Environmental Product Declaration

In accordance with ISO 14025:2006 for:

Sodium chlorate ($NaClO_3$)

from Nouryon

EPD registration number:	S-P-08340
Publication date:	2023-03-17
Valid until:	2028-03-17

Programme information

Programme:	The International EPD® System, www.environdec.com
Programme operator:	EPD International AB
EPD registration number:	S-P-08340
Publication date:	2023-03-17
Valid until:	2028-03-17

Programme:	The International EPD® System EPD International AB Box 210 60 SE-100 31 Stockholm Sweden www.environdec.com info@environdec.com

Product category rules (PCR):
Name: Basic chemicals product category
PCR 2021:03
Version 1.1
UN CPC code(s): Group 342 (Basic inorganic chemicals)

PCR review was conducted by:
The Technical Committee of the International EPD® System. A full list of members available on www.environdec.com. The review panel may be contacted via info@environdec.com.
Chair of the PCR review: Lard-Gunnar Lindfors

Independent third-party verification of the declaration and data, according to ISO 14025:2006:

☐ EPD process certification ☒EPD verification

Third party verifier:
Damien Prunel, LCIE Bureau Veritas
signature of the third party verifier:

Approved by: The International EPD® System

Procedure for follow-up of data during EPD validity involves third party verifier:

☒ Yes ☐ No

The EPD owner has the sole ownership, liability, and responsibility for the EPD. EPDs within the same product category but from different programmes may not be comparable.

- An EPD should provide current information and may be updated if conditions change. The stated validity is therefore subject to the continued registration and publication at www.environdec.com.
- This EPD is in conformity with ISO14025:2006
- EPDs within the same product category but from different programmes may not be comparable.

Company information

Owner of the EPD:
Rasmus Olsson, Product Manager SC and ClO2
Phone: +46709577625
Email: Rasmus.L.Olsson@nouryon.com
Address: Gamlestadsvägen 18 B-C, 415 02 Göteborg, Sweden

Description of the organisation:
Nouryon is a global specialty chemicals leader, providing essential chemicals to manufacturing of everyday products such as construction materials, paper, food, pharmaceuticals, and personal care items. With its about 7,800 employees Nouryon operates in over 80 countries around the world. Sustainability is a cornerstone of the overall strategy to achieve long-term success in Nouryon and the focus is on providing innovative and sustainable solutions that meet customers need, while also improving the company's environmental performance and maximizing the positive societal impact.
Further information on www.nouryon.com

Product-related or management system-related certifications:
RC 14001:2015 certification for: Ambès, Oulu, Stockvik, Alby + Columbus, Magog, Moses Lake
ISO 9001:2015 certification for: Ambès, Oulu, Stockvik, Alby + Columbus, Magog, Moses Lake
No certifications for: Jupiá, Bahia, Imperatriz, Jundiaí
EMAS registration for: Nouryon company
EcoVadis Platinum rating for: Nouryon company

Name and location of production site:
Alby: Nouryon Pulp and Performance Chemicals AB: Albyfabrikerna, Albyvägen 65, 841 44 Alby (Sweden)
Ambès: Nouryon Pulp and Performance Chemicals SAS: Pulp & Performance Chemicals, Z.I. du Bec, 33810 Ambès (France)
Bahia: Nouryon Pulp and Performance Indústria Quimica Bahia Ltda: Fazenda Brasilandia; Rod. BA 275, Km. 24 Lote 10; Zona Rural, Bahia, 45820-970 Eunápolis (Brazil)
Columbus: Nouryon Chemicals LLC: 4374 Nashville Ferry Road, East, 39702 Columbus, MS (United States)
Imperatriz: Nouryon Pulp and Performance Indústria Quimica Ltda: Avenida Newton Bello, S/N, Estrada Imperatriz a Coquelandia, Maranhão, 65919-050 Imperatriz (Brazil)
Jundiaí: Nouryon Pulp and Performance Indústria Quimica Ltda: Rodovia Dom Gabriel; Paulino Bueno Couto Km 65,2 SP, 13212-240 Jundiaí (Brazil)
Jupiá: Nouryon Pulp and Performance Indústria Quimica Ltda: Rodovia BR-158, Km 231 Fazenda Santa Vera Mato Grosso do Sul (MS), 79621-065 Jupiá, Três Lagoas (Brazil)
Magog: Nouryon Pulp and Performance Canada Inc.: Pâte et performance Canada inc. / Pulp and Performance Canada Inc., 1900, rue St-Patrice Est, J1X 3W5 Magog (Québec, Canada)
Moses Lake: Nouryon Chemicals LLC: 2701 Road N-NE, 98837 Moses Lake (United States)
Oulu: Nouryon Finland Oy: Nuottasaarentie 17, 90400 Oulu (Finland)
Stockvik: Nouryon Pulp and Performance Chemicals AB: Stockviksvägen 20, 854 67 Sundsvall (Sweden)

Product information

Product name
Sodium chlorate ($NaClO_3$)

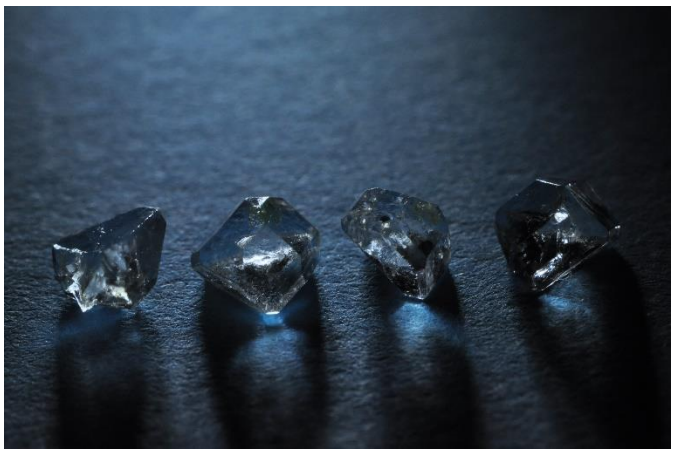
Product identification
CAS 7775-09-9

Product description
Sodium chlorate ($NaClO_3$) is an efficient oxidising agent. Sodium chlorate from Nouryon is supplied to customers in crystalline or liquid form under the brand name Eka SC. It is delivered in bulk by tanker trucks, railcars or tank containers containing up to 60 ton, or in "bigbags" containing approximately 1 Mt.

Sodium chlorate from Nouryon is mainly used at pulp mills in the production of chlorine dioxide used for Elemental Chlorine-Free (ECF) bleaching of chemical pulp. It is also the preferred intermediate for sodium

perchlorate and sodium chlorite manufacturing. It has further industrial applications as a specialty oxidant, among others in surface treatment of metals, oxidizing chemical reactions and the mining industry.

Sodium chlorate is produced by electrolysis of a salt solution. The raw materials are sodium chloride (NaCl), water and electrical power. Hydrogen gas (H_2) is formed as a by-product in the process and can be used as a chemical raw material (for hydrogenation, manufacturing of hydrogen peroxide etc.) or as a fuel. The solution formed is chcrystallized and the chlorate crystals are separated, washed and dried.



UN CPC code: Group 342 (Basic inorganic chemicals n.e.c.)

Other codes for product classification:
CPV 24312200-6 (Hypochlorites and chlorates)
UNSPSC 41141507 (Chlorate standards)
NACE 20.13 (Manufacture of other inorganic basic chemicals)

Geographical scope: Global
The sodium chlorate product is produced for world-wide distribution

LCA information

The Environmental performance was calculated using LCA (life cycle assessment).

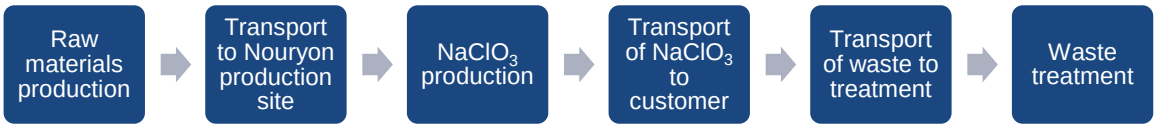
Declared unit:
All environmental impacts are calculated using the declared unit of “1 kg of sodium chlorate in crystalline form (100% concentration)”, ready for delivery, as prescribed in the PCR of basic chemicals.

Reference service life: not applicable for this product category

Time representativeness:
Site-specific data for the year 2020 was collected from Nouryon through a questionnaire and from Enablon, including information about the production processes, transport and end-of-life.

Database(s) and LCA software used:
The software GaBi version 10.5.1.124 is used to perform the LCA. Background data is sourced from Ecoinvent 3.7.1 (2020). The temporal correlation is as of the documentation of the respective used processes. The datasets representatives is within 10 years of the reference year.

System diagram:



Description of system boundaries:
All major steps from the extraction of natural resources until transport of the product to customer are included in the environmental performance of the manufacturing phase (cradle-to-gate).

Upstream activities
- Raw material supply: This life cycle stage includes the production process of raw materials. The bill of materials (BOM) is supplied by Nouryon. None of the materials in the BOM are listed in the "Candidate List of Substances of Very High Concern for authorisation" by ECHA.

Core activities
- Transport of raw materials: This life cycle stage includes the transport of raw materials to the Nouryon production factory gate. Specific data regarding the transport mode and distances were communicated by Nouryon.
- Production: This life cycle stage describes the production process of $NaClO_3$. Specific and generic data on utilities, freshwater consumption and emissions was obtained by Nouryon via direct measurement. During this life cycle stage, hazardous and non-hazardous waste are generated, which are incinerated or sent to landfill. The transport mode and distance for waste were communicated by Nouryon, or if not available, it is based on the Product Environmental Footprint Category Rules Guidance Version 6.3 – May 2018.

Downstream activities
- Transport of product to customers: This life cycle stage describes the transport of the $NaClO_3$ product from the production site to the main customer. Specific data regarding the transport mode and distances were communicated by Nouryon.

Excluded lifecycle stages:
The use stage of the chemical product is excluded due to a strong variation in possible applications of $NaClO_3$. End-of-life treatment of the chemical product is excluded because all of the following criteria are fulfilled:
- the product is physically integrated with other products in subsequent life-cycle process so they cannot be physically separated from them at end of life,
- the product or material is no longer identifiable at end-of-life as a result of a physical or chemical transformation process,
- the product or material does not contain biogenic carbon, and
- the EPD shall not be used for business-to-consumer communication.

More information:
The environmental indicators of the $NaClO_3$ product are presented as the weighted average of the eleven production sites, based on the production volume of each production site.

Content declaration

Product

Materials / chemical substances	m%	Environmental / hazardous properties
Sodium chlorate ($NaClO_3$)	> 99.5%	H271: May cause fire or explosion; strong oxidiser H302: Harmful if swallowed H411: Toxic to aquatic life with long lasting effects

Packaging
Distribution packaging: the $NaClO_3$ product is transported in bulk, so there is no packaging.

Consumer packaging: n.r.

Recycled material
Provenience of recycled materials (pre-consumer or post-consumer) in the product:
Not relevant for this product category.

Environmental performance

Potential environmental impact

Parameter	Unit	Upstream	Core	Down-stream	Total
Global warming potential (GWP) – fossil	kg CO_2 eq.	1.77E-01	7.38E-01	7.60E-02	9.92E-01
Global warming potential (GWP) – biogenic	kg CO_2 eq.	7.56E-04	1.36E-02	3.52E-04	1.47E-02
Global warming potential (GWP) – land use and land use transformation	kg CO_2 eq.	2.33E-04	9.12E-02	5.45E-05	9.14E-02
Global warming potential (GWP) – total	kg CO_2 eq.	1.78E-01	8.43E-01	7.64E-02	1.10E+00
Acidification potential (AP)	mol H+ eq.	1.17E-03	6.47E-03	5.40E-04	8.18E-03
Eutrophication potential (EP) – aquatic freshwater	kg P eq.	8.92E-05	2.43E-04	1.11E-05	3.43E-04
Eutrophication potential (EP) – aquatic marine	kg N eq.	2.89E-04	2.90E-03	1.84E-04	3.38E-03
Eutrophication potential (EP) – terrestrial	Mol N eq.	2.58E-03	1.84E-02	2.00E-03	2.29E-02
Photochemical ozone creation potential (POCP)	kg NMVOC eq.	6.94E-04	4.35E-03	5.64E-04	5.61E-03
Depletion potential of the stratospheric ozone layer (ODP)	kg CFC 11 eq.	3.30E-08	5.37E-08	1.46E-08	1.01E-07
Abiotic depletion potential (ADP) – Minerals and metals	kg Sb eq.	8.03E-06	1.05E-06	2.63E-07	9.34E-06
Abiotic depletion potential (ADP) – Fossil resources	MJ	3.26E+00	2.07E+01	1.13E+00	2.51E+01
Water deprivation potential (WDP)	m^3 eq.	1.19E-01	-1.46E-01	1.07E-02	-1.56E-02

Use of resources

Parameter		Unit	Upstream	Core	Down-stream	Total
Primary energy resources – Renewable	Use as energy carrier	MJ, net calorific value	2.55E-01	2.43E+01	3.21E-02	2.46E+01
	Used as raw materials	MJ, net calorific value	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	TOTAL	MJ, net calorific value	2.55E-01	2.43E+01	3.21E-02	2.46E+01
Primary energy resources – Non-renewable	Use as energy carrier	MJ, net calorific value	3.26E+00	2.08E+01	1.13E+00	2.52E+01
	Used as raw materials	MJ, net calorific value	5.23E-05	3.72E-05	3.02E-05	1.20E-04
	TOTAL	MJ, net calorific value	3.26E+00	2.08E+01	1.13E+00	2.52E+01

Secondary material	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Renewable secondary fuels	MJ, net calorific value	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Non-renewable secondary fuels	MJ, net calorific value	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Net use of fresh water	m^3	2.78E-03	-8.20E-02	2.49E-04	-7.89E-02

Waste production

Parameter	Unit	Upstream	Core	Down-stream	Total
Hazardous waste disposed	kg	0.00E+00	1.71E-03	0.00E+00	1.71E-03
Non-hazardous waste disposed	kg	0.00E+00	1.91E-03	0.00E+00	1.91E-03
Radioactive waste disposed	kg	0.00E+00	6,08E-05	0.00E+00	0.00E+00

Output flows

Parameter	Unit	Upstream	Core	Down-stream	Total
Components for reuse	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Material for recycling	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for energy recovery	kg	0.00E+00	5.68E-02	0.00E+00	5.68E-02
Exported energy, electricity	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported energy, thermal	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Interpretation

The impact of the upstream stage is comparable in all production sites, because mostly the same raw materials in similar quantities are consumed to produce sodium chlorate on all sites. Most of the GWP total of the upstream stage can be attributed to sodium chloride, since this also accounts for the majority of the mass input of the raw materials. Other contributors to GWP total of the core stage are sodium hydroxide and hydrochloric acid, which are also the second and third contributors to the raw material input on mass basis.

The processes that contribute to the core stage depend on the electricity and heating source used on that production site. Another contributor to the GWP of the core stage, is transport of raw materials.
The GWP in the downstream stage is caused by transport of the product.

The other impact categories, abiotic depletion (ADP) elements and fossils, acidification potential (AP), eutrophication potential (EP), ozone depletion potential (ODP) and photochemical ozone formation potential (POFP) all show a similar distribution of the impact between the life cycle stages as GWP. Still, some processes contribute more significantly to certain impact categories than others, depending on the production site.
The raw material sodium chloride (upstream) is one of the largest contributors for all impact categories and on all production sites. Electricity from natural gas contributes to ADP fossils and ODP, while electricity from biomass contributes to GWP land use and land use change and water use can be attributed to nuclear electricity. Electricity and heat from wood chips are the main contributor to GWP biogenic, and transport processes contribute significantly to ODP and POFP.

References

1. International Organization for Standardization: Environmental management – Life Cycle Assessment – Principles and Framework (ISO 14040:2006)
2. International Organization for Standardization: Environmental management – Life Cycle Assessment – Requirements and guidelines (ISO 14044:2006)
3. European Commission: Product Environmental Footprint (PEF) Guide – Version 6.3 – May 2018. Environmental impact categories version 2.0
4. General Program instructions for the International EPD System. Version 3.01 2019-09-18.
5. PCR 2021:03 version 1.1; BASIC CHEMICALS PRODUCT CATEGORY CLASSIFICATION: UN CPC 3428
6. Steghuis, G. Personal communication with Gerard Steghuis, Senior Sustainability Specialist at Nouryon (2021-2023)
7. Wernet, G., Bauer, C., Steubing, B., Reinhard, J., Moreno-Ruiz, E., and Weidema, B., 2016. The ecoinvent database version 3 (part I): overview and methodology. The International Journal of Life Cycle Assessment, [online] 21(9), pp.1218–1230. Available at: http://link.springer.com/10.1007/s11367-016-1087-8 [Accessed 28-02-2022].
8. Sphera Solutions GmbH, Leinfelden-Echterdingen, GaBi software System and Database for Life Cycle Engineering, 1992-2020 Sphera Solutions GmbH.
9. Nouryon AB. (2022). Quality Management System standard ISO 9001:2015 for Nouryon Integrated Supply Chain EMEA manufacturing of bleaching and oxidizing chemicals, polymer production and processing chemicals, specialty polymers, surfactants and chelating agents, specialty chemicals and intermediates to provide markets with essential, innovative, and high-performance ingredients and solutions. Retrieved from https://www.nouryon.com/globalassets/inriver/resources/certificate-iso-9001-multi-site-emea-surfactants-polymers-chelate-en.pdf
10. Nouryon Chemicals LLC. (2022). Quality Management System standard ISO 9001:2015 for Nouryon Chemicals LLC Integrated Supply Chain HQ'd in Houston, TX USA, with Regional Support and Manufacturing Alkoxylates, Amine Surfactants, Ethyl Hydroxyethyl Cellulose Ether (EHEC), Naphtalene Sulphonates, Sodium and Bio Polymers, Sulfur Derivatives, Expancel, High Purity Metal Organics (HPMO), Hydrogen Peroxide, Colloidal Silica Solutions, Levasil, Metal Alkyls, Organic Peroxides and other organic initiators, AZO Compounds, Accelerators, Polymerization Catalysts, Acid Chlorides, Polymer Additives, Carbon Disulfide, Sulfuric Acid, Crystex ®, Sulfur Monochloride, Sulfur Dichloride, Sodium Hydrosulfide, Monochloroacetic Acid, and Sodium Chlorate.. Retrieved from https://www.nouryon.com/globalassets/inriver/resources/certificate-iso-9001-multi-site-americas-surfactants-polymers-catalysts-bleaching-oxidizing-chemicals-cellulose-derivatives-english.pdf
11. Nouryon AB (2022). Environmental Management System standard ISO 14001:2015 for Nouryon Integrated Supply Chain EMEA manufacturing of bleaching and oxidizing chemicals, polymer production and processing chemicals, specialty polymers, surfactants and chelating agents, specialty chemicals and intermediates to provide markets with essential, innovative, and hig-performance ingredients and solutions. Retrieved from https://www.nouryon.com/globalassets/inriver/resources/certificate-iso-14001-multi-site-emea-surfactants-polymers-chelates-en.pdf
12. Nouryon Chemicals LLC (2022). Management System standard RC 14001:2015 for Nouryon Chemicals LLC Integrated Supply Chain HQ'd in Houston TX USA, with Regional Support and Manufacturing Alkoxylates, Amine Surfactants, Ethyl Hydroxyethyl Cellulose Ether (EHEC), Naphtalene Sulphonates, Sodium and Bio Polymers, Sulfur Derivatives, Expancel, High Purity Metal Organics (HPMO), Hydrogen Peroxide, Colloidal Silica Solutions, Levasil, Metal Alkyls, Organic Peroxides and other organic initiators, AZO Compounds, Accelerators, Polymerization Catalysts, Acid Chlorides, Polymer Additives, Carbon Disulfide, Sulfuric Acid, Crystex ®, Sulfur Monochloride, Sulfur Dichloride, Sodium Hydrosulfide, Monochloroacetic Acid, and Sodium Chlorate. Retrieved from

https://www.nouryon.com/globalassets/inriver/resources/certificate-rc-14001-multi-site-americas-surfactants-polymers-catalysts-bleaching-oxidizing-chemicals-cellulose-derivatives-english.pdf
13. Nouryon (2022). Nouryon achieves EcoVadis Platinum rating for sustainability performance. Retrieved from https://www.nouryon.com/news-and-events/news-overview/2022/ecovadis-2022/
14. Official Journal of the European Union. Commission Regulation (EC) No 213/2008 of 28 November 2007 amending Regulation (EC) No 2195/2002 of the European Parliament and of the Council on the Common Procurement Vocabulary (CPV) and Directives 2004/17/EC and 2004/18/EC of the European Parliament and of the Council on public procurement procedures, as regards the revision of the CPV (2007). Retrieved from https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32008R0213&from=NL
15. UNSPC. (2023). Search code, Version 23.0701. Retrieved from https://www.unspsc.org/
16. NACEv2. (2023). Volledige lijst van alle NACE-codes. Retrieved from https://nacev2.com/en/activity/manufacture-of-other-inorganic-basic-chemicals
17. European Chemicals Agency (2023). C&L inventory. Retrieved from https://echa.europa.eu/nl/information-on-chemicals/cl-inventory-database
18. European Chemicals Agency. (2023). Candidate List of substances of very high concern for Authorisation. Retrieved from https://echa.europa.eu/candidate-list-table?p_p_id=disslists_WAR_disslistsportlet&p_p_lifecycle=1&p_p_state=normal&p_p_mode=view&_disslists_WAR_disslistsportlet_javax.portlet.action=searchDissLists

Your partner
in essential solutions
for a sustainable future

Nouryon