GREEN EPICHLOROHYDRIN

EPD®

ENVIRONMENTAL PRODUCT DECLARATION

In agreement with ISO 14025:2006,
PCR Basic Module CPC Division 34: Basic chemicals, version 1.0

SPOLCHEMIE®

Number:
Date: **1.6.2011**
Rev.: 0

Organization	**Spolek pro chemickou a hutní výrobu, akciová společnost** Registration No.: **00011789** VAT No.: **CZ699001352** The company is recorded in the Company Register kept by the Regional Court in Ústí nad Labem, Section B, File 47. The record in the Company Register (effective from 31.12. 1990) was ordered by the District Court in Ústí nad Labem (27.12. 1990, f.m. Sa 47)
Address	**Revoluční 1930/86** **400 32 Ústí nad Labem** **Czech Republic**
Statutory body	**Paul Yianni**, CEO
EPD representative	**Jan Votava**, Quality & REACH Manager
Contact	Phone: **+420 477 162 037** Fax: **+420 477 163 244** E-mail: info**@spolchemie.cz** Web: **www.spolchemie.cz**

Product:	**Epichlorohydrin G** **Epichlorohydrin made from glycerine (CAS 106-89-8)**
Use:	The epichlorohydrin is used in a wide variety of applications. It is a basic chemical for broad number of chemical synthesis.
Weight /kg/:	ECH is liquid, volume and weight depends on customer request.
Product lifetime /days/:	The products are under warranty for 365 days - 1 year. If the product is stored under producer recommended conditions, the product lifetime is approximately 3 years.
Hazardous substance content:	Yes/~~No~~
UN CPC:	CPC Division 34: Basic chemicals (subclass 34170)

1 PROGRAMME RELATED INFORMATION

1.1 NAME OF THE PROGRAMME AND PROGRAMME OPERATOR

Programme operator for the International **EPD® system** is the **International EPD Consortium (IEC)**

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For information about the international EPD® system please contact:

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1.2 THE REFERENCE PCR DOCUMENT

The reference documents for this EPD are General Programme Instructions (GPI, 2008) and Product Category Rules Basic Model (PCR, 2010). PCR are specified for specified information modules “gate-to-gate”, so called core modules. The structure and aggregation level of the core modules is defined by the United Nation Statistics Division - Classification Registry CPC codes (http://unstats.un.org).

EPDs from different programmes may not be comparable.

1.3 REGISTRATION NUMBER

The registration number of this EPD is:

1.4 DATE OF PUBLICATION AND VALIDITY

The publication date of this EPD is: **April 2011**

This EPD is valid until: **April 2014**

1.5 GEOGRAPHICAL SCOPE OF APPLICATION OF EPD

The geographical scope of this EPD is fully international.

1.6 YEAR OR REFERENCE PERIOD OF THE UNDERLYING DATA TO THE EPD

The reference period to this EPD is year 2008. Data shown below refers to 2008 and have been collected directly from the Spolchemie plant. Other used data were taken from the GaBi database (PE International, 2010).

2 PRODUCT RELATED INFORMATION

Trade name of product: **Epichlorohydrin G**

Epichlorohydrin made from glycerin (CAS 106-89-8))

Unequivocal identification of the product according to the CPC classification system:

CPC Division 34: Basic chemicals (subclass 3417).

2.1 SPECIFICATION OF THE COMPANY

The Epichlorohydrin G is produced in Spolek pro chemickou a hutní výrobu, akciová společnost (Spolchemie) located in Ústí nad Labem, Czech Republic (for more see also page 2 or www.spolchemie.cz).

Main activities of the Company are Research, Development, Production and processing of chemical and biochemical products and trading in these products. Spolchemie manufactures about 500 products within two main product profiles:

SYNHETIC RESINS	Basic and special resins. Modified low, medium, and high molecular epoxy resins Alkyd resins, water soluble resins, lacquer colophony - type resins.
CHLOR-ALKALI BASED COMPOUNDS AND SPECIAL INORGANICS COMPOUNDS	Sodium and potassium hydroxide (soda and potash lye), chlorine, hydrochloric acid, sodium hypochlorite. Epichlorohydrin, allylchloride, potassium permanganate, aluminium oxide, synthetic sapphire.

2.2 INTENDED USE

Epichlorohydrin is a versatile product widely used in polymer / resin chemistry. The main consumer is liquid epoxy resin industry. It is also used in production of reactive diluents (glycidyl ethers), elastomers, glycidyl methacrylates, polyamide-epichlorohydrin wet strenght resin in paper industry, ion-exchange resin, polyamide water treatment chemicals, crosslinking agent in modified starch, polyether rubber in automotive etc.

2.3 SPECIFICATION OF THE PRODUCT

This EPD is for production of epichlorohydrin (CAS 106-89-8) which is either sold on international market or used for captive liquid epoxy resin production. Epichlorohydrin is intermediate product for number of syntheses.

2.4 CONTENT OF MATERIALS AND CHEMICAL SUBSTANCES

The hazardous chemical substances included in the products manufactured by Spolchemie plant is the following: epichlorohydrin – 100%.

The product is a pure chemical compound (CAS 106-89-8).

Classification of the substance: H226, H301, H311,H314, H317, H318, H331, H350, H361, P202, P3210, P260, P260B, P280, P301+330+331, P303+361+353, P304+340, P305+351+338, P308+313, P403+233, P501, T, R10, R34, R45-23/24/25, S1/2, S45, S53

2.5 LIFE CYCLE ASSESSMENT AND ENVIRONMENTAL PERFORMANCE

The LCA calculations rules used for this declaration outlines the overall requirements to follow for the International EPD® system. These rules follow the International standards ISO 14040 and ISO 14044. The international EPD® system has adopted an LCA calculations procedure which is separated into different life cycle stages:

- **Upstream processes (from cradle-to-gate)**
- **Manufacturing processes (from gate-to-gate)**
- **Downstream processes (from gate-to-grave)**

The reference LCA study for this EPD is ECH G LCA (Kočí, 2010). It was also used to evaluate carbon footprint following with other environmental impacts due to the production of epichlorohydrin in order to support the communication of the Spolchemie environmental performances. For this study it was used the Life Cycle Assessment method which is regulated by the International standards ISO 140 40 and ISO 140 44.

The product system for this LCA has been described by using specific data when available; generic data have been used in accordance with PCR and GPI requirements.

2.6 FUNCTIONAL / DECLARED UNIT

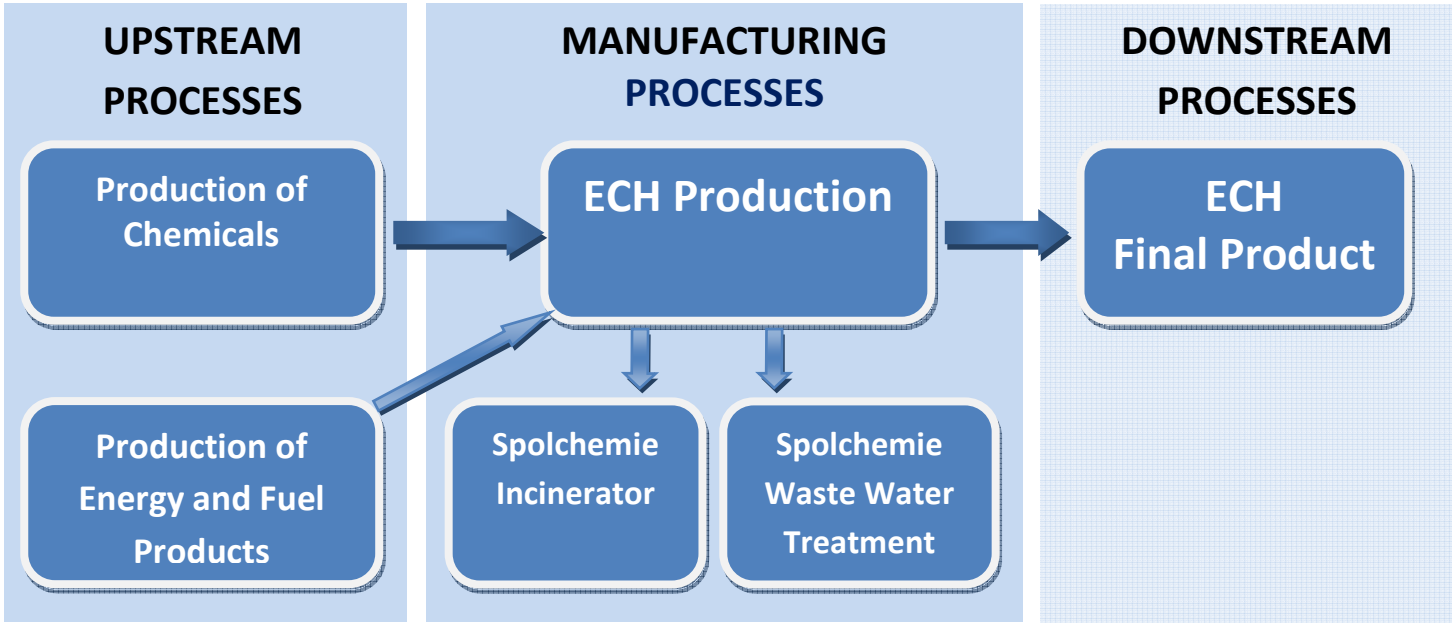
Declared unit is selected as 1000 kg of the product – epichlorohydrin. No packaging of the final product was assessed, as no specific packaging for this product is used.

The annual total 2008 epichlorohydrin production resulted in a value of about 14.000 tons that corresponds to 14.000 DU. The current capacity of Spolchemie plant is production of 18.000 tons per year that corresponds to 18.000 DU.

2.7 SYSTEM BOUNDARIES

The boundaries of the industrial system considered include all the phases from raw materials extraction to final production. In detail, the system comprises: core raw material production, epichlorohydrin production, treatment of off gases in incinerator, treatment of waste organic in incinerator, treatment of waste water in industrial waste water treatment plant. As stated in GPI (GPI, 2008) all elementary flows at resource extraction are included, except for the flows that fall under the general 1% cut off rule.

Figure 1 System Boundaries



The upstream processes include the following inflow of raw materials and energy wares needed for the production of the product (PCR Basic Module, 2010):

- Extraction of resources
- Transport of resources to refinement and transport of materials to manufacturer
- Refinement of resources
- The production processes of energy wares used in the extraction, refinement and manufacturing
- Production of auxiliary products used such as detergents for cleaning etc.

The core processes include (PCR Basic Module, 2010):

- Manufacturing of the epichlorohydrin
- Storage
- Treatment of waste generated from the manufacturing of main parts and assembly of the product

Downstream processes defined in GPI (GPI, 2008) are not relevant as no packaging of final product is realized as transport to costumers in tanks is realized.

2.8 DESCRIPTION OF MANUFACTURING PHASE

Epichlorohydrin from glycerine is produced in two reaction steps starting from catalytic hydrochlorination of glycerine by HCl in liquid phase to produce intermediate dichloropropanol, and following by alkaline dehydrochlorination and life steam stripping to produce epichlorohydrin. Finally the crude epichlorohydrin is purified by series of distillation steps from which the product is transferred to final storage / loading facilities. Chlorinated organic wastes are incinerated to recover HCl as feedstock for the first reaction step, waste water are treated by high-efficient bio-treatment plant.

2.9 TRANSPORT DATA

The delivery from suppliers is carried out by truck, train and/or pipeline. As the Spolchemie plant is located in Ústí nad Labem, where other chemical plants are operated, some chemicals are produced on site. Transport of other chemicals was modeled using GaBi databasis (PE International, 2010).

2.10 DESCRIPTION OF USE PHASE

The use phase is not included in system boundaries. Epichlorohydrin is either processed in captive Liquid Epoxy Resin plant or is sold to customers all over the world and ends up in different chemical syntheses. The product is not considered to contribute to an increased environmental load during the use phase and it will eventually end up together with other chemical waste.

2.11 RECYCLING AND END-OF-LIFE INFORMATION

Since the product is located at the beginning of several sectors, end of life scenarios are not included in this declaration.

3 ENVIRONMENTAL PERFORMANCE-RELATED INFORMATION

The environmental parameters are declared for up-stream processes and for core processes (manufacturing). Inclusion of use phase into declaration is not reasonable, as stated above. As stated in reference PCR basic module for Basic chemicals (PCR Basic Module, 2010) the environmental performance of the product is divided on:

3.1 Use of resources

3.2 Potential impacts

3.3 Other indicators

All environmental performance is reported per declared unit.

3.1 USE OF RESOURCES

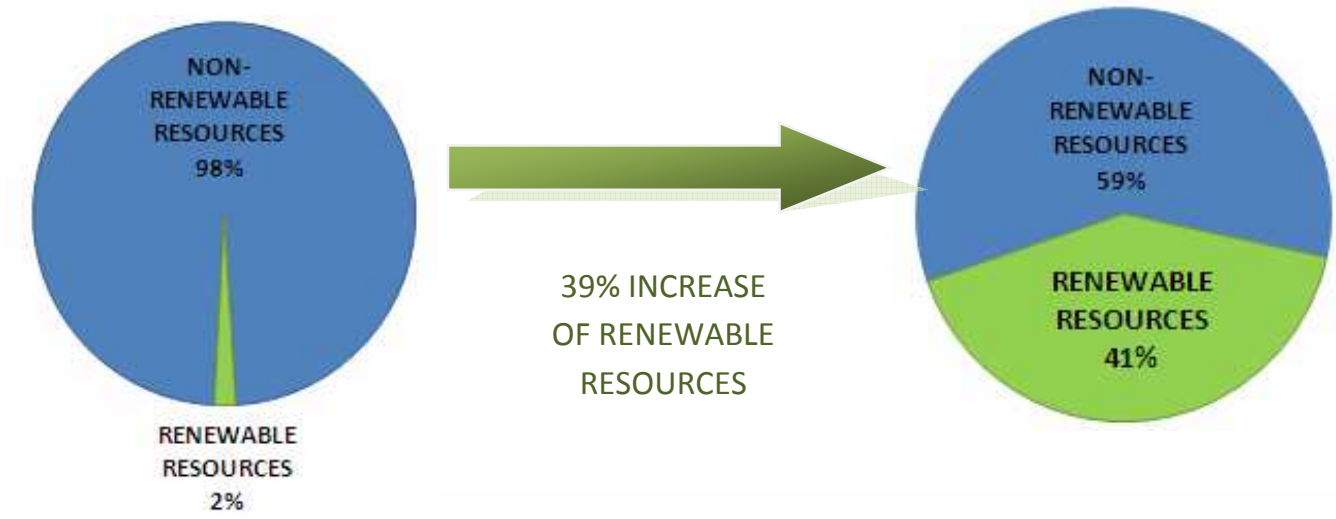
Table 1 reports the main consumption of resources for epichlorohydrin production. Use of resources without energy content is expressed in kg/D.U. The use of resources with energy content is expressed in MJ/D.U. All energy data are expressed as net caloric value. Electricity consumption during manufacturing (core) processes is expressed in kWh/D.U. (PCR Basic Module, 2010).

Table 1 Resource consumption associated with the Epichlorohydrin G manufacturing phase (data are referred to D.U.)

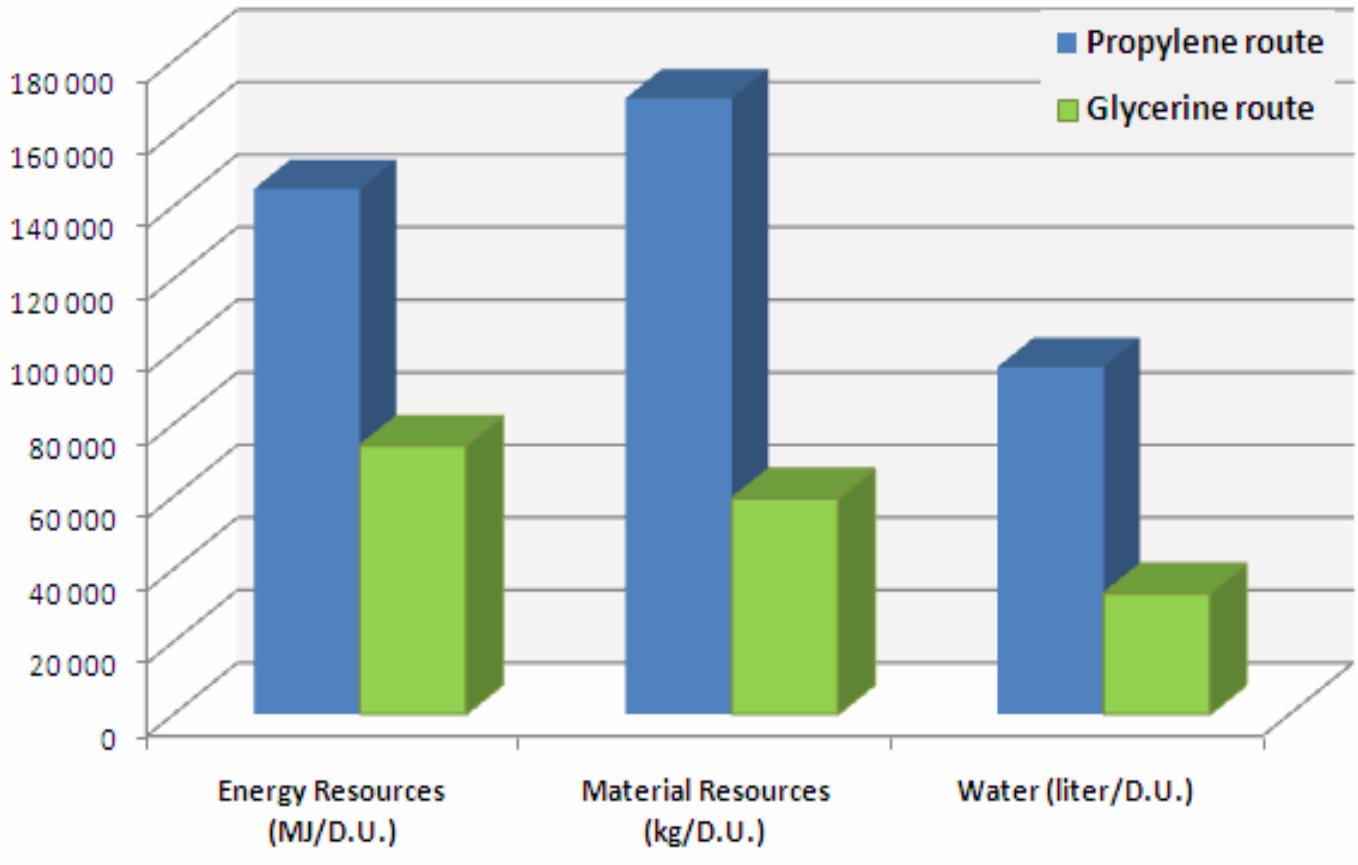
			Unit	Total ECH production	Core	Upstream
NON-RENEWABLE RESOURCES	Material resources	Sodium chloride (rock salt)	kg/D.U.	437	51,1	386
		Crude oil for material production	kg/D.U.	3,03	0	3,03
		Other material (non energy) resources	kg/D.U.	**59 000**	**39 000**	**20 000**
	Energy resources (used for energy conversion purposes)	Non renewable energy resources (Total)	MJ/D.U.	**43 400**	**16 500**	**26 900**
		Crude oil (resource)	MJ/D.U.	5 550	1 670	3 870
		Hard coal (resource)	MJ/D.U.	12 500	9 120	3 360
		Lignite (resource)	MJ/D.U.	5 010	2 280	2 730
		Natural gas (resource)	MJ/D.U.	15 400	2 300	13 100
		Uranium (resource)	MJ/D.U.	5 000	1 160	3 840

			Unit	Total ECH production	Core	Upstream
RENEAWBLE RESOURCES	Water		liter/D.U.	33 300	28 600	4 640
	Energy resources (used for energy conversion purposes)	Renewable energy resources	MJ/D.U.	**30 600**	**77,5**	**30 500**
		Primary energy from hydro power	MJ/D.U.	290	64,0	227
		Primary energy from solar energy	MJ/D.U.	30 100	25,9	30 100
		Primary energy from wind power	MJ/D.U.	229	-12,4	242
		Renewable fuels	MJ/D.U.	0,0154	0,0000422	0,0154
		Wood	MJ/D.U.	0,407	0,0593	0,347
		Electricity consumption (during manufacturing)	kWh/D.U.	350,73	350,73	-

Total Energy Resources Consumption (MJ/D.U.)
Comparison Propylene Route vs. Glycerine Route



Total Resources Consumption
Propylene route vs. Glycerine route



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3.2 POTENTIAL ENVIRONMENTAL IMPACT

The reported results of environmental impacts resulted from characterization models recommended by EPD® programme (PCR Basic Module, 2010) of epichlorohydrin production. Total pollutant emissions from the operations included in the system boundaries are as potential environmental impacts.

Table 2 Main environmental results associated with the Epichlorohydrin G manufacturing phase using CML 2001 characterization with respect to (PCR Basic Module, 2010). Data are referred to D.U

	Total	Core processes	Upstream processes
Acidification (AP) [kg SO_2-Equiv./D.U.]	**25,8**	8,23	17,6
Eutrophication (EP) [kg Phosphate-Equiv./D.U.]	**5,77**	0,374	5,4
Global Warming (GWP 100 years) [kg CO_2-Equiv./D.U.]	**1500**	1360	145
Ozone Layer Depletion (ODP, steady state) [kg CFC11-Equiv./D.U.]	**0,000134**	0,0000313	0,000103
Photochemical Ozone Creation (POCP) [kg Ethene-Equiv./D.U.]	**0,991**	0,476	0,515

3.3 OTHER INDICATORS

3.3.1 MATERIAL SUBJECT TO RECYCLING

During the production of one D.U. of epichlorohydrin G 91,30 kg of hydrochloric acid HCl (24,1 % w/w) as waste product is collected and send for recovery.

3.3.2 HAZARDOUS AND OTHER WASTE

Hazardous waste is defined by regional directives. In different regions substances of different properties are characterized as hazardous waste. For purpose of this EPD only waste and hazardous waste from core processes located in Spolchemie, Czech Republic are reported.

Table 3 Hazardous and other wastes (data are referred to D.U.)

	kg/D.U.
Hazardous waste - total	46,96
Sludge [Hazardous waste]	46,96
Other waste	0,00

3.3.3 TOXIC SUBSTANCES

Emission of toxic substances is expressed in kg/D.U.

Table 4 Emissions of toxic substances. Data are referred to D.U.

kg/D.U.	Total	Core processes	Upstream processes
Heavy metals to air	0,00201	0,00111	0,000909
Group NMVOC to air	1,16	0,161	1,00
Group PAH to air	0,000289	0,0000785	0,000210
Halogenated organic emissions to air	0,000175	0,0000404	0,000134
Heavy metals to fresh water	1,16	0,161	1,00
Halogenated organic emissions to fresh water	0,00000183	0,000000213	0,00000162
Heavy metals to sea water	0,000959	0,00029	0,000670
Heavy metals to agricultural soil	0,467	0,00	0,467
Heavy metals to industrial soil	0,0210	0,00398	0,0171

4 ADDITIONAL ENVIRONMENTAL INFORMATION

Obtained certificates EN ISO 9001 and EN ISO 14001, and the commitment of whole company´s staff to quality give the customers a guarantee of a standard quality of products. Spolchemie has established and applied a combined management system for development, production, sales and services of products of Inorganics and Resins. An audit was performed, Report No. 015619. Proof has been furnished that the requirements according to EN ISO 9001 and ISO 14001 are fulfilled since 1997. For actual certificate see www.spolchemie.cz.

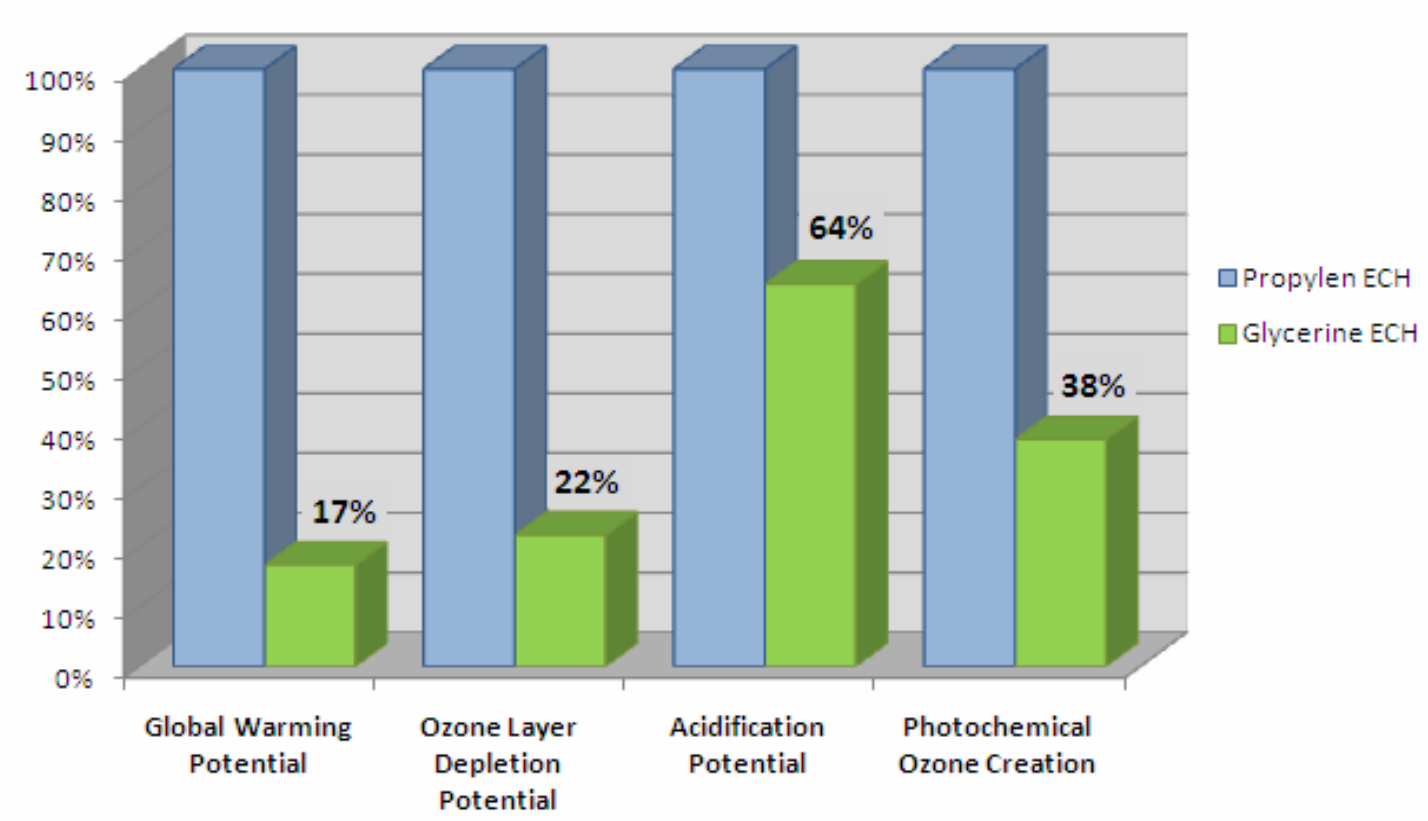
Spolchemie has established and applied an Occupational Health & Safety Management System for development, production, sales and services of products of Inorganic and Resins. An audit was performed, Report No. 060021. Proof has been furnished that the requirements according to OHSAS 18001 are fulfilled since 1997. For actual certificate see www.spolchemie.cz.

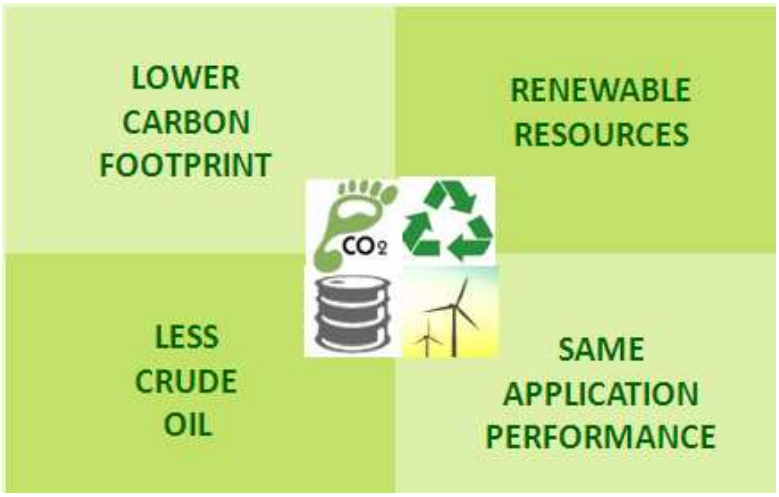
Obtained certificates RESPONSIBLE CARE, in chemical industry. Spolchemie are oriented for enhancement of environmental, health and safety is fulfilled since 1997. For actual certificate see www.spolchemie.cz.

Spolchemie also produces epichlorohydrin by the traditional production route from propylene. We have completed a study on the environmental impact of epichlorohydrin based on propylene using the same EPD methodology. The propylene route to epichlorohydrin used in Spolchemie is comparable to the route used for the vast majority of epichlorohydrin production worldwide. Comparison of the environmental impact data of the epichlorohydrin produced by the two processes gives the following differences: epichlorohydrin produced by the Spolchemie proprietary glycerine route has generally much lower environmental impact than epichlorohydrin produced from propylene conventional route. Differences are approximately as following:

- **83%** lower figure for Global Warming potential
- **78%** lower figure for Ozone Layer depletion potential
- **36%** lower figure for Acidification potential
- **62%** lower figure for Photochemical Ozone Creation

Environmental impact comparison graph





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REDUCTION OF CARBON FOOTPRINT - 7 140 kg LESS production of Carbon Dioxide*

*For illustration, production of 1 000kg of **Epichlorohydrin G** from glycerine by the Spolchemie outputs around **7 410 kg less (!)** carbon dioxide compared with 1 000kg Epichlorohydrin P produced by the conventional propylene – allyl chloride process.

Using green ECH-G saves about 7,4 MT CO_2 equivalent per 1 MT ECH-G

7,4 MT CO_2 is a Significant Amount

A modern small car
for example **Toyota Yaris Cool**
produces 118g CO_2
per kilometre driven

Using 1 MT ECH-G from Spolek
in place of conventional ECH
produces 7,4 MT less CO_2

7,4 MT less CO_2 is equivalent to:
7400kg / 0.118km / kg
= 62 712 km driven

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5 MANDATORY STATEMENT

The same products environmental declarations from different programmes need not to be comparable. Downstream processes are excluded what is in relation to PCR, 2010.

5.1 MEANS OF OBTAINING EXPLANANTORY MATERIALS

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Web: www.spolchemie.cz

5.2 REFERENCES

The main references used to prepare this EPD are:

- PCR Basic Module for Basic Chemicals (PCR Basic Module, 2010)
- Kočí, V.: LCA study of epichlorohydrin based on glycerin, Praha, 2010
- General Programme Instructions for EPD, 2008-02-29
- Announcement of Rules of the National Eco-Labelling Programme publication, Official Journal of the Ministry of the Environment of the Czech Republic, annual vol. XVII, vol. 8, 2007.

5.3 VALIDITY OF EPD

If changes in any of the environmental impacts are larger than +- 5% the EPD shall be adjusted. Regardless, the EPD shall be reviewed every three years. Next review is planned in year 2014.

This declaration was generated by doc. Ing. Vladimír Kočí, Ph.D., e-mail: vladimir.koci@lcastudio.cz

Independent verification of the declaration and data accordance to ISO 14025:2006:

☐ internal ☒ external

Programme:	EPD ® system (www.environdec.com)
Verification procedure:	ISO 14025: 2006 Environmental labels and declarations – Type III environmental declarations – principle and procedures General Programme Instructions for Environmental Product Declarations, EPD, version 1.0 Rules of the National Eco-Labelling Programme
Product category rules (PCR):	PCR Basic Module Basic chemicals, version 1.0, dated 2010-11-30

Výzkumný ústav pozemních staveb - Certifikační společnost, s.r.o., (Building Research Institute – Certification Company, Ltd.) – Certification Body for EPD verification no. 3013 accredited by Czech Accreditation Institute made independent verification of EPD in 5th April 2011 in agreement with ISO 14025:2006. The certificate results from the Final report no. P-3013EPD-11-0204 from 1st June 2011 that includes certification body ascertaining and validity conditions of the certificate.

The verified EPD has reg. no. 3013EPD-11-0204-01.

Registration number	**3013EPD - 11 - 0204** from 1st June 2011
Certified validity	to 1st June 2014
Contact	Výzkumný ústav pozemních staveb - Certifikační společnost, s.r.o., Pražská 16, 102 21 Praha 10 – Hostivař Czech Republic tel.: +420 271751148 fax: ++420 241017241 e-mail: votockova@vups.cz

1st June 2011

Tereza Votočková
Head of Certification Body

stamp

Distributed to:
No. 1 Spolek pro chemickou a hutní výrobu, akciová společnost
No. 2 Certification Body
No. 3 Mgr. Tereza Votočková, head of Certification Body
No. 4 CENIA