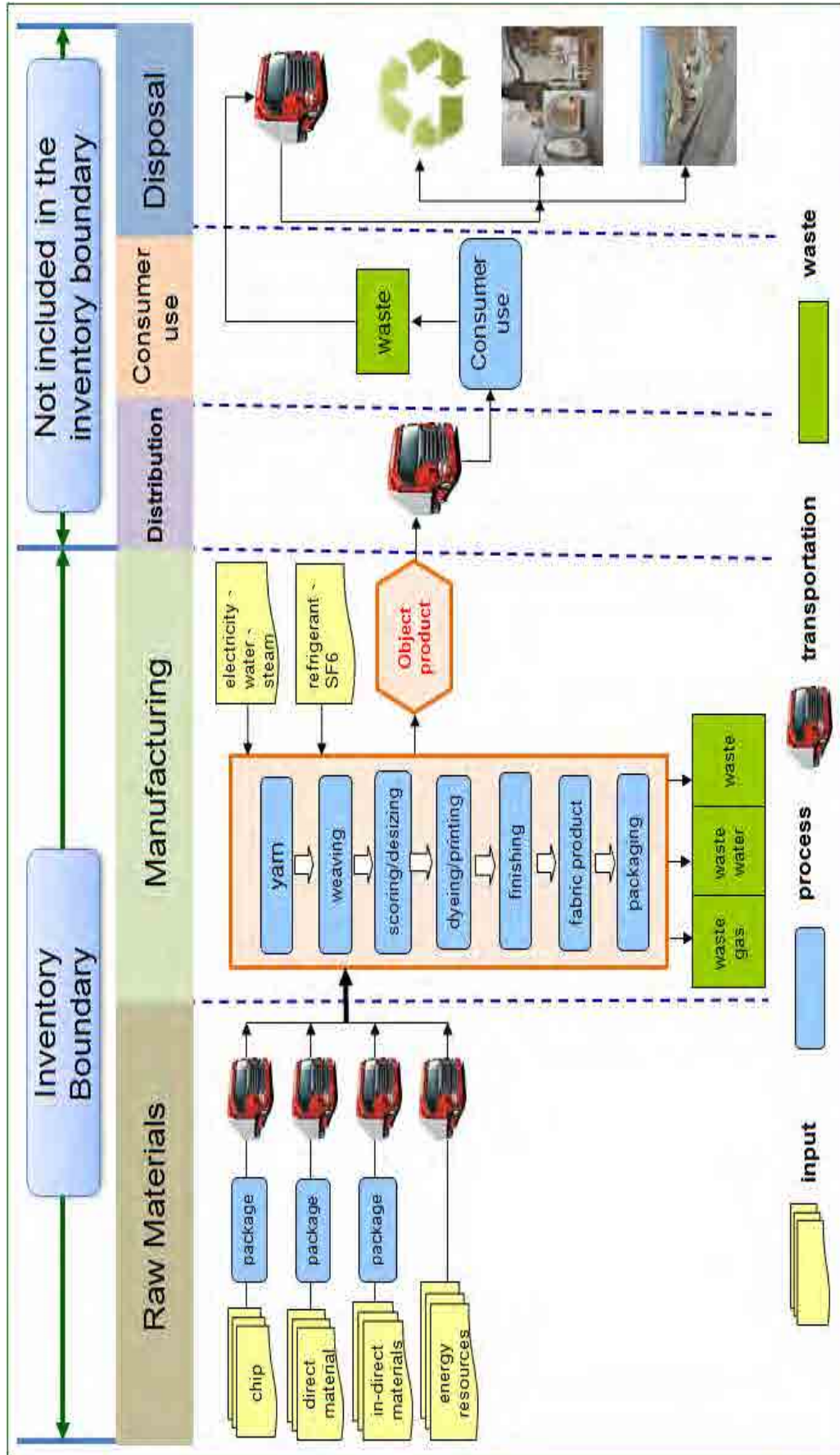


Figure 6: The process-map of the weaving fabric from a functional textile manufacturing

● **Agree and record the system boundary of the study**

After we draw the product life-cycle map and finish aforementioned estimation, we are able to obtain the following information:

- ✧ a list of all direct materials of chemicals and dye ; a list of all in-direct materials of paper tubs and threads ; a list of all fabric production activities.
- ✧ a list of all included activities and processes within each produced stage
- ✧ a list of all excluded activities and processes, and the steps taken to determine their exclusion.

● **Prioritize data collection activities**

A good initial check is to look for any previous carbon footprint or life cycle assessment (LCA) studies that have been carried out on the product system (or a similar product system) to be studied. A quick internet search, using typical search engines can help with this.

- ✧ Raw materials are commonly a hotspot for the carbon footprint of a product. By using a bill of materials and/or the process map, it is possible to do some quick, 'back of the envelope' calculations to identify areas where the impact is likely to be high, and therefore primary data collection should be prioritized.
- ✧ Processing energy is also often a large contributor to emissions. By looking at the process map it is possible to identify potential processes that are likely to use a lot of energy. Even if a rough amount for energy consumption is known (e.g. from industry guidance), it is possible to do the same 'back of the envelope' calculations to ascertain where in the life cycle specific information is likely to be needed.

5.2 Step 2-Data collection

The data needed to carry out a product carbon footprint calculation fall into the following categories:

- ✧ Activity data: referring to quantities of inputs and outputs (materials, energy, gaseous emissions, solid/liquid wastes, co-products, etc.) for a process – typically described for a unit of production for a specified year of production (e.g. kg CO₂e per kg of for woven fabrics in 2011). This also includes details of any transportation of incoming materials, wastes or distribution of the final product (distances travelled, vehicles used, etc.).

Activity data can be from either:

- primary sources – first-hand information, specific to the activity in question (e.g. chemicals/dyestuff amount using at dyeing process), collected internally or from the supply chain or
- secondary sources – average, or typical, information about a general activity (e.g. components of chemicals, fuel consumption of truck engines) from a published study or other source.

✧ Emission factors: values that convert activity data quantities into GHG emissions – based on the ‘embodied’ emissions associated with producing materials/fuels/energy, operating transport carriers, treating wastes, etc. These are usually expressed in units of ‘kg CO₂e’ (e.g. kg CO₂e per kg of for woven fabrics, per liter of diesel, per km of transport or per kg of waste to landfill), and are most often from secondary sources.

● Draw up a data collection plan

The data collection plan outline top targets for primary data collection, and highlight areas where secondary data will be sought instead, recognizing where primary data collection may not be feasible. For FTC case, the input and output flows in the main phases is shown as Figure 7, and the data collection outline follows each item of the inputs, manufacturing and outputs.

FTC has a highly effective Enterprise resource planning (ERP) system, and its taskforce members are familiar with the system. These are keys to the success of this ecological footprint project.

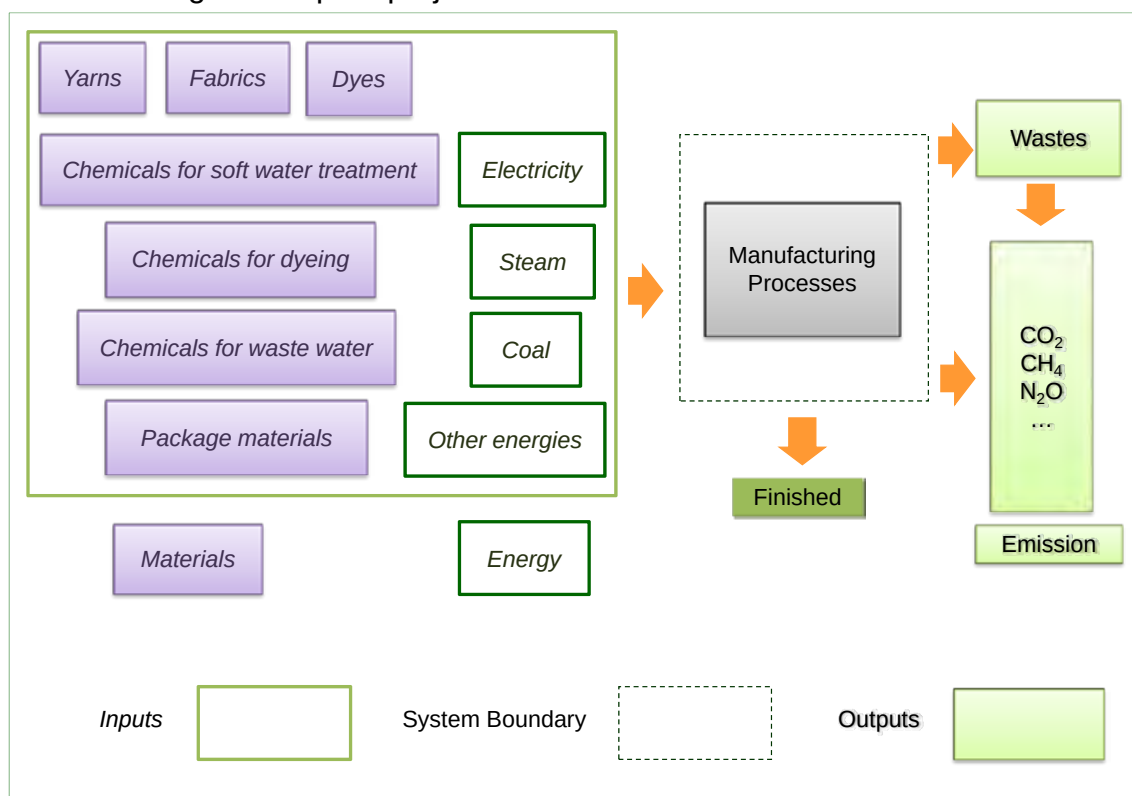


Figure 7: Data collection plan for the functional textile manufactory

● Engaging suppliers to collect primary data

It seems that not much supply is willing to offer carbon footprint data or information in textile industry supplier chain until today. It is really hard to collect the primary data from up-stream supplier, especially the chemicals' supplier. That is the reason why have to ask them to offer the MSDS to instead of the secondary data.

● Collecting and using secondary data

For FTC case, the secondary data we used were shown as follows :

- ✧ emission factors – which convert primary activity data (material/energy/process inputs and outputs) into GHG emissions (in kg CO₂e), e.g. some of chemicals, dyes, biodiesel etc.
- ✧ information to fill gaps in primary activity data : For overall inventory data, there were NO data gaps because all data was assessed along the whole supply chain with cradle – to – gate approaches. Cut off are materials below 5% contribution.

● Collecting data for downstream' activities

'Downstream' activities refer to processes that occur during product distribution, retail, use and end-of-life. For FTC case is no necessary to collect because it is the cradle-to-gate assessment.

● Assessing and recording data quality

When performing the LCIQ calculation process, it is important to validate the collected data. The data can be obtained internally (from corporate) and externally (from literature or other references). In particular, the internal data generally cannot be collected from one single department; therefore, it is important to have a good communication channel or mechanism for collecting such data. FTC has an ERP system which provides a good mechanism to collect data from various departments.

All installations relate to the products are covered in the verification, and the main emissions are from :

- ✧ Energy use (including energy sources, such as electricity)
Combustion processes
- ✧ Refrigerant loss and other fugitive gases
- ✧ Operations
- ✧ Waste
- ✧ Service provision and delivery are not applicable for the assessment of cradle to gate

All sources of emissions anticipated to make a material contribution to the life cycle GHG emissions of the functional. At least 95% of the anticipated life cycle GHG emissions of the functional unit. The each LCA stage in the assessment less than amount 5% GHG emissions to total product life cycle GHG emissions can be cut-off. However there is no any item is omitted in the report of assessment.

About the Data quality, the company provided data on :

- (1) Distances from agents or suppliers of ingredients to the Company factory,
- (2) Quantities and types of ingredients for the manufacturing of the product,
- (3) Quantity and type of materials used in packaging the finished product,
- (4) Quantity and type of waste arising from manufacture and its treatment,
- (5) Distances and loads of raw material transported.

The quality of these data is good and required no clarifications. An assessment of the quality of data received from Formosa Taffeta Co., Ltd. can be seen below in table below. To determine the quality of data received, completeness, validity, consistency and accuracy were evaluated subjectively by Formosa Taffeta Co., Ltd. In its PCF report, the data has been assessed as different quality level shown as below Figure 8 :

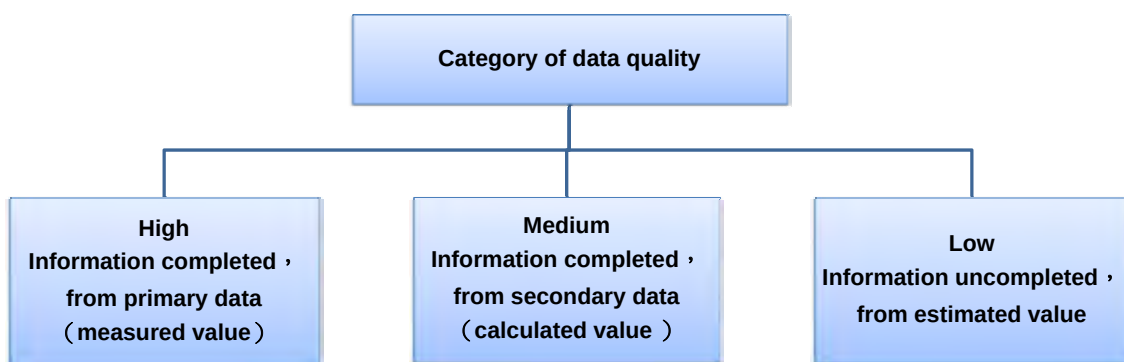


Figure 8. Category of data quality in the case study

Meanwhile, assessment of product life cycle GHG emissions should use data that will reduce bias and uncertainty as far as practicable by using the best quality data achievable. The company quantifies most of their emission data from public sources in order to reduce uncertainty.

5.3 Step 3-Footprint calculations

FTC has selected and used the combination of calculation based on product life cycle GHG activities primary data multiplied by related GHG emission factor/mass balance approach and measurement. With the help of EPR system, we collected the needed data for performing the LCIQ calculation.

Also, the emission factors from the LCA database are applied as for most secondary data sources in its PCF report. As a result of carrying out the product life cycle greenhouse gas emissions, it is shown as follows:

Item	kgCO ₂ eq
Nylon dyeing & setting process for woven fabrics	27.718
Nylon dyeing & wicking finishing process for woven fabrics	35.156
Nylon dyeing & water repellent process for woven fabrics	28.270
Nylon dyeing & water repellent & calendaring process for woven fabrics	29.946
Nylon dyeing & PU coating process for woven fabrics	38.799
Nylon dyeing & acrylic coating process for woven fabrics	29.409
Nylon dyeing & laminating process for woven fabrics	70.455
Nylon printing & water repellent process for woven fabrics	28.648
Nylon printing & water repellent & calendaring process for woven fabrics	32.520
Nylon printing & PU coating process for woven fabrics	48.451
Nylon printing & acrylic coating process for woven fabrics	29.009
Nylon printing & laminating process for woven fabrics	86.644
Polyester dyeing & setting process for woven fabrics	25.394
Polyester dyeing & wicking finishing process for woven fabrics	28.346
Polyester dyeing & water repellent process for woven fabrics	26.300
Polyester dyeing & water repellent & calendaring process for woven fabrics	28.316
Polyester dyeing & PU coating process for woven fabrics	36.513
Polyester dyeing & acrylic coating process for woven fabrics	27.914
Polyester dyeing & laminating process for woven fabrics	39.077
Polyester printing & water repellent process for woven fabrics	24.036
Polyester printing & water repellent & calendaring process for woven fabrics	28.415
Polyester printing & PU coating process for woven fabrics	39.309
Polyester printing & acrylic coating process for woven fabrics	33.640
Polyester printing & laminating process for woven fabrics	36.430

Note: unit = 1kg fabric

5.4 Step 4-Interpreting footprint results and driving reductions

As a result of carrying out the third-party verification of product life cycle greenhouse gas emissions, it is the opinion of BSI with reasonable assurance, and it is also a requirement of PAS 2050 that claims of conformity state the level of assurance. One product verification statement is shown as an example in the following:



After we perform the LCIQ calculation, the project team identifies carbon hotspots in the production process for driving emission reduction. Based on the identified hotspots, as shown in the blue highlighted area of Figure 10, FTC has initiated the following four reduction plans.

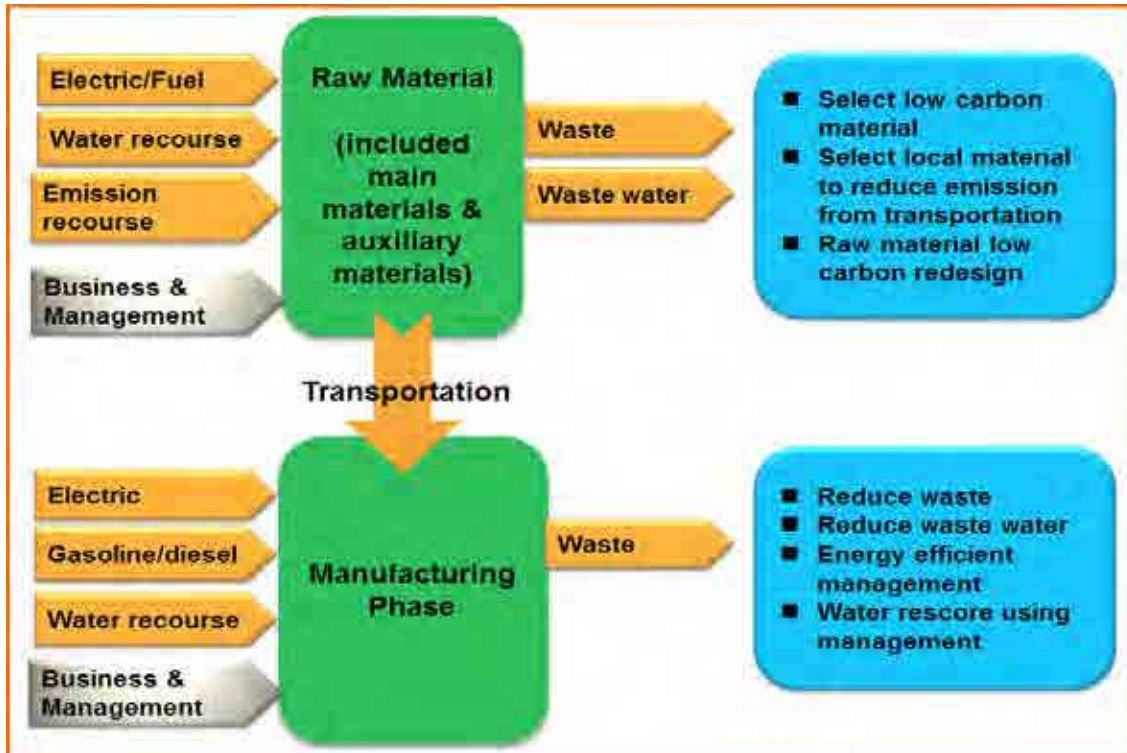


Figure 10. From LCA process to find out the Hot Spots

1. To reduce water consumption in textile processes. For example, install a condensed steam water recycling system and use more recycled water in both weaving and dyeing processes.
2. To lower electricity consumption in textile processes. For example, improve lighting and air-conditioning systems in facilities. Another example, adjusting product production combinations so that machines can be used to produce more the same products for a longer time and hence, FTC will be better in the control of electricity consumption.
3. To implement a low pressure steam saving plan. For example, FTC will implement a focus production so that fewer machines will need to be turn on and wait for the equipment to reach a certain temperature. FTC will also recycle water heat from dyeing machines, forming machines, and desizing wastewater. These recycled heats will be used in the production processes.
4. To reduce fuel consumption. For example, FTC will implement a focus production strategy in order to improve overall equipment effectiveness.

5.5 Cost Estimation

Generally, the costs of conducting an environmental footprint study include the carbon footprint inventorying fee and the third party verification fee. The third party verification fee is charged based on the number of auditors per day. ISO19011: 2002/14064-3: 2006 has clearly specified a total of auditors and auditing days that are needed for a normal environmental footprint case.

The product carbon footprint verification of Formosa Taffeta Co., Ltd was based upon the client's product carbon footprint management system & inventory report. The verification process included one off-site document review and two stages on-site verification which prepared in accordance with ISO19011: 2002/14064-3: 2006. The Initial Stage 1 verification was expected to take 10 verification man days and 2 verification man-days for Stage 2 verification. The service charge for conducting a footprint inventory is according to the number of evaluated products, the number of chemicals used in the production process, types of textile processes, and the number of production facilities used in producing evaluated products.

5.6 Summary

Environmental footprint is a new concept, and we definitely need to do it for our environmental sake. When we conduct an environmental footprint, we want to know the amount of carbon emissions generated from production processes. But which methodology or tool we should use to calculate emissions? We haven't seen a study discussing a feasible tool for compiling a carbon footprint inventory. In the APEC project, we designed the LCIQ tool and tested its feasibility in a case study. This tool is used in the data collection process, which is schematically shown in Figure 11. We really appreciate that the FTC participated in this case study. We are also happy that this tool helped FTC's 24 types of functional textiles to receive the Carbon Footprint Verification, the highest level for this verification.

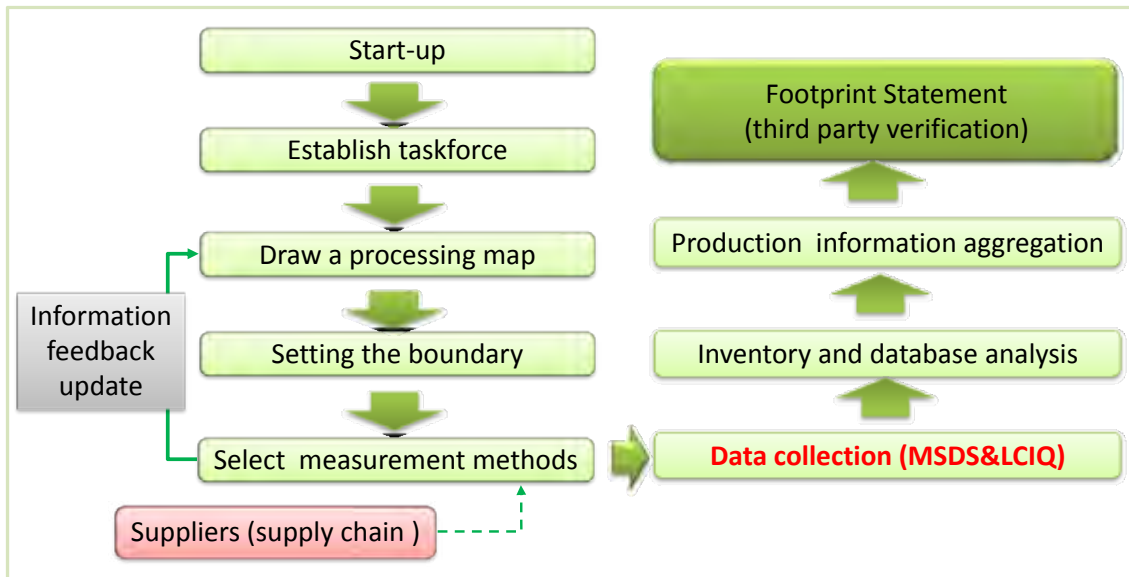


Figure 11. Product carbon footprint inventory process

We have learnt many valuable lessons from conducting this case study. And we believe that the followings are keys to the success of environmental footprint:

- (1) a commitment to environmental footprint;
- (2) organize an effective taskforce;
- (3) have a good ERP system so that we can easily get the data or information requested in the PAS 2050; and
- (4) Good assistance in obtaining the MSDS information from raw material suppliers.

CHAPTER 6.

CONCLUSIONS

Carbon footprint inventory can provide an opportunity to adjust the textile supply chain operations.

Product carbon footprint is a useful tool for understanding the climate impacts of bringing products and services to market. The insight it can offer into a product's supply chain and its efficiency of production can be used to improve product environmental performance and identify cost savings, often yielding a significant return on investment. Provided with this level of insight, companies can align their business practices to minimize risk and maximize competitive advantage, especially in sectors where life-cycle climate impacts are used for product differentiation.

When we conduct a carbon footprint verification, we want to know the amount of direct and indirect carbon emissions generated from production processes. But which methodology or tool we should use to calculate emissions? So, in the APEC project, we introduce a measurement tool which we call it "LCIQ" -- standards for Life Cycle Inventory Questionnaire.

Companies can also use the results of product carbon footprint to provide consumers with information that helps them make informed decisions. In particular, the use of product carbon labels is expected to increase as a means of communicating life-cycle GHG emission impacts to consumers and others who purchase and use goods and services. The goal and scope definition includes defining the system boundaries and the functional unit of analysis.

Although a good ERP system plays an important role in the success of carbon footprint inventory in the case study, both the concept of footprint inventory and the LCIQ calculation process can be applied to any environmental footprint case. The textile industry output is about 60 billion kg of fabric annually around the globe. And according to a report from the United Nations Industrial Development Organization, in 2004, the textile industry used 26% of global energy use and produced 18.5% of CO₂ emissions. Of course, the manufacturing technology has improved with time. But, we are still heavily polluting the place we are living in. So, we definitely need to do it for our environmental sake.

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ABBREVIATIONS AND ACRONYMS

APEC	=	Asia-Pacific Economic Cooperation
BSI	=	British Standards Institution
FTC	=	Formosa Taffeta Co., Ltd
GHG	=	Greenhouse gas
GWP	=	Global warming potential
ISTWG	=	Industrial Science and Technology Working Group
KG	=	Kilogram
LCA	=	Life-cycle analysis
LCIQ	=	Life-cycle inventory questionnaire
MSDS	=	Materials safety data sheet
OECD	=	Organization for Economic Co-operation and Development
TKM	=	Tonne-kilometre
TTRI	=	Taiwan Textile Research Institute
UNEP	=	United Nations Environment Programmer

AAPPENDIX A : TAIWAN TEXTILE RESEARCH INSTITUTE (TTRI)



Create Taiwan Textile Research Institute (TTRI) as the integrator of technology and leadership of industry. Offer variety textile business with customized service the multi-integrated and transform service.

Textile industry in Taiwan can be categorized into three types of representatives: ones that are equipped with good R&D and innovation competence, and they can form partnership relationship to jointly share results of R&D; ones that are of medium-size establishments, and R&D capability of them is considered rather insufficient, but they can take apart in the special projects by the government and make use of these projects to help deepen their R&D competence; those small and medium-size enterprises that are short in R&D funding, manpower, and capital, so that government can provide counseling resources and information to help them conduct management counseling.

With three 100-billion projects to expect continuous growth from textile industry. As for the structure of textile industry in Taiwan, more than just making adjustment and enhancing textile industry among industrial structure as well as the proportion for the development of family decoration and industrial textiles (at present the ratio for the industrial structure of clothing/family decoration/industrial textile is 60:20:20, and it will be adjusted to 50:17:33 in the future). It is necessary that manufacturers should also strengthen their brand name, innovation and marketing capability so there will be niche for sustainable growth. Chairman Wang has especially emphasized the importance for the three 100-billion projects for textile industry jointly planned and programmed by the Industrial Development Bureau, Department of Industrial Technology, and Bureau of Foreign Trade. For the main axis of the first 100-billion project, it is primarily carried out to help double the production value of textiles for industry, and that of the second 100-billion is primarily to put up the R&D alliance for functional textiles as nano and environmental-friendly products, while that of the third 100-billion project is to conduct brand name market for fashion of designed in Taiwan. The Taiwan

Textile Research Institute (TTRI) is one of the main executives. It is hoped that the textile industries could use these projects as much as they can in order to create another climax for textile industry.

Based on the favorable existing and persisting foundation of textile industry, we should continue to conduct innovation of novel value as well as take service to the textile industry as vocation as we combine efforts from the industry to strengthen R&D and promotion work within TTRI, as a result, we can create new niche for the textile industry with all of the manufacturers from the industry.

AAPPENDIX B : FORMOSA TAFFETA CO., LTD. (FTC)



FORMOSA TAFFETA CO., LTD. (FTC) was established in April 1973. At that time in Taiwan, the textile industry and export trading business was flourishing. The Formosa Chemical and Fiber Co., a member of the Formosa Plastic Group, in conjunction with a selected number of private investors, cooperated together to establish FTC. FTC utilized the most modern machinery and became a vital link in the middle-stream textile industry with its weaving, dyeing, printing and finishing process and gained the reputation of being a "faithful supplier". FTC has had a business philosophy of harmony, creativity, service and contribution, and providing various quality products to down-stream processing industries. The company has sought to upgrade the quality of life both for its customers and its product users.

FTC is one of the top three manufacturers worldwide of filament woven fabric with its specialized integrated process. FTC produces type cord, chafer, and conveyor ducks. Its capacity is 2,200 tons per month and it is a renowned manufacturer in Asia. The main processes are: twisting, weaving, dipping and packing. It uses the latest machinery and experiment equipment from Germany, France, Switzerland and Japan to strictly ensure its product quality. It is popular in the Asian and Australian markets and has ISO 9002 Certificate from famous institutes in the U.K., Germany, U.S.A., The Netherlands, Australia and New Zealand. This product is very much trusted by its customers. For furnishing textiles include such thing as curtains, curtain lining, shower curtains, sheets, seat covers, table cloths, and base fabric for towels. These textiles utilize cotton, polyamide, and polyester blends or interweave. They are characterized by their light resistant, down proof, water proof, water repellent, stain release, mold resistant, deodorizing, bacteria resistance and flame retardant qualities. Style and appearance can be altered to accommodate popular fashion trends by adding two-tone, mélange, dobby, printing, and finishing. It gives you the ability to provide a more aesthetic and pleasing feeling to your home environment.

FTC attaches great importance to four conditions: quality and creativity, strict and careful inspection of products, strategically alignments with world-famous companies, and the annual attendance at prestigious trade fairs. This allows FTC to cooperate, develop and grow with its customers and gain a high

reputation in the textile industry. By choosing FTC products, customers symbolize the importance they place on quality and the readiness to win their buyers' trust. FTC attaches great importance to four conditions: quality and creativity, strict and careful inspection of products, strategically alignments with world-famous companies, and the annual attendance at prestigious trade fairs. This allows FTC to cooperate, develop and grow with its customers and gain a high reputation in the textile industry. By choosing FTC products, customers symbolize the importance they place on quality and the readiness to win their buyers' trust.

APPENDIX C : TEN SETS OF MSDS RESULTING FROM 1 CASE STUDY

Set 1: The MSDS of Oxalic acid

SIGMA-ALDRICH

sigma-aldrich.com

SAFETY DATA SHEET

according to Regulation (EC) No. 1907/2006

Version 5.3 Revision Date 09.04.2013

Print Date 08.07.2013

GENERIC EU MSDS - NO COUNTRY SPECIFIC DATA - NO OEL DATA

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1 Product identifiers

Product name : Oxalic acid

Product Number : 194131

Brand : Aldrich

Index-No. : 607-006-00-8

REACH No. : A registration number is not available for this substance as the substance or its uses are exempted from registration, the annual tonnage does not require a registration or the registration is envisaged for a later registration deadline.

CAS-No. : 144-62-7

1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Manufacture of substances

1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich Chemie GmbH
Riedstrasse 2
D-89555 STEINHEIM

Telephone : +49 89-6513-1444

Fax : +49 7329-97-2319

E-mail address : eurtechserv@sial.com

1.4 Emergency telephone number

Emergency Phone # : +49 7329-97-2323

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

Classification according to Regulation (EC) No 1272/2008

Acute toxicity, Oral (Category 4), H302

Acute toxicity, Dermal (Category 4), H312

Serious eye damage (Category 1), H318

For the full text of the H-Statements mentioned in this Section, see Section 16.

Classification according to EU Directives 67/548/EEC or 1999/45/EC

Xn, Xi Harmful, Irritant R21/22, R41

For the full text of the R-phrases mentioned in this Section, see Section 16.

2.2 Label elements

Labelling according Regulation (EC) No 1272/2008

Pictogram



Signal word : Danger

Hazard statement(s)

H302 + H312

H318

Harmful if swallowed or in contact with skin
Causes serious eye damage.

Precautionary statement(s)

P280

P305 + P351 + P338

Wear protective gloves/ eye protection/ face protection.

IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.

Supplemental Hazard
Statements

none

2.3 Other hazards - none

SECTION 3: Composition/information on ingredients

3.1 Substances

Formula : $C_2H_2O_4$
Molecular Weight : 90,03 g/mol
CAS-No. : 144-62-7
EC-No. : 205-634-3
Index-No. : 607-006-00-8

Hazardous ingredients according to Regulation (EC) No 1272/2008

Component	Classification	Concentration
Oxalic acid		
	Acute Tox. 4; Eye Dam. 1; H302 + H312, H318	-

Hazardous ingredients according to Directive 1999/45/EC

Component	Classification	Concentration
Oxalic acid		
	Xn, R21/22 - R41	-

For the full text of the H-Statements and R-Phrases mentioned in this Section, see Section 16

SECTION 4: First aid measures

4.1 Description of first aid measures

General advice

Consult a physician. Show this safety data sheet to the doctor in attendance.

If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

In case of skin contact

Wash off with soap and plenty of water. Consult a physician.

In case of eye contact

Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.

If swallowed

Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

4.3 Indication of any immediate medical attention and special treatment needed

no data available

SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable extinguishing media

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

5.2 Special hazards arising from the substance or mixture

Carbon oxides

5.3 Advice for firefighters

Wear self contained breathing apparatus for fire fighting if necessary.

5.4 Further information

no data available

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

Use personal protective equipment. Avoid dust formation. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas. Avoid breathing dust. For personal protection see section 8.

6.2 Environmental precautions

Do not let product enter drains.

6.3 Methods and materials for containment and cleaning up

Pick up and arrange disposal without creating dust. Sweep up and shovel. Keep in suitable, closed containers for disposal.

6.4 Reference to other sections

For disposal see section 13.

SECTION 7: Handling and storage

7.1 Precautions for safe handling

Avoid contact with skin and eyes. Avoid formation of dust and aerosols. Provide appropriate exhaust ventilation at places where dust is formed. For precautions see section 2.2.

7.2 Conditions for safe storage, including any incompatibilities

Store in cool place. Keep container tightly closed in a dry and well-ventilated place.

Moisture sensitive.

7.3 Specific end use(s)

A part from the uses mentioned in section 1.2 no other specific uses are stipulated

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

Components with workplace control parameters

8.2 Exposure controls

Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

Personal protective equipment

Eye/face protection

Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

The selected protective gloves have to satisfy the specifications of EU Directive 89/686/EEC and the standard EN 374 derived from it.

Full contact

Material: Nitrile rubber

Minimum layer thickness: 0,11 mm
Break through time: 480 min
Material tested: Dermatrill® (KCL 740 / Aldrich Z677272, Size M)

Splash contact
Material: Nitrile rubber
Minimum layer thickness: 0,11 mm
Break through time: 480 min
Material tested: Dermatrill® (KCL 740 / Aldrich Z677272, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de,
test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

Body Protection

Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face particle respirator type N100 (US) or type P3 (EN 143) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Control of environmental exposure

Do not let product enter drains.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

- | | |
|---|--------------------------------------|
| a) Appearance | Form: powder
Colour: white |
| b) Odour | odourless |
| c) Odour Threshold | no data available |
| d) pH | 1,3 at 9 g/l |
| e) Melting point/freezing point | Melting point/range: 189,5 °C - dec. |
| f) Initial boiling point and boiling range | 157 °C at 1.013 hPa |
| g) Flash point | no data available |
| h) Evaporation rate | no data available |
| i) Flammability (solid, gas) | no data available |
| j) Upper/lower flammability or explosive limits | no data available |
| k) Vapour pressure | < 0,01 hPa at 20 °C |
| l) Vapour density | no data available |
| m) Relative density | 1,9 g/cm ³ at 25 °C |
| n) Water solubility | 108 g/l at 25 °C - soluble |
| o) Partition coefficient: n-octanol/water | no data available |

- | | |
|------------------------------|-------------------|
| p) Auto-ignition temperature | no data available |
| q) Decomposition temperature | no data available |
| r) Viscosity | no data available |
| s) Explosive properties | no data available |
| t) Oxidizing properties | no data available |

9.2 Other safety information

Surface tension 70,1 mN/m at 25 °C

SECTION 10: Stability and reactivity

10.1 Reactivity

no data available

10.2 Chemical stability

Stable under recommended storage conditions.

10.3 Possibility of hazardous reactions

no data available

10.4 Conditions to avoid

Avoid moisture.

10.5 Incompatible materials

Metals, Alkali metals

10.6 Hazardous decomposition products

Other decomposition products - no data available
In the event of fire: see section 5

SECTION 11: Toxicological information

11.1 Information on toxicological effects

Acute toxicity

LD50 Oral - rat - female - 1.080 mg/kg

LD50 Dermal - rabbit - 20.000 mg/kg

Skin corrosion/irritation

Skin - rabbit

Result: No skin irritation
(OECD Test Guideline 404)

Serious eye damage/eye irritation

Eyes - rabbit

Result: Risk of serious damage to eyes. - 24 h
(OECD Test Guideline 405)

Respiratory or skin sensitisation

- mouse

Result: Does not cause skin sensitisation.

Germ cell mutagenicity

S. typhimurium

Result: negative

Carcinogenicity

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

Reproductive toxicity

Possible risk of congenital malformation in the fetus.

Reproductive toxicity - mouse - Oral

Effects on Fertility: Other measures of fertility Effects on Embryo or Fetus: Fetotoxicity (except death, e.g., stunted fetus).

Specific target organ toxicity - single exposure

no data available

Specific target organ toxicity - repeated exposure

no data available

Aspiration hazard

no data available

Additional Information

Repeated dose toxicity - Lowest observed adverse effect level - 150 mg/kg

RTECS: RO2450000

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

SECTION 12: Ecological information

12.1 Toxicity

Toxicity to fish static test LC50 - *Leuciscus idus melanotus* - 160 mg/l - 48 h

Toxicity to daphnia and other aquatic invertebrates Immobilization EC50 - *Daphnia magna* (Water flea) - 162,2 mg/l - 48 h (OECD Test Guideline 202)

12.2 Persistence and degradability

Biodegradability aerobic - Exposure time 20 d
Result: 89 % - Readily biodegradable.

12.3 Bioaccumulative potential

no data available

12.4 Mobility in soil

no data available

12.5 Results of PBT and vPvB assessment

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

12.6 Other adverse effects

no data available

SECTION 13: Disposal considerations

13.1 Waste treatment methods

Product

Offer surplus and non-recyclable solutions to a licensed disposal company. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.

Contaminated packaging

Dispose of as unused product.

SECTION 14: Transport information

14.1 UN number

ADR/RID: -

IMDG: -

IATA: -

14.2 UN proper shipping name

ADR/RID: Not dangerous goods

IMDG: Not dangerous goods

IATA: Not dangerous goods

14.3 Transport hazard class(es)		
ADR/RID: -	IMDG: -	IATA: -
14.4 Packaging group		
ADR/RID: -	IMDG: -	IATA: -
14.5 Environmental hazards		
ADR/RID: no	IMDG Marine pollutant: no	IATA: no
14.6 Special precautions for user		
no data available		

SECTION 15: Regulatory information

This safety datasheet complies with the requirements of Regulation (EC) No. 1907/2006.

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

no data available

15.2 Chemical Safety Assessment

For this product a chemical safety assessment was not carried out

SECTION 16: Other information

Full text of H-Statements referred to under sections 2 and 3.

Acute Tox.	Acute toxicity
Eye Dam.	Serious eye damage
H302	Harmful if swallowed.
H302 + H312	Harmful if swallowed or in contact with skin
H312	Harmful in contact with skin.
H318	Causes serious eye damage.

Full text of R-phrases referred to under sections 2 and 3

Xn	Harmful
R21/22	Harmful in contact with skin and if swallowed.
R41	Risk of serious damage to eyes.

Further information

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The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See www.sigma-aldrich.com and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

Set 2: The MSDS of Sulfuric acid

Safety Data Sheet (SDS)

Prepared to GHS Rev04(2011): U.S. OSHA, CMA, ANSI, Canadian WHMIS Standards,
Australian WorkSafe, Japanese Industrial Standard JIS Z 7250:2000, and European
Directives

Printing date 01/10/2013

Reviewed on 01/10/2013

1 Product and Company Identification

- **Product identifier**
- **Trade name:** Sulfuric Acid 98%
- **CAS Number:**
7664-93-9
- **EC number:**
231-639-5
- **Index number:**
016-020-00-8
- **Details of the supplier of the safety data sheet**
- **Manufacturer/Supplier:**
NuGeneration Technologies, LLC (dba NuGenTec)
1155 Park Avenue, Emeryville, CA 94608
info@nugentec.com
888-996-8436 or 707-820-4080 for product information
- **Emergency telephone number:** Contact Infotrac: 1-352-326-2510

www.nugentec.com

2 Hazards identification

- **Classification of the substance or mixture**



GHS05 Corrosion

Skin Corr. 1A H314 Causes severe skin burns and eye damage.

- **Label elements**

- **GHS label elements**

The substance is classified and labelled according to the Globally Harmonized System (GHS).

- **Hazard pictograms**



GHS05

- **Signal word** Danger

- **Hazard-determining components of labelling:**

sulphuric acid

- **Hazard statements**

H314 Causes severe skin burns and eye damage.

- **Precautionary statements**

Precautionary statements

P101

If medical advice is needed, have product container or label at hand.

P102

Keep out of reach of children.

P103

Read label before use.

P260

Do not breathe dust/fume/gas/mist/vapours/spray.

(Contd. on page 2)

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Trade name: Sulfuric Acid 98%

(Contd. of page 1)

P303+P361+P353 IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower.

P305+P351+P338 IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.

P310 Immediately call a POISON CENTER or doctor/physician.

P405 Store locked up.

P501 Dispose of contents/container in accordance with local/regional/national/international regulations.

• **Classification system:**

• **NFPA ratings (scale 0 - 4)**



Health = 4
Fire = 0
Reactivity = 2

• **HMIS-ratings (scale 0 - 4)**



Health = 4
Fire = 0
Reactivity = 2

• **Other hazards**

• **Results of PBT and vPvB assessment**

• **PBT:** Not applicable.

• **vPvB:** Not applicable.

3 Composition/information on ingredients

• **Chemical characterization: Substances**

• **CAS No. Description**

7664-93-9 sulphuric acid

• **Identification number(s)**

• **EC number:** 231-639-5

• **Index number:** 016-020-00-8

4 First aid measures

• **Description of first aid measures**

• **General information:** Immediately remove any clothing soiled by the product.

• **After inhalation:** In case of unconsciousness place patient stably in side position for transportation.

• **After skin contact:** Immediately wash with water and soap and rinse thoroughly.

• **After eye contact:** Rinse opened eye for several minutes under running water. Then consult a doctor.

• **After swallowing:** Drink copious amounts of water and provide fresh air. Immediately call a doctor.

• **Information for doctor:**

• **Most important symptoms and effects, both acute and delayed** No further relevant information available.

(Contd. on page 3)

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Reviewed on 01/10/2013

Trade name: Sulfuric Acid 98%

· **Indication of any immediate medical attention and special treatment needed**
No further relevant information available.

(Contd. of page 2)

5 Firefighting measures

- **Extinguishing media**
- **Suitable extinguishing agents:**
CO₂, extinguishing powder or water spray. Fight larger fires with water spray or alcohol resistant foam.
- **Special hazards arising from the substance or mixture** No further relevant information available.
- **Advice for firefighters**
- **Protective equipment:** No special measures required.

6 Accidental release measures

- **Personal precautions, protective equipment and emergency procedures**
Wear protective equipment. Keep unprotected persons away.
- **Environmental precautions:**
Dilute with plenty of water.
Do not allow to enter sewers/ surface or ground water.
- **Methods and material for containment and cleaning up:**
Absorb with liquid-binding material (sand, diatomite, acid binders, universal binders, sawdust).
Use neutralizing agent.
Dispose contaminated material as waste according to item 13.
Ensure adequate ventilation.
- **Reference to other sections**
See Section 7 for information on safe handling.
See Section 8 for information on personal protection equipment.
See Section 13 for disposal information.

7 Handling and storage

- **Handling:**
- **Precautions for safe handling** No special precautions are necessary if used correctly.
- **Information about protection against explosions and fires:** No special measures required.
- **Conditions for safe storage, including any incompatibilities**
- **Storage:**
- **Requirements to be met by storerooms and receptacles:** No special requirements.
- **Information about storage in one common storage facility:** Not required.
- **Further information about storage conditions:** Keep receptacle tightly sealed.
- **Specific end use(s)** No further relevant information available.

USA

(Contd. on page 4)

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Reviewed on 01/10/2013

Trade name: Sulfuric Acid 98%

(Contd. of page 3)

8 Exposure controls/personal protection

· **Additional information about design of technical systems:** No further data; see item 7.

· **Control parameters**

· **Components with limit values that require monitoring at the workplace:**

7664-93-9 sulphuric acid

PEL	1 mg/m ³
REL	1 mg/m ³
TLV	0.2* mg/m ³
	*as thoracic fraction

· **Additional information:** The lists that were valid during the creation were used as basis.

· **Exposure controls**

· **Personal protective equipment:**

· **General protective and hygienic measures:**

Keep away from foodstuffs, beverages and feed.

Immediately remove all soiled and contaminated clothing.

Wash hands before breaks and at the end of work.

Avoid contact with the eyes and skin.

· **Breathing equipment:** Not required.

· **Protection of hands:**



Protective gloves

The glove material has to be impermeable and resistant to the product/ the substance/ the preparation.

Due to missing tests no recommendation to the glove material can be given for the product/ the preparation/ the chemical mixture.

Selection of the glove material on consideration of the penetration times, rates of diffusion and the degradation

· **Material of gloves**

The selection of the suitable gloves does not only depend on the material, but also on further marks of quality and varies from manufacturer to manufacturer.

· **Penetration time of glove material**

The exact break through time has to be found out by the manufacturer of the protective gloves and has to be observed.

· **Eye protection:**



Tightly sealed goggles

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Reviewed on 01/10/2013

Trade name: Sulfuric Acid 98%

(Contd. of page 4)

9 Physical and chemical properties

· Information on basic physical and chemical properties

· General Information

· Appearance:

Form:	Fluid
Color:	Not determined.
Odor:	Mild
Odour threshold:	Not determined.

· pH-value at 20 °C (68 °F): 0.1

· Change in condition

Melting point/Melting range:	~32 °C
Boiling point/Boiling range:	295 °C (563 °F)

· Flash point: Not applicable.

· Flammability (solid, gaseous): Not applicable.

· Ignition temperature:

Decomposition temperature: Not determined.

· Auto igniting: Not determined.

· Danger of explosion: Product does not present an explosion hazard.

· Explosion limits:

Lower:	Not determined.
Upper:	Not determined.

· Vapor pressure at 20 °C (68 °F): <0.01 hPa (<0 mm Hg)

· Density at 20 °C (68 °F): 1.84 g/cm³ (15.355 lbs/gal)

· Relative density: Not determined.

· Vapour density: Not determined.

· Evaporation rate: Not determined.

· Solubility in / Miscibility with

Water: Fully miscible.

· Partition coefficient (n-octanol/water): Not determined.

· Viscosity:

Dynamic:	Not determined.
Kinematic:	Not determined.

Organic solvents: 0.0 %

· Other information: No further relevant information available.

USA

(Contd. on page 6)

Safety Data Sheet (SDS)

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Reviewed on 01/10/2013

Trade name: Sulfuric Acid 98%

(Contd. of page 5)

10 Stability and reactivity

- **Reactivity**
- **Chemical stability**
- **Thermal decomposition / conditions to be avoided:** No decomposition if used according to specifications.
- **Possibility of hazardous reactions** No dangerous reactions known.
- **Conditions to avoid** No further relevant information available.
- **Incompatible materials:** No further relevant information available.
- **Hazardous decomposition products:** No dangerous decomposition products known.

11 Toxicological information

- **Information on toxicological effects**
- **Acute toxicity:**
- **Primary irritant effect:**
- **on the skin:** Strong caustic effect on skin and mucous membranes.
- **on the eye:** Strong caustic effect.
- **Sensitization:** No sensitizing effects known.
- **Additional toxicological information:**
Swallowing will lead to a strong caustic effect on mouth and throat and to the danger of perforation of esophagus and stomach.

- **Carcinogenic categories**

- **IARC (International Agency for Research on Cancer)**

7664-93-9	sulphuric acid	1
-----------	----------------	---

- **NTP (National Toxicology Program)**

7664-93-9	sulphuric acid	K
-----------	----------------	---

12 Ecological information

- **Toxicity**
- **Aquatic toxicity:** No further relevant information available.
- **Persistence and degradability** No further relevant information available.
- **Behavior in environmental systems:**
- **Bioaccumulative potential** No further relevant information available.
- **Mobility in soil** No further relevant information available.
- **Additional ecological information:**
- **General notes:**
Water hazard class 1 (Assessment by list): slightly hazardous for water
Do not allow undiluted product or large quantities of it to reach ground water, water course or sewage system.
Must not reach bodies of water or drainage ditch undiluted or unneutralized.
Rinse off of bigger amounts into drains or the aquatic environment may lead to decreased pH-values. A low pH-value harms aquatic organisms. In the dilution of the use-level the pH-value is considerably increased, so that after the use of the product the aqueous waste, emptied into drains, is only low water-dangerous.

(Contd. on page 7)

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Reviewed on 01/10/2013

Trade name: Sulfuric Acid 98%

(Contd. of page 6)

- **Results of PBT and vPvB assessment**
- **PBT:** Not applicable.
- **vPvB:** Not applicable.
- **Other adverse effects** No further relevant information available.

13 Disposal considerations

- **Waste treatment methods**
- **Recommendation:**
Must not be disposed of together with household garbage. Do not allow product to reach sewage system.
- **Uncleaned packagings:**
- **Recommendation:** Disposal must be made according to official regulations.
- **Recommended cleansing agent:** Water, if necessary with cleansing agents.

14 Transport information

· UN-Number	None
· DOT, ADR, IMDG, IATA	UN1830
· UN proper shipping name	None
· DOT, IMDG, IATA	SULPHURIC ACID
· ADR	1830 SULPHURIC ACID
· Transport hazard class(es)	
· DOT	
	
· Class	8 Corrosive substances.
· Label	8
· ADR, IMDG, IATA	
	
· Class	8 Corrosive substances
· Label	8
· Packing group	
· DOT, ADR, IMDG, IATA	II
· Environmental hazards:	
· Marine pollutant:	No

(Contd. on page 8)

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Printing date 01/10/2013

Reviewed on 01/10/2013

Trade name: Sulfuric Acid 98%

(Contd. of page 7)

- | | |
|--|-------------------------------|
| · Special precautions for user | Warning: Corrosive substances |
| · Danger code (Kemler): | 80 |
| · EMS Number: | F-A,S-B |
| · Segregation groups | Acids |
| · Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code | Not applicable. |
| · UN "Model Regulation": | UN1830, SULPHURIC ACID, 8, II |

15 Regulatory information

- **Safety, health and environmental regulations/legislation specific for the substance or mixture**

- **Sara** None Listed

- **Section 355 (extremely hazardous substances):**

Substance is listed.

- **Section 313 (Specific toxic chemical listings):**

Substance is listed.

- **TSCA (Toxic Substances Control Act):**

Substance is listed.

- **Proposition 65**

- **Chemicals known to cause cancer:**

Substance is not listed.

- **Chemicals known to cause reproductive toxicity for females:**

Substance is not listed.

- **Chemicals known to cause reproductive toxicity for males:**

Substance is not listed.

- **Chemicals known to cause developmental toxicity:**

Substance is not listed.

- **Carcinogenic categories**

- **EPA (Environmental Protection Agency)**

Substance is not listed.

- **TLV (Threshold Limit Value established by ACGIH)**

7664-93-9 sulphuric acid

A2

- **NIOSH-Ca (National Institute for Occupational Safety and Health)**

Substance is not listed.

- **OSHA-Ca (Occupational Safety & Health Administration)**

Substance is not listed.

- **GHS label elements**

The substance is classified and labelled according to the Globally Harmonized System (GHS).

(Contd. on page 9)

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Printing date 01/10/2013

Reviewed on 01/10/2013

Trade name: Sulfuric Acid 98%

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Hazard pictograms



GHS05

Signal word Danger

Hazard-determining components of labelling:

sulphuric acid

Hazard statements

H314 Causes severe skin burns and eye damage.

Precautionary statements

P101 If medical advice is needed, have product container or label at hand.

P102 Keep out of reach of children.

P103 Read label before use.

P260 Do not breathe dust/fume/gas/mist/vapours/spray.

P303+P361+P353 IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower.

P305+P351+P338 IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.

P310 Immediately call a POISON CENTER or doctor/physician.

P405 Store locked up.

P501 Dispose of contents/container in accordance with local/regional/national/international regulations.

Chemical safety assessment: A Chemical Safety Assessment has not been carried out.

16 Other information

This information is based on our present knowledge. However, this shall not constitute a guarantee for any specific product features and shall not establish a legally valid contractual relationship.

Abbreviations and acronyms:

ADR: Accord européen sur le transport des marchandises dangereuses par Route (European Agreement concerning the International Carriage of Dangerous Goods by Road)

IMDG: International Maritime Code for Dangerous Goods

DOT: US Department of Transportation

IATA: International Air Transport Association

ACGIH: American Conference of Governmental Industrial Hygienists

EINECS: European Inventory of Existing Commercial Chemical Substances

CAS: Chemical Abstracts Service (division of the American Chemical Society)

NFPA: National Fire Protection Association (USA)

HMIS: Hazardous Materials Identification System (USA)

USA

Set 3: The MSD of Hydrochloric acid

SIGMA-ALDRICH

sigma-aldrich.com

SAFETY DATA SHEET

according to Regulation (EC) No. 1907/2006

Version 6.2 Revision Date 05.02.2013

Print Date 08.07.2013

GENERIC EU MSDS - NO COUNTRY SPECIFIC DATA - NO OEL DATA

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1 Product identifiers

Product name : Hydrochloric acid

Product Number : H1758

Brand : Sigma

Index-No. : 017-002-01-X

REACH No. : A registration number is not available for this substance as the substance or its uses are exempted from registration, the annual tonnage does not require a registration or the registration is envisaged for a later registration deadline.

CAS-No. : 7647-01-0

1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Manufacture of substances

1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich Chemie GmbH
Riedstrasse 2
D-89555 STEINHEIM

Telephone : +49 89-6513-1444

Fax : +49 7329-97-2319

E-mail address : eurtechserv@sial.com

1.4 Emergency telephone number

Emergency Phone # : +49 7329-97-2323

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

Classification according to Regulation (EC) No 1272/2008

Skin corrosion (Category 1B), H314

Specific target organ toxicity - single exposure (Category 3), H335

For the full text of the H-Statements mentioned in this Section, see Section 16.

Classification according to EU Directives 67/548/EEC or 1999/45/EC

C Corrosive R34

Xi Irritant R37

For the full text of the R-phrases mentioned in this Section, see Section 16.

2.2 Label elements

Labelling according Regulation (EC) No 1272/2008

Pictogram



Signal word : Danger

Hazard statement(s)

H314 Causes severe skin burns and eye damage.

H335 May cause respiratory irritation.

Precautionary statement(s)

P261

Avoid breathing vapours.

P280

Wear protective gloves/ protective clothing/ eye protection/ face protection.

P305 + P351 + P338

IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.

P310

Immediately call a POISON CENTER or doctor/ physician.

Supplemental Hazard
Statements

none

According to European Directive 67/548/EEC as amended.

Hazard symbol(s)

C Corrosive



R-phrases(s)

R34

Causes burns.

R37

Irritating to respiratory system.

S-phrases(s)

S26

In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.

S45

In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

2.3 Other hazards - none

SECTION 3: Composition/information on ingredients

3.2 Mixtures

Formula : HCl

Molecular Weight : 36,46 g/mol

Hazardous ingredients according to Regulation (EC) No 1272/2008

Component	Classification	Concentration
Hydrochloric acid		
CAS-No. 7647-01-0	Skin Corr. 1B; STOT SE 3; H314, H335	25 - 50 %
EC-No. 231-595-7		
Index-No. 017-002-01-X		

Hazardous ingredients according to Directive 1999/45/EC

Component	Classification	Concentration
Hydrochloric acid		
CAS-No. 7647-01-0	C, R34 - R37	25 - 50 %
EC-No. 231-595-7		
Index-No. 017-002-01-X		

For the full text of the H-Statements and R-Phrases mentioned in this Section, see Section 16

SECTION 4: First aid measures

4.1 Description of first aid measures

General advice

Consult a physician. Show this safety data sheet to the doctor in attendance.

If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

In case of skin contact

Take off contaminated clothing and shoes immediately. Wash off with soap and plenty of water. Consult a physician.

In case of eye contact

Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.

If swallowed

Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

4.3 Indication of any immediate medical attention and special treatment needed

no data available

SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable extinguishing media

Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.

5.2 Special hazards arising from the substance or mixture

Hydrogen chloride gas
Hydrogen chloride gas

5.3 Advice for firefighters

Wear self contained breathing apparatus for fire fighting if necessary.

5.4 Further information

The product itself does not burn.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

Use personal protective equipment. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas. For personal protection see section 8.

6.2 Environmental precautions

Do not let product enter drains.

6.3 Methods and materials for containment and cleaning up

Soak up with inert absorbent material and dispose of as hazardous waste. Keep in suitable, closed containers for disposal.

6.4 Reference to other sections

For disposal see section 13.

SECTION 7: Handling and storage

7.1 Precautions for safe handling

Avoid contact with skin and eyes. Avoid inhalation of vapour or mist. For precautions see section 2.2.

7.2 Conditions for safe storage, including any incompatibilities

Store in cool place. Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage.

7.3 Specific end use(s)

A part from the uses mentioned in section 1.2 no other specific uses are stipulated

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

Components with workplace control parameters

8.2 Exposure controls

Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

Personal protective equipment

Eye/face protection

Tightly fitting safety goggles. Faceshield (8-inch minimum). Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

The selected protective gloves have to satisfy the specifications of EU Directive 89/686/EEC and the standard EN 374 derived from it.

Full contact

Material: Nitrile rubber

Minimum layer thickness: 0,4 mm

Break through time: 480 min

Material tested: Camatril® (KCL 730 / Aldrich Z677442, Size M)

Splash contact

Material: Nitrile rubber

Minimum layer thickness: 0,11 mm

Break through time: 120 min

Material tested: Dermatril® (KCL 740 / Aldrich Z677272, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

Body Protection

Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type ABEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Control of environmental exposure

Do not let product enter drains.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

- a) Appearance Form: liquid

	Colour: light yellow
b) Odour	pungent
c) Odour Threshold	no data available
d) pH	no data available
e) Melting point/freezing point	-30 °C
f) Initial boiling point and boiling range	> 100 °C - lit.
g) Flash point	not applicable
h) Evaporation rate	no data available
i) Flammability (solid, gas)	no data available
j) Upper/lower flammability or explosive limits	no data available
k) Vapour pressure	227 hPa at 21,1 °C 547 hPa at 37,7 °C
l) Vapour density	no data available
m) Relative density	1,2 g/cm ³ at 25 °C
n) Water solubility	soluble
o) Partition coefficient: n-octanol/water	no data available
p) Auto-ignition temperature	no data available
q) Decomposition temperature	no data available
r) Viscosity	no data available
s) Explosive properties	no data available
t) Oxidizing properties	no data available

9.2 Other safety information

no data available

SECTION 10: Stability and reactivity

10.1 Reactivity

no data available

10.2 Chemical stability

Stable under recommended storage conditions.

10.3 Possibility of hazardous reactions

no data available

10.4 Conditions to avoid

no data available

10.5 Incompatible materials

Bases, Amines, Alkali metals, Metals, permanganates, e.g. potassium permanganate, Fluorine, metal acetylides, hexalithium disilicide

10.6 Hazardous decomposition products

Other decomposition products - no data available
In the event of fire: see section 5

SECTION 11: Toxicological information

11.1 Information on toxicological effects

Acute toxicity

no data available (Hydrochloric acid)

Inhalation: no data available (Hydrochloric acid)

Skin corrosion/irritation

Skin - rabbit

Result: Causes burns.

Serious eye damage/eye irritation

Eyes - rabbit (Hydrochloric acid)

Result: Corrosive to eyes

Respiratory or skin sensitisation

no data available (Hydrochloric acid)

Germ cell mutagenicity

no data available (Hydrochloric acid)

Carcinogenicity

This product is or contains a component that is not classifiable as to its carcinogenicity based on its IARC, ACGIH, NTP, or EPA classification. (Hydrochloric acid)

(Hydrochloric acid)

IARC: 3 - Group 3: Not classifiable as to its carcinogenicity to humans (Hydrochloric acid)

Reproductive toxicity

no data available (Hydrochloric acid)

Specific target organ toxicity - single exposure

The substance or mixture is classified as specific target organ toxicant, single exposure, category 3 with respiratory tract irritation. (Hydrochloric acid)

Specific target organ toxicity - repeated exposure

no data available

Aspiration hazard

no data available (Hydrochloric acid)

Additional Information

RTECS: MW4025000

burning sensation, Cough, wheezing, laryngitis, Shortness of breath, spasm, inflammation and edema of the larynx, spasm, inflammation and edema of the bronchi, pneumonitis, pulmonary edema, Material is extremely destructive to tissue of the mucous membranes and upper respiratory tract, eyes, and skin. (Hydrochloric acid)

SECTION 12: Ecological information

12.1 Toxicity

Toxicity to fish LC50 - Gambusia affinis (Mosquito fish) - 282 mg/l - 96 h (Hydrochloric acid)

12.2 Persistence and degradability

no data available

12.3 Bioaccumulative potential

no data available

12.4 Mobility in soil

no data available (Hydrochloric acid)

12.5 Results of PBT and vPvB assessment

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

Sigma - H1758

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12.6 Other adverse effects

no data available

SECTION 13: Disposal considerations

13.1 Waste treatment methods

Product

Offer surplus and non-recyclable solutions to a licensed disposal company.

Contaminated packaging

Dispose of as unused product.

SECTION 14: Transport information

14.1 UN number

ADR/RID: 1789

IMDG: 1789

IATA: 1789

14.2 UN proper shipping name

ADR/RID: HYDROCHLORIC ACID

IMDG: HYDROCHLORIC ACID

IATA: Hydrochloric acid

14.3 Transport hazard class(es)

ADR/RID: 8

IMDG: 8

IATA: 8

14.4 Packaging group

ADR/RID: II

IMDG: II

IATA: II

14.5 Environmental hazards

ADR/RID: no

IMDG Marine pollutant: no

IATA: no

14.6 Special precautions for user

no data available

SECTION 15: Regulatory information

This safety datasheet complies with the requirements of Regulation (EC) No. 1907/2006.

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

no data available

15.2 Chemical Safety Assessment

For this product a chemical safety assessment was not carried out

SECTION 16: Other information

Full text of H-Statements referred to under sections 2 and 3.

H314 Causes severe skin burns and eye damage.

H335 May cause respiratory irritation.

Skin Corr. Skin corrosion

STOT SE Specific target organ toxicity - single exposure

Full text of R-phrases referred to under sections 2 and 3

C Corrosive

R34 Causes burns.

R37 Irritating to respiratory system.

Further information

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The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held

liable for any damage resulting from handling or from contact with the above product. See www.sigma-aldrich.com and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

Set 4: The MSDS of Sodium Hydroxide



Safety Data Sheet (SDS)

OSHA Hazard Communication Standard 29 CFR 1910.1200. Prepared to GHS
Rev03.

Printing date 04/24/2013

Reviewed on 04/24/2013

1 Product and Company Identification

- **Product identifier**
- **Trade name:** 10N Sodium Hydroxide (NaOH)
- **Article number:** NGT-10N NaOH
- **Relevant identified uses of the substance or mixture and uses advised against**
- **Product description** PC21 Laboratory chemicals
- **Details of the supplier of the safety data sheet**
- **Manufacturer/Supplier:**
NuGeneration Technologies, LLC (dba NuGenTec)
1155 Park Avenue, Emeryville, CA 94608
info@nugentec.com
- **Emergency telephone number:** Contact Infotrac: 1-800-535-5053

www.nugentec.com

2 Hazard(s) identification

- **Classification of the substance or mixture**



GHS05 Corrosion

H314 Causes severe skin burns and eye damage.

- **Label elements**

- **GHS label elements**

The product is classified and labeled according to the Globally Harmonized System (GHS).

- **Hazard pictograms**



GHS05

- **Signal word** Danger

- **Hazard-determining components of labeling:**

sodium hydroxide

- **Hazard statements**

H314 Causes severe skin burns and eye damage.

- **Precautionary statements**

Precautionary statements

P101 If medical advice is needed, have product container or label at hand.

P102 Keep out of reach of children.

P103 Read label before use.

P260 Do not breathe dust/fume/gas/mist/vapours/spray.

P303+P361+P353 IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower.

P305+P351+P338 IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.

P310 Immediately call a POISON CENTER or doctor/physician.

(Contd. on page 2)

USA

Safety Data Sheet (SDS)

OSHA Hazard Communication Standard 29 CFR 1910.1200. Prepared to GHS
Rev03.

Printing date 04/24/2013

Reviewed on 04/24/2013

Trade name: 10N Sodium Hydroxide (NaOH)

(Contd. of page 1)

P405 Store locked up.

P501 Dispose of contents/container in accordance with local/regional/national/international regulations.

· **Classification system:** NFPA/HMIS Definitions: 0-Least, 1-Slight, 2-Moderate, 3-High, 4-Extreme

· **NFPA ratings (scale 0 - 4)**



Health = 3
Fire = 0
Reactivity = 1

· **HMIS-ratings (scale 0 - 4)**



HEALTH 3 Health = 3
FIRE 0 Fire = 0
REACTIVITY 1 Reactivity = 1

· **Other hazards**

· **Results of PBT and vPvB assessment**

· **PBT:** Not applicable.

· **vPvB:** Not applicable.

3 Composition/information on ingredients

7732-18-5 water, distilled, conductivity or of similar purity

60%

· **Chemical characterization:** Mixtures

· **Description:** Mixture of the substances listed below with nonhazardous additions.

· **Dangerous components:**

1310-73-2 sodium hydroxide

 H314

40%

4 First-aid measures

· **Description of first aid measures**

· **General information:** Immediately remove any clothing soiled by the product.

· **After inhalation:** In case of unconsciousness place patient stably in side position for transportation.

· **After skin contact:** Immediately wash with water and soap and rinse thoroughly.

· **After eye contact:** Rinse opened eye for several minutes under running water. Then consult a doctor.

· **After swallowing:** Drink copious amounts of water and provide fresh air. Immediately call a doctor.

· **Information for doctor:**

· **Most important symptoms and effects, both acute and delayed**

No further relevant information available.

· **Indication of any immediate medical attention and special treatment needed**

No further relevant information available.

USA

(Contd. on page 3)

Safety Data Sheet (SDS)

OSHA Hazard Communication Standard 29 CFR 1910.1200. Prepared to GHS
Rev03.

Printing date 04/24/2013

Reviewed on 04/24/2013

Trade name: 10N Sodium Hydroxide (NaOH)

(Contd. of page 2)

5 Fire-fighting measures

- **Extinguishing media**
- **Suitable extinguishing agents:**
CO₂, extinguishing powder or water spray. Fight larger fires with water spray or alcohol resistant foam.
- **Special hazards arising from the substance or mixture** No further relevant information available.
- **Advice for firefighters**
- **Protective equipment:** No special measures required.

6 Accidental release measures

- **Personal precautions, protective equipment and emergency procedures**
Wear protective equipment. Keep unprotected persons away.
- **Environmental precautions:**
Dilute with plenty of water.
Do not allow to enter sewers/ surface or ground water.
- **Methods and material for containment and cleaning up:**
Absorb with liquid-binding material (sand, diatomite, acid binders, universal binders, sawdust).
Use neutralizing agent.
Dispose contaminated material as waste according to item 13.
Ensure adequate ventilation.
- **Reference to other sections**
See Section 7 for information on safe handling.
See Section 8 for information on personal protection equipment.
See Section 13 for disposal information.

7 Handling and storage

- **Handling:**
- **Precautions for safe handling**
Ensure good ventilation/exhaustion at the workplace.
Prevent formation of aerosols.
- **Information about protection against explosions and fires:** No special measures required.
- **Conditions for safe storage, including any incompatibilities**
- **Storage:**
- **Requirements to be met by storerooms and receptacles:** No special requirements.
- **Information about storage in one common storage facility:** Not required.
- **Further information about storage conditions:** Keep receptacle tightly sealed.
- **Specific end use(s)** No further relevant information available.

8 Exposure controls/personal protection

- **Additional information about design of technical systems:** No further data; see item 7.

(Contd. on page 4)

USA

Safety Data Sheet (SDS)

OSHA Hazard Communication Standard 29 CFR 1910.1200. Prepared to GHS
Rev03.

Printing date 04/24/2013

Reviewed on 04/24/2013

Trade name: 10N Sodium Hydroxide (NaOH)

(Contd. of page 3)

Control parameters

Components with limit values that require monitoring at the workplace:

1310-73-2 sodium hydroxide

PEL 2 mg/m³

REL Short-term value: C 2 mg/m³

TLV Short-term value: C 2 mg/m³

Additional information: The lists that were valid during the creation were used as basis.

Exposure controls

Personal protective equipment:

General protective and hygienic measures:

Keep away from foodstuffs, beverages and feed.

Immediately remove all soiled and contaminated clothing.

Wash hands before breaks and at the end of work.

Avoid contact with the eyes and skin.

Breathing equipment:

In case of brief exposure or low pollution use respiratory filter device. In case of intensive or longer exposure use respiratory protective device that is independent of circulating air.

Protection of hands:



Protective gloves

The glove material has to be impermeable and resistant to the product/ the substance/ the preparation. Due to missing tests no recommendation to the glove material can be given for the product/ the preparation/ the chemical mixture.

Selection of the glove material on consideration of the penetration times, rates of diffusion and the degradation

Material of gloves

The selection of the suitable gloves does not only depend on the material, but also on further marks of quality and varies from manufacturer to manufacturer. As the product is a preparation of several substances, the resistance of the glove material can not be calculated in advance and has therefore to be checked prior to the application.

Penetration time of glove material

The exact break through time has to be found out by the manufacturer of the protective gloves and has to be observed.

Eye protection:



Tightly sealed goggles

USA

(Contd. on page 5)

Safety Data Sheet (SDS)

OSHA Hazard Communication Standard 29 CFR 1910.1200. Prepared to GHS
Rev03.

Printing date 04/24/2013

Reviewed on 04/24/2013

Trade name: 10N Sodium Hydroxide (NaOH)

(Contd. of page 4)

9 Physical and chemical properties

· Information on basic physical and chemical properties

· General Information

· Appearance:

Form:	Liquid
Color:	Colorless
Odor:	Odorless
Odour threshold:	Not determined.

· pH-value at 20 °C (68 °F): >13.7

· Change in condition

Melting point/Melting range:	~32 °C
Boiling point/Boiling range:	> 100 °C (> 212 °F)

· Flash point: Not applicable.

· Flammability (solid, gaseous): Not applicable.

· Ignition temperature:

Decomposition temperature: Not determined.

· Auto igniting: Product is not selfigniting.

· Danger of explosion: Product does not present an explosion hazard.

· Explosion limits:

Lower:	Not determined.
Upper:	Not determined.

· Vapor pressure at 20 °C (68 °F): 23 hPa (17 mm Hg)

· Density at 20 °C (68 °F): 1.452 g/cm³ (12.117 lbs/gal)

· Relative density: Not determined.

· Vapour density: Not determined.

· Evaporation rate: Not determined.

· Solubility in / Miscibility with

Water: Fully miscible.

· Partition coefficient (n-octanol/water): Not determined.

· Viscosity:

Dynamic at 20 °C (68 °F):	1 mPas
Kinematic:	Not determined.

· Solvent content:

Organic solvents:	0.0 %
Water:	60.0 %

Solids content: 40.0 %

(Contd. on page 6)

USA

Safety Data Sheet (SDS)

OSHA Hazard Communication Standard 29 CFR 1910.1200. Prepared to GHS
Rev03.

Printing date 04/24/2013

Reviewed on 04/24/2013

Trade name: 10N Sodium Hydroxide (NaOH)

· **Other information**

No further relevant information available.

(Contd. of page 5)

10 Stability and reactivity

- **Reactivity**
- **Chemical stability**
- **Thermal decomposition / conditions to be avoided:**
No decomposition if used according to specifications.
- **Possibility of hazardous reactions** No dangerous reactions known.
- **Conditions to avoid** No further relevant information available.
- **Incompatible materials:** No further relevant information available.
- **Hazardous decomposition products:** No dangerous decomposition products known.

11 Toxicological information

- **Information on toxicological effects**
- **Acute toxicity:**

· **LD/LC50 values that are relevant for classification:**

1310-73-2 sodium hydroxide

Oral LD50 2000 mg/kg (rat)

- **Primary irritant effect:**
- **on the skin:** Strong caustic effect on skin and mucous membranes.
- **on the eye:** Strong caustic effect.
- **Sensitization:** No sensitizing effects known.
- **Additional toxicological information:**
The product shows the following dangers according to internally approved calculation methods for preparations:
Corrosive
Swallowing will lead to a strong caustic effect on mouth and throat and to the danger of perforation of esophagus and stomach.

- **Carcinogenic categories**

· **IARC (International Agency for Research on Cancer)**

None of the ingredients is listed.

· **NTP (National Toxicology Program)**

None of the ingredients is listed.

12 Ecological information

- **Toxicity**
- **Aquatic toxicity:** No further relevant information available.
- **Persistence and degradability** No further relevant information available.
- **Behavior in environmental systems:**
- **Bioaccumulative potential** No further relevant information available.

(Contd. on page 7)

USA

Safety Data Sheet (SDS)

OSHA Hazard Communication Standard 29 CFR 1910.1200. Prepared to GHS
Rev03.

Printing date 04/24/2013

Reviewed on 04/24/2013

Trade name: 10N Sodium Hydroxide (NaOH)

(Contd. of page 6)

- **Mobility in soil** No further relevant information available.
- **Additional ecological information:**
- **General notes:**
 Water hazard class 1 (Self-assessment): slightly hazardous for water
 Do not allow undiluted product or large quantities of it to reach ground water, water course or sewage system.
 Must not reach bodies of water or drainage ditch undiluted or unneutralized.
 Rinse off of bigger amounts into drains or the aquatic environment may lead to increased pH-values. A high pH-value harms aquatic organisms. In the dilution of the use-level the pH-value is considerably reduced, so that after the use of the product the aqueous waste, emptied into drains, is only low water-dangerous.
- **Results of PBT and vPvB assessment**
- **PBT:** Not applicable.
- **vPvB:** Not applicable.
- **Other adverse effects** No further relevant information available.

13 Disposal considerations

- **Waste treatment methods**
- **Recommendation:**
 Must not be disposed of together with household garbage. Do not allow product to reach sewage system.
- **Uncleaned packagings:**
- **Recommendation:** Disposal must be made according to official regulations.
- **Recommended cleansing agent:** Water, if necessary with cleansing agents.

14 Transport information

- **UN-Number**
- **DOT, ADR, IMDG, IATA**
- **UN proper shipping name**
- **DOT, IMDG, IATA**
- **ADR**
- **Transport hazard class(es)**
- **DOT**



- **Class**

UN1824
None
SODIUM HYDROXIDE SOLUTION
1824 SODIUM HYDROXIDE SOLUTION

8 Corrosive substances.

(Contd. on page 8)

USA

Safety Data Sheet (SDS)

OSHA Hazard Communication Standard 29 CFR 1910.1200. Prepared to GHS
Rev03.

Printing date 04/24/2013

Reviewed on 04/24/2013

Trade name: 10N Sodium Hydroxide (NaOH)

· Label	8	(Contd. of page 7)
· ADR, IMDG, IATA		
		
· Class	8 Corrosive substances	
· Label	8	
· Packing group		
· DOT, ADR, IMDG, IATA	II	
· Environmental hazards:		
· Marine pollutant:	No	
· Special precautions for user	Warning: Corrosive substances	
· Danger code (Kemler):	80	
· EMS Number:	F-A,S-B	
· Segregation groups	Alkalis	
· Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code	Not applicable.	
· UN "Model Regulation":	UN1824, SODIUM HYDROXIDE SOLUTION, 8, II	

15 Regulatory information

- Safety, health and environmental regulations/legislation specific for the substance or mixture
- Sara

· Section 355 (extremely hazardous substances):

None of the ingredients is listed.

· Section 313 (Specific toxic chemical listings):

None of the ingredients is listed.

· TSCA (Toxic Substances Control Act):

All ingredients are listed.

· Proposition 65

· Chemicals known to cause cancer:

None of the ingredients is listed.

· Chemicals known to cause reproductive toxicity for females:

None of the ingredients is listed.

· Chemicals known to cause reproductive toxicity for males:

None of the ingredients is listed.

· Chemicals known to cause developmental toxicity:

None of the ingredients is listed.

(Contd. on page 9)

USA

Safety Data Sheet (SDS)

OSHA Hazard Communication Standard 29 CFR 1910.1200. Prepared to GHS
Rev03.

Printing date 04/24/2013

Reviewed on 04/24/2013

Trade name: 10N Sodium Hydroxide (NaOH)

(Contd. of page 8)

· **Carcinogenic categories**

· **EPA (Environmental Protection Agency)**

None of the ingredients is listed.

· **TLV (Threshold Limit Value established by ACGIH)**

None of the ingredients is listed.

· **NIOSH-Ca (National Institute for Occupational Safety and Health)**

None of the ingredients is listed.

· **OSHA-Ca (Occupational Safety & Health Administration)**

None of the ingredients is listed.

· **GHS label elements**

The product is classified and labeled according to the Globally Harmonized System (GHS).

· **Hazard pictograms**



GHS05

· **Signal word** Danger

· **Hazard-determining components of labeling:**

sodium hydroxide

· **Hazard statements**

H314 Causes severe skin burns and eye damage.

· **Precautionary statements**

P101 If medical advice is needed, have product container or label at hand.

P102 Keep out of reach of children.

P103 Read label before use.

P260 Do not breathe dust/fume/gas/mist/vapours/spray.

P303+P361+P353 IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower.

P305+P351+P338 IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.

P310 Immediately call a POISON CENTER or doctor/physician.

P405 Store locked up.

P501 Dispose of contents/container in accordance with local/regional/national/international regulations.

· **Chemical safety assessment:** A Chemical Safety Assessment has not been carried out.

16 Other information

This information is based on our present knowledge. However, this shall not constitute a guarantee for any specific product features and shall not establish a legally valid contractual relationship.

· **Abbreviations and acronyms:**

ADR: Accord européen sur le transport des marchandises dangereuses par Route (European Agreement concerning the International Carriage of Dangerous Goods by Road)

(Contd. on page 10)

USA



Safety Data Sheet (SDS)

OSHA Hazard Communication Standard 29 CFR 1910.1200. Prepared to GHS
Rev03.

Printing date 04/24/2013

Reviewed on 04/24/2013

Trade name: 10N Sodium Hydroxide (NaOH)

(Contd. of page 9)

IMDG: International Maritime Code for Dangerous Goods
DOT: US Department of Transportation
IATA: International Air Transport Association
ACGIH: American Conference of Governmental Industrial Hygienists
NFPA: National Fire Protection Association (USA)
HMIS: Hazardous Materials Identification System (USA)
LC50: Lethal concentration, 50 percent
LD50: Lethal dose, 50 percent

USA

Set 5: The MSDS of Polyurethane resin

TAI CHIN CHEMICAL INDUSTRY CO., LTD

Material Safety Data Sheet

1. Product and company identification

CHEMICAL NAME/FAMILY : polyurethane resin
OTHER NAME : -
PRODUCT NAME : CU4700A
Recommended usage : polyurethane resin is used for industrial application only with standard grade.
MAKER/SUPPLIER/DISTRIBUTOR :
SUPPLIER : TAI CHIN CHEMICAL INDUSTRY CO., LTD
Address : NO. 402 FENG JEN ROAD, JEN WU-SHIANG, KAOHSIUNG, TAIWAN R.O.C
Telephone number / fax number : 886-7-371-1621 / 886-7-371-1911

2. Hazards identification

HAZARD CLASSIFICATION : Flammable Liquid Category 3 Acute Toxicity (Oral) Category 5 Skin Corrosion/ Irritation Category 3 Serious Eye Damage/ Eye Irritation Category 2 Reproductive Toxicity Category 1 Specific Target Organ Toxicity Repeated Exposure Category 1		
Label elements:		
Hazard symbols : Flame , Health Hazzard , Exclamation °		
Signal Word : DANGER		
Hazard statements Highly flammable liquid and vapor Harmful if inhaled Causes skin irritation Causes serious eye irritation May cause damage to organs through prolonged or repeated exposure. May cause long lasting harmful effects to aquatic life. May be fatal if swallowed and enters airways. Long-term or the redundant exposition will cause the damage to the organ The long-term exposition will possibly harm the nerve, the liver		
Precautionary statements Use only in well ventilated area. Control of exposure by mechanical ventilation in an unventilated or confined space. Avoid breathing vapors and contact with skin and eyes. Wear breathing apparatus/protective gloves/face protection. Store in well-ventilated place. Disposal must be in accordance with applicable federal, state, or local regulations.		
Further Information : -		

3. Composition / information on ingredients

chemical name	CAS No.	Hazardous components (%)
Dimethyl Formamide	68-12-2	74~78%

CU4700A

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Material Safety Data Sheet

4. First-aid measures

Eye:	1. Flush immediately with warm water for at least 20 minutes. 2. Ensure complete irrigation of the eye by keeping eyelids apart and away from eye and moving the eyelids by occasionally lifting the upper and lower lids. 3. If pain persists or recurs seek medical attention. 4. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.
Skin:	1. Removing contaminated clothing, shoes, and leathery wearings, cleaning procedure is available before reused or waste treatment. 2. Washing affected area thoroughly with soap and water for at least 20 minutes. 3. Call a Physician if irritation develops or persists.
Ingestion:	1. If spontaneous vomiting appears imminent or occurs, hold patient's head down, lower than their hips to help avoid possible aspiration of vomits. 2. If victim is conscious and alert, give 2~4 cupfuls of milk/water to dilute the substance in stomach. 3. Never give anything by mouth to an unconscious person. 4. Don't induce vomiting unless directed to do so by medical person. 5. If vomiting occurs, lean patient forward or place on left side (head-down position, if possible) to maintain open airway and prevent aspiration. 6. Then seek for medical attention.
Inhalation:	1. Remove from further exposure and flush thoroughly with air. 2. Lay patient down. Keep warm and rested. 3. Prostheses such as false teeth, which may block airway, should be removed, where possible, prior to initiating first aid procedures. 4. If respiratory irritation, seek immediate medical assistance and call a physician.

5. Fire - fighting measures

Extinguishing media
- Suitable : Foam. Powders. Water spray.
- Not suitable : If there is a fire close by, use suitable extinguishing agents.
Specific hazards : Combustible.
Protection of fire-fighters : Boots, gloves, goggles.

6. Accidental release measures

Personal protective equipment:
1. Eyes : Chemical safety goggles are recommended, and a face shield is added when needed.
Skin : Wear appropriate protective gloves to avoid skin contact.
Clothing: When direct contact is likely, use rubberized clothings, apron and boots.
Respiratory : When limits are exceeded, wear a respirator approved by NIOSH/MSHA for protection against organic dust, mists and vapors.
2. Remove all sources of ignition. No smoking, naked lights or ignition sources. Ventilate area of leak or spill.
3. Keep unnecessary and unprotected personnel from entering. Evacuate personnel from the danger area.
Consult with an expert about the emergency procedures. Personal precautions
Environmental precautions :
1. Prevent spillage from entering drains, surface, and groundwater.
2. Contain and recover liquid when possible. Use non-sparking tools and equipment.
3. Collect liquid in an appropriate container or absorb with an inert material (e.g. vermiculite, dry sand, earth), and place in a chemical waste container.
4. Report the accidental spill/release to Local/State government

TAI CHIN CHEMICAL INDUSTRY CO., LTD

Material Safety Data Sheet

Methods for cleaning up

Minor spill:

1. Remove all ignition sources.
2. Clean up all spills immediately.
3. Avoid breathing vapors and contact with skin and eyes.
4. Control personal contact by using protective equipment.
5. Contain and absorb small quantities with vermiculite or other absorbent material.
6. Wipe up.
7. Collect residues in a flammable waste container.

Major spill

1. Clear area of personnel and move upwind.
2. Alert emergency responders and tell them location and nature of hazard.
3. May be violently or explosively reactive.
4. Wear breathing apparatus plus protective gloves.
5. Prevent spillage from entering drains or water course.
6. No smoking, naked lights or ignition sources. Increase ventilation.
7. Stop leak if safe to do so.
8. Water spray or fog may be used to disperse/absorb vapor.
9. Contain spill with sand, earth or vermiculite.
10. Use only spark-free shovels and explosion proof equipment.
11. Collect recoverable product into labeled containers for recycling..
12. Absorb remaining product with sand, earth or vermiculite.
13. Collect solid residues and seal in labeled drums for disposal.
14. Wash area and prevent runoff into drains.
15. If contamination of drains or waterways occurs, advise emergency services

7. Handling and storage

HANDLING

1. Wash thoroughly after handling.
2. Use only in well ventilated area.
3. Ground and bond containers when transferring.
4. Use spark-free tools and explosion proof equipment.
5. Empty containers retain product residue (liquid/vapor), and can be dangerous.
6. Do not pressurize, cut, weld, braze, solder, drill, or expose empty containers to heat, sparks or open flames.

STORAGE

1. Store in original containers in approved flame-proof area.
2. No smoking, naked lights, heat or ignition sources.
3. DO NOT store in pits, depressions, basements or areas where vapors may be trapped.
4. Keep containers securely sealed.
5. Store away from incompatible materials in a cool, dry well ventilated area.
6. Protect containers against physical damage and check regularly for leaks.
7. Keep containers tightly closed and store in a cool, dry, well-ventilated place, plainly labeled, and out of closed vehicles.
8. Ground all equipment containing this material.

8. Exposure controls / personal protection

LIMIT OF EXPOSURE:

Taiwan TWA : 7 ppm (skin).

Taiwan STEL : 11 ppm (skin).

Engineering measures : Ensure good ventilation of the work station.

Personal protective equipment

Eye Protection:

Safety glasses equipped with side shields are recommended as minimum protection in industrial settings. Chemical goggles

CU4700A

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Material Safety Data Sheet

should be worn during transfer operations or when there is a likelihood of misting, splashing, or spraying of this material. A suitable emergency eye wash water and safety shower should be located near the work station.
Skin protection: Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.
Clothing: Avoid skin contact. Wear long-sleeved fire-retardant garments (e.g., Nomex®) while working with flammable and combustible liquids. Additional chemical-resistant protective gear may be required if splashing or spraying conditions exist. This may include an apron, boots and additional facial protection. If product comes in contact with clothing, immediately remove soaked clothing and shower. Promptly remove and discard contaminated leather goods.
Respirators: For known vapor concentrations above the occupational exposure guidelines (see below), use a NIOSH-approved organic vapor respirator if adequate protection is provided. Protection factors vary depending upon the type of respirator used. Respirators should be used in accordance with OSHA requirements (29 CFR 1910.134). For airborne vapor concentrations that exceed the recommended protection factors for organic vapor respirators, use a full-face, positive-pressure, supplied air respirator. Due to fire and explosion hazards, do not enter atmospheres containing concentrations greater than 10% of the lower flammable limit of this product.
Collective emergency : Safety shower. Equipment Eye fountain.
Hygiene measures : Always wash your hands after handling the product.

9. Physical and chemical properties

APPEARANCE: yellow liquid	Odour : aromatic petroleum odour
Viscosity : 115000~145000 m.Pa.s/20°C	Melting temperature : -
pH : -	Flash point : above 58C (Closed cup)
Boiling temperature :153°C	Specific gravity (water=1) at 20°C : 0.95
Vapour pressure : 2.7mmHg, at 20°C.	Specific Vapour gravity (air=1) : 2.51
Auto-ignition temperature : -	Degradation temp : No data
Solubility in water : Insoluble	Explosion higher%(V/V) :15.2% @100°C
Octanol/water partition coefficient : -0.76	Explosion Lower%(V/V) : 2.2% @100°C

10. Stability and reactivity

Stability : Stable at room temperature.
Materials to avoid : Strong oxidizing agents. Fairly strong acid. Reacts with bases.: isocyanate
Conditions to avoid : away from any source of heat,away from any source of ignition. away from incompatible materials.
Possibility of hazardous reactions : -
Hazardous substance from decomposition : Carbon oxide(CO + CO ₂), Hazardous gas

11. Toxicological information

Acute toxicity : LD50: 2800 mg/kg (rat, oral) LC50: 9400 ppm/2h (rat, inhalation)
Local effects : Unpublished reports Chronic effect Carcinogenicity: ACGIH : A4-Not classifiable as a Human Carcinogen. OSHA : Possible select carcinogen. IARC : Group 3 carcinogen. Epidemiology: Not available.

TAI CHIN CHEMICAL INDUSTRY CO., LTD

Material Safety Data Sheet

Teratogenicity: Teratogenic effects have occurred in experimental animals.
Reproductive Effects:
Neurotoxicity:
Mutagenicity: Not available.
Respiratory Sensitisation : Not available.
Repeated dose toxicity : Not available.
Germ Cell Mutagenicity : Not available.
Carcinogenicity : Not available.
Reproductive toxicity : Adverse reproductive effects have occurred in experimental animals.

12. Ecological information

Ecotoxicity LC ₅₀ (96 hr.) Fish: 2695~3677 mg/l
BIODEGRADABILITY Ultimate aerobic biodegradability : Unpublished reports
Bioaccumulation : Not bioaccumulable.

13. Disposal considerations

RESIDUES FROM PRODUCT Prohibition : Discharging waste into rivers and drains is forbidden. Destruction/Disposal : Incinerate at a licensed installation.
CONTAMINATED PACKAGING Prohibition : Do not dispose of the product at a rubbish tip. Decontamination/cleaning : Wash out general purpose tankers (rail-road) with water. Recover the cleaning water and dispose of at a specialist site. Destruction/Disposal : Incinerate bags and flexible containers.
NOTE : The user's attention is drawn to the possible existence of local regulations regarding disposal.

14 Transport information

UN NUMBER : UN 1866
INTERNATIONAL TRANSPORT HAZARD CLASSIFICATION : 3
PACKING CLASSIFICATION : - Land : NOT restricted. Sea : NOT restricted. Air : NOT restricted.
OTHER REGULATIONS : —

15. Regulatory information

a. LABELLING EC regulations : Mandatory labeling (prescribed) of hazardous substances:
APPLICABLE identification of the hazardous product : Name of the product : (refer to the name which appears in section 1).
NOTE : The regulatory information given above only indicates the principal regulations specifically applicable to the product described in the Safety Data Sheet. The user's attention is drawn to the possible existence of additional provisions which complete these regulations. Refer to all applicable national, international and local regulations or provisions.

TAI CHIN CHEMICAL INDUSTRY CO., LTD

Material Safety Data Sheet

16. Other information

REFERENCE	Globally Harmonized System of Classification and Labeling of Chemicals.
SUPPLIER	SUPPLIER : TAI CHIN CHEMICAL INDUSTRY CO., LTD
	ADDRESS/TEL : NO. 402 FENG JEN ROAD. JEN WU-SHIANG, KAOHSIUNG, TAIWAN R.O.C(07-3711621)
MAKER	NAME : CHEN CHIN-YUAN
DATE	2010 / 1 / 9

Set 6: The MSDS of Benzyl alcohol

SIGMA-ALDRICH

sigma-aldrich.com

SAFETY DATA SHEET

according to Regulation (EC) No. 1907/2006

Version 6.1 Revision Date 28.02.2013

Print Date 08.07.2013

GENERIC EU MSDS - NO COUNTRY SPECIFIC DATA - NO OEL DATA

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1 Product identifiers

Product name : Benzyl alcohol

Product Number : 305197

Brand : Sigma-Aldrich

Index-No. : 603-057-00-5

REACH No. : A registration number is not available for this substance as the substance or its uses are exempted from registration, the annual tonnage does not require a registration or the registration is envisaged for a later registration deadline.

CAS-No. : 100-51-6

1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Manufacture of substances

1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich Chemie GmbH
Riedstrasse 2
D-89555 STEINHEIM

Telephone : +49 89-6513-1444

Fax : +49 7329-97-2319

E-mail address : eurtechserv@sial.com

1.4 Emergency telephone number

Emergency Phone # : +49 7329-97-2323

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

Classification according to Regulation (EC) No 1272/2008

Acute toxicity, Inhalation (Category 4), H332

Acute toxicity, Oral (Category 4), H302

For the full text of the H-Statements mentioned in this Section, see Section 16.

Classification according to EU Directives 67/548/EEC or 1999/45/EC

Xn Harmful R20/22

For the full text of the R-phrases mentioned in this Section, see Section 16.

2.2 Label elements

Labelling according Regulation (EC) No 1272/2008

Pictogram



Signal word : Warning

Hazard statement(s)
H302 Harmful if swallowed.
H332 Harmful if inhaled.

Precautionary statement(s) : none

Supplemental Hazard Statements : none

2.3 Other hazards - none

SECTION 3: Composition/information on ingredients

3.1 Substances

Synonyms : Benzenemethanol

Formula : C₇H₈O

Molecular Weight : 108,14 g/mol

CAS-No. : 100-51-6

EC-No. : 202-859-9

Index-No. : 603-057-00-5

Hazardous ingredients according to Regulation (EC) No 1272/2008

Component	Classification	Concentration
Benzyl alcohol		
	Acute Tox. 4; H302, H332	-

Hazardous ingredients according to Directive 1999/45/EC

Component	Classification	Concentration
Benzyl alcohol		
	Xn, R20/22	-

For the full text of the H-Statements and R-Phrases mentioned in this Section, see Section 16

SECTION 4: First aid measures

4.1 Description of first aid measures

General advice

Consult a physician. Show this safety data sheet to the doctor in attendance.

If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

In case of skin contact

Wash off with soap and plenty of water. Consult a physician.

In case of eye contact

Flush eyes with water as a precaution.

If swallowed

Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

4.3 Indication of any immediate medical attention and special treatment needed

no data available

SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable extinguishing media

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

5.2 Special hazards arising from the substance or mixture

Carbon oxides

Carbon oxides

5.3 Advice for firefighters

Wear self contained breathing apparatus for fire fighting if necessary.

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5.4 Further information
no data available

SECTION 6: Accidental release measures

- 6.1 Personal precautions, protective equipment and emergency procedures**
Use personal protective equipment. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. For personal protection see section 8.
- 6.2 Environmental precautions**
Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.
- 6.3 Methods and materials for containment and cleaning up**
Soak up with inert absorbent material and dispose of as hazardous waste. Keep in suitable, closed containers for disposal.
- 6.4 Reference to other sections**
For disposal see section 13.

SECTION 7: Handling and storage

- 7.1 Precautions for safe handling**
Avoid contact with skin and eyes. Avoid inhalation of vapour or mist. For precautions see section 2.2.
- 7.2 Conditions for safe storage, including any incompatibilities**
Store in cool place. Keep container tightly closed in a dry and well-ventilated place.
Handle and store under inert gas. hygroscopic
- 7.3 Specific end use(s)**
A part from the uses mentioned in section 1.2 no other specific uses are stipulated

SECTION 8: Exposure controls/personal protection

- 8.1 Control parameters**
Components with workplace control parameters
- 8.2 Exposure controls**
Appropriate engineering controls
Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.
- Personal protective equipment**
- Eye/face protection**
Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).
- Skin protection**
Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.
- The selected protective gloves have to satisfy the specifications of EU Directive 89/686/EEC and the standard EN 374 derived from it.
- Full contact
Material: butyl-rubber
Minimum layer thickness: 0,3 mm
Break through time: 480 min
Material tested: Butoject® (KCL 897 / Aldrich Z677647, Size M)
- Splash contact
Material: Nitrile rubber

Minimum layer thickness: 0,4 mm

Break through time: 30 min

Material tested: Camatril® (KCL 730 / Aldrich Z677442, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de,

test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

Body Protection

Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type ABEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Control of environmental exposure

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

- | | |
|---|---|
| a) Appearance | Form: liquid, clear
Colour: colourless |
| b) Odour | no data available |
| c) Odour Threshold | no data available |
| d) pH | no data available |
| e) Melting point/freezing point | Melting point/range: -16 - -13 °C |
| f) Initial boiling point and boiling range | 203 - 205 °C |
| g) Flash point | 96 °C - closed cup |
| h) Evaporation rate | no data available |
| i) Flammability (solid, gas) | no data available |
| j) Upper/lower flammability or explosive limits | no data available |
| k) Vapour pressure | 5,00 hPa at 77 °C
17,7 hPa at 100 °C
0,125 hPa at 25 °C |
| l) Vapour density | 3,73 - (Air = 1.0) |
| m) Relative density | 1,045 g/mL at 25 °C |
| n) Water solubility | 33 g/l at 20 °C |
| o) Partition coefficient: n-octanol/water | log Pow: 1,1 |
| p) Auto-ignition temperature | no data available |

- | | |
|------------------------------|-------------------|
| q) Decomposition temperature | no data available |
| r) Viscosity | no data available |
| s) Explosive properties | no data available |
| t) Oxidizing properties | no data available |

9.2 Other safety information

- | | |
|-------------------------|--------------------|
| Surface tension | 39 mN/m at 20 °C |
| Relative vapour density | 3,73 - (Air = 1.0) |

SECTION 10: Stability and reactivity

10.1 Reactivity

no data available

10.2 Chemical stability

hygroscopic

Stable under recommended storage conditions.

10.3 Possibility of hazardous reactions

no data available

10.4 Conditions to avoid

A mixture of benzyl alcohol and 58% sulfuric acid decomposed violently when heated to 180°C. Benzyl alcohol containing 1.4% hydrogen bromide and 1.1% of an iron(II) salt polymerized exothermally when heated above 100°C.

10.5 Incompatible materials

Strong oxidizing agents

10.6 Hazardous decomposition products

Other decomposition products - no data available
In the event of fire: see section 5

SECTION 11: Toxicological information

11.1 Information on toxicological effects

Acute toxicity

LD50 Oral - rat - 1.230 mg/kg

Remarks: Behavioral:Somnolence (general depressed activity). Behavioral:Excitement. Behavioral:Coma.

Inhalation: no data available

LD50 Dermal - rabbit - 2.000 mg/kg

Skin corrosion/irritation

Skin - rabbit

Result: Irritating to skin. - 24 h

Serious eye damage/eye irritation

no data available

Respiratory or skin sensitisation

no data available

Germ cell mutagenicity

no data available

Carcinogenicity

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

Reproductive toxicity

no data available

Specific target organ toxicity - single exposure

no data available

Specific target organ toxicity - repeated exposure

no data available

Aspiration hazard

no data available

Additional Information

RTECS: DN3150000

Central nervous system depression

Liver - Irregularities - Based on Human Evidence

SECTION 12: Ecological information

12.1 Toxicity

Toxicity to fish LC50 - Lepomis macrochirus (Bluegill) - 10 mg/l - 96 h

Toxicity to daphnia and other aquatic invertebrates EC50 - Daphnia magna (Water flea) - 55 mg/l - 24 h

12.2 Persistence and degradability

Biodegradability Biotic/Aerobic - Exposure time 28 d
Result: 92 - 96 % - Readily biodegradable.

12.3 Bioaccumulative potential

no data available

12.4 Mobility in soil

no data available

12.5 Results of PBT and vPvB assessment

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

12.6 Other adverse effects

Toxic to aquatic life.

SECTION 13: Disposal considerations

13.1 Waste treatment methods

Product

Offer surplus and non-recyclable solutions to a licensed disposal company.

Contaminated packaging

Dispose of as unused product.

SECTION 14: Transport information

14.1 UN number

ADR/RID: - IMDG: - IATA: 3334

14.2 UN proper shipping name

ADR/RID: Not dangerous goods
IMDG: Not dangerous goods
IATA: Aviation regulated liquid, n.o.s. (Benzyl alcohol)

14.3 Transport hazard class(es)

ADR/RID: - IMDG: - IATA: 9

14.4 Packaging group

ADR/RID: - IMDG: - IATA: III

14.5 Environmental hazards

ADR/RID: no IMDG Marine pollutant: no IATA: no

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14.6 Special precautions for user
no data available

SECTION 15: Regulatory information

This safety datasheet complies with the requirements of Regulation (EC) No. 1907/2006.

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture
no data available

15.2 Chemical Safety Assessment
For this product a chemical safety assessment was not carried out

SECTION 16: Other information

Full text of H-Statements referred to under sections 2 and 3.

Acute Tox.	Acute toxicity
H302	Harmful if swallowed.
H332	Harmful if inhaled.

Full text of R-phrases referred to under sections 2 and 3

Xn	Harmful
R20/22	Harmful by inhalation and if swallowed.

Further information

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The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See www.sigma-aldrich.com and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

Set 7: The MSDS of Environmental protection diesel

Safety Data Sheet (SDS)

Prepared to GHS Rev04(2011): U.S. OSHA, CMA, ANSI, Canadian WHMIS Standards,
Australian WorkSafe, Japanese Industrial Standard JIS Z 7250:2000, and European
Directives

Printing date 01/10/2013

Reviewed on 01/10/2013

1 Product and Company Identification

· **Product identifier**

· **Trade name:** Dimethylformamide (DMF)

· **CAS Number:**

68-12-2

· **EC number:**

200-679-5

· **Index number:**

616-001-00-X

· **Details of the supplier of the safety data sheet**

High Purity DMF, Pharmaceutical Grade DMF Manufactured by BASF

· **Manufacturer/Supplier:**

NuGeneration Technologies, LLC (dba NuGenTec)

1155 Park Avenue, Emeryville, CA 94608

info@nugentec.com

888-996-8436 or 707-820-4080 for product information

· **Emergency telephone number:** Contact Infotrac: 1-352-326-2510

www.nugentec.com

2 Hazards identification

· **Classification of the substance or mixture**



GHS02 Flame

Flam. Liq. 3 H226 Flammable liquid and vapour.



GHS08 Health hazard

Repr. 1B H360 May damage fertility or the unborn child.



GHS07

Eye Irrit. 2A H319 Causes serious eye irritation.

· **Label elements**

· **GHS label elements**

The substance is classified and labelled according to the Globally Harmonized System (GHS).

· **Hazard pictograms**



GHS02

GHS07

GHS08

· **Signal word** Danger

(Contd. on page 2)

USA

Safety Data Sheet (SDS)

Prepared to GHS Rev04(2011): U.S. OSHA, CMA, ANSI, Canadian WHMIS Standards,
Australian WorkSafe, Japanese Industrial Standard JIS Z 7250:2000, and European
Directives

Printing date 01/10/2013

Reviewed on 01/10/2013

Trade name: Dimethylformamide (DMF)

(Contd. of page 1)

· Hazard-determining components of labelling:

N,N-dimethylformamide

· Hazard statements

H226 Flammable liquid and vapour.

H319 Causes serious eye irritation.

H360 May damage fertility or the unborn child.

· Precautionary statements

Precautionary statements

P101 If medical advice is needed, have product container or label at hand.

P102 Keep out of reach of children.

P103 Read label before use.

P210 Keep away from heat/sparks/open flames/hot surfaces. - No smoking.

P241 Use explosion-proof electrical/ventilating/lighting/equipment.

P303+P361+P353 IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower.

P305+P351+P338 IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.

P405 Store locked up.

P501 Dispose of contents/container in accordance with local/regional/national/international regulations.

· Classification system:

· NFPA ratings (scale 0 - 4)



Health = 2

Fire = 2

Reactivity = 0

· HMIS-ratings (scale 0 - 4)



Health = *2

Fire = 2

Reactivity = 0

· Other hazards

· Results of PBT and vPvB assessment

· PBT: Not applicable.

· vPvB: Not applicable.

3 Composition/information on ingredients

· Chemical characterization: Substances

· CAS No. Description

68-12-2 *N,N*-dimethylformamide

· Identification number(s)

· EC number: 200-679-5

(Contd. on page 3)

USA

Safety Data Sheet (SDS)

Prepared to GHS Rev04(2011): U.S. OSHA, CMA, ANSI, Canadian WHMIS Standards,
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Directives

Printing date 01/10/2013

Reviewed on 01/10/2013

Trade name: Dimethylformamide (DMF)

· **Index number:** 616-001-00-X

(Contd. of page 2)

4 First aid measures

· **Description of first aid measures**

· **General information:**

Symptoms of poisoning may even occur after several hours; therefore medical observation for at least 48 hours after the accident.

· **After inhalation:** Supply fresh air; consult doctor in case of complaints.

· **After skin contact:** Generally the product does not irritate the skin.

· **After eye contact:**

Rinse opened eye for several minutes under running water. If symptoms persist, consult a doctor.

· **After swallowing:** If symptoms persist consult doctor.

· **Information for doctor:**

· **Most important symptoms and effects, both acute and delayed** No further relevant information available.

· **Indication of any immediate medical attention and special treatment needed**

No further relevant information available.

5 Firefighting measures

· **Extinguishing media**

· **Suitable extinguishing agents:**

CO₂, extinguishing powder or water spray. Fight larger fires with water spray or alcohol resistant foam.

· **Special hazards arising from the substance or mixture** No further relevant information available.

· **Advice for firefighters**

· **Protective equipment:** No special measures required.

6 Accidental release measures

· **Personal precautions, protective equipment and emergency procedures** Not required.

· **Environmental precautions:**

Do not allow product to reach sewage system or any water course.

Inform respective authorities in case of seepage into water course or sewage system.

Dilute with plenty of water.

Do not allow to enter sewers/ surface or ground water.

· **Methods and material for containment and cleaning up:**

Absorb with liquid-binding material (sand, diatomite, acid binders, universal binders, sawdust).

Dispose contaminated material as waste according to item 13.

Ensure adequate ventilation.

· **Reference to other sections**

See Section 7 for information on safe handling.

See Section 8 for information on personal protection equipment.

(Contd. on page 4)

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Reviewed on 01/10/2013

Trade name: Dimethylformamide (DMF)

See Section 13 for disposal information.

(Contd. of page 3)

7 Handling and storage

- **Handling:**
- **Precautions for safe handling**
Ensure good ventilation/exhaustion at the workplace.
Open and handle receptacle with care.
Prevent formation of aerosols.
- **Information about protection against explosions and fires:**
Protect from heat.
Protect against electrostatic charges.
Keep respiratory protective device available.
- **Conditions for safe storage, including any incompatibilities**
- **Storage:**
- **Requirements to be met by storerooms and receptacles:** No special requirements.
- **Information about storage in one common storage facility:** Not required.
- **Further information about storage conditions:**
Keep receptacle tightly sealed.
Protect from heat and direct sunlight.
- **Specific end use(s)** No further relevant information available.

8 Exposure controls/personal protection

- **Additional information about design of technical systems:** No further data; see item 7.
- **Control parameters**

Components with limit values that require monitoring at the workplace:
68-12-2 N,N-dimethylformamide

PEL	30 mg/m ³ , 10 ppm
	Skin
REL	30 mg/m ³ , 10 ppm
	Skin
TLV	30 mg/m ³ , 10 ppm
	Skin; BEI

(Contd. on page 5)

USA

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Printing date 01/10/2013

Reviewed on 01/10/2013

Trade name: Dimethylformamide (DMF)

(Contd. of page 4)

· Ingredients with biological limit values:

68-12-2 N,N-dimethylformamide

BEI	15 mg/L urine end of shift N-Methylformamide
	40 mg/L urine prior to last shift of workweek N-Acetyl-S-(N-methylcarbamoyl) cysteine (semi-quantitative)

· **Additional information:** The lists that were valid during the creation were used as basis.

· Exposure controls

· Personal protective equipment:

· General protective and hygienic measures:

Keep away from foodstuffs, beverages and feed.
Immediately remove all soiled and contaminated clothing.
Wash hands before breaks and at the end of work.
Store protective clothing separately.
Avoid contact with the eyes.
Avoid contact with the eyes and skin.

· Breathing equipment:

In case of brief exposure or low pollution use respiratory filter device. In case of intensive or longer exposure use respiratory protective device that is independent of circulating air.

· Protection of hands:



Protective gloves

The glove material has to be impermeable and resistant to the product/ the substance/ the preparation.
Due to missing tests no recommendation to the glove material can be given for the product/ the preparation/ the chemical mixture.
Selection of the glove material on consideration of the penetration times, rates of diffusion and the degradation

· Material of gloves

The selection of the suitable gloves does not only depend on the material, but also on further marks of quality and varies from manufacturer to manufacturer.

· Penetration time of glove material

The exact break through time has to be found out by the manufacturer of the protective gloves and has to be observed.

(Contd. on page 6)

USA

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Printing date 01/10/2013

Reviewed on 01/10/2013

Trade name: Dimethylformamide (DMF)

· Eye protection:

(Contd. of page 5)



Tightly sealed goggles

9 Physical and chemical properties

· Information on basic physical and chemical properties

· General Information

· Appearance:

Form:	Fluid
Color:	Colorless
Odor:	Amine-like
Odour threshold:	Not determined.

· pH-value at 20 °C (68 °F): 7

· Change in condition

Melting point/Melting range:	-61 °C (-78 °F)
Boiling point/Boiling range:	152 °C (306 °F)

· Flash point: 58 °C (136 °F)

· Flammability (solid, gaseous): Not applicable.

· Ignition temperature: 440 °C (824 °F)

· Decomposition temperature: Not determined.

· Auto igniting: Not determined.

· Danger of explosion: Not determined.

· Explosion limits:

Lower:	2.2 Vol %
Upper:	16 Vol %

· Vapor pressure at 20 °C (68 °F): 3.5 hPa (3 mm Hg)

· Density at 20 °C (68 °F): 0.95 g/cm³ (7.928 lbs/gal)

· Relative density: Not determined.

· Vapour density: Not determined.

· Evaporation rate: Not determined.

· Solubility in / Miscibility with

Water: Fully miscible.

· Partition coefficient (n-octanol/water): Not determined.

· Viscosity:

Dynamic: Not determined.

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Printing date 01/10/2013

Reviewed on 01/10/2013

Trade name: Dimethylformamide (DMF)

(Contd. of page 6)

Kinematic:	Not determined.
Organic solvents:	0.0 %
Other information	No further relevant information available.

10 Stability and reactivity

- **Reactivity**
- **Chemical stability**
- **Thermal decomposition / conditions to be avoided:** No decomposition if used according to specifications.
- **Possibility of hazardous reactions** No dangerous reactions known.
- **Conditions to avoid** No further relevant information available.
- **Incompatible materials:** No further relevant information available.
- **Hazardous decomposition products:** No dangerous decomposition products known.

11 Toxicological information

- **Information on toxicological effects**
- **Acute toxicity:**
- **LD/LC50 values that are relevant for classification:**

68-12-2 N,N-dimethylformamide

Oral	LD50	2800 mg/kg (rat)
Dermal	LD50	4720 mg/kg (rabbit)
Inhalative	LC50/4 h	9400 mg/l (mouse)

- **Primary irritant effect:**
- **on the skin:** No irritant effect.
- **on the eye:** Irritating effect.
- **Sensitization:** No sensitizing effects known.
- **Additional toxicological information:**
- **Carcinogenic categories**

- **IARC (International Agency for Research on Cancer)**

68-12-2 N,N-dimethylformamide

3

- **NTP (National Toxicology Program)**

Substance is not listed.

12 Ecological information

- **Toxicity**
- **Aquatic toxicity:** No further relevant information available.
- **Persistence and degradability** No further relevant information available.
- **Behavior in environmental systems:**
- **Bioaccumulative potential** No further relevant information available.

(Contd. on page 8)

USA

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Printing date 01/10/2013

Reviewed on 01/10/2013

Trade name: Dimethylformamide (DMF)

(Contd. of page 7)

- **Mobility in soil** No further relevant information available.
- **Additional ecological information:**
- **General notes:**
Water hazard class 1 (Assessment by list): slightly hazardous for water
Do not allow undiluted product or large quantities of it to reach ground water, water course or sewage system.
- **Results of PBT and vPvB assessment**
- **PBT:** Not applicable.
- **vPvB:** Not applicable.
- **Other adverse effects** No further relevant information available.

13 Disposal considerations

- **Waste treatment methods**
- **Recommendation:**
Must not be disposed of together with household garbage. Do not allow product to reach sewage system.
- **Uncleaned packagings:**
- **Recommendation:** Disposal must be made according to official regulations.
- **Recommended cleansing agent:** Water, if necessary with cleansing agents.

14 Transport information

- | | |
|----------------------------------|--------------------------------------|
| · UN-Number | None |
| · DOT, ADR, IMDG, IATA | UN2265 |
| · UN proper shipping name | None |
| · DOT, IMDG, IATA | N,N-DIMETHYLFORMAMIDE, solution |
| · ADR | 2265 N,N-DIMETHYLFORMAMIDE, solution |

- **Transport hazard class(es)**

- **DOT**



- **Class** 3 Flammable liquids.
- **Label** 3

- **ADR, IMDG, IATA**



- **Class** 3 Flammable liquids
- **Label** 3

(Contd. on page 9)

USA

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Reviewed on 01/10/2013

Trade name: Dimethylformamide (DMF)

(Contd. of page 8)

· Packing group	III
· DOT, ADR, IMDG, IATA	III
· Environmental hazards:	
· Marine pollutant:	No
· Special precautions for user	Warning: Flammable liquids
· Danger code (Kemler):	30
· EMS Number:	F-E,S-D
· Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code	Not applicable.
· UN "Model Regulation":	UN2265, N,N-DIMETHYLFORMAMIDE, solution, 3, III

15 Regulatory information

- **Safety, health and environmental regulations/legislation specific for the substance or mixture**
- **Sara** None Listed

· **Section 355 (extremely hazardous substances):**

Substance is not listed.

· **Section 313 (Specific toxic chemical listings):**

Substance is listed.

· **TSCA (Toxic Substances Control Act):**

Substance is listed.

· **Proposition 65**

· **Chemicals known to cause cancer:**

Substance is not listed.

· **Chemicals known to cause reproductive toxicity for females:**

Substance is not listed.

· **Chemicals known to cause reproductive toxicity for males:**

Substance is not listed.

· **Chemicals known to cause developmental toxicity:**

Substance is not listed.

· **Carcinogenic categories**

· **EPA (Environmental Protection Agency)**

Substance is not listed.

· **TLV (Threshold Limit Value established by ACGIH)**

68-12-2 N,N-dimethylformamide

A4

· **NIOSH-Ca (National Institute for Occupational Safety and Health)**

Substance is not listed.

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Reviewed on 01/10/2013

Trade name: Dimethylformamide (DMF)

(Contd. of page 9)

· OSHA-Ca (Occupational Safety & Health Administration)

Substance is not listed.

· GHS label elements

The substance is classified and labelled according to the Globally Harmonized System (GHS).

· Hazard pictograms



GHS02 GHS07 GHS08

· Signal word Danger

· Hazard-determining components of labelling:

N,N-dimethylformamide

· Hazard statements

H226 Flammable liquid and vapour.

H319 Causes serious eye irritation.

H360 May damage fertility or the unborn child.

· Precautionary statements

P101 If medical advice is needed, have product container or label at hand.

P102 Keep out of reach of children.

P103 Read label before use.

P210 Keep away from heat/sparks/open flames/hot surfaces. - No smoking.

P241 Use explosion-proof electrical/ventilating/lighting/equipment.

P303+P361+P353 IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower.

P305+P351+P338 IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.

P405 Store locked up.

P501 Dispose of contents/container in accordance with local/regional/national/international regulations.

· Chemical safety assessment: A Chemical Safety Assessment has not been carried out.

16 Other information

This information is based on our present knowledge. However, this shall not constitute a guarantee for any specific product features and shall not establish a legally valid contractual relationship.

· Abbreviations and acronyms:

ADR: Accord européen sur le transport des marchandises dangereuses par Route (European Agreement concerning the International Carriage of Dangerous Goods by Road)

IMDG: International Maritime Code for Dangerous Goods

DOT: US Department of Transportation

IATA: International Air Transport Association

ACGIH: American Conference of Governmental Industrial Hygienists

EINECS: European Inventory of Existing Commercial Chemical Substances

CAS: Chemical Abstracts Service (division of the American Chemical Society)

NFPA: National Fire Protection Association (USA)

HMIS: Hazardous Materials Identification System (USA)

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USA



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Reviewed on 01/10/2013

Trade name: Dimethylformamide (DMF)

LC50: Lethal concentration, 50 percent
LD50: Lethal dose, 50 percent

(Contd. of page 10)

USA

Set 8: The MSDS of LIDTREX AC-802

SIGMA-ALDRICH

sigma-aldrich.com

SAFETY DATA SHEET

according to Regulation (EC) No. 1907/2006

Version 5.0 Revision Date 24.10.2012

Print Date 08.07.2013

GENERIC EU MSDS - NO COUNTRY SPECIFIC DATA - NO OEL DATA

1. IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

1.1 Product identifiers

Product name : Oxalic acid dihydrate

Product Number : 247537
Brand : Sigma-Aldrich
Index-No. : 607-006-00-8
CAS-No. : 6153-56-6

1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Manufacture of substances

1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich Chemie GmbH
Riedstrasse 2
D-89555 STEINHEIM

Telephone : +49 89-6513-1444
Fax : +49 7329-97-2319
E-mail address : eurtechserv@sial.com

1.4 Emergency telephone number

Emergency Phone # : +49 7329-97-2323

2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

Classification according to Regulation (EC) No 1272/2008 [EU-GHS/CLP]

Acute toxicity, Oral (Category 4)

Acute toxicity, Dermal (Category 4)

Skin corrosion (Category 1B)

Classification according to EU Directives 67/548/EEC or 1999/45/EC

Harmful in contact with skin and if swallowed.

2.2 Label elements

Labelling according Regulation (EC) No 1272/2008 [CLP]

Pictogram



Signal word : Danger

Hazard statement(s)

H302 + H312

H314

Harmful if swallowed or in contact with skin
Causes severe skin burns and eye damage.

Precautionary statement(s)

P280

Wear protective gloves/ protective clothing/ eye protection/ face protection.

P305 + P351 + P338

IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.

P310

Immediately call a POISON CENTER or doctor/ physician.

Supplemental Hazard

none

Statements

According to European Directive 67/548/EEC as amended.

Hazard symbol(s)



R-pharse(s)

R21/22

Harmful in contact with skin and if swallowed.

S-pharse(s)

S24/25

Avoid contact with skin and eyes.

2.3 Other hazards - none

3. COMPOSITION/INFORMATION ON INGREDIENTS

3.1 Substances

Synonyms : Ethanedioic acid

Formula : $C_2H_2O_4 \cdot 2H_2O$

Molecular Weight : 126,07 g/mol

Component		Concentration
Oxalic acid dihydrate		
CAS-No.	6153-56-6	-
EC-No.	205-634-3	-
Index-No.	607-006-00-8	-

4. FIRST AID MEASURES

4.1 Description of first aid measures

General advice

Consult a physician. Show this safety data sheet to the doctor in attendance.

If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

In case of skin contact

Take off contaminated clothing and shoes immediately. Wash off with soap and plenty of water. Consult a physician.

In case of eye contact

Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.

If swallowed

Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

4.2 Most important symptoms and effects, both acute and delayed

burning sensation, Cough, wheezing, laryngitis, Shortness of breath, spasm, inflammation and edema of the larynx, spasm, inflammation and edema of the bronchi, pneumonitis, pulmonary edema, Material is extremely destructive to tissue of the mucous membranes and upper respiratory tract, eyes, and skin.

4.3 Indication of any immediate medical attention and special treatment needed

no data available

5. FIREFIGHTING MEASURES

5.1 Extinguishing media

Suitable extinguishing media

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

5.2 Special hazards arising from the substance or mixture

Carbon oxides

5.3 Advice for firefighters

Wear self contained breathing apparatus for fire fighting if necessary.

5.4 Further information

no data available

6. ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures

Use personal protective equipment. Avoid dust formation. Avoid breathing vapors, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas. Avoid breathing dust.

6.2 Environmental precautions

Do not let product enter drains.

6.3 Methods and materials for containment and cleaning up

Pick up and arrange disposal without creating dust. Sweep up and shovel. Keep in suitable, closed containers for disposal.

6.4 Reference to other sections

For disposal see section 13.

7. HANDLING AND STORAGE

7.1 Precautions for safe handling

Avoid contact with skin and eyes. Avoid formation of dust and aerosols. Provide appropriate exhaust ventilation at places where dust is formed.

7.2 Conditions for safe storage, including any incompatibilities

Store in cool place. Keep container tightly closed in a dry and well-ventilated place.

hygroscopic

7.3 Specific end uses

no data available

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1 Control parameters

Components with workplace control parameters

8.2 Exposure controls

Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

Personal protective equipment

Eye/face protection

Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

The selected protective gloves have to satisfy the specifications of EU Directive 89/686/EEC and the standard EN 374 derived from it.

Immersion protection

Material: Nitrile rubber

Minimum layer thickness: 0,11 mm

Break through time: > 480 min

Material tested: Dermatrill® (Aldrich Z677272, Size M)

Splash protection

Material: Nitrile rubber

Minimum layer thickness: 0,11 mm

Break through time: > 30 min

Material tested: Dermatrill® (Aldrich Z677272, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 873000, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an Industrial Hygienist familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

Body Protection

Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face particle respirator type N100 (US) or type P3 (EN 143) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

- | | |
|---|--|
| a) Appearance | Form: crystalline
Colour: colourless |
| b) Odour | no data available |
| c) Odour Threshold | no data available |
| d) pH | 1 at 126,1 g/l at 25 °C |
| e) Melting point/freezing point | Melting point/range: 104 - 106 °C - lit. |
| f) Initial boiling point and boiling range | no data available |
| g) Flash point | no data available |
| h) Evaporation rate | no data available |
| i) Flammability (solid, gas) | no data available |
| j) Upper/lower flammability or explosive limits | no data available |
| k) Vapour pressure | < 0,01 hPa at 20 °C |
| l) Vapour density | no data available |
| m) Relative density | no data available |
| n) Water solubility | ca.126,1 g/l at 20 °C |
| o) Partition coefficient: n-octanol/water | log Pow: -0,81 |
| p) Autoignition temperature | no data available |
| q) Decomposition temperature | no data available |
| r) Viscosity | no data available |

Sigma-Aldrich - 247537

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- | | |
|-------------------------|-------------------|
| s) Explosive properties | no data available |
| t) Oxidizing properties | no data available |

9.2 Other safety information

Bulk density	0,90 g/l
--------------	----------

10. STABILITY AND REACTIVITY

10.1 Reactivity

no data available

10.2 Chemical stability

no data available

10.3 Possibility of hazardous reactions

no data available

10.4 Conditions to avoid

Avoid moisture.

10.5 Incompatible materials

Bases, Metals, Acid chlorides, Alkali metals

10.6 Hazardous decomposition products

Other decomposition products - no data available

11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Acute toxicity

Skin corrosion/irritation

Skin - rabbit - Mild skin irritation

Serious eye damage/eye irritation

Eyes - rabbit - Severe eye irritation

Respiratory or skin sensitization

no data available

Germ cell mutagenicity

Genotoxicity in vitro - Not mutagenic in Ames Test.

Histidine reversion (Ames)

Carcinogenicity

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

Reproductive toxicity

Possible risk of congenital malformation in the fetus.

Specific target organ toxicity - single exposure

no data available

Specific target organ toxicity - repeated exposure

no data available

Aspiration hazard

no data available

Potential health effects

Inhalation

May be harmful if inhaled. Material is extremely destructive to the tissue of the mucous membranes and upper respiratory tract.

Ingestion

Harmful if swallowed. Causes burns.

Skin

Harmful if absorbed through skin. Causes skin burns.

Eyes

Causes eye burns.

Signs and Symptoms of Exposure

burning sensation, Cough, wheezing, laryngitis, Shortness of breath, spasm, inflammation and edema of the larynx, spasm, inflammation and edema of the bronchi, pneumonitis, pulmonary edema, Material is extremely destructive to tissue of the mucous membranes and upper respiratory tract, eyes, and skin.

Additional Information

RTECS: Not available

12. ECOLOGICAL INFORMATION

12.1 Toxicity

Toxicity to fish LC50 - *Leuciscus idus* (Golden orfe) - 160 mg/l - 48 h

Toxicity to daphnia and other aquatic invertebrates EC50 - *Daphnia magna* (Water flea) - 137 mg/l - 48 h

12.2 Persistence and degradability

Biodegradability

12.3 Bioaccumulative potential

no data available

12.4 Mobility in soil

no data available

12.5 Results of PBT and vPvB assessment

no data available

12.6 Other adverse effects

no data available

13. DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods

Product

Offer surplus and non-recyclable solutions to a licensed disposal company. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.

Contaminated packaging

Dispose of as unused product.

14. TRANSPORT INFORMATION

14.1 UN number

ADR/RID: 3261

IMDG: 3261

IATA: 3261

14.2 UN proper shipping name

ADR/RID: CORROSIVE SOLID, ACIDIC, ORGANIC, N.O.S. (Oxalic acid dihydrate)

IMDG: CORROSIVE SOLID, ACIDIC, ORGANIC, N.O.S. (Oxalic acid dihydrate)

IATA: Corrosive solid, acidic, organic, n.o.s. (Oxalic acid dihydrate)

14.3 Transport hazard class(es)

ADR/RID: 8

IMDG: 8

IATA: 8

14.4 Packaging group

ADR/RID: III

IMDG: III

IATA: III

14.5 Environmental hazards

ADR/RID: no

IMDG Marine pollutant: no

IATA: no

14.6 Special precautions for user

no data available

15. REGULATORY INFORMATION

This safety datasheet complies with the requirements of Regulation (EC) No. 1907/2006.

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture
no data available

15.2 Chemical Safety Assessment
no data available

16. OTHER INFORMATION

Further information

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The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See www.sigma-aldrich.com and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

Set 9: The MSDS of ES Red 7408

Safety Data Sheet (SDS)

Prepared to GHS Rev04(2011): U.S. OSHA, CMA, ANSI, Canadian WHMIS Standards,
Australian WorkSafe, Japanese Industrial Standard JIS Z 7250:2000, and European
Directives

Printing date 01/10/2013

Reviewed on 01/10/2013

1 Product and Company Identification

· **Product identifier**

· **Trade name:** Hydrogen Peroxide 20% - 40%

· **CAS Number:** 7722-84-1

· **Application of the substance / the preparation**

Hydrogen Peroxide, Aqueous Solution (with 20-40% Hydrogen Peroxide)

· **Details of the supplier of the safety data sheet**

· **Manufacturer/Supplier:**

NuGeneration Technologies, LLC (dba NuGenTec)

1155 Park Avenue, Emeryville, CA 94608

info@nugentec.com

888-996-8436 or 707-820-4080 for product information

· **Emergency telephone number:** Contact Infotrac: 1-352-326-2510

www.nugentec.com

2 Hazards identification

· **Classification of the substance or mixture**



GHS03 Flame over circle

Ox. Liq. 2 H272 May intensify fire; oxidizer.



GHS05 Corrosion

Eye Dam. 1 H318 Causes serious eye damage.



GHS07

Acute Tox. 4 H302 Harmful if swallowed.

Skin Irrit. 2 H315 Causes skin irritation.

STOT SE 3 H335-H336 May cause respiratory irritation. May cause drowsiness or dizziness.

· **Label elements**

· **GHS label elements** The product is classified and labelled according to the Globally Harmonized System (GHS).

· **Hazard pictograms**



GHS03



GHS05



GHS07

· **Signal word** Danger

· **Hazard-determining components of labelling:**

hydrogen peroxide solution

(Contd. on page 2)

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Trade name: Hydrogen Peroxide 20% - 40%

(Contd. of page 1)

• Hazard statements

- H272 May intensify fire; oxidizer.
- H302 Harmful if swallowed.
- H315 Causes skin irritation.
- H318 Causes serious eye damage.
- H335-H336 May cause respiratory irritation. May cause drowsiness or dizziness.

• Precautionary statements

Precautionary statements

- P101 If medical advice is needed, have product container or label at hand.
- P102 Keep out of reach of children.
- P103 Read label before use.
- P221 Take any precaution to avoid mixing with combustibles.
- P210 Keep away from heat/sparks/open flames/hot surfaces. - No smoking.
- P305+P351+P338 IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
- P310 Immediately call a POISON CENTER or doctor/physician.
- P405 Store locked up.
- P501 Dispose of contents/container in accordance with local/regional/national/international regulations.

• Classification system:

• NFPA ratings (scale 0 - 4)



Health = 3
Fire = 0
Reactivity = 1

The substance possesses oxidizing properties.

• HMIS-ratings (scale 0 - 4)



Health = 3
Fire = 0
Reactivity = 1

• Other hazards

• Results of PBT and vPvB assessment

- **PBT:** Not applicable.
- **vPvB:** Not applicable.

3 Composition/information on ingredients

7732-18-5 | water, distilled, conductivity or of similar purity

10-60%

• Chemical characterization: Mixtures

- **Description:** Mixture of the substances listed below with nonhazardous additions.

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Trade name: Hydrogen Peroxide 20% - 40%

(Contd. of page 2)

· Dangerous components:

7722-84-1	hydrogen peroxide solution	15-50%
	 Ox. Liq. 1, H271;  Skin Corr. 1A, H314;  Acute Tox. 4, H302; Acute Tox. 4, H332	

4 First aid measures

- **Description of first aid measures**
- **General information:**
Symptoms of poisoning may even occur after several hours; therefore medical observation for at least 48 hours after the accident.
- **After inhalation:** In case of unconsciousness place patient stably in side position for transportation.
- **After skin contact:** Immediately wash with water and soap and rinse thoroughly.
- **After eye contact:** Rinse opened eye for several minutes under running water. Then consult a doctor.
- **After swallowing:** Immediately call a doctor.
- **Information for doctor:**
- **Most important symptoms and effects, both acute and delayed** No further relevant information available.
- **Indication of any immediate medical attention and special treatment needed**
No further relevant information available.

5 Firefighting measures

- **Extinguishing media**
- **Suitable extinguishing agents:**
CO₂, extinguishing powder or water spray. Fight larger fires with water spray or alcohol resistant foam.
- **Special hazards arising from the substance or mixture** No further relevant information available.
- **Advice for firefighters**
- **Protective equipment:** No special measures required.

6 Accidental release measures

- **Personal precautions, protective equipment and emergency procedures** Not required.
- **Environmental precautions:** Do not allow to enter sewers/ surface or ground water.
- **Methods and material for containment and cleaning up:**
Absorb with liquid-binding material (sand, diatomite, acid binders, universal binders, sawdust).
Dispose contaminated material as waste according to item 13.
Ensure adequate ventilation.
- **Reference to other sections**
See Section 7 for information on safe handling.
See Section 8 for information on personal protection equipment.
See Section 13 for disposal information.

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Trade name: Hydrogen Peroxide 20% - 40%

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7 Handling and storage

- **Handling:**
- **Precautions for safe handling**
Ensure good ventilation/exhaustion at the workplace.
Prevent formation of aerosols.
- **Information about protection against explosions and fires:** No special measures required.
- **Conditions for safe storage, including any incompatibilities**
- **Storage:**
- **Requirements to be met by storerooms and receptacles:** No special requirements.
- **Information about storage in one common storage facility:** Not required.
- **Further information about storage conditions:** Keep receptacle tightly sealed.
- **Specific end use(s)** No further relevant information available.

8 Exposure controls/personal protection

- **Additional information about design of technical systems:** No further data; see item 7.
- **Control parameters**

· **Components with limit values that require monitoring at the workplace:**

7722-84-1 hydrogen peroxide solution

PEL 1.4 mg/m³, 1 ppm

REL 1.4 mg/m³, 1 ppm

TLV 1.4 mg/m³, 1 ppm

- **Additional information:** The lists that were valid during the creation were used as basis.
- **Exposure controls**
- **Personal protective equipment:**
- **General protective and hygienic measures:**
Keep away from foodstuffs, beverages and feed.
Immediately remove all soiled and contaminated clothing.
Wash hands before breaks and at the end of work.
Avoid contact with the skin.
Avoid contact with the eyes and skin.
- **Breathing equipment:**
In case of brief exposure or low pollution use respiratory filter device. In case of intensive or longer exposure use respiratory protective device that is independent of circulating air.
- **Protection of hands:**



Protective gloves

The glove material has to be impermeable and resistant to the product/ the substance/ the preparation.
Due to missing tests no recommendation to the glove material can be given for the product/ the preparation/ the chemical mixture.

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Trade name: Hydrogen Peroxide 20% - 40%

(Contd. of page 4)

- Selection of the glove material on consideration of the penetration times, rates of diffusion and the degradation
- **Material of gloves**
The selection of the suitable gloves does not only depend on the material, but also on further marks of quality and varies from manufacturer to manufacturer. As the product is a preparation of several substances, the resistance of the glove material can not be calculated in advance and has therefore to be checked prior to the application.
 - **Penetration time of glove material**
The exact break through time has to be found out by the manufacturer of the protective gloves and has to be observed.
 - **Eye protection:**



Tightly sealed goggles

9 Physical and chemical properties

· Information on basic physical and chemical properties

· General Information

· Appearance:

Form:	Liquid
Color:	Colorless
Odor:	Odorless
Odour threshold:	Not determined.

· pH-value at 20 °C (68 °F): 3.7

· Change in condition

Melting point/Melting range:	~32 °C
Boiling point/Boiling range:	103 °C (217 °F)

· Flash point: Not applicable.

· Flammability (solid, gaseous): Not applicable.

· Ignition temperature:

Decomposition temperature: Not determined.

· Auto igniting: Product is not selfigniting.

· Danger of explosion: Product does not present an explosion hazard.

· Explosion limits:

Lower:	Not determined.
Upper:	Not determined.

· Vapor pressure at 20 °C (68 °F): 23 hPa (17 mm Hg)

· Density at 20 °C (68 °F): 1.15 g/cm³ (9.597 lbs/gal)

· Relative density: Not determined.

· Vapour density: Not determined.

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Trade name: Hydrogen Peroxide 20% - 40%

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· Evaporation rate	Not determined.
· Solubility in / Miscibility with Water:	Not miscible or difficult to mix.
· Partition coefficient (n-octanol/water):	Not determined.
· Viscosity:	
Dynamic:	Not determined.
Kinematic:	Not determined.
· Solvent content:	
Organic solvents:	0.0 %
Water:	60.0 %
· Other information	No further relevant information available.

10 Stability and reactivity

- **Reactivity**
- **Chemical stability**
- **Thermal decomposition / conditions to be avoided:** No decomposition if used according to specifications.
- **Possibility of hazardous reactions** No dangerous reactions known.
- **Conditions to avoid** No further relevant information available.
- **Incompatible materials:** No further relevant information available.
- **Hazardous decomposition products:** No dangerous decomposition products known.

11 Toxicological information

- **Information on toxicological effects**
- **Acute toxicity:**
- **Primary irritant effect:**
- **on the skin:** Irritant to skin and mucous membranes.
- **on the eye:** Strong irritant with the danger of severe eye injury.
- **Sensitization:** No sensitizing effects known.
- **Additional toxicological information:**
The product shows the following dangers according to internally approved calculation methods for preparations:
Harmful
Irritant
- **Carcinogenic categories**

· IARC (International Agency for Research on Cancer)

7722-84-1 hydrogen peroxide solution

3

· NTP (National Toxicology Program)

None of the ingredients is listed.

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Trade name: Hydrogen Peroxide 20% - 40%

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12 Ecological information

- **Toxicity**
- **Aquatic toxicity:** No further relevant information available.
- **Persistence and degradability** No further relevant information available.
- **Behavior in environmental systems:**
- **Bioaccumulative potential** No further relevant information available.
- **Mobility in soil** No further relevant information available.
- **Additional ecological information:**
- **General notes:**
Water hazard class 1 (Self-assessment): slightly hazardous for water
Do not allow undiluted product or large quantities of it to reach ground water, water course or sewage system.
- **Results of PBT and vPvB assessment**
- **PBT:** Not applicable.
- **vPvB:** Not applicable.
- **Other adverse effects** No further relevant information available.

13 Disposal considerations

- **Waste treatment methods**
- **Recommendation:**
Must not be disposed of together with household garbage. Do not allow product to reach sewage system.
- **Uncleaned packagings:**
- **Recommendation:** Disposal must be made according to official regulations.

14 Transport information

- | | |
|-------------------------------------|--|
| · UN-Number | None |
| · DOT, ADR, IMDG, IATA | UN2014 |
| · UN proper shipping name | None |
| · DOT, IMDG, IATA | HYDROGEN PEROXIDE, AQUEOUS SOLUTION |
| · ADR | 2014 HYDROGEN PEROXIDE, AQUEOUS SOLUTION |
| · Transport hazard class(es) | |
| · DOT | |
| · Class | 5.1 Oxidising substances. |

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Trade name: Hydrogen Peroxide 20% - 40%

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· Label	5.1, 8
· ADR	
· Class	5.1 Oxidizing substances
· Label	5.1, 8
· IMDG, IATA	
	
· Class	5.1 Oxidising substances.
· Label	8
· Packing group	
· DOT, ADR, IMDG, IATA	II
· Environmental hazards:	
· Marine pollutant:	No
· Special precautions for user	Warning: Oxidizing substances
· Danger code (Kemler):	80
· EMS Number:	F-A,S-B
· Segregation groups	Peroxides
· Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code	Not applicable.
· Transport/Additional information:	
· DOT	
· Remarks:	Hydrogen Peroxide, Aqueous Solution with more than 20% & <40%
· UN "Model Regulation":	UN2014, HYDROGEN PEROXIDE, AQUEOUS SOLUTION, 5.1,8, II

15 Regulatory information

- Safety, health and environmental regulations/legislation specific for the substance or mixture
- Sara None Listed

· Section 355 (extremely hazardous substances):

7722-84-1 hydrogen peroxide solution

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Trade name: Hydrogen Peroxide 20% - 40%

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· **Section 313 (Specific toxic chemical listings):**

None of the ingredients is listed.

· **TSCA (Toxic Substances Control Act):**

All ingredients are listed.

· **Proposition 65**

· **Chemicals known to cause cancer:**

None of the ingredients is listed.

· **Chemicals known to cause reproductive toxicity for females:**

None of the ingredients is listed.

· **Chemicals known to cause reproductive toxicity for males:**

None of the ingredients is listed.

· **Chemicals known to cause developmental toxicity:**

None of the ingredients is listed.

· **Carcinogenic categories**

· **EPA (Environmental Protection Agency)**

None of the ingredients is listed.

· **TLV (Threshold Limit Value established by ACGIH)**

7722-84-1 hydrogen peroxide solution

A3

· **NIOSH-Ca (National Institute for Occupational Safety and Health)**

None of the ingredients is listed.

· **OSHA-Ca (Occupational Safety & Health Administration)**

None of the ingredients is listed.

· **GHS label elements** The product is classified and labelled according to the Globally Harmonized System (GHS).

· **Hazard pictograms**



GHS03 GHS05 GHS07

· **Signal word** Danger

· **Hazard-determining components of labelling:**

hydrogen peroxide solution

· **Hazard statements**

H272 May intensify fire; oxidizer.

H302 Harmful if swallowed.

H315 Causes skin irritation.

H318 Causes serious eye damage.

H335-H336 May cause respiratory irritation. May cause drowsiness or dizziness.

· **Precautionary statements**

P101 If medical advice is needed, have product container or label at hand.

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Reviewed on 01/10/2013

Trade name: Hydrogen Peroxide 20% - 40%

(Contd. of page 9)

- P102 Keep out of reach of children.
P103 Read label before use.
P221 Take any precaution to avoid mixing with combustibles.
P210 Keep away from heat/sparks/open flames/hot surfaces. - No smoking.
P305+P351+P338 IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P310 Immediately call a POISON CENTER or doctor/physician.
P405 Store locked up.
P501 Dispose of contents/container in accordance with local/regional/national/international regulations.
- **Chemical safety assessment:** A Chemical Safety Assessment has not been carried out.

16 Other information

This information is based on our present knowledge. However, this shall not constitute a guarantee for any specific product features and shall not establish a legally valid contractual relationship.

· **Abbreviations and acronyms:**

ADR: Accord européen sur le transport des marchandises dangereuses par Route (European Agreement concerning the International Carriage of Dangerous Goods by Road)
IMDG: International Maritime Code for Dangerous Goods
DOT: US Department of Transportation
IATA: International Air Transport Association
ACGIH: American Conference of Governmental Industrial Hygienists
NFPA: National Fire Protection Association (USA)
HMIS: Hazardous Materials Identification System (USA)

USA

Set 10: The MSDS of Polyurethane (PU) NC-5021



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1 Product and Company Identification

- **Product identifier**
- **Trade name:** Ferric Sulfate (FeS)
- **CAS Number:**
7782-63-0
- **EC number:**
231-753-5
- **Index number:**
026-003-01-4
- **Details of the supplier of the safety data sheet**
- **Manufacturer/Supplier:**
NuGeneration Technologies, LLC (dba NuGenTec)
1155 Park Avenue, Emeryville, CA 94608
info@nugentec.com
888-996-8436 or 707-820-4080 for product information
- **Emergency telephone number:** Contact Infotrac: 1-352-326-2510

www.nugentec.com

2 Hazards identification

- **Classification of the substance or mixture**



GHS07

Acute Tox. 4 H302 Harmful if swallowed.
Skin Irrit. 2 H315 Causes skin irritation.
Eye Irrit. 2 H319 Causes serious eye irritation.

- **Label elements**

- **GHS label elements**

The substance is classified and labelled according to the Globally Harmonized System (GHS).

- **Hazard pictograms**



GHS07

- **Signal word** Warning

- **Hazard-determining components of labelling:**

iron(II) sulfate (1:1) heptahydrate

- **Hazard statements**

H302 Harmful if swallowed.
H315 Causes skin irritation.
H319 Causes serious eye irritation.

- **Precautionary statements**

Precautionary statements
P101 If medical advice is needed, have product container or label at hand.

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Trade name: Ferric Sulfate (FeS)

(Contd. of page 1)

- P102 Keep out of reach of children.
P103 Read label before use.
P280 Wear protective gloves/clothing.
P305+P351+P338 IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P321 Specific treatment (see on this label).
P362 Take off contaminated clothing and wash before reuse.
P301+P312 IF SWALLOWED: Call a POISON CENTER or doctor/physician if you feel unwell.
P501 Dispose of contents/container in accordance with local/regional/national/international regulations.

· **Classification system:**

· **NFPA ratings (scale 0 - 4)**



Health = 1
Fire = 0
Reactivity = 0

· **HMIS-ratings (scale 0 - 4)**



HEALTH 1 Health = 1
FIRE 0 Fire = 0
REACTIVITY 0 Reactivity = 0

· **Other hazards**

· **Results of PBT and vPvB assessment**

· **PBT:** Not applicable.

· **vPvB:** Not applicable.

3 Composition/information on ingredients

· **Chemical characterization: Substances**

· **CAS No. Description**

7782-63-0 iron(II) sulfate (1:1) heptahydrate

· **Identification number(s)**

· **EC number:** 231-753-5

· **Index number:** 026-003-01-4

4 First aid measures

· **Description of first aid measures**

· **General information:**

Symptoms of poisoning may even occur after several hours; therefore medical observation for at least 48 hours after the accident.

· **After inhalation:** In case of unconsciousness place patient stably in side position for transportation.

· **After skin contact:** Immediately wash with water and soap and rinse thoroughly.

· **After eye contact:**

Rinse opened eye for several minutes under running water. If symptoms persist, consult a doctor.

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Reviewed on 01/10/2013

Trade name: Ferric Sulfate (FeS)

(Contd. of page 2)

- **After swallowing:** Immediately call a doctor.
- **Information for doctor:**
- **Most important symptoms and effects, both acute and delayed** No further relevant information available.
- **Indication of any immediate medical attention and special treatment needed**
No further relevant information available.

5 Firefighting measures

- **Extinguishing media**
- **Suitable extinguishing agents:**
CO₂, extinguishing powder or water spray. Fight larger fires with water spray or alcohol resistant foam.
- **Special hazards arising from the substance or mixture** No further relevant information available.
- **Advice for firefighters**
- **Protective equipment:** No special measures required.

6 Accidental release measures

- **Personal precautions, protective equipment and emergency procedures** Not required.
- **Environmental precautions:** Do not allow to enter sewers/ surface or ground water.
- **Methods and material for containment and cleaning up:**
Dispose contaminated material as waste according to item 13.
- **Reference to other sections**
See Section 7 for information on safe handling.
See Section 8 for information on personal protection equipment.
See Section 13 for disposal information.

7 Handling and storage

- **Handling:**
- **Precautions for safe handling** No special precautions are necessary if used correctly.
- **Information about protection against explosions and fires:** No special measures required.
- **Conditions for safe storage, including any incompatibilities**
- **Storage:**
- **Requirements to be met by storerooms and receptacles:** No special requirements.
- **Information about storage in one common storage facility:** Not required.
- **Further information about storage conditions:** Keep receptacle tightly sealed.
- **Specific end use(s)** No further relevant information available.

8 Exposure controls/personal protection

- **Additional information about design of technical systems:** No further data; see item 7.
- **Control parameters**
- **Components with limit values that require monitoring at the workplace:** Not required.

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Reviewed on 01/10/2013

Trade name: Ferric Sulfate (FeS)

(Contd. of page 3)

• **Additional information:** The lists that were valid during the creation were used as basis.

• **Exposure controls**

• **Personal protective equipment:**

• **General protective and hygienic measures:**

Keep away from foodstuffs, beverages and feed.

Immediately remove all soiled and contaminated clothing.

Wash hands before breaks and at the end of work.

Avoid contact with the eyes and skin.

• **Breathing equipment:** Not required.

• **Protection of hands:**



Protective gloves

The glove material has to be impermeable and resistant to the product/ the substance/ the preparation.

Due to missing tests no recommendation to the glove material can be given for the product/ the preparation/ the chemical mixture.

Selection of the glove material on consideration of the penetration times, rates of diffusion and the degradation

• **Material of gloves**

The selection of the suitable gloves does not only depend on the material, but also on further marks of quality and varies from manufacturer to manufacturer.

• **Penetration time of glove material**

The exact break through time has to be found out by the manufacturer of the protective gloves and has to be observed.

• **Eye protection:**



Tightly sealed goggles

9 Physical and chemical properties

• **Information on basic physical and chemical properties**

• **General Information**

• **Appearance:**

Form: Solid

Color: Not determined.

• **Odor:** Mild

• **Odour threshold:** Not determined.

• **pH-value:** Not applicable.

• **Change in condition**

Melting point/Melting range: ~32 C

Boiling point/Boiling range: Undetermined.

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Trade name: Ferric Sulfate (FeS)

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· Flash point:	Not applicable.
· Flammability (solid, gaseous):	Product is not flammable.
· Ignition temperature:	
· Decomposition temperature:	Not determined.
· Auto igniting:	Not determined.
· Danger of explosion:	Product does not present an explosion hazard.
· Explosion limits:	
Lower:	Not determined.
Upper:	Not determined.
· Vapor pressure:	Not applicable.
· Density at 20 °C (68 °F):	3.097 g/cm ³ (25.844 lbs/gal)
· Relative density	Not determined.
· Vapour density	Not applicable.
· Evaporation rate	Not applicable.
· Solubility in / Miscibility with Water:	Insoluble.
· Partition coefficient (n-octanol/water):	Not determined.
· Viscosity:	
Dynamic:	Not applicable.
Kinematic:	Not applicable.
Organic solvents:	0.0 %
· Solids content:	100.0 %
· Other information	No further relevant information available.

10 Stability and reactivity

- **Reactivity**
- **Chemical stability**
- **Thermal decomposition / conditions to be avoided:** No decomposition if used according to specifications.
- **Possibility of hazardous reactions** No dangerous reactions known.
- **Conditions to avoid** No further relevant information available.
- **Incompatible materials:** No further relevant information available.
- **Hazardous decomposition products:** No dangerous decomposition products known.

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Safety Data Sheet (SDS)

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11 Toxicological information

- **Information on toxicological effects**
- **Acute toxicity:**
- **Primary irritant effect:**
- **on the skin:** Irritant to skin and mucous membranes.
- **on the eye:** Irritating effect.
- **Sensitization:** No sensitizing effects known.
- **Additional toxicological information:**

- **Carcinogenic categories**

- **IARC (International Agency for Research on Cancer)**

Substance is not listed.

- **NTP (National Toxicology Program)**

Substance is not listed.

12 Ecological information

- **Toxicity**
- **Aquatic toxicity:** No further relevant information available.
- **Persistence and degradability** No further relevant information available.
- **Behavior in environmental systems:**
- **Bioaccumulative potential** No further relevant information available.
- **Mobility in soil** No further relevant information available.
- **Additional ecological information:**
- **General notes:**
- Water hazard class 1 (Self-assessment): slightly hazardous for water
- Do not allow undiluted product or large quantities of it to reach ground water, water course or sewage system.
- **Results of PBT and vPvB assessment**
- **PBT:** Not applicable.
- **vPvB:** Not applicable.
- **Other adverse effects** No further relevant information available.

13 Disposal considerations

- **Waste treatment methods**
- **Recommendation:**
- Must not be disposed of together with household garbage. Do not allow product to reach sewage system.
- **Uncleaned packagings:**
- **Recommendation:** Disposal must be made according to official regulations.

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14 Transport information

· UN-Number	None
· ADR	UN3287
· UN proper shipping name	None
· ADR	3287 TOXIC LIQUID, INORGANIC, N.O.S.
· Transport hazard class(es)	Not-Regulated
· ADR	
· Class	6.1 Toxic substances
· Packing group	
· ADR	III
· Environmental hazards:	
· Marine pollutant:	No
· Special precautions for user	Warning: Toxic substances
· Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code	Not applicable.
· UN "Model Regulation":	UN3287, TOXIC LIQUID, INORGANIC, N.O.S., 6.1, III

*

15 Regulatory information

- Safety, health and environmental regulations/legislation specific for the substance or mixture
- Sara None Listed

· Section 355 (extremely hazardous substances):

Substance is not listed.

· Section 313 (Specific toxic chemical listings):

Substance is not listed.

· TSCA (Toxic Substances Control Act):

Substance is not listed.

· Proposition 65

· Chemicals known to cause cancer:

Substance is not listed.

· Chemicals known to cause reproductive toxicity for females:

Substance is not listed.

· Chemicals known to cause reproductive toxicity for males:

Substance is not listed.

· Chemicals known to cause developmental toxicity:

Substance is not listed.

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· Carcinogenic categories

· EPA (Environmental Protection Agency)

Substance is not listed.

· TLV (Threshold Limit Value established by ACGIH)

Substance is not listed.

· NIOSH-Ca (National Institute for Occupational Safety and Health)

Substance is not listed.

· OSHA-Ca (Occupational Safety & Health Administration)

Substance is not listed.

· GHS label elements

The substance is classified and labelled according to the Globally Harmonized System (GHS).

· Hazard pictograms



GHS07

· Signal word Warning

· Hazard-determining components of labelling:

iron(II) sulfate (1:1) heptahydrate

· Hazard statements

H302 Harmful if swallowed.

H315 Causes skin irritation.

H319 Causes serious eye irritation.

· Precautionary statements

P101 If medical advice is needed, have product container or label at hand.

P102 Keep out of reach of children.

P103 Read label before use.

P280 Wear protective gloves/clothing.

P305+P351+P338 IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.

P321 Specific treatment (see on this label).

P362 Take off contaminated clothing and wash before reuse.

P301+P312 IF SWALLOWED: Call a POISON CENTER or doctor/physician if you feel unwell.

P501 Dispose of contents/container in accordance with local/regional/national/international regulations.

· Chemical safety assessment: A Chemical Safety Assessment has not been carried out.

16 Other information

This information is based on our present knowledge. However, this shall not constitute a guarantee for any specific product features and shall not establish a legally valid contractual relationship.

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· **Abbreviations and acronyms:**

ADR: Accord européen sur le transport des marchandises dangereuses par Route (European Agreement concerning the International Carriage of Dangerous Goods by Road)
ACGIH: American Conference of Governmental Industrial Hygienists
EINECS: European Inventory of Existing Commercial Chemical Substances
CAS: Chemical Abstracts Service (division of the American Chemical Society)
NFPA: National Fire Protection Association (USA)
HMIS: Hazardous Materials Identification System (USA)

· *** Data compared to the previous version altered.**

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