Environmental Product Declaration

GCP Applied Technologies

Non - Chloride Accelerators

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According to
ISO 21930
ISO 14040/44

1. General Information

Manufacturer Name:	**GCP Applied Technologies Inc.** 62 Whittemore Avenue Cambridge, Massachusetts 02140 USA https://gcpat.com/en
Program Operator:	ASTM International 100 Barr Harbor Drive West Conshohocken, PA 19428-2959, USA https://www.astm.org/
Declaration Number:	EPD 404
Reference PCR:	ISO 21930 2017 serves as the core PCR
Date of Issuance:	October 27, 2022
End of Validity:	October 27, 2027
Product Name:	Non - Chloride Accelerators
EPD Owner:	GCP Applied Technologies
Declared Unit:	1000 kg of Admixture
EPD Scope:	Cradle-to-gate (A1, A2, and A3)
Verification:	Independent verification of the declaration according to ISO 14040 and ISO 21930. ☐ internal ☒ external
Prepared By:	Athena Sustainable Materials Institute
LCA Reviewer and EPD Verifier:	Anne Greig Principal, Four Elements Consulting, LLC anne@fourelementsllc.com

2. Product

2.1 Product Description and Application

The declared product is Non-Chloride Accelerators. This accelerator admixture increases the cure rate, particularly in lower temperature applications. Admixtures are chemicals added in very small amounts to concrete to modify the properties while the concrete is still fluid and also after it has hardened and is in service. The quantity added is less than 0.2% and usually less than 0.1% of the concrete weight but even at this low level, admixtures have a very significant effect on the concrete properties.

2.2 Base Materials

Product formulations were included in the LCA for peer review. Table 3 presents the raw materials used in the product but quantities or percentages are not shown for confidentiality reasons.

3. LCA Calculation Rules

3.1 Declared Unit

The declared unit is 1000 kg of Non - Chloride Accelerating admixtures.

3.2 System Boundary

The system boundary for this study is limited to a cradle-to-gate focus. The following three life cycle stages as per the governing PCRs are included in the study scope (see also Table 4):

- ***A1 Raw material supply*** (upstream processes): Extraction, handling, and processing of input materials.
- ***A2 Transportation****:* Transportation of all raw materials from the suppliers to the gate of the manufacturing facility.
- ***A3 Manufacturing*** (core process): Manufacturing of the admixture products, including all energy and materials required and all emissions and wastes produced. This includes: packaging, including transportation and waste disposal, to make admixtures ready for shipment.

3.3 Estimates and Assumptions

All significant foreground data was gathered from the manufacturer based on measured values (i.e. without estimation).

3.4 Cut-off Criteria

The cut-off criteria for all activity stage flows considered within the system boundary conform with ISO 21930: 2017 Section 7.1.8. Specifically, the cut-off criteria were applied as follows:

- All inputs and outputs for which data are available are included in the calculated effects and no collected core process data are excluded.
- A one percent cut-off is considered for renewable and non-renewable primary energy consumption and the total mass of inputs within a unit process. The sum of the total neglected flows does not exceed 5% of all energy consumption and mass of inputs.
- All flows known to contribute a significant impact or to uncertainty are included.
- The cut-off rules are not applied to hazardous and toxic material flows – all of which are included in the life cycle inventory.

No material or energy input or output was knowingly excluded from the system boundary indicators of this standard. Conservative assumptions in combination with plausibility considerations and expert judgment were used to demonstrate compliance with these criteria.

3.5 Background Data and 3.6 Data Quality

Data was gathered for the primary material and energy inputs used in production for calendar year 2015. Table 3 describe each LCI data source for raw materials (A1), transportation by mode (A2) and the core manufacture process (A3). Table 3 also includes a data quality assessment for all secondary data on the basis of the technological, temporal, and geographical representativeness.

Table 3: Secondary Data Sources and Data Quality Assessment

A1: Raw Material Inputs

Inputs	LCI Data Source	Geography	Year	Data Quality Assessment
Acetic Acid	USLCI 2014: Acetic acid, at plant/kg/RNA	Global	2014	**Technology:** very good Process models average global technology **Time:** very good Data is <10 years old **Geography:** very good Data is representative of global conditions.
Calcium Chloride	ecoinvent 3: Calcium chloride {GLO}| market for | Alloc Def, U	Global	2018	**Technology:** very good Process models average global technology **Time:** very good Data is <5 years old **Geography:** fair Data is representative of global conditions.
Calcium Lignosulphonate	ecoinvent 3: Lime, hydrated, loose weight {RoW}| production | Alloc Def, U; 0.14:1 Ratio based on stoichiometry[1]	Global	2018	**Technology:** very good Process models average global technology **Time:** very good Data is <5 years old **Geography:** very good Data is representative of global conditions.
Calcium Nitrate	ecoinvent 3: Calcium nitrate {RoW}| production | Alloc Def, U	Global	2018	**Technology:** very good Process models average global technology **Time:** very good Data is <5 years old **Geography:** very good Data is representative of global conditions.

[1] Calcium lignosulfonate is produced from the addition of hydrated lime Ca(OH)2 to spent pulping liquor (a waste output of paper production) which reacts to form calcium lignosulfonate via the "Howard Process". The spent pulping liquor was assumed to enter the product system with no burdens and thus the only modeled input was the hydrated lime. The amount of hydrated lime was calculated based on the stoichiometry of the reaction. The ratio of Ca in the inputs and outputs was used to calculate the amount of hydrated lime. The input Ca(OH)2 contains 54% Ca while the lignosulfonate output C20H24CaO10S2 contains 7.5% Ca. The ratio was calculated to be 0.14:1 and thus for every 1kg calcium lignosulfonate, 0.14 kg of hydrated lime was modeled.

Corn Syrup	ecoinvent 3: Maize starch {RER}| citric acid production | Alloc Def, U; 1.08:1 Ratio based on literature[2]	Global	2018	**Technology:** very good Process models average global technology **Time:** very good Data is <5 years old **Geography:** very good Data is representative of global conditions.
Diethylene Glycol	USEI:Diethylene glycol, at plant/RER with US electricity U	USA	2018	**Technology:** very good **Time:** good Data is <5 years old **Geography:** very good Data is representative of global conditions.
Glycerin	ecoinvent 3: Glycerine {US}| esterification of soybean oil | Alloc Def, U	Global	2018	**Technology:** very good Process models average global technology **Time:** very good Data is <5 years old **Geography:** very good Data is representative of global conditions.
Hydrated Lime	ecoinvent 3: Glycerine {US}| esterification of soybean oil | Alloc Def, U	Global	2018	**Technology:** very good Process models average global technology **Time:** very good Data is <5 years old **Geography:** very good Data is representative of global conditions.
Melamine	USEI : Melamine-urea-formaldehyde resin, at plant/US	USA	2018	**Technology:** very good **Time:** very good Data is <5 years old **Geography:** very good Data is representative of global conditions.
Molasses	USEI : Molasses, from sugar beet, at sugar refinery/CH with US electricity U	USA	2018	**Technology:** very good **Time:** very good Data is <5 years old **Geography:** very good Data is representative of global conditions.

[2] http://www.starch.eu/wp-content/uploads/2012/09/2012-08-Eco-profile-of-starch-products-summary-report.pdf

Nitrogen, Liquid	USEI : Nitrogen, liquid, at plant/RER with US electricity U	USA	2018	**Technology:** very good **Time:** very good Data is <5 years old **Geography:** very good Data is representative of global conditions.
Other Inorganic Chemicals	USEI : Chemicals inorganic, at plant/GLO with US electricity U	USA	2018	**Technology:** very good **Time:** very good Data is <5 years old **Geography:** very good Data is representative of global conditions.
Other Organic Chemicals	USEI : Chemicals organic, at plant/GLO with US electricity U	USA	2018	**Technology:** very good **Time:** very good Data is <5 years old **Geography:** very good Data is representative of global conditions.
Polyacrylates	ecoinvent 3: Polyacrylamide {GLO}| production | Alloc Def, U	Global	2018	**Technology:** very good Process models average global technology **Time:** very good Data is <5 years old **Geography:** very good Data is representative of global conditions.
Polycarboxylates	ecoinvent 3: Polycarboxylates, 40% active substance {RER}| production | Alloc Def, U	Global	2018	**Technology:** very good Process models average global technology **Time:** very good Data is <5 years old **Geography:** very good Data is representative of global conditions.
Potassium Hydroxide	USEI: Potassium hydroxide, at regional storage/RER with US electricity U	USA	2018	**Technology:** very good **Time:** very good Data is <5 years old **Geography:** very good Data is representative of global conditions.

Rosin	ecoinvent 3: Rosin size, for paper production {RoW}| production | Alloc Def, U	Global	2018	**Technology:** very good Process models average global technology **Time:** very good Data is <5 years old **Geography:** very good Data is representative of global conditions.
Silica	ecoinvent 3: Silica sand {RoW}| production | Alloc Def, U	Global	2018	**Technology:** very good Process models average global technology **Time:** very good Data is <5 years old **Geography:** very good Data is representative of global conditions.
Sodium Formate	ecoinvent 3: Sodium formate {RoW}| pentaerythritol production in sodium hydroxide solution | Alloc Def, U	Global	2018	**Technology:** very good Process models average global technology **Time:** very good Data is <5 years old **Geography:** very good Data is representative of global conditions.
Sodium Gluconate	ecoinvent 3: Chelating agent - DTPA 41	Global	2018	**Technology:** very good Process models average global technology **Time:** very good Data is <5 years old **Geography:** very good Data is representative of global conditions.
Sodium Hydroxide	USEI: Sodium hydroxide, 50% in H2O, production mix, at plant/RER with US electricity U	USA	2018	**Technology:** very good **Time:** very good Data is <5 years old **Geography:** very good Data is representative of global conditions.
Sucrose	ecoinvent 3: Sugar, from sugarcane {RoW}| cane sugar production with ethanol by-product | Alloc Def, U	Global	2018	**Technology:** very good Process models average global technology **Time:** very good Data is <5 years old **Geography:** very good Data is representative of global conditions.

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Triethanolamine	USEI: Triethanolamine, at plant/RER with US electricity U	USA	2018	**Technology:** very good **Time:** very good Data is <5 years old **Geography:** very good Data is representative of global conditions.

A2: Transportation				
Inputs	**LCI Data Source**	**Geography**	**Year**	**Data Quality Assessment**
Trucking	USLCI 2014: Transport, combination truck, diesel powered/tkm/RNA	Global	2014	**Technology:** very good **Time:** good Data is <5 years old **Geography:** very good Data is representative of global conditions.

A3: Manufacturing				
Energy	**LCI Data Source**	**Geography**	**Year**	**Data Quality Assessment**
Electricity TRE NERC Region	ecoinvent 3: Electricity, medium voltage {TRE}| market for | Alloc Def, U	USA	2021	**Technology**: very good **Time:** very good **Geography**: very good.
Electricity SERC NERC Region	ecoinvent 3: Electricity, medium voltage {SERC}| market for | Alloc Def, U	USA	2021	**Technology**: very good **Time:** very good **Geography**: very good.
Electricity WECC NERC Region	ecoinvent 3: Electricity, medium voltage {WECC}| market for | Alloc Def, U	USA	2021	**Technology**: very good **Time:** very good **Geography**: very good.
Electricity RFC NERC Region	ecoinvent 3: Electricity, medium voltage {RFC}| market for | Alloc Def, U	USA	2021	**Technology**: very good **Time:** very good **Geography**: very good.
Electricity FRCC NERC Region	ecoinvent 3: Electricity, medium voltage {FRCC}| market for | Alloc Def, U	USA	2021	**Technology**: very good **Time:** very good **Geography**: very good.

Natural Gas	USLCI 2014: Natural gas, combusted in industrial equipment NREL /RNA	USA	2014	**Technology**: very good **Time:** very good **Geography**: very good.
Propane	USLCI 2014: Liquefied petroleum gas, combusted in industrial boiler NREL /US	USA	2014	**Technology**: very good **Time:** very good **Geography**: very good.

Packaging	LCI Data Source	Geography	Year	Data Quality Assessment
Plastic packing	USLCI 2014: High density polyethylene resin, at plant NREL /RNA	Global	2018	**Technology:** very good Process models average global technology **Time:** good Data is <5 years old **Geography:** very good Data is representative of global conditions.

Waste	LCI Data Source	Geography	Year	Data Quality Assessment
Non-hazardous Waste	USEI: Disposal, emulsion paint, 0% water, to inert material landfill/CH with US electricity U	USA	2018	**Technology:** very good Process models average global technology **Time:** good Data is <5 years old **Geography:** very good Data is representative of global conditions.
Hazardous Waste	USEI: Disposal, emulsion paint, 0% water, to inert material landfill/CH with US electricity U	USA	2018	**Technology:** very good Process models average global technology **Time:** good Data is <5 years old **Geography:** very good Data is representative of global conditions.

3.7 Period under Review

Data was gathered for the primary material and energy inputs used in the production for calendar year 2015.

3.8 Allocation

"Mass" was deemed as the most appropriate physical parameter for allocation used for the admixture manufacturing system to calculate the input energy flows (electricity, natural gas and propane), packaging materials and waste flows per declared unit of 1,000 kg of product output.

3.9 Comparability

This LCA was created using industry average data for upstream materials. Data variation can result from differences in supplier locations, manufacturing processes, manufacturing efficiency and fuel types used. EPDs are comparable only if they comply with this document, use the same sub-category PCR where applicable, include all relevant information modules and are based on equivalent scenarios with respect to the context of construction works.

4. Technical Information

The various processes that occur at each stage are classified and grouped in information modules (or simply "modules"), labeled with alpha-numeric designations "A1" through "C4". A declared unit is defined for LCAs covering “cradle-to-gate”, or the production stage (shown Table 4), which consists of three modules: A1 Raw Material Supply; A2 Transport (to the manufacturer); and A3 Manufacturing. This study focuses on the product stage only and no Module D credits or burdens are included in the assessment.

The **Product stage** includes the following processes:

- **A1 Raw Material Supply** [1]: Extraction and processing of input raw materials (see Table 3, weighted average plant generic formulations for eight admixture products, including fuels used in extraction and transport within the process.
- **A2 Transport** [1]: Weighted average transportation of raw materials from extraction site or source to manufacturing site and including empty backhauls and transportation to interim distribution centers or terminals.
- **A3 Manufacturing** [1]: Manufacturing of the admixture products, including all energy and materials required and all emissions and wastes produced. This includes:

- Packaging, including transportation and waste disposal, to make admixtures ready for shipment;

- Average transportation from manufacturing site to landfill for on-site wastes, including empty backhauls and the waste disposal process.

The A3 module includes material handling and product mixing, lighting and heating, ventilation and air conditioning (HVAC), operation of environmental equipment (baghouses and bin vents), on-site transportation (loading and unloading) and storage of products.

The **Product Stage** excludes the following processes [1]:

- Production, manufacture, and construction of manufacturing capital goods and infrastructure;
- Production and manufacture of production equipment, delivery vehicles, and laboratory equipment;
- Personnel-related activities (travel, furniture, and office supplies); and
- Energy and water use related to company management and sales activities that may be located either within the factory site or at another location.

Table 4: Description of the System Boundary (x: included in LCA; mnd: module not declared)

Product			Construction Installation		Use							End-of-life				Benefits of Loads Beyond the System Boundary		
Raw Material supply	Transport	Manufacturing	Transport	Construction / Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational Energy Use	Operational Water Use	De-Construction/ Demolition	Transport	Waste processing	Disposal	Reuse	Recovery	Recycling
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D	D	D
x	x	x	mnd	mnd	mnd	mnd	mnr	mnr	mnr	mnd	mnd	mnd	mnd	mnd	mnd	mnd	mnd	mnd

5. LCA: Results

Life cycle impact assessment (LCIA) is the phase in which the set of results of the inventory analysis – the inventory flow table – is further processed and interpreted in terms of environmental impacts and resource use inventory metrics.Table 5 below summmarizes the LCA results for the cradle-to-gate (A1-A3) product system.

Table 5: Product Stage LCA Results for Non - Chloride Accelerators						
CALCULATED RESULTS A1-A3 PER 1000 kg						
Core Mandatory Impact Indicator			**Total**	**A1**	**A2**	**A3**
Global warming potential	GWP	kg CO2e	1673.55	1489.78	61.30	122.46
Depletion potential of the stratospheric ozone layer	ODP	kg CFC11e	1.07E-04	8.74E-05	2.33E-09	1.99E-05
Acidification potential of soil and water sources	AP	kg SO2e	8.45	6.17	0.37	1.92
Eutrophication potential	EP	kg Ne	2.45	2.23	0.02	0.19
Formation potential of tropospheric ozone	SFP	kg O3e	79.05	64.08	10.00	4.96
Abiotic depletion potential for fossil resources	ADPf	MJ, NCV	13657.68	8346.44	788.80	4522.45
Abiotic depletion potential for non-fossil mineral resources	ADPe	kg Sbe	1891.18	1079.89	117.34	693.94
Use of Primary Resources			**Total**	**A1**	**A2**	**A3**
Renewable primary energy carrier used as energy	RPRE	MJ, NCV	409.45	381.14	0.00	28.31
Renewable primary energy carrier used as material	RPRM	MJ, NCV	0.00	0.00	0.00	0.00
Non-renewable primary energy carrier used as energy	NRPRE	MJ, NCV	15549.60	9673.66	836.39	5039.55
Non-renewable primary energy carrier used as material	NRPRM	MJ, NCV	0.00	0.00	0.00	0.00
Secondary Material, Secondary Fuel and Recovered Energy			**Total**	**A1**	**Total**	**A1**
Secondary material	SM	kg	0.00	0.00	0.00	0.00
Renewable secondary fuel	RSF	MJ, NCV	0.00	0.00	0.00	0.00
Non-renewable secondary fuel	NRSF	MJ, NCV	0.00	0.00	0.00	0.00
Recovered energy	RE	MJ, NCV	0.00	0.00	0.00	0.00
Mandatory Inventory Parameters			**Total**	**A1**	**A2**	**A3**
Consumption of freshwater resources	FW	m3	0.11	0.11	0.00	0.00
Indicators Describing Waste			**Total**	**A1**	**A2**	**A3**
Hazardous waste disposed	HWD	kg	4.06	0.00	0.00	4.06
Non-hazardous waste disposed	NHWD	kg	0.16	0.00	0.00	0.16
High-level radioactive waste, conditioned, to final repository	HLRW	m3	4.18E-10	3.76E-10	0.00E+00	4.17E-11
Intermediate- and low-level radioactive waste, to final repository	ILLRW	m3	1.00E-08	9.64E-09	0.00E+00	3.76E-10
Components for re-use	CRU	kg	0.00	0.00	0.00	0.00
Materials for recycling	MR	kg	0.00	0.00	0.00	0.00
Materials for energy recovery	MER	kg	0.00	0.00	0.00	0.00
Recovered energy exported from the product system	EE	MJ, NCV	0.00	0.00	0.00	0.00

* The declared product does not contain any biogenic carbon.

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6. Interpretation

Figure 1 shows the relative contribution to the cumulative impacts of the A1 through A3 phases of the cradle-to-gate life cycle. The impact categories global warming potential, ozone depletion potential, eutrophication potential, smog creation potential, renewable and non-renewable materials are dominated by A1: raw material supply. These impacts are caused by the upstream production of the material inputs into the admixtures and account for most of impacts in the various impact categories.

Transportation impacts are relatively insignificant overall except in the smog creation potential impact category where it contributes between 8% up to 32% of overall impacts.

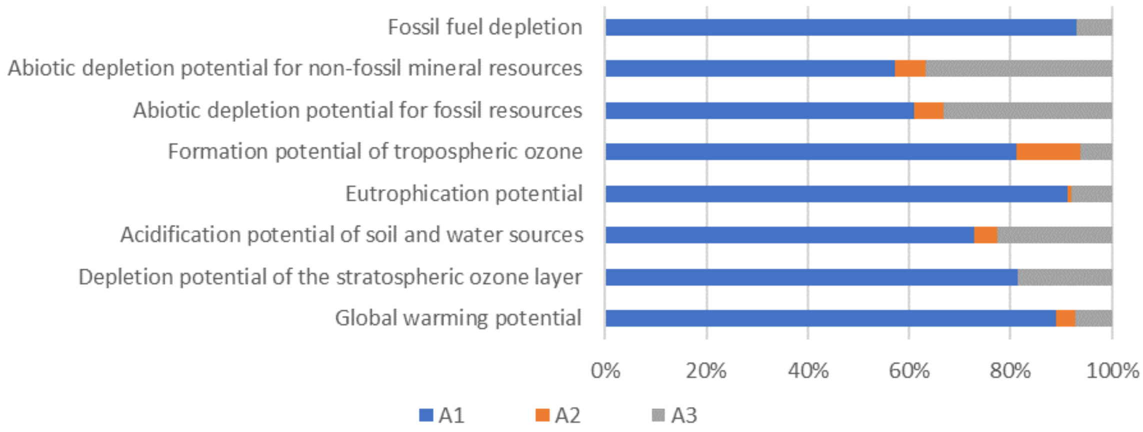

Figure 1. Contribution Analysis: A1-A3 Breakdown Non - Chloride Accelerators

7. Additonal Environmental Information

Substances of high concern are chemicals that may have serious effects on human health and the environment. No substances of high concern are indentifed in the declared product.

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8. References

1. Athena Sustainable Materials Institute (2020) A Cradle-to-Gate Life Cycle Assessment of GCP Applied Technologies Concrete Admixtures V.2.0

2. International Organization for Standardization (2017) International Standard ISO 21930:2017 Sustainability in buildings and civil engineering works - Core rules for environmental product declarations of construction products and services.

3. ISO 14044:2006/AMD 1:2017/ AMD 2:2020 Environmental management - Life cycle assessment - Requirements and guidelines.

4. ISO 14040: 2006 Environmental management - Life cycle assessment - Principles and framework.

5. ISO 14021:1999 Environmental labels and declarations - Self-declared environmental claims (Type II environmental labelling)

6. EN 15804:2012 Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products.