Certified Environmental Product Declaration (EPD) for Hydrogen peroxide (H_2O_2)

Description of the product and the company

The product

Hydrogen peroxide (H_2O_2) is an efficient oxidising agent. Hydrogen peroxide from Eka Chemicals is supplied as aqueous solution at a maximum concentration of 70 wt%.
Hydrogen peroxide (H_2O_2) is produced from hydrogen and atmospheric oxygen. The reactions take place in an organic solvent, which is circulated in the process, with palladium as a catalyst. In the first step hydrogen gas is added, and the solvent is hydrogenated. The next step is the oxidation where oxygen from the air is added. Now hydrogen peroxide is formed. The peroxide is extracted from the solvent with water and distilled to the wished concentration, varying from 19-70 wt%. Finally, a small quantity of stabiliser is added. The manufacturing of hydrogen peroxide takes place in Bohus and Alby, Sweden and in Rjukan, Norway.

The functional unit in this study is 1000 kg of 100 wt% hydrogen peroxide. This means that the environmental load presented is valid for 1000 kg of hydrogen peroxide. The displayed figures include all production processes but the results have been recalculated as 100% product and are given as an average for Eka Chemicals production in Sweden and Norway. The average is weighted according to production volumes from the plants. Since the product is sold as a water solution it is very important to notice the concentration referred to.

Hydrogen peroxide from Eka Chemicals contains max 500 mg/kg stabiliser and 30-81 wt% water. Hydrogen peroxide (100%) is classified and labelled corrosive, harmful and oxidising.

Table 1 Declaration of content and labelling

	Category of danger	Symbol letters	Risk phrases
Hydrogen peroxide	Corrosive, Harmful, Oxidising	C, Xn ,O	R5, 8, 20/22, 35
Stabiliser	-	-	-
Water	-	-	-

R5: Heating may cause an explosion
R8: Contact with combustible material may cause fire
R20/22: Harmful by inhalation and if swallowed
R35: Causes severe burns

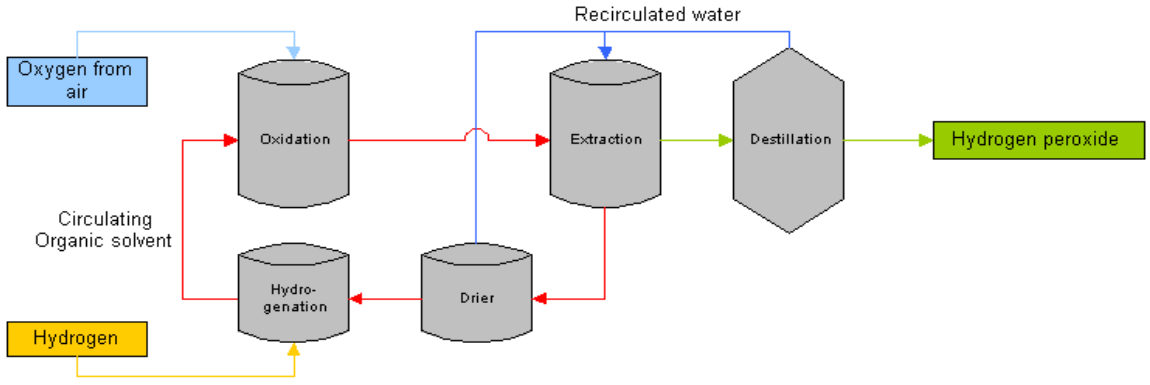

Figure 1 Manufacturing of hydrogen peroxide

The company

Akzo Nobel is proud to be one of the world's leading industrial companies. Based in Amsterdam, the Netherlands, we make and supply a wide range of paints, coatings and specialty chemicals – pro forma 2007 revenue totaled €14.4 billion. In fact, we are the largest global paints and coatings company. As a major producer of specialty chemicals we supply industries worldwide with quality ingredients for life's essentials. We think about the future, but act in the present. We're passionate about introducing new ideas and developing sustainable answers for our customers. That's why our

60,000 employees – who are based in more than 80 countries – are committed to excellence and delivering Tomorrow's Answers Today.
Eka Chemicals, with 2,700 employees in 28 countries 2007, is a business unit within AkzoNobel. Turnover 2007 amounted to 991 mEUR. Eka Chemicals is a leading supplier of bleaching chemicals, paper chemicals and systems to the pulp and paper industry throughout the world, and supplies certain special chemicals to the pharmaceuticals industry, water treatment, the electronics industry etc.

Presentation of environmental performance

All major steps, from the extraction of natural resources until the products leave the gates in Alby, Bohus and Rjukan are included in the environmental performance of the manufacturing phase. A few of these are displayed in the simplified flowchart below.

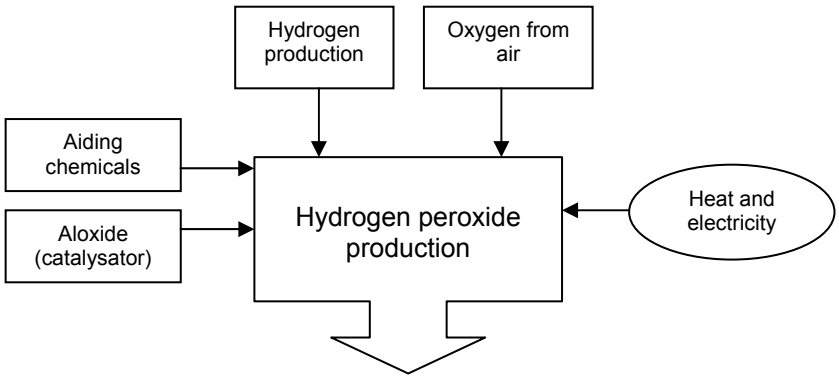

Figure 2 Flowchart for production of hydrogen peroxide

The data used were collected for year 2007 and others are said to be valid for that time according to suppliers. Site-specific data have been retrieved for all major raw materials or have been guaranteed to correspond with site-specific data according to suppliers.

In this study economical allocation has been the base for calculations, meaning the environmental load from a production has been divided according to economical value of the products produced.
From the hydrogen peroxide production no by-products are produced and there is no need for any allocations in that specific process. In Bohus hydrogen is produced in a steam reformer and in this process, steam is formed a by product. The system is expanded to included the avoided heat/steam production which is approximately 30% district heating (produced from waste heat, natural gas and biofuels) and 70% from incineration of EO oil.

The manufacturing phase

The figures displayed below cover not only the environmental load derived from the production site of hydrogen peroxide. All other steps during the life cycle up until the product leaves the gates in Alby, Bohus and Rjukan are included like natural resource extraction, raw material production, energy production and transportation. All figures are given for 1000 kg of hydrogen peroxide.

Table 2 Non renewable resources

Without energy content	kg	With energy content	MJ
Sodium chloride	48	Natural gas	5550
Rock	38	Crude oil	2910
Bauxite	17	Coal	230
Limestone	4		
Phosphate rock	1		

This table displays the total use of non renewable resources, including feedstock, needed for 1000 kg hydrogen peroxide.

Table 3 Renewable resources

Without energy content	kg	With energy content	MJ
-	-	Hydro energy	4000
		Biomass	540
		Wind energy	0,1

The net electricity consumption is not a resource use since the resources used for, and emissions and waste derived from, electricity production are included in the other displayed figures. It simply displays how much electricity that has been consumed within the system studied. Within the system 1-2 MWh has been consumed.

Table 4 Electricity sources

Electricity production source	%
Hydro power	60
Nuclear power	32
Natural gas	1
Biofuel	3
Coal	1
Unspecified	3

Unspecified means that the electricity grid is not known and is represented by a mix of electricity production sources.

Note that energy is not the same as electricity. For example nuclear energy is a measure of the total energy content in the uranium fuel in the same way as crude oil is a measure of energy content. Hence nuclear energy is not the same as nuclear electricity (here named Nuclear power), like crude oil is not the same as electricity produced from oil.

In accordance with the guidelines for EPDs, the most important air and water emissions are expressed both as inventory data and as influence on different environmental impact categories. The result is displayed below.

Table 5 Emissions to air

Emissions to air	g
CO_2	523000
NOx	760
CH4	410
SO_2	360
HC	300
Particles	170
CO	130

Table 6 Emissions to water

Emissions to water	g
COD	2500
Gypsum	1200
TOC	13
BOD	8

Table 7 Waste generation

Waste	kg
Other waste	32
Hazardous waste	0,3

Table 8 Emissions, expressed in terms of environmental impact

Category of impact	Equivalent unit	Impact
Global warming (GWP)	g CO_2	533000
Acidification (AP)	mole H^+	28
Ozone depletion (ODP)	g CFC-11	0,005
Photochemical ozone creation (POCP)	g ethene	103
Eutrophication (EP)	g O_2	7100

An explanation of these impact categories is found at the end of this EPD.

Some of the emissions presented as special parameters have indexes in the different impact categories and are therefore influencing them. The environmental flows shown are in some cases demanded by the Product-Specific Requirements (PSR) for chemical products. In other cases they are displayed because they are considered to be significant for the production of hydrogen peroxide.

The use phase

Hydrogen peroxide from Eka Chemicals is mainly used at pulp mills for bleaching of pulp but is also used for bleaching of recycled paper in the de-inking process, and in textile bleaching. Hydrogen peroxide is also used in many other important applications in the chemical industry. The product is not considered to contribute to an increased environmental load during the use phase and its decomposition products are water and oxygen.

The environmental impact from the transport to customer is given for the transport of 1000 kg of product, 100 km for the means of transport in question. This makes it possible for customers to assess the environmental load derived from transportation of hydrogen peroxide. The actual means used depend on where the customer is situated. Some times all three means are used.

Table 9 Envrionmental impact from transport to customer

Impact	Unit	Train[1]	Truck[2]	Ship[3]
Crude oil	MJ	-	91	22
Hydro energy	MJ	23	-	-
CO_2	g	0,4	6720	1540
CO	g	0,01	6	0,9
HC	g	0,001	6	2
NOx	g	0,001	42	43
SO_2	g	0,0006	1,4	26
Particles	g	0,0001	0,7	2

The means of transport are approximated with a train transport, a truck transport and a ship transport.

1. *The train is a Swedish electric train.*
2. *The truck has a maximum weight of 60 ton, a Euro III engine and is using EC1-diesel. The loading factor is 50%.*
3. *The ship has a maximum weight of more than 8000 ton and a loading factor of 50-60%.*

Information from the company and the accredited certification body

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Information from the accredited certification body

This Environmental Product Declaration has been reviewed by the Swedish National Testing and Research Institute (SP), who is an accredited certification body by SWEDAC. It is approved according to the Product Specific Requirement, PSR 2000:5 for Chemical Products and the Swedish Environmental Council requirements for environmental product declarations, MSR 1999:2.
Valid until: January 2012
Registration number: S-P-00031

SP, Box 857, SE-501 15 Borås, Sweden
Phone: +46 33 16 50 00. Fax: +46 33 13 55 02.

Other information

From March 2009 the framework for EPD is revised and the characterisation factors and units will be revised, The results with the new factors and units will be::

Table 9 Emissions, expressed in terms of environmental impact (revised)

Category of impact	Equivalent unit	Impact
Global warming (GWP)	g CO_2	534000
Acidification (AP)	g SO2	740
Ozone depletion (ODP)	g CFC-11	0,009
Photochemical ozone creation (POCP)	g ethene	125
Eutrophication (EP)	g PO4 3-	155
An explanation of these impact categories is found at the end of this EPD.		

More information about environmental product declarations - the EPD system – can be found on the Internet: http://www.environdec.com

References

- LCA documentation for hydrogen peroxide, 2008
- Product-Specific Requirements Chemical Products, (PSR 2000:5)
- Requirements for Environmental Product Declarations, EPD (MSR 1999:2) – an application of ISO TR 14025.

Glossary

Acidification potential, AP. Chemical alternation of the environment, resulting in hydrogen ions being produced more rapidly than they are dispersed or neutralised. Occurs mainly through fallout of sulphur and nitrogen compounds from combustion processes. Acidification can be harmful to terrestrial and aquatic life.

Eutrophication potential, EP. Enrichment of bodies of water by nitrates and phosphates from organic material or the surface runoff. This increases the growth of aquatic plants and can produce alga blooms that deoxygenate water and smother other aquatic life.

Global warming potential, GWP. The index used to translate the level of emissions of various gases into a common measure to compare their contributions to the absorption by the atmosphere of infrared radiation. GWPs are calculated as the absorption that would result from the emission of 1 kg of a gas to that from emission of 1 kg of carbon dioxide over 100 years.

Life Cycle Assessment, LCA.. A management tool for appraising and quantifying the total environment impact of products or activities over their entire life cycle of particular materials, processes, products, technologies, services or activities.

Ozone depletion potential, ODP. The index used to translate the level of emissions of various substances into a common measure to compare their contributes to the breakdown of the ozone layer. ODPs are calculated as the change that would result from the emission of 1 kg of a substance to that from emission of 1 kg of CFC-11 (a freon)

Photochemical ozone creation potential, POCP. The index used to translate the level of emissions of various gases into a common measure to compare their contributions to the change of ground-level ozone concentration. POCPs are calculated as the change that would result from the emission of 1 kg of a gas to that from emission of 1 kg of ethene.