

ENVIRONMENTAL PRODUCT DECLARATION



Environmental Product Declaration for concrete products produced by **HOLCIM EL SALVADOR AT FRUMECER KM29** mobile facility in El Salvador.

ADMINISTRATIVE INFORMATION

International Certified Environmental Product Declaration

Declared Product:	This Environmental Product Declaration (EPD) covers concrete products produced by Holcim Nicaragua. Declared unit: 1 m3 of concrete
Declaration Owner:	Holcim El Salvador
	S/N Calle Holcim y Av. El Espino, Madre Selva Antiguo
	Cuascatlán, El Salvador
	www.holcim.com.sv
Program Operator:	Labeling Sustainability
	Address, 11670 W Sunset Blvd.
	City, State, Los Angeles, CA
	www.labelingsustainability.com
Product Category Rule:	Core PCR: ISO 21930:2017 Sustainability in buildings and civil engineering works – Core rules for environmental product declarations of construction products and services SubPCR: NSF International (March 2020). Product Category Rule (PCR) for Environmental Product Declarations (EPD) PCR for Concrete, v2.1
	Sub PCR Program Operator: NSF International
	Sub-category PCR review was conducted by: Thomas P. Gloria, Ph. D. of Industrial Ecology Consultants: 35 Bracebridge, Rd., Newton, MA 02459-1728, t.gloria@industrial-ecology.com. Dr. Michael Overcash of Environmental Clarity: 2908 Chipmunk Lane, Raleigh, NC 27607-3117, mrovercash@earthlink.net. Mr. Bill Stough of Sustainable Research Group: PO Box 1684, Grand Rapids, MI 49501-1684, bstough@sustainableresearchgroup.com.
Independent LCA Reviewer and EPD Verifier:	This EPD was independently verified in accordance with ISO 14025 and ISO 21930. The life cycle assessment was independently reviewed in accordance ISO 14044 and the referenced PCR.
	Independent verification of the declaration, according to ISO 14025:2006
	Internal <input type="checkbox"/> ; External <input checked="" type="checkbox"/>
	Third Party Verifier Geoffrey Guest, Certified 3rd Party Verifier under the International EPD Program (www.environdec.com), CSA Group (www.csaregistry.ca)
Date of Issue:	31 May 2023
Period of Validity:	5 years; valid until 31 May 2028
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COMPANY DESCRIPTION

Holcim El Salvador as part of the Holcim Group, a world leader in innovative and sustainable solutions for construction, is making it possible to have greener cities, smarter infrastructures and improve the standard of living of people around the world. With sustainability at the core of its strategy, Holcim is becoming a Net Zero company, where its people and communities are the foundation of its success. The company is driving circular construction as a world leader in recycling to build more with less. Holcim El Salvador produces and markets cement and ready-mix concrete, as well as other products and solutions for construction. In El Salvador, the company has more than 500 people who are passionate about building progress for people and the planet. It has a nationwide presence through 2 cement plants with a current installed capacity to produce 1.9 million tons of cement per year, 6 fixed ready-mix concrete plants, corporate offices, 1 Geocycle platform, 1 aggregates plant, 1 Distribution Center Disensa, hundreds of Disensa points of sale throughout the country and the Holcim Foundation.

STUDY GOAL

The intended application of this life cycle assessment (LCA) is to comply with the procedures for creating a Type III environmental product declaration (EPD) and publish the EPD for public review on the website, <http://labelingsustainability.com/>. This level of study is in accordance with EPD Product Category Rule (PCR) for Ready Mix Concrete published by NSF International (2019) and is a sub-PCR of International Standards Organization (ISO) 21930:2017 Sustainability in buildings and civil works - Core rules for EPDs of construction products and services; International Standards Organization (ISO) 14025:2006 Environmental labels and declarations, Type III environmental declarations-Principles and procedures; ISO 14044:2006 Environmental management, Life cycle assessment- Requirements and guidelines; and ISO 14040:2006 Environmental management, Life cycle assessment-Principles and framework. The performance of this study and its subsequent publishing is in alignment with the business-to-business (B2B) communication requirements for the environmental assessment of building products. The study does not intend to support comparative assertions and is intended to be disclosed to the public.

This project report was commissioned to differentiate Holcim El Salvador from their competition for the following reasons: generate an advantage for the organization; offer customers information to help them make informed product decisions; improve the environmental performance of Holcim El Salvador by continuously measuring, controlling and reducing the environmental impacts of their products; help project facilitators working on Leadership in Energy and Environmental Design (LEED) projects achieve their credit goal; and to strengthen Holcim El Salvador's license to operate in the community. The intended audience for this LCA report is Holcim El Salvador's employees, their suppliers, project specifiers of their products, architects, and engineers. The EPD report is also available for policy makers, government officials interested in sustainability, academic professors, and LCA professionals. This LCA report does not include product comparisons from other facilities.

DESCRIPTION OF PRODUCT AND SCOPE

This EPD reports on 149 concrete mixes manufactured at the Holcim El Salvador KM 29 concrete facility in El Chaparral, El Salvador



This LCA assumes the impacts from products manufactured in accordance with the standards outlined in this report. This LCA is a cradle-to-gate study, and therefore, stages extending beyond the plant gate are not included in this LCA. Excluded stages include transportation of the manufactured material to the construction site; on-site construction processes and components; building (infrastructure) use and maintenance; and "end-of-life" effects.

READY MIX CONCRETE DESIGN SUMMARY

The following tables provide a list of ready mix concrete products considered in this EPD along with key performance parameters.

Mix designs: 0 to 15 MPa:

Table 1: Declared products with Mix designs: 0 to 15MPa considered in this environmental product declaration.

Mix#	Unique name/ID	Short description	Product type	28 day strength, MPa	H ₂ O to cement ratio
1	100 BOMBA ECOPACT	10 MPa 28d strength ready mix concrete.	Ready Mix	10	0.7000
2	100 BOMBA CON TEMPERATURA ECOPACT	10 MPa 28d strength ready mix concrete.	Ready Mix	10	0.7000
3	100 BOMBA CON RETARDANTE ECOPACT	10 MPa 28d strength ready mix concrete.	Ready Mix	10	0.7000
4	100 BOMBA CON RETARDANTE Y TEMPERATURA ECOPACT	10 MPa 28d strength ready mix concrete.	Ready Mix	10	0.7000
5	100 BOMBA CON FIBRA ECOPACT	10 MPa 28d strength ready mix concrete.	Ready Mix	10	0.6923
6	100 BOMBA CON FIBRA Y RETARDANTE ECOPACT	10 MPa 28d strength ready mix concrete.	Ready Mix	10	0.6923
7	100 BOMBA CON FRIBRA Y TEMPERATURA ECOPACT	10 MPa 28d strength ready mix concrete.	Ready Mix	10	0.6923
8	100 DIRECTO ECOPACT	10 MPa 28d strength ready mix concrete.	Ready Mix	10	0.6800
9	100 DIRECTO CON TEMPERATURA ECOPACT	10 MPa 28d strength ready mix concrete.	Ready Mix	10	0.6800
10	100 DIRECTO CON RETARDANTE ECOPACT	10 MPa 28d strength ready mix concrete.	Ready Mix	10	0.6538
11	100 DIRECTO CON RETARDANTE Y TEMPERATURA ECOPACT	10 MPa 28d strength ready mix concrete.	Ready Mix	10	0.6538



12	100 DIRECTO CON FIBRA ECOPACT	10 MPa 28d strength ready mix concrete.	Ready Mix	10	0.6923
13	100 DIRECTO CON FIBRA Y RETARDANTE ECOPACT	10 MPa 28d strength ready mix concrete.	Ready Mix	10	0.6731
14	100 DIRECTO CON FRIBRA Y TEMPERATURA ECOPACT	10 MPa 28d strength ready mix concrete.	Ready Mix	10	0.6923
15	140 DIRECTO ECOPACT	14 MPa 28d strength ready mix concrete.	Ready Mix	14	0.6140
16	140 DIRECTO CON RETARDANTE ECOPACT	14 MPa 28d strength ready mix concrete.	Ready Mix	14	0.6140
17	140 DIRECTO CON TEMPERATURA ECOPACT	14 MPa 28d strength ready mix concrete.	Ready Mix	14	0.6140
18	140 DIRECTO CON RETARDANTE Y TEMPERATURA ECOPACT	14 MPa 28d strength ready mix concrete.	Ready Mix	14	0.6140
19	140 BOMBA ECOPACT	14 MPa 28d strength ready mix concrete.	Ready Mix	14	0.6316
20	140 BOMBA CON RETARDANTE ECOPACT	14 MPa 28d strength ready mix concrete.	Ready Mix	14	0.6316
21	140 BOMBA CON TEMPERATURA ECOPACT	14 MPa 28d strength ready mix concrete.	Ready Mix	14	0.6316
22	140 BOMBA CON RETARDANTE Y TEMPERATURA ECOPACT	14 MPa 28d strength ready mix concrete.	Ready Mix	14	0.6316

Mix designs: 15 to 20 MPa:

Table 2: Declared products with Mix designs: 15 to 20MPa considered in this environmental product declaration.

Mix#	Unique name/ID	Short description	Product type	28 day strength, MPa	H ₂ O to cement ratio
23	180 BOMBA ECOPACT	18 MPa 28d strength ready mix concrete.	Ready Mix	18	0.5833
24	180 BOMBA CON TEMPERATURA ECOPACT	18 MPa 28d strength ready mix concrete.	Ready Mix	18	0.5833
25	180 BOMBA CON RETARDANTE ECOPACT	18 MPa 28d strength ready mix concrete.	Ready Mix	18	0.5833
26	180 BOMBA CON RETARDANTE Y	18 MPa 28d strength ready mix concrete.	Ready Mix	18	0.5833



	TEMPERATURA ECOPACT				
27	180 BOMBA CON FIBRA ECOPACT	18 MPa 28d strength ready mix concrete.	Ready Mix	18	0.5806
28	180 BOMBA CON FIBRA Y RETARDANTE ECOPACT	18 MPa 28d strength ready mix concrete.	Ready Mix	18	0.5806
29	180 BOMBA CON FRIBRA Y TEMPERATURA ECOPACT	18 MPa 28d strength ready mix concrete.	Ready Mix	18	0.5806
30	180 DIRECTO ECOPACT	18 MPa 28d strength ready mix concrete.	Ready Mix	18	0.5667
31	180 DIRECTO CON TEMPERATURA ECOPACT	18 MPa 28d strength ready mix concrete.	Ready Mix	18	0.5667
32	180 DIRECTO CON RETARDANTE ECOPACT	18 MPa 28d strength ready mix concrete.	Ready Mix	18	0.5574
33	180 DIRECTO CON RETARDANTE Y TEMPERATURA ECOPACT	18 MPa 28d strength ready mix concrete.	Ready Mix	18	0.5574
34	180 DIRECTO CON FIBRA ECOPACT	18 MPa 28d strength ready mix concrete.	Ready Mix	18	0.5806
35	180 DIRECTO CON FIBRA Y RETARDANTE ECOPACT	18 MPa 28d strength ready mix concrete.	Ready Mix	18	0.5806
36	180 DIRECTO CON FRIBRA Y TEMPERATURA ECOPACT	18 MPa 28d strength ready mix concrete.	Ready Mix	18	0.5806

Mix designs: 21 to 25 MPa:

Table 3: Declared products with Mix designs: 21 to 25MPa considered in this environmental product declaration.

Mix#	Unique name/ID	Short description	Product type	28 day strength, MPa	H ₂ O to cement ratio
37	210 DIRECTO ECOPACT	21 MPa 28d strength ready mix concrete.	Ready Mix	21	0.4722
38	210 DIRECTO CON TEMPERATURA ECOPACT	21 MPa 28d strength ready mix concrete.	Ready Mix	21	0.4722
39	210 DIRECTO CON RETARDANTE ECOPACT	21 MPa 28d strength ready mix concrete.	Ready Mix	21	0.4722
40	210 DIRECTO CON RETARDANTE Y	21 MPa 28d strength ready mix concrete.	Ready Mix	21	0.4722



	TEMPERATURA ECOPACT				
41	210 DIRECTO CON FIBRA ECOPACT	21 MPa 28d strength ready mix concrete.	Ready Mix	21	0.4865
42	210 DIRECTO CON FIBRA Y RETARDANTE ECOPACT	21 MPa 28d strength ready mix concrete.	Ready Mix	21	0.4865
43	210 DIRECTO CON FRIBRA Y TEMPERATURA ECOPACT	21 MPa 28d strength ready mix concrete.	Ready Mix	21	0.4865
44	210 BOMBA ECOPACT	21 MPa 28d strength ready mix concrete.	Ready Mix	21	0.5000
45	210 BOMBA CON TEMPERATURA ECOPACT	21 MPa 28d strength ready mix concrete.	Ready Mix	21	0.5000
46	210 BOMBA CON RETARDANTE ECOPACT	21 MPa 28d strength ready mix concrete.	Ready Mix	21	0.5143
47	210 BOMBA CON RETARDANTE Y TEMPERATURA ECOPACT	21 MPa 28d strength ready mix concrete.	Ready Mix	21	0.5143
48	210 BOMBA CON FIBRA ECOPACT	21 MPa 28d strength ready mix concrete.	Ready Mix	21	0.5000
49	210 BOMBA CON FIBRA Y RETARDANTE ECOPACT	21 MPa 28d strength ready mix concrete.	Ready Mix	21	0.5000
50	210 BOMBA CON FRIBRA Y TEMPERATURA ECOPACT	21 MPa 28d strength ready mix concrete.	Ready Mix	21	0.5000
51	210 BOMBA PP ECOPACT	21 MPa 28d strength ready mix concrete.	Ready Mix	21	0.5000
52	210 BOMBA PP CON TEMPERATURA ECOPACT	21 MPa 28d strength ready mix concrete.	Ready Mix	21	0.5000
53	210 SEMIFLUIDO ECOPACT	21 MPa 28d strength ready mix concrete.	Ready Mix	21	0.4800
54	210 SEMIFLUIDO CON TEMPERATURA ECOPACT	21 MPa 28d strength ready mix concrete.	Ready Mix	21	0.4800
55	210 SEMIFLUIDO CON RETARDANTE ECOPACT	21 MPa 28d strength ready mix concrete.	Ready Mix	21	0.4800
56	210 SEMIFLUIDO CON RETARDANTE Y TEMPERATURA ECOPACT	21 MPa 28d strength ready mix concrete.	Ready Mix	21	0.4800



57	210 SEMIFLUIDO CON FIBRA ECOPACT	21 MPa 28d strength ready mix concrete.	Ready Mix	21	0.5067
58	210 SEMIFLUIDO CON FIBRA Y RETARDANTE ECOPACT	21 MPa 28d strength ready mix concrete.	Ready Mix	21	0.5067
59	210 SEMIFLUIDO CON FRIBRA Y TEMPERATURA ECOPACT	21 MPa 28d strength ready mix concrete.	Ready Mix	21	0.5067
60	210 SEMIFLUIDO 3/8 ECOPACT	21 MPa 28d strength ready mix concrete.	Ready Mix	21	0.4634
61	210 SEMIFLUIDO 3/8 CON RETARDANTE ECOPACT	21 MPa 28d strength ready mix concrete.	Ready Mix	21	0.4578
62	210 SEMIFLUIDO 3/8 CON TEMPERATURA ECOPACT	21 MPa 28d strength ready mix concrete.	Ready Mix	21	0.4634
63	210 SEMIFLUIDO 3/8 CON RETARDANTE Y TEMPERATURA ECOPACT	21 MPa 28d strength ready mix concrete.	Ready Mix	21	0.4578
64	210 FLUIDO ECOPACT	21 MPa 28d strength ready mix concrete.	Ready Mix	21	0.4868
65	210 FLUIDO CON TEMPERATURA ECOPACT	21 MPa 28d strength ready mix concrete.	Ready Mix	21	0.4868
66	210 FLUIDO CON RETARDANTE ECOPACT	21 MPa 28d strength ready mix concrete.	Ready Mix	21	0.4868
67	210 FLUIDO CON RETARDANTE Y TEMPERATURA ECOPACT	21 MPa 28d strength ready mix concrete.	Ready Mix	21	0.4868
68	210 FLUIDO CON FIBRA ECOPACT	21 MPa 28d strength ready mix concrete.	Ready Mix	21	0.4805
69	210 FLUIDO CON FIBRA Y RETARDANTE ECOPACT	21 MPa 28d strength ready mix concrete.	Ready Mix	21	0.4805
70	210 FLUIDO CON FRIBRA Y TEMPERATURA ECOPACT	21 MPa 28d strength ready mix concrete.	Ready Mix	21	0.4805
71	210 FLUIDO 3/8 ECOPACT	21 MPa 28d strength ready mix concrete.	Ready Mix	21	0.4588
72	210 FLUIDO 3/8 CON RETARDANTE ECOPACT	21 MPa 28d strength ready mix concrete.	Ready Mix	21	0.4588



73	210 FLUIDO 3/8 CON TEMPERATURA ECOPACT	21 MPa 28d strength ready mix concrete.	Ready Mix	21	0.4588
74	210 FLUIDO 3/8 CON RETARDANTE Y TEMPERATURA ECOPACT	21 MPa 28d strength ready mix concrete.	Ready Mix	21	0.4588
75	210 LANZADO ECOPACT	21 MPa 28d strength ready mix concrete.	Ready Mix	21	0.4070
76	210 LANZADO CON TEMPERATURA ECOPACT	21 MPa 28d strength ready mix concrete.	Ready Mix	21	0.4070
77	210 PERMEABLE ECOPACT	21 MPa 28d strength ready mix concrete.	Ready Mix	21	0.2041
78	245 DIRECTO ECOPACT	24 MPa 28d strength ready mix concrete.	Ready Mix	24	0.4605
79	245 BOMBA ECOPACT	24 MPa 28d strength ready mix concrete.	Ready Mix	24	0.4675
80	250 DIRECTO ECOPACT	25 MPa 28d strength ready mix concrete.	Ready Mix	25	0.4605
81	250 BOMBA ECOPACT	25 MPa 28d strength ready mix concrete.	Ready Mix	25	0.4675

Mix designs: 26 to 30 MPa:

Table 4: Declared products with Mix designs: 26 to 30MPa considered in this environmental product declaration.

Mix#	Unique name/ID	Short description	Product type	28 day strength, MPa	H ₂ O to cement ratio
82	280 DIRECTO ECOPACT	27 MPa 28d strength ready mix concrete.	Ready Mix	27	0.4217
83	280 DIRECTO CON TEMPERATURA ECOPACT	27 MPa 28d strength ready mix concrete.	Ready Mix	27	0.4217
84	280 DIRECTO CON RETARDANTE ECOPACT	27 MPa 28d strength ready mix concrete.	Ready Mix	27	0.4217
85	280 DIRECTO CON RETARDANTE Y TEMPERATURA ECOPACT	27 MPa 28d strength ready mix concrete.	Ready Mix	27	0.4217
86	280 DIRECTO CON FIBRA ECOPACT	27 MPa 28d strength ready mix concrete.	Ready Mix	27	0.4286
87	280 DIRECTO CON FIBRA Y RETARDANTE ECOPACT	27 MPa 28d strength ready mix concrete.	Ready Mix	27	0.4286
88	280 DIRECTO CON FRIBRA Y TEMPERATURA ECOPACT	27 MPa 28d strength ready mix concrete.	Ready Mix	27	0.4286



89	280 BOMBA ECOPACT	27 MPa 28d strength ready mix concrete.	Ready Mix	27	0.4368
90	280 BOMBA CON TEMPERATURA ECOPACT	27 MPa 28d strength ready mix concrete.	Ready Mix	27	0.4368
91	280 BOMBA CON RETARDANTE ECOPACT	27 MPa 28d strength ready mix concrete.	Ready Mix	27	0.4253
92	280 BOMBA CON RETARDANTE Y TEMPERATURA ECOPACT	27 MPa 28d strength ready mix concrete.	Ready Mix	27	0.4253
93	280 BOMBA CON FIBRA ECOPACT	27 MPa 28d strength ready mix concrete.	Ready Mix	27	0.4318
94	280 BOMBA CON FIBRA Y RETARDANTE ECOPACT	27 MPa 28d strength ready mix concrete.	Ready Mix	27	0.4318
95	280 BOMBA CON FRIBRA Y TEMPERATURA ECOPACT	27 MPa 28d strength ready mix concrete.	Ready Mix	27	0.4318
96	280 BOMBA PP ECOPACT	27 MPa 28d strength ready mix concrete.	Ready Mix	27	0.4368
97	280 BOMBA PP CON TEMPERATURA ECOPACT	27 MPa 28d strength ready mix concrete.	Ready Mix	27	0.4368
98	280 SEMIFLUIDO ECOPACT	27 MPa 28d strength ready mix concrete.	Ready Mix	27	0.4318
99	280 SEMIFLUIDO CON TEMPERATURA ECOPACT	27 MPa 28d strength ready mix concrete.	Ready Mix	27	0.4318
100	280 SEMIFLUIDO CON RETARDANTE ECOPACT	27 MPa 28d strength ready mix concrete.	Ready Mix	27	0.4318
101	280 SEMIFLUIDO CON RETARDANTE Y TEMPERATURA ECOPACT	27 MPa 28d strength ready mix concrete.	Ready Mix	27	0.4318
102	280 SEMIFLUIDO CON FIBRA ECOPACT	27 MPa 28d strength ready mix concrete.	Ready Mix	27	0.4382
103	280 SEMIFLUIDO CON FIBRA Y RETARDANTE ECOPACT	27 MPa 28d strength ready mix concrete.	Ready Mix	27	0.4382
104	280 SEMIFLUIDO CON FRIBRA Y TEMPERATURA ECOPACT	27 MPa 28d strength ready mix concrete.	Ready Mix	27	0.4382
105	280 SEMIFLUIDO 3/8 ECOPACT	27 MPa 28d strength ready mix concrete.	Ready Mix	27	0.4043



106	280 SEMIFLUIDO 3/8 CON RETARDANTE ECOPACT	27 MPa 28d strength ready mix concrete.	Ready Mix	27	0.4000
107	280 SEMIFLUIDO 3/8 CON TEMPERATURA ECOPACT	27 MPa 28d strength ready mix concrete.	Ready Mix	27	0.4043
108	280 SEMIFLUIDO 3/8 CON RETARDANTE Y TEMPERATURA ECOPACT	27 MPa 28d strength ready mix concrete.	Ready Mix	27	0.4000
109	280 FLUIDO ECOPACT	27 MPa 28d strength ready mix concrete.	Ready Mix	27	0.4222
110	280 FLUIDO CON TEMPERATURA ECOPACT	27 MPa 28d strength ready mix concrete.	Ready Mix	27	0.4222
111	280 FLUIDO CON RETARDANTE ECOPACT	27 MPa 28d strength ready mix concrete.	Ready Mix	27	0.4176
112	280 FLUIDO CON RETARDANTE Y TEMPERATURA ECOPACT	27 MPa 28d strength ready mix concrete.	Ready Mix	27	0.4176
113	280 FLUIDO CON FIBRA ECOPACT	27 MPa 28d strength ready mix concrete.	Ready Mix	27	0.4286
114	280 FLUIDO CON FIBRA Y RETARDANTE ECOPACT	27 MPa 28d strength ready mix concrete.	Ready Mix	27	0.4286
115	280 FLUIDO CON FRIBRA Y TEMPERATURA ECOPACT	27 MPa 28d strength ready mix concrete.	Ready Mix	27	0.4286
116	280 FLUIDO 3/8 ECOPACT	27 MPa 28d strength ready mix concrete.	Ready Mix	27	0.3878
117	280 FLUIDO 3/8 CON RETARDANTE ECOPACT	27 MPa 28d strength ready mix concrete.	Ready Mix	27	0.3878
118	280 FLUIDO 3/8 CON TEMPERATURA ECOPACT	27 MPa 28d strength ready mix concrete.	Ready Mix	27	0.3878
119	280 FLUIDO 3/8 CON RETARDANTE Y TEMPERATURA ECOPACT	27 MPa 28d strength ready mix concrete.	Ready Mix	27	0.3878
120	280 LANZADO ECOPACT	27 MPa 28d strength ready mix concrete.	Ready Mix	27	0.3838
121	280 LANZADO CON TEMPERATURA ECOPACT	27 MPa 28d strength ready mix concrete.	Ready Mix	27	0.3838



122	300 BOMBA ECOPACT	29 MPa 28d strength ready mix concrete.	Ready Mix	29	0.3619
123	300 BOMBA CON RETARDANTE ECOPACT	29 MPa 28d strength ready mix concrete.	Ready Mix	29	0.3619
124	300 BOMBA CON TEMPERATURA ECOPACT	29 MPa 28d strength ready mix concrete.	Ready Mix	29	0.3619
125	300 BOMBA CON RETARDANTE Y TEMPERATURA ECOPACT	29 MPa 28d strength ready mix concrete.	Ready Mix	29	0.3619

Mix designs: 31 to 35 MPa:

Table 5: Declared products with Mix designs: 31 to 35MPa considered in this environmental product declaration.

Mix#	Unique name/ID	Short description	Product type	28 day strength, MPa	H2O to cement ratio
126	350 BOMBA ECOPACT	34 MPa 28d strength ready mix concrete.	Ready Mix	34	0.3551
127	350 BOMBA CON RETARDANTE ECOPACT	34 MPa 28d strength ready mix concrete.	Ready Mix	34	0.3551
128	350 BOMBA CON TEMPERATURA ECOPACT	34 MPa 28d strength ready mix concrete.	Ready Mix	34	0.3551
129	350 BOMBA CON RETARDANTE Y TEMPERATURA ECOPACT	34 MPa 28d strength ready mix concrete.	Ready Mix	34	0.3551
130	350 SEMIFLUIDO ECOPACT	34 MPa 28d strength ready mix concrete.	Ready Mix	34	0.3824
131	350 SEMIFLUIDO CON RETARDANTE ECOPACT	34 MPa 28d strength ready mix concrete.	Ready Mix	34	0.3824
132	350 SEMIFLUIDO CON TEMPERATURA ECOPACT	34 MPa 28d strength ready mix concrete.	Ready Mix	34	0.3824
133	350 SEMIFLUIDO CON RETARDANTE Y TEMPERATURA ECOPACT	34 MPa 28d strength ready mix concrete.	Ready Mix	34	0.3824
134	350 FLUIDO ECOPACT	34 MPa 28d strength ready mix concrete.	Ready Mix	34	0.3578
135	350 FLUIDO CON RETARDANTE ECOPACT	34 MPa 28d strength ready mix concrete.	Ready Mix	34	0.3578
136	350 FLUIDO CON TEMPERATURA ECOPACT	34 MPa 28d strength ready mix concrete.	Ready Mix	34	0.3578



137	350 FLUIDO CON RETARDANTE Y TEMPERATURA ECOPACT	34 MPa 28d strength ready mix concrete.	Ready Mix	34	0.3578
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Mix designs: 41 to 45 MPa:

Table 6: Declared products with Mix designs: 41 to 45MPa considered in this environmental product declaration.

Mix#	Unique name/ID	Short description	Product type	28 day strength, MPa	H ₂ O to cement ratio
138	420 BOMBA ECOPACT	41 MPa 28d strength ready mix concrete.	Ready Mix	41	0.3762
139	420 BOMBA CON RETARDANTE ECOPACT	41 MPa 28d strength ready mix concrete.	Ready Mix	41	0.3762
140	420 BOMBA CON TEMPERATURA ECOPACT	41 MPa 28d strength ready mix concrete.	Ready Mix	41	0.3762
141	420 BOMBA CON RETARDANTE Y TEMPERATURA ECOPACT	41 MPa 28d strength ready mix concrete.	Ready Mix	41	0.3762
142	420 SEMIFLUIDO ECOPACT	41 MPa 28d strength ready mix concrete.	Ready Mix	41	0.3654
143	420 SEMIFLUIDO CON RETARDANTE ECOPACT	41 MPa 28d strength ready mix concrete.	Ready Mix	41	0.3654
144	420 SEMIFLUIDO CON TEMPERATURA ECOPACT	41 MPa 28d strength ready mix concrete.	Ready Mix	41	0.3654
145	420 SEMIFLUIDO CON RETARDANTE Y TEMPERATURA ECOPACT	41 MPa 28d strength ready mix concrete.	Ready Mix	41	0.3654
146	420 FLUIDO ECOPACT	41 MPa 28d strength ready mix concrete.	Ready Mix	41	0.3654
147	420 FLUIDO CON RETARDANTE ECOPACT	41 MPa 28d strength ready mix concrete.	Ready Mix	41	0.3654
148	420 FLUIDO CON TEMPERATURA ECOPACT	41 MPa 28d strength ready mix concrete.	Ready Mix	41	0.3654
149	420 FLUIDO CON RETARDANTE Y TEMPERATURA ECOPACT	41 MPa 28d strength ready mix concrete.	Ready Mix	41	0.3654



READY MIX CONCRETE DESIGN COMPOSITION

The following figures provide mass breakdown (kg per functional unit) of the material composition of each ready mix concrete design considered. Please note that the presented breakdown has been randomly altered by +/-10%, and is therefore only an approximation; this manipulation is to ensure confidentiality.

Table 7: Ready mix concrete composition

Product Components	Raw Material, weight%
Cement	Proprietary
Aggregates	30-60.00
Others	0.01-5.00
Total	100.00

A1 RAW MATERIAL RECYCLED CONTENT AND MATERIAL LOSSES –

The following table provides a list of the raw material inputs (module A1) across all products considered, their recyclability content and assumed material losses.

Table 8: Module A1 raw material inputs, the recyclability content and assumed material losses (dry basis)

product.name	mix.category	primary.content	post.industrial.content	post.consumer.content	material.losses
Cemento Fuerte Industrial	Cemento Fuerte Industrial	1	0	0	0
Water	tap water	1	0	0	0.05
Gravel	gravel, crushed	1	0	0	0.05
Crushed sand	sand	1	0	0	0.05
Additives	chemical, organic	1	0	0	0.05
Acrylic Fibre	acrylic filler	1	0	0	0.05



SYSTEM BOUNDARIES

The following figure depicts the cradle-to-gate system boundary considered in this study:

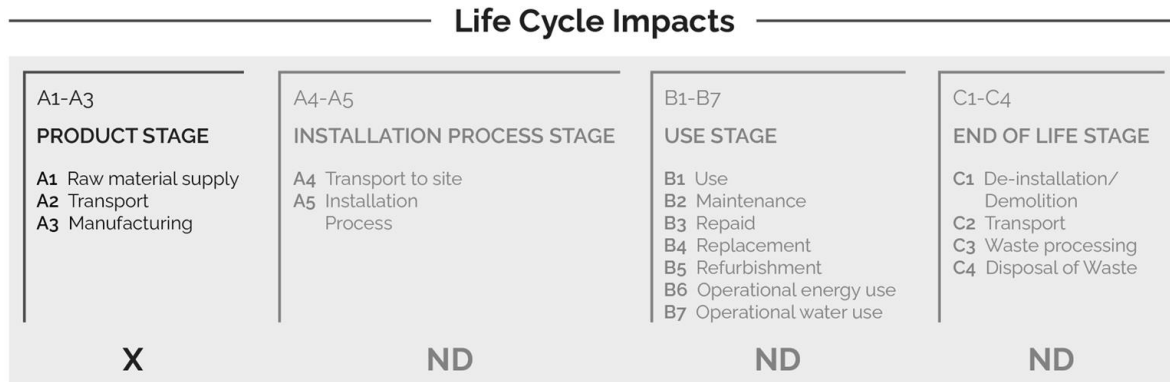


Figure 1: General life cycle phases for consideration in a construction works system.

This is a Cradle-to-gate life cycle assessment and the following life cycle stages are included in the study:

- A1: Raw material supply (upstream processes) - Extraction, handling, and processing of the materials used in manufacturing the declared products in this LCA.
- A2: Transportation - Transportation of A1 materials from the supplier to the "gate" of the manufacturing facility (i.e. A3).
- A3: Manufacturing (core processes)- The energy and other utility inputs used to store, move, and manufacturer the declared products and to operate the facility.

As according to the PCR, the following figure illustrates the general activities and input requirements for producing ready mix concrete products and is not necessarily exhaustive.

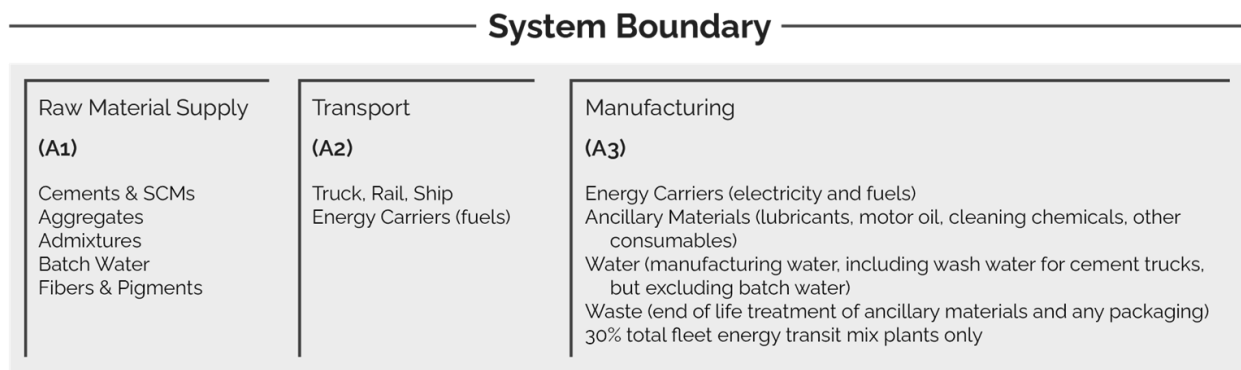


Figure 2: General system inputs considered in the product system and categorized by modules in scope



In addition, as according to the relevant PCR, the following requirements are excluded from this study:

- Production, manufacture, and construction of A3 building/capital goods and infrastructure.
- Production and manufacture of steel production equipment, steel delivery vehicles, earth-moving equipment, and laboratory equipment.
- Personnel-related activities (travel, furniture, office supplies).
- Energy use related to company management and sales activities.

For this LCA the manufacturing plant, owned and operated by Holcim El Salvador, is located at their Planta KM 29 facility in El Salvador. All operating data is formulated using the actual data from Holcim El Salvador's plant at the above location, including water, energy consumption and waste generation. All inputs for this system boundary are calculated for the plant.

This life cycle inventory was organized in a spreadsheet and was then input into an RStudio environment where pre-calculated LCIA results for relevant products/activities stemming from the ecoinvent v3.8 database and a local EPD database in combination with primary data from Holcim El Salvador were utilized. Explanations of the contribution of each data source to this study are outlined in the section 'Data Sources and Quality'. Further LCI details for each declared product are provided in the sections 'Detailed LCI tables' and 'Transport tables' of the detailed LCA report. A parameter uncertainty analysis was also performed where key statistical results (e.g. min/mean/max etc.) are provided in the detailed LCA report.

CUT-OFF CRITERIA

ISO 14044:2006 and the focus PCR requires the LCA model to contain a minimum of 95% of the total inflows (mass and energy) to the upstream and core modules be included in this study. The cut-off criteria were applied to all other processes unless otherwise noted above as follows. A 1% cut-off is considered for all renewable and non-renewable primary energy consumption and the total mass of inputs within a unit process where the total of the neglected inputs does not exceed 5%.

DATA SOURCES AND DATA QUALITY ASSESSMENT

Raw material transport: A combination of actual mode/distance combinations were assumed for key bulk materials whereas ecoinvent default multi-modal market mix distances were assumed for other inputs where no original data could be provided.

Electricity: Electricity consumption values are for Holcim El Salvador in calendar year 2021. These values were direct reported from Holcim records. The unit process "market for electricity, medium voltage/electricity, medium voltage/EC/kWh" was used to represent the El Salvador grid electricity used by the concrete plant.

Process/space heating: Not applicable.

Fuel required for machinery: Machinery-related fuel requirements were determined from direct Holcim information. The types of machinery used include generators and transportation equipment used for moving materials.



Waste generation: Waste generation values are directly reported from Holcim operations for both bulk wastes. No Hazardous waste High-level radioactive waste is generated on-site at this facility.

Recovered energy: Not applicable.

Recycled/reused material/components: The amount of returned concrete is based on Holcim primary data for the reference year, 2021.

Module A1 material losses: Due to lack of data, default loss factors of 5% were assumed. The PCR states "A3 shall include an assumption of 5% material loss unless product specific data is available and transparently reported in the project LCA report underlying the EPD;"

Direct A3 emissions accounting: Not applicable.

Waste transport requirements: Transportation distances are using estimated values. The waste hauler cannot guarantee the exact distances traveled due to the variation of route and actual location of disposal. Most waste disposal sites are near the plant therefore the 25 km distance is a representative estimate. Returned concrete and wash water, measured in kilograms, is based on direct Holcim reporting for the reference year 2021.

Product transport requirements: The diesel fuel used by the mixing trucks is direct primary information reported from Holcim El Salvador records for the year 2021. Holcim records their fuel for their trucks in L/km and therefore the information was converted with the following formula: (Ave. km to site) * 2 for return L diesel/km / (ave. m3 of concrete in a load) total concrete volume in m3 * fraction allocated to A3. A4 is outside the scope of this study.

The following tables depict a list of assumed life cycle inventory utilized in the LCA modeling to generate the impact results across the life cycle modules in scope. An assessment of the quality of each LCI activities utilized from various sources is also provided.

Table g: **LCI inputs assumed for module A1 (i.e. raw material supply) Data Quality Assessment Key Fair=1, Good=2, Very Good =3.**

Input	LCI.activity	Data.source	Geo	Year	Technology	Time	Geography	Reliability	Completeness
Water	tap water production, conventional with biological treatment/tap water/RoW/kg	ecoinvent v3.8	Santa Ana	v3.8 in 2021	2	3	1	3	3
Acrylic Fibre	market for acrylic filler/acrylic filler/RoW/kg	ecoinvent v3.8	San Salvador	v3.8 in 2021	2	3	1	3	3
Additives	market for chemical, organic/chemical, organic/GLO/kg	ecoinvent v3.8	Sonsonate	v3.8 in 2021	2	3	1	3	3



Cemento Fuerte Industrial	Cemento Fuerte Industrial	Progam Operator: Labeling Sustainability-EPD ID: ae8c3b6d-1972-4402-b184-115794c37a67	Santa Ana	21 July 2023	3	3	3	3	3
Crushed sand	sand quarry operation, extraction from river bed/sand/BR/kg; Note: modifications made (see ecoinvent activity changes table)	ecoinvent v3.8	La Libertad	v3.8 in 2021	2	3	1	3	3
Gravel	gravel production, crushed/gravel, crushed/BR/kg; Note: modifications made (see ecoinvent activity changes table)	ecoinvent v3.8	La Libertad	v3.8 in 2021	2	3	1	3	3

DATA QUALITY ASSESSMENT

Data quality/variability requirements, as specified in the PCR, are applied. This section describes the achieved data quality relative to the ISO 14044:2006 requirements. Data quality is judged based on its precision (measured, calculated, or estimated), completeness (e.g., unreported emissions), consistency (degree of uniformity of the methodology applied within a study serving as a data source) and representativeness (geographical, temporal, and technological).

Precision: Through measurement and calculation, the manufacturers collected and provided primary data on their annual production. For accuracy, the LCA practitioner and 3rd Party Verifier validated the plant gate-to-gate data.

Completeness: All relevant specific processes, including inputs (raw materials, energy, and ancillary materials) and outputs (emissions and production volume) were considered and modeled to represent the specified and declared products. The majority of relevant background materials and processes were taken from ecoinvent v3.8 LCI datasets where relatively recent region-specific electricity inputs were utilized. The most relevant EPDs requiring key A1 inputs were also utilized where readily available.

Consistency: To ensure consistency, the same modeling structure across the respective product systems was utilized for all inputs, which consisted of raw material inputs and ancillary material, energy flows, water resource inputs, product, and co-products outputs, returned and recovered Cement materials, emissions to air, water and soil, and waste recycling and treatment. The same background LCI datasets from the ecoinvent v3.8 database were used across all product systems. Crosschecks concerning the plausibility of mass and energy flows were continuously conducted. The LCA team conducted mass and energy balances at the plant and selected process level to maintain a high level of consistency.



Reproducibility: Internal reproducibility is possible since the data and the models are stored and available in a machine readable project file for all foreground and background processes, and in Labeling Sustainability's proprietary Ready Mix Concrete LCA calculator* for all production facility and product-specific calculations. A considerable level of transparency is provided throughout the detailed LCA report as the specifications and material quantity make-up for the declared products are presented and key primary and secondary LCI data sources are summarized. The provision of more detailed publicly accessible data to allow full external reproducibility was not possible due to reasons of confidentiality.

*Labeling Sustainability has developed a proprietary tool that allows the calculation of PCR-compliant LCA results for Ready Mix Concrete product designs. The tool auto-calculates results by scaling base-unit technosphere inputs (i.e. 1 kg sand, 1 kWh electricity, etc.) to replicate the reference flow conversions that take place in any typical LCA software like openLCA or SimaPro. The tool was tested against several LCAs performed in openLCA and the tool generated identical results to those realized in openLCA across every impact category and inventory metric (where comparisons could be readily made).

Representativeness: The representativeness of the data is summarized as follows.

- Time related coverage of the manufacturing processes primary collected data from 2021-01-01 to 2021-12-31.
- Upstream (background) LCI data was either the PCR specified default (if applicable) or more appropriate LCI datasets as found in the country-adjusted ecoinvent v3.8 database.
- Geographical coverage for inputs required by the A3 facility(ies) is representative of its region of focus; other upstream and background processes are based on US, North American, or global average data and adjusted to regional electricity mixes when relevant.
- Technological coverage is typical or average and specific to the participating facilities for all primary data.

ENVIRONMENTAL INDICATORS AND INVENTORY METRICS

Per the PCR, this EPD supports the life cycle impact assessment indicators and inventory metrics as listed in the tables below. As specified in the PCR, the most recent US EPA Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts (TRACI), impact categories were utilized as they provide a North American context for the mandatory category indicators to be included in the EPD. Additionally, the PCR requires a set of inventory metrics to be reported with the LCIA indicators.

It should be noted that emerging LCA impact categories and inventory items are still under development and can have high levels of uncertainty that preclude international acceptance pending further development. Use caution when interpreting data in any of the following categories.



LIMITATIONS

This EPD is a declaration of potential environmental impact and does not support or provide definitive comparisons of the environmental performance of specific products. Only EPDs prepared from cradle-to-grave life cycle results and based on the same function and reference service life and quantified by the same functional unit can be used to assist purchasers and users in making informed comparisons between products.

LCIA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks. Further, LCA offers a wide array of environmental impact indicators, and this EPD reports a collection of those, as specified by the PCR.

In addition to the impact results, this EPD provides several metrics related to resource consumption and waste generation. While these data may be informational in other ways, they do not provide a measure of impact on the environment.

TOTAL IMPACT SUMMARY

The following table reports the total LCA results for each product produced at the given ready mix concrete facility on a per 1m³ of concrete basis.

Mix designs: 0 to 15 MPa

Table 10: **Total life cycle (across modules in scope) impact results for Mix designs: 0 to 15MPa, assuming the geometric mean point values on a per 1 m³ of concrete basis.**

a) Midpoint Impact Categories:

Indicator/LCI Metric	AP	EP	GWP	ODP	PCOP	ADPe	ADPf
Unit	moles of H ⁺ -Eq	kg N	kg CO ₂ -Eq	kg CFC-11-Eq	kg NO _x -Eq	kg Sb-Eq	MJ, net calorific value
Minimum	70.8	0.134	376	4.44e-05	0.952	0.00232	5800
Maximum	79.6	0.148	422	4.92e-05	1.07	0.00263	6520
Mean	75.1	0.141	397	4.67e-05	1.01	0.00247	6140
Median	74	0.139	390	4.59e-05	0.998	0.00241	6020
100 BOMBA ECOPACT	70.8	0.134	376	4.44e-05	0.952	0.00232	5800
100 BOMBA CON TEMPERATURA ECOPACT	70.8	0.134	376	4.44e-05	0.952	0.00232	5800
100 BOMBA CON RETARDANTE ECOPACT	70.8	0.134	376	4.44e-05	0.952	0.00232	5800
100 BOMBA CON RETARDANTE Y TEMPERATURA ECOPACT	70.8	0.134	376	4.44e-05	0.952	0.00232	5800
100 BOMBA CON FIBRA ECOPACT	73.1	0.138	389	4.59e-05	0.981	0.00241	6010



100 BOMBA CON FIBRA Y RETARDANTE ECOPACT	73.1	0.138	389	4.59e-05	0.981	0.00241	6010
100 BOMBA CON FRIBRA Y TEMPERATURA ECOPACT	73.1	0.138	389	4.59e-05	0.981	0.00241	6010
100 DIRECTO ECOPACT	71.6	0.135	376	4.44e-05	0.966	0.00233	5810
100 DIRECTO CON TEMPERATURA ECOPACT	71.6	0.135	376	4.44e-05	0.966	0.00233	5810
100 DIRECTO CON RETARDANTE ECOPACT	74	0.139	389	4.59e-05	0.997	0.00241	6010
100 DIRECTO CON RETARDANTE Y TEMPERATURA ECOPACT	74	0.139	389	4.59e-05	0.997	0.00241	6010
100 DIRECTO CON FIBRA ECOPACT	74.1	0.139	390	4.59e-05	0.998	0.00242	6020
100 DIRECTO CON FIBRA Y RETARDANTE ECOPACT	74.1	0.139	390	4.59e-05	0.998	0.00242	6020
100 DIRECTO CON FRIBRA Y TEMPERATURA ECOPACT	74.1	0.139	390	4.59e-05	0.998	0.00242	6020
140 DIRECTO ECOPACT	79.2	0.148	421	4.92e-05	1.06	0.00263	6520
140 DIRECTO CON RETARDANTE ECOPACT	79.2	0.148	421	4.92e-05	1.06	0.00263	6520
140 DIRECTO CON TEMPERATURA ECOPACT	79.2	0.148	421	4.92e-05	1.06	0.00263	6520
140 DIRECTO CON RETARDANTE Y TEMPERATURA ECOPACT	79.2	0.148	421	4.92e-05	1.06	0.00263	6520
140 BOMBA ECOPACT	79.6	0.148	422	4.92e-05	1.07	0.00263	6520
140 BOMBA CON RETARDANTE ECOPACT	79.6	0.148	422	4.92e-05	1.07	0.00263	6520
140 BOMBA CON TEMPERATURA ECOPACT	79.6	0.148	422	4.92e-05	1.07	0.00263	6520
140 BOMBA CON RETARDANTE Y	79.6	0.148	422	4.92e-05	1.07	0.00263	6520



TEMPERATURA ECOPACT												
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b) Inventory Metrics:

Indicator/LC I Metric	TPE	RE	NRE	NR R	RR	WD P	LFW	LFHW	CBW C	CW/WC	CH W	CNH W
Unit	MJ- Eq	MJ - Eq	MJ- Eq	kg	m3	m3	kg waste	kg waste	m3	m3	kg	kg
Minimum	6420	171	6240	165	0.00291	10.6	93.8	0.00564	0.178	0.000898	0	7.66
Maximum	7280	196	7070	186	0.00338	12.1	99.2	0.00618	0.189	0.000898	0	7.66
Mean	6820	183	6630	175	0.00313	11.5	96.4	0.0059	0.185	0.000898	0	7.66
Median	6680	178	6500	171	0.00306	11.9	95.6	0.00582	0.184	0.000898	0	7.66
100 BOMBA ECOPACT	6420	171	6240	165	0.00296	12	93.8	0.00564	0.184	0.000898	0	7.66
100 BOMBA CON TEMPERATU RA ECOPACT	6440	173	6260	165	0.00297	12	93.8	0.00564	0.184	0.000898	0	7.66
100 BOMBA CON RETARDANT E ECOPACT	6450	172	6260	165	0.00296	12	93.8	0.00564	0.184	0.000898	0	7.66
100 BOMBA CON RETARDANT E Y TEMPERATU RA ECOPACT	6440	173	6260	165	0.00291	12	93.8	0.00564	0.184	0.000898	0	7.66
100 BOMBA CON FIBRA ECOPACT	6640	178	6490	171	0.00303	12.1	95.5	0.00581	0.189	0.000898	0	7.66
100 BOMBA CON FIBRA Y RETARDANT E ECOPACT	6670	177	6510	171	0.00301	12.1	95.5	0.00581	0.189	0.000898	0	7.66
100 BOMBA CON FRIBRA Y TEMPERATU RA ECOPACT	6670	179	6500	171	0.00305	12.1	95.5	0.00581	0.189	0.000898	0	7.66
100 DIRECTO ECOPACT	6440	172	6260	165	0.00296	11.4	93.9	0.00564	0.178	0.000898	0	7.66
100 DIRECTO CON TEMPERATU RA ECOPACT	6430	172	6290	165	0.003	11.4	93.9	0.00564	0.178	0.000898	0	7.66



100 DIRECTO CON RETARDANT E ECOPACT	669 0	17 9	650 0	172	0.0030 3	11.9	95.4	0.0058 1	0.178	0.0008 98	0	7.66
100 DIRECTO CON RETARDANT E Y TEMPERATU RA ECOPACT	669 0	17 8	649 0	171	0.0030 7	11.9	95.4	0.0058 1	0.178	0.0008 98	0	7.66
100 DIRECTO CON FIBRA ECOPACT	668 0	17 8	649 0	171	0.0030 7	11.9	95.6	0.0058 2	0.189	0.0008 98	0	7.66
100 DIRECTO CON FIBRA Y RETARDANT E ECOPACT	665 0	17 8	649 0	172	0.0030 6	11.9	95.6	0.0058 2	0.184	0.0008 98	0	7.66
100 DIRECTO CON FRIBRA Y TEMPERATU RA ECOPACT	668 0	18 0	649 0	171	0.0030 8	11.9	95.6	0.0058 2	0.189	0.0008 98	0	7.66
140 DIRECTO ECOPACT	722 0	19 5	704 0	185	0.0033 6	10.6	99.2	0.0061 7	0.184	0.0008 98	0	7.66
140 DIRECTO CON RETARDANT E ECOPACT	725 0	19 4	705 0	185	0.0033 8	10.6	99.2	0.0061 7	0.184	0.0008 98	0	7.66
140 DIRECTO CON TEMPERATU RA ECOPACT	724 0	19 5	705 0	185	0.0033 3	10.6	99.2	0.0061 7	0.184	0.0008 98	0	7.66
140 DIRECTO CON RETARDANT E Y TEMPERATU RA ECOPACT	724 0	19 5	704 0	185	0.0032 9	10.6	99.2	0.0061 7	0.184	0.0008 98	0	7.66
140 BOMBA ECOPACT	724 0	19 5	705 0	186	0.0033	10.9	99.2	0.0061 8	0.189	0.0008 98	0	7.66
140 BOMBA CON RETARDANT E ECOPACT	725 0	19 6	704 0	186	0.0033 3	10.9	99.2	0.0061 8	0.189	0.0008 98	0	7.66
140 BOMBA CON TEMPERATU RA ECOPACT	724 0	19 6	707 0	185	0.0032 9	10.9	99.2	0.0061 8	0.189	0.0008 98	0	7.66
140 BOMBA CON RETARDANT E Y	728 0	19 6	704 0	186	0.0033 2	10.9	99.2	0.0061 8	0.189	0.0008 98	0	7.66



TEMPERATURA ECOPACT											
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Mix designs: 15 to 20 MPa

Table 11: Total life cycle (across modules in scope) impact results for Mix designs: 15 to 20MPa, assuming the geometric mean point values on a per 1 m³ of concrete basis.

a) Midpoint Impact Categories:

Indicator/LCI Metric	AP	EP	GWP	ODP	PCOP	ADPe	ADPf
Unit	moles of H ⁺ -Eq	kg N	kg CO ₂ -Eq	kg CFC-11-Eq	kg NO _x -Eq	kg Sb-Eq	MJ, net calorific value
Minimum	82.7	0.154	441	5.13e-05	1.1	0.00276	6820
Maximum	85.8	0.159	455	5.27e-05	1.15	0.00286	7040
Mean	84.3	0.156	448	5.2e-05	1.13	0.00281	6930
Median	84.5	0.157	448	5.2e-05	1.13	0.00281	6930
180 BOMBA ECOPACT	82.8	0.154	441	5.13e-05	1.11	0.00276	6830
180 BOMBA CON TEMPERATURA ECOPACT	82.8	0.154	441	5.13e-05	1.11	0.00276	6830
180 BOMBA CON RETARDANTE ECOPACT	82.8	0.154	441	5.13e-05	1.11	0.00276	6830
180 BOMBA CON RETARDANTE Y TEMPERATURA ECOPACT	82.7	0.154	441	5.13e-05	1.1	0.00276	6820
180 BOMBA CON FIBRA ECOPACT	85.1	0.158	455	5.27e-05	1.13	0.00285	7040
180 BOMBA CON FIBRA Y RETARDANTE ECOPACT	85.1	0.158	455	5.27e-05	1.13	0.00285	7040
180 BOMBA CON FRIBRA Y TEMPERATURA ECOPACT	85.1	0.158	455	5.27e-05	1.13	0.00285	7040
180 DIRECTO ECOPACT	83.5	0.155	442	5.13e-05	1.12	0.00276	6830
180 DIRECTO CON TEMPERATURA ECOPACT	83.5	0.155	442	5.13e-05	1.12	0.00276	6830
180 DIRECTO CON RETARDANTE ECOPACT	84.5	0.157	448	5.2e-05	1.13	0.00281	6930
180 DIRECTO CON RETARDANTE Y	84.5	0.157	448	5.2e-05	1.13	0.00281	6930



TEMPERATURA ECOPACT							
180 DIRECTO CON FIBRA ECOPACT	85.8	0.159	455	5.27e-05	1.15	0.00286	7040
180 DIRECTO CON FIBRA Y RETARDANTE ECOPACT	85.8	0.159	455	5.27e-05	1.15	0.00286	7040
180 DIRECTO CON FRIBRA Y TEMPERATURA ECOPACT	85.8	0.159	455	5.27e-05	1.15	0.00286	7040

b) Inventory Metrics:

Indicator/LCI Metric	TPE	RE	NRE	NR	RR	WD	LFW	LFHW	CBW	CWWC	CH	CNH
Unit	MJ-Eq	MJ-Eq	MJ-Eq	kg	m3	m3	kg waste	kg waste	m3	m3	kg	kg
Minimum	7570	202	7350	194	0.00343	10.3	102	0.00641	0.178	0.000898	0	7.66
Maximum	7830	213	7620	200	0.00364	11	103	0.00658	0.189	0.000898	0	7.66
Mean	7700	208	7490	197	0.00354	10.6	102	0.0065	0.184	0.000898	0	7.66
Median	7700	208	7480	198	0.00352	10.6	102	0.00649	0.184	0.000898	0	7.66
180 BOMBA ECOPACT	7580	202	7380	194	0.00347	11	102	0.00642	0.184	0.000898	0	7.66
180 BOMBA CON TEMPERATURA ECOPACT	7570	205	7350	194	0.0035	11	102	0.00642	0.184	0.000898	0	7.66
180 BOMBA CON RETARDANTE ECOPACT	7570	204	7400	195	0.00351	10.8	102	0.00641	0.184	0.000898	0	7.66
180 BOMBA CON RETARDANTE Y TEMPERATURA ECOPACT	7570	205	7390	194	0.00343	10.7	102	0.00641	0.184	0.000898	0	7.66
180 BOMBA CON FIBRA ECOPACT	7790	213	7610	200	0.00357	10.7	103	0.00658	0.189	0.000898	0	7.66
180 BOMBA CON FIBRA Y RETARDANTE ECOPACT	7820	211	7600	200	0.0036	10.7	103	0.00658	0.189	0.000898	0	7.66



180 BOMBA CON FRIBRA Y TEMPERATURA ECOPACT	7810	211	7600	200	0.00362	10.7	103	0.00658	0.189	0.000898	0	7.66
180 DIRECTO ECOPACT	7600	206	7400	194	0.00348	10.4	102	0.00642	0.178	0.000898	0	7.66
180 DIRECTO CON TEMPERATURA ECOPACT	7590	203	7390	194	0.00349	10.4	102	0.00642	0.178	0.000898	0	7.66
180 DIRECTO CON RETARDANTE ECOPACT	7710	209	7470	198	0.00348	10.3	102	0.00649	0.178	0.000898	0	7.66
180 DIRECTO CON RETARDANTE Y TEMPERATURA ECOPACT	7700	208	7480	197	0.00353	10.3	102	0.00649	0.178	0.000898	0	7.66
180 DIRECTO CON FIBRA ECOPACT	7820	211	7590	200	0.00357	10.3	103	0.00658	0.189	0.000898	0	7.66
180 DIRECTO CON FIBRA Y RETARDANTE ECOPACT	7830	211	7560	200	0.00364	10.3	103	0.00658	0.189	0.000898	0	7.66
180 DIRECTO CON FRIBRA Y TEMPERATURA ECOPACT	7820	213	7620	200	0.00364	10.3	103	0.00658	0.189	0.000898	0	7.66

Mix designs: 21 to 25 MPa

Table 12: Total life cycle (across modules in scope) impact results for Mix designs: 21 to 25MPa, assuming the geometric mean point values on a per 1 m³ of concrete basis.

a) Midpoint Impact Categories:

Indicator/LCI Metric	AP	EP	GWP	ODP	PCOP	ADPe	ADPf
Unit	moles of H ⁺ -Eq	kg N	kg CO ₂ -Eq	kg CFC-11-Eq	kg NO _x -Eq	kg Sb-Eq	MJ, net calorific value
Minimum	93.9	0.173	507	5.82e-05	1.24	0.00319	7850
Maximum	130	0.233	690	7.71e-05	1.72	0.00445	10700
Mean	101	0.186	550	6.28e-05	1.33	0.00349	8530
Median	99.8	0.183	540	6.17e-05	1.32	0.00342	8370
210 DIRECTO ECOPACT	97.5	0.179	520	5.96e-05	1.29	0.00329	8060



210 DIRECTO CON TEMPERATURA ECOPACT	97.5	0.179	520	5.96e-05	1.29	0.00329	8060
210 DIRECTO CON RETARDANTE ECOPACT	97.5	0.179	520	5.96e-05	1.29	0.00329	8060
210 DIRECTO CON RETARDANTE Y TEMPERATURA ECOPACT	97.5	0.179	520	5.96e-05	1.29	0.00329	8060
210 DIRECTO CON FIBRA ECOPACT	99.8	0.182	533	6.1e-05	1.32	0.00338	8260
210 DIRECTO CON FIBRA Y RETARDANTE ECOPACT	99.8	0.182	533	6.1e-05	1.32	0.00338	8260
210 DIRECTO CON FRIBRA Y TEMPERATURA ECOPACT	99.8	0.182	533	6.1e-05	1.32	0.00338	8260
210 BOMBA ECOPACT	94.5	0.174	507	5.82e-05	1.25	0.0032	7850
210 BOMBA CON TEMPERATURA ECOPACT	94.5	0.174	507	5.82e-05	1.25	0.0032	7850
210 BOMBA CON RETARDANTE ECOPACT	93.9	0.173	507	5.82e-05	1.24	0.00319	7850
210 BOMBA CON RETARDANTE Y TEMPERATURA ECOPACT	93.9	0.173	507	5.82e-05	1.24	0.00319	7850
210 BOMBA CON FIBRA ECOPACT	96.8	0.178	520	5.96e-05	1.28	0.00329	8060
210 BOMBA CON FIBRA Y RETARDANTE ECOPACT	96.2	0.177	520	5.96e-05	1.27	0.00329	8060
210 BOMBA CON FRIBRA Y TEMPERATURA ECOPACT	96.8	0.178	520	5.96e-05	1.28	0.00329	8060
210 BOMBA PP ECOPACT	93.9	0.173	507	5.82e-05	1.24	0.00319	7850
210 BOMBA PP CON TEMPERATURA ECOPACT	93.9	0.173	507	5.82e-05	1.24	0.00319	7850
210 SEMIFLUIDO ECOPACT	99.6	0.183	539	6.16e-05	1.32	0.00341	8360
210 SEMIFLUIDO CON TEMPERATURA ECOPACT	99.6	0.183	539	6.16e-05	1.32	0.00341	8360



210 SEMIFLUIDO CON RETARDANTE ECOPACT	99.6	0.183	539	6.16e-05	1.32	0.00341	8360
210 SEMIFLUIDO CON RETARDANTE Y TEMPERATURA ECOPACT	99.6	0.183	539	6.16e-05	1.32	0.00341	8360
210 SEMIFLUIDO CON FIBRA ECOPACT	100	0.183	540	6.17e-05	1.32	0.00342	8370
210 SEMIFLUIDO CON FIBRA Y RETARDANTE ECOPACT	100	0.183	540	6.17e-05	1.32	0.00342	8370
210 SEMIFLUIDO CON FRIBRA Y TEMPERATURA ECOPACT	100	0.183	540	6.17e-05	1.32	0.00342	8370
210 SEMIFLUIDO 3/8 ECOPACT	105	0.194	584	6.64e-05	1.37	0.0037	9060
210 SEMIFLUIDO 3/8 CON RETARDANTE ECOPACT	106	0.195	591	6.72e-05	1.39	0.00374	9170
210 SEMIFLUIDO 3/8 CON TEMPERATURA ECOPACT	105	0.194	584	6.64e-05	1.37	0.0037	9060
210 SEMIFLUIDO 3/8 CON RETARDANTE Y TEMPERATURA ECOPACT	106	0.195	591	6.72e-05	1.39	0.00374	9170
210 FLUIDO ECOPACT	99.7	0.184	546	6.24e-05	1.31	0.00345	8460
210 FLUIDO CON TEMPERATURA ECOPACT	99.7	0.184	546	6.24e-05	1.31	0.00345	8460
210 FLUIDO CON RETARDANTE ECOPACT	99.7	0.184	546	6.24e-05	1.31	0.00345	8460
210 FLUIDO CON RETARDANTE Y TEMPERATURA ECOPACT	99.7	0.184	546	6.24e-05	1.31	0.00345	8460
210 FLUIDO CON FIBRA ECOPACT	101	0.186	553	6.31e-05	1.33	0.0035	8570
210 FLUIDO CON FIBRA Y RETARDANTE ECOPACT	101	0.186	553	6.31e-05	1.33	0.0035	8570
210 FLUIDO CON FRIBRA Y TEMPERATURA ECOPACT	101	0.186	553	6.31e-05	1.33	0.0035	8570



210 FLUIDO 3/8 ECOPACT	108	0.199	604	6.85e-05	1.41	0.00383	9370
210 FLUIDO 3/8 CON RETARDANTE ECOPACT	108	0.199	604	6.85e-05	1.41	0.00383	9370
210 FLUIDO 3/8 CON TEMPERATURA ECOPACT	108	0.199	604	6.85e-05	1.41	0.00383	9370
210 FLUIDO 3/8 CON RETARDANTE Y TEMPERATURA ECOPACT	108	0.199	604	6.85e-05	1.41	0.00383	9370
210 LANZADO ECOPACT	109	0.2	610	6.93e-05	1.42	0.00387	9470
210 LANZADO CON TEMPERATURA ECOPACT	109	0.2	610	6.93e-05	1.42	0.00387	9470
210 PERMEABLE ECOPACT	130	0.233	690	7.71e-05	1.72	0.00445	10700
245 DIRECTO ECOPACT	102	0.187	546	6.23e-05	1.35	0.00346	8460
245 BOMBA ECOPACT	102	0.187	552	6.3e-05	1.35	0.0035	8560
250 DIRECTO ECOPACT	102	0.187	546	6.23e-05	1.35	0.00346	8460
250 BOMBA ECOPACT	102	0.187	552	6.3e-05	1.35	0.0035	8560

b) Inventory Metrics:

Indicator/L CI Metric	TPE	RE	NRE	NR R	RR	WD P	LFW	LFHW	CBW C	CWWC	CH W	CNH W
Unit	MJ-Eq	MJ-Eq	MJ-Eq	kg	m3	m3	kg waste	kg waste	m3	m3	kg	kg
Minimum	8690	236	8450	223	0.00395	1.01	109	0.00718	0.105	0.000898	0	7.66
Maximum	11900	332	11600	306	0.00551	12.7	130	0.00928	0.205	0.000898	0	7.66
Mean	9480	258	9220	243	0.00439	10.2	114	0.00769	0.189	0.000898	0	7.66
Median	9320	254	9060	239	0.00433	9.94	113	0.00758	0.189	0.000898	0	7.66
210 DIRECTO ECOPACT	8930	243	8730	229	0.00415	9.16	111	0.00734	0.178	0.000898	0	7.66
210 DIRECTO CON TEMPERATURA ECOPACT	8940	244	8680	229	0.00412	9.16	111	0.00734	0.178	0.000898	0	7.66



210 DIRECTO CON RETARDANTE ECOPACT	8960	246	8740	230	0.00414	9.16	111	0.00734	0.178	0.000898	0	7.66
210 DIRECTO CON RETARDANTE Y TEMPERATURA ECOPACT	8940	243	8710	230	0.0041	9.16	111	0.00734	0.178	0.000898	0	7.66
210 DIRECTO CON FIBRA ECOPACT	9210	251	8910	236	0.00438	8.98	112	0.0075	0.189	0.000898	0	7.66
210 DIRECTO CON FIBRA Y RETARDANTE ECOPACT	9190	250	8930	235	0.00424	8.98	112	0.0075	0.189	0.000898	0	7.66
210 DIRECTO CON FIBRA Y TEMPERATURA ECOPACT	9200	250	8950	236	0.00419	8.98	112	0.0075	0.189	0.000898	0	7.66
210 BOMBA ECOPACT	8710	236	8480	223	0.00404	9.83	109	0.00718	0.184	0.000898	0	7.66
210 BOMBA CON TEMPERATURA ECOPACT	8690	239	8450	223	0.004	9.83	109	0.00718	0.184	0.000898	0	7.66
210 BOMBA CON RETARDANTE ECOPACT	8730	237	8520	223	0.00395	10.4	109	0.00718	0.189	0.000898	0	7.66
210 BOMBA CON RETARDANTE Y TEMPERATURA ECOPACT	8700	237	8500	224	0.00408	10.4	109	0.00718	0.189	0.000898	0	7.66
210 BOMBA CON FIBRA ECOPACT	8980	244	8680	230	0.00414	9.86	111	0.00735	0.189	0.000898	0	7.66



210 BOMBA CON FIBRA Y RETARDANTE ECOPACT	8930	245	8690	230	0.00417	10.5	111	0.00735	0.189	0.000898	0	7.66
210 BOMBA CON FRIBRA Y TEMPERATURA ECOPACT	8920	241	8690	229	0.00412	9.86	111	0.00735	0.189	0.000898	0	7.66
210 BOMBA PP ECOPACT	8760	237	8490	224	0.00401	10.3	109	0.00718	0.184	0.000898	0	7.66
210 BOMBA PP CON TEMPERATURA ECOPACT	8720	238	8490	224	0.00399	10.3	109	0.00718	0.184	0.000898	0	7.66
210 SEMIFLUIDO ECOPACT	9300	253	9020	238	0.00431	9.92	113	0.00756	0.189	0.000898	0	7.66
210 SEMIFLUIDO CON TEMPERATURA ECOPACT	9290	254	9060	238	0.00426	9.92	113	0.00756	0.189	0.000898	0	7.66
210 SEMIFLUIDO CON RETARDANTE ECOPACT	9260	251	9050	238	0.00434	9.92	113	0.00756	0.189	0.000898	0	7.66
210 SEMIFLUIDO CON RETARDANTE Y TEMPERATURA ECOPACT	9320	255	9050	238	0.00439	9.92	113	0.00756	0.189	0.000898	0	7.66
210 SEMIFLUIDO CON FIBRA ECOPACT	9300	254	9010	238	0.00426	9.94	113	0.00758	0.2	0.000898	0	7.66
210 SEMIFLUIDO CON FIBRA Y RETARDANTE ECOPACT	9310	254	9020	239	0.00425	9.94	113	0.00758	0.2	0.000898	0	7.66
210 SEMIFLUIDO	9270	252	9030	239	0.00428	9.94	113	0.00758	0.2	0.000898	0	7.66



CON FRIBRA Y TEMPERATURA ECOPACT												
210 SEMIFLUIDO 3/8 ECOPACT	10000	276	9760	258	0.00467	11.7	118	0.00808	0.2	0.000898	0	7.66
210 SEMIFLUIDO 3/8 CON RETARDANTE ECOPACT	10200	277	9900	261	0.00477	11.7	119	0.00817	0.2	0.000898	0	7.66
210 SEMIFLUIDO 3/8 CON TEMPERATURA ECOPACT	10100	272	9800	258	0.00462	11.7	118	0.00808	0.2	0.000898	0	7.66
210 SEMIFLUIDO 3/8 CON RETARDANTE Y TEMPERATURA ECOPACT	10200	275	9910	261	0.00476	11.7	119	0.00817	0.2	0.000898	0	7.66
210 FLUIDO ECOPACT	9390	256	9160	241	0.00434	11.4	114	0.00764	0.194	0.000898	0	7.66
210 FLUIDO CON TEMPERATURA ECOPACT	9400	257	9110	242	0.0043	11.4	114	0.00764	0.194	0.000898	0	7.66
210 FLUIDO CON RETARDANTE ECOPACT	9390	254	9150	241	0.00439	11.4	114	0.00764	0.194	0.000898	0	7.66
210 FLUIDO CON RETARDANTE Y TEMPERATURA ECOPACT	9390	254	9160	241	0.00433	11.4	114	0.00764	0.194	0.000898	0	7.66
210 FLUIDO CON FIBRA ECOPACT	9540	257	9230	244	0.00442	11.4	114	0.00773	0.194	0.000898	0	7.66
210 FLUIDO CON FIBRA Y	9500	258	9250	244	0.0044	11.4	114	0.00773	0.194	0.000898	0	7.66



RETARDANTE ECOPACT												
210 FLUIDO CON FRIBRA Y TEMPERATURA ECOPACT	9520	260	9270	244	0.0044	11.4	114	0.00773	0.194	0.000898	0	7.66
210 FLUIDO 3/8 ECOPACT	10400	284	10100	268	0.00482	11.7	120	0.00831	0.205	0.000898	0	7.66
210 FLUIDO 3/8 CON RETARDANTE ECOPACT	10500	284	10200	267	0.00486	11.7	120	0.00831	0.205	0.000898	0	7.66
210 FLUIDO 3/8 CON TEMPERATURA ECOPACT	10400	285	10100	268	0.00482	11.7	120	0.00831	0.205	0.000898	0	7.66
210 FLUIDO 3/8 CON RETARDANTE Y TEMPERATURA ECOPACT	10400	283	10100	268	0.00482	11.7	120	0.00831	0.205	0.000898	0	7.66
210 LANZADO ECOPACT	10500	288	10200	270	0.00491	12.7	121	0.0084	0.184	0.000898	0	7.66
210 LANZADO CON TEMPERATURA ECOPACT	10500	287	10300	270	0.00486	12.7	121	0.0084	0.184	0.000898	0	7.66
210 PERMEABLE ECOPACT	11900	332	11600	306	0.00551	1.01	130	0.00928	0.105	0.000898	0	7.66
245 DIRECTO ECOPACT	9430	260	9160	241	0.00446	8.38	114	0.00764	0.184	0.000898	0	7.66
245 BOMBA ECOPACT	9480	260	9250	245	0.00434	9.34	114	0.00771	0.189	0.000898	0	7.66
250 DIRECTO ECOPACT	9380	257	9140	241	0.00433	8.38	114	0.00764	0.184	0.000898	0	7.66
250 BOMBA ECOPACT	9510	260	9240	244	0.00448	9.34	114	0.00771	0.189	0.000898	0	7.66



Mix designs: 26 to 30 MPa

Table 13: Total life cycle (across modules in scope) impact results for Mix designs: 26 to 30MPa, assuming the geometric mean point values on a per 1 m³ of concrete basis.

a) Midpoint Impact Categories:

Indicator/LCI Metric	AP	EP	GWP	ODP	PCOP	ADPe	ADPf
Unit	moles of H ⁺ -Eq	kg N	kg CO ₂ -Eq	kg CFC-11-Eq	kg NO _x -Eq	kg Sb-Eq	MJ, net calorific value
Minimum	110	0.2	592	6.71e-05	1.46	0.00377	9180
Maximum	134	0.242	736	8.22e-05	1.75	0.00472	11400
Mean	118	0.214	645	7.28e-05	1.54	0.00412	10000
Median	115	0.209	631	7.13e-05	1.51	0.00402	9790
280 DIRECTO ECOPACT	110	0.2	592	6.71e-05	1.46	0.00377	9180
280 DIRECTO CON TEMPERATURA ECOPACT	110	0.2	592	6.71e-05	1.46	0.00377	9180
280 DIRECTO CON RETARDANTE ECOPACT	110	0.2	592	6.71e-05	1.46	0.00377	9180
280 DIRECTO CON RETARDANTE Y TEMPERATURA ECOPACT	110	0.2	592	6.71e-05	1.46	0.00377	9180
280 DIRECTO CON FIBRA ECOPACT	112	0.202	599	6.78e-05	1.47	0.00382	9290
280 DIRECTO CON FIBRA Y RETARDANTE ECOPACT	112	0.202	599	6.78e-05	1.47	0.00382	9290
280 DIRECTO CON FRIBRA Y TEMPERATURA ECOPACT	112	0.202	599	6.78e-05	1.47	0.00382	9290
280 BOMBA ECOPACT	114	0.207	618	6.98e-05	1.5	0.00394	9580
280 BOMBA CON TEMPERATURA ECOPACT	114	0.207	618	6.98e-05	1.5	0.00394	9580
280 BOMBA CON RETARDANTE ECOPACT	114	0.207	618	6.98e-05	1.5	0.00394	9580
280 BOMBA CON RETARDANTE Y TEMPERATURA ECOPACT	114	0.207	618	6.98e-05	1.5	0.00394	9580
280 BOMBA CON FIBRA ECOPACT	115	0.209	625	7.06e-05	1.51	0.00399	9690



280 BOMBA CON FIBRA Y RETARDANTE ECOPACT	115	0.209	625	7.06e-05	1.51	0.00399	9690
280 BOMBA CON FRIBRA Y TEMPERATURA ECOPACT	115	0.209	625	7.06e-05	1.51	0.00399	9690
280 BOMBA PP ECOPACT	113	0.206	618	6.99e-05	1.49	0.00393	9580
280 BOMBA PP CON TEMPERATURA ECOPACT	113	0.206	618	6.99e-05	1.49	0.00393	9580
280 SEMIFLUIDO ECOPACT	114	0.207	624	7.06e-05	1.49	0.00397	9690
280 SEMIFLUIDO CON TEMPERATURA ECOPACT	114	0.207	624	7.06e-05	1.49	0.00397	9690
280 SEMIFLUIDO CON RETARDANTE ECOPACT	114	0.207	624	7.06e-05	1.49	0.00397	9690
280 SEMIFLUIDO CON RETARDANTE Y TEMPERATURA ECOPACT	114	0.207	624	7.06e-05	1.49	0.00397	9690
280 SEMIFLUIDO CON FIBRA ECOPACT	115	0.209	631	7.13e-05	1.5	0.00402	9790
280 SEMIFLUIDO CON FIBRA Y RETARDANTE ECOPACT	115	0.209	631	7.13e-05	1.5	0.00402	9790
280 SEMIFLUIDO CON FRIBRA Y TEMPERATURA ECOPACT	115	0.209	631	7.13e-05	1.5	0.00402	9790
280 SEMIFLUIDO 3/8 ECOPACT	121	0.219	663	7.47e-05	1.58	0.00424	10300
280 SEMIFLUIDO 3/8 CON RETARDANTE ECOPACT	122	0.221	670	7.54e-05	1.59	0.00428	10400
280 SEMIFLUIDO 3/8 CON TEMPERATURA ECOPACT	121	0.219	663	7.47e-05	1.58	0.00424	10300
280 SEMIFLUIDO 3/8 CON RETARDANTE Y TEMPERATURA ECOPACT	122	0.221	670	7.54e-05	1.59	0.00428	10400
280 FLUIDO ECOPACT	116	0.211	637	7.2e-05	1.51	0.00406	9890



280 FLUIDO CON TEMPERATURA ECOPACT	116	0.211	637	7.2e-05	1.51	0.00406	9890
280 FLUIDO CON RETARDANTE ECOPACT	117	0.213	644	7.27e-05	1.53	0.0041	9990
280 FLUIDO CON RETARDANTE Y TEMPERATURA ECOPACT	117	0.213	644	7.27e-05	1.53	0.0041	9990
280 FLUIDO CON FIBRA ECOPACT	117	0.213	644	7.28e-05	1.53	0.00411	10000
280 FLUIDO CON FIBRA Y RETARDANTE ECOPACT	117	0.213	644	7.28e-05	1.53	0.00411	10000
280 FLUIDO CON FRIBRA Y TEMPERATURA ECOPACT	117	0.213	644	7.28e-05	1.53	0.00411	10000
280 FLUIDO 3/8 ECOPACT	125	0.226	689	7.74e-05	1.63	0.00441	10700
280 FLUIDO 3/8 CON RETARDANTE ECOPACT	125	0.226	689	7.74e-05	1.63	0.00441	10700
280 FLUIDO 3/8 CON TEMPERATURA ECOPACT	125	0.226	689	7.74e-05	1.63	0.00441	10700
280 FLUIDO 3/8 CON RETARDANTE Y TEMPERATURA ECOPACT	125	0.226	689	7.74e-05	1.63	0.00441	10700
280 LANZADO ECOPACT	124	0.226	696	7.84e-05	1.61	0.00444	10800
280 LANZADO CON TEMPERATURA ECOPACT	123	0.226	696	7.82e-05	1.6	0.00443	10800
300 BOMBA ECOPACT	134	0.242	736	8.22e-05	1.75	0.00472	11400
300 BOMBA CON RETARDANTE ECOPACT	134	0.242	736	8.22e-05	1.75	0.00472	11400
300 BOMBA CON TEMPERATURA ECOPACT	134	0.242	736	8.22e-05	1.75	0.00472	11400
300 BOMBA CON RETARDANTE Y TEMPERATURA ECOPACT	134	0.242	736	8.22e-05	1.75	0.00472	11400



b) Inventory Metrics:

Indicator/LCI Metric	TPE	RE	NRE	NR R	RR	WD P	LFW	LFHW	CBW C	CWWC	CH W	CNH W
Unit	MJ-Eq	MJ-Eq	MJ-Eq	kg	m3	m3	kg waste	kg waste	m3	m3	kg	kg
Minimum	10200	278	9900	261	0.0047	7.22	119	0.00818	0.184	0.000898	0	7.66
Maximum	12700	352	12400	326	0.006	13.1	136	0.00987	0.205	0.000898	0	7.66
Mean	11100	305	10800	286	0.00516	9.08	125	0.00881	0.198	0.000898	0	7.66
Median	10900	299	10600	280	0.00504	9.06	124	0.00865	0.2	0.000898	0	7.66
280 DIRECTO ECOPACT	10200	279	9920	262	0.00471	7.67	119	0.00818	0.184	0.000898	0	7.66
280 DIRECTO CON TEMPERATURA ECOPACT	10200	278	9920	261	0.00471	7.67	119	0.00818	0.184	0.000898	0	7.66
280 DIRECTO CON RETARDANTE ECOPACT	10200	283	9900	262	0.0047	7.67	119	0.00818	0.184	0.000898	0	7.66
280 DIRECTO CON RETARDANTE Y TEMPERATURA ECOPACT	10200	280	9900	261	0.00478	7.67	119	0.00818	0.184	0.000898	0	7.66
280 DIRECTO CON FIBRA ECOPACT	10300	282	10000	265	0.00477	7.69	120	0.00827	0.189	0.000898	0	7.66
280 DIRECTO CON FIBRA Y RETARDANTE ECOPACT	10300	283	10000	265	0.00478	7.69	120	0.00827	0.189	0.000898	0	7.66
280 DIRECTO CON FRIBRA Y TEMPERATU	10300	284	10000	265	0.00476	7.69	120	0.00827	0.189	0.000898	0	7.66



RA ECOPACT												
280 BOMBA ECOPACT	1070 0	29 1	1030 0	274	0.004 93	8.23	122	0.0084 8	0.2	0.0008 98	0	7.66
280 BOMBA CON TEMPERATU RA ECOPACT	1070 0	29 2	1040 0	273	0.004 84	8.23	122	0.0084 8	0.2	0.0008 98	0	7.66
280 BOMBA CON RETARDANT E ECOPACT	1060 0	29 3	1040 0	273	0.004 92	8.22	122	0.0084 8	0.194	0.0008 98	0	7.66
280 BOMBA CON RETARDANT E Y TEMPERATU RA ECOPACT	1070 0	29 2	1040 0	273	0.004 9	8.22	122	0.0084 8	0.194	0.0008 98	0	7.66
280 BOMBA CON FIBRA ECOPACT	1080 0	29 7	1050 0	276	0.005	8.24	123	0.0085 8	0.2	0.0008 98	0	7.66
280 BOMBA CON FIBRA Y RETARDANT E ECOPACT	1080 0	29 7	1050 0	277	0.004 98	8.24	123	0.0085 8	0.2	0.0008 98	0	7.66
280 BOMBA CON FRIBRA Y TEMPERATU RA ECOPACT	1080 0	29 6	1050 0	277	0.005 07	8.24	123	0.0085 8	0.2	0.0008 98	0	7.66
280 BOMBA PP ECOPACT	1060 0	28 9	1030 0	273	0.004 88	9.08	122	0.0084 8	0.2	0.0008 98	0	7.66
280 BOMBA PP CON TEMPERATU RA ECOPACT	1060 0	29 2	1040 0	274	0.005 04	9.08	122	0.0084 8	0.2	0.0008 98	0	7.66
280 SEMIFLUIDO ECOPACT	1080 0	29 2	1050 0	276	0.004 95	10	123	0.0085 7	0.2	0.0008 98	0	7.66
280 SEMIFLUIDO CON TEMPERATU RA ECOPACT	1070 0	29 4	1040 0	276	0.004 95	10	123	0.0085 7	0.2	0.0008 98	0	7.66
280 SEMIFLUIDO	1070 0	29 2	1050 0	276	0.004 94	10	123	0.0085 7	0.2	0.0008 98	0	7.66



CON RETARDANT E ECOPACT												
280 SEMIFLUIDO CON RETARDANT E Y TEMPERATU RA ECOPACT	1070 0	29 5	1050 0	276	0.005 03	10	123	0.0085 7	0.2	0.0008 98	0	7.66
280 SEMIFLUIDO CON FIBRA ECOPACT	1080 0	29 9	1060 0	280	0.005 02	10.1	124	0.008 65	0.205	0.0008 98	0	7.66
280 SEMIFLUIDO CON FIBRA Y RETARDANT E ECOPACT	1090 0	29 8	1060 0	280	0.005 04	10.1	124	0.008 65	0.205	0.0008 98	0	7.66
280 SEMIFLUIDO CON FRIBRA Y TEMPERATU RA ECOPACT	1090 0	29 9	1060 0	279	0.005 03	10.1	124	0.008 65	0.205	0.0008 98	0	7.66
280 SEMIFLUIDO 3/8 ECOPACT	1150 0	31 5	1110 0	294	0.0052 7	9.09	127	0.009 02	0.2	0.0008 98	0	7.66
280 SEMIFLUIDO 3/8 CON RETARDANT E ECOPACT	1160 0	31 7	1130 0	297	0.0053 7	9.1	128	0.009 09	0.2	0.0008 98	0	7.66
280 SEMIFLUIDO 3/8 CON TEMPERATU RA ECOPACT	1150 0	31 5	1110 0	294	0.0053 3	9.09	127	0.009 02	0.2	0.0008 98	0	7.66
280 SEMIFLUIDO 3/8 CON RETARDANT E Y TEMPERATU RA ECOPACT	1150 0	31 9	1120 0	297	0.0054 6	9.1	128	0.009 09	0.2	0.0008 98	0	7.66



280 FLUIDO ECOPACT	1100 0	30 1	1070 0	283	0.005 04	10.5	124	0.0087 2	0.2	0.0008 98	0	7.66
280 FLUIDO CON TEMPERATURA ECOPACT	1100 0	30 2	1070 0	282	0.0051	10.5	124	0.0087 2	0.2	0.0008 98	0	7.66
280 FLUIDO CON RETARDANTE ECOPACT	1110 0	30 6	1080 0	285	0.0051 7	10.5	125	0.008 8	0.2	0.0008 98	0	7.66
280 FLUIDO CON RETARDANTE Y TEMPERATURA ECOPACT	1110 0	30 6	1080 0	285	0.0051 7	10.5	125	0.008 8	0.2	0.0008 98	0	7.66
280 FLUIDO CON FIBRA ECOPACT	1110 0	30 4	1080 0	285	0.0051 6	10.5	125	0.008 81	0.205	0.0008 98	0	7.66
280 FLUIDO CON FIBRA Y RETARDANTE ECOPACT	1110 0	30 5	1080 0	285	0.0052 4	10.5	125	0.008 81	0.205	0.0008 98	0	7.66
280 FLUIDO CON FRIBRA Y TEMPERATURA ECOPACT	1110 0	30 5	1080 0	285	0.005 03	10.5	125	0.008 81	0.205	0.0008 98	0	7.66
280 FLUIDO 3/8 ECOPACT	1190 0	32 8	1160 0	306	0.0055	9.04	130	0.0093 2	0.2	0.0008 98	0	7.66
280 FLUIDO 3/8 CON RETARDANTE ECOPACT	1190 0	32 7	1160 0	306	0.005 62	9.04	130	0.0093 2	0.2	0.0008 98	0	7.66
280 FLUIDO 3/8 CON TEMPERATURA ECOPACT	1180 0	32 3	1150 0	306	0.0054 4	9.04	130	0.0093 2	0.2	0.0008 98	0	7.66
280 FLUIDO 3/8 CON RETARDANTE Y TEMPERATURA ECOPACT	1190 0	32 5	1160 0	305	0.0055	9.04	130	0.0093 2	0.2	0.0008 98	0	7.66



280 LANZADO ECOPACT	12000	326	11700	310	0.00561	13.1	131	0.00944	0.2	0.000898	0	7.66
280 LANZADO CON TEMPERATURA ECOPACT	12000	329	11700	308	0.00556	11.8	131	0.0094	0.2	0.000898	0	7.66
300 BOMBA ECOPACT	12700	351	12400	326	0.0059	7.22	136	0.00987	0.2	0.000898	0	7.66
300 BOMBA CON RETARDANTE ECOPACT	12700	352	12400	326	0.0058	7.22	136	0.00987	0.2	0.000898	0	7.66
300 BOMBA CON TEMPERATURA ECOPACT	12700	350	12400	326	0.00595	7.22	136	0.00987	0.2	0.000898	0	7.66
300 BOMBA CON RETARDANTE Y TEMPERATURA ECOPACT	12700	352	12400	326	0.006	7.22	136	0.00987	0.2	0.000898	0	7.66

Mix designs: 31 to 35 MPa

Table 14: Total life cycle (across modules in scope) impact results for Mix designs: 31 to 35MPa, assuming the geometric mean point values on a per 1 m³ of concrete basis.

a) Midpoint Impact Categories:

Indicator/LCI Metric	AP	EP	GWP	ODP	PCOP	ADPe	ADPf
Unit	moles of H ⁺ -Eq	kg N	kg CO ₂ -Eq	kg CFC-11-Eq	kg NO _x -Eq	kg Sb-Eq	MJ, net calorific value
Minimum	130	0.235	716	8.02e-05	1.7	0.00459	11100
Maximum	138	0.249	762	8.5e-05	1.8	0.00489	11800
Mean	135	0.243	742	8.3e-05	1.76	0.00476	11500
Median	136	0.245	749	8.37e-05	1.78	0.00481	11600
350 BOMBA ECOPACT	136	0.245	749	8.37e-05	1.78	0.00481	11600
350 BOMBA CON RETARDANTE ECOPACT	136	0.245	749	8.37e-05	1.78	0.00481	11600
350 BOMBA CON TEMPERATURA ECOPACT	136	0.245	749	8.37e-05	1.78	0.00481	11600



350 BOMBA CON RETARDANTE Y TEMPERATURA ECOPACT	136	0.245	749	8.37e-05	1.78	0.00481	11600
350 SEMIFLUIDO ECOPACT	131	0.236	716	8.02e-05	1.7	0.00459	11100
350 SEMIFLUIDO CON RETARDANTE ECOPACT	131	0.236	716	8.02e-05	1.7	0.00459	11100
350 SEMIFLUIDO CON TEMPERATURA ECOPACT	131	0.236	716	8.02e-05	1.7	0.00459	11100
350 SEMIFLUIDO CON RETARDANTE Y TEMPERATURA ECOPACT	130	0.235	716	8.02e-05	1.7	0.00459	11100
350 FLUIDO ECOPACT	138	0.249	762	8.5e-05	1.8	0.00489	11800
350 FLUIDO CON RETARDANTE ECOPACT	138	0.249	762	8.5e-05	1.8	0.00489	11800
350 FLUIDO CON TEMPERATURA ECOPACT	138	0.249	762	8.5e-05	1.8	0.00489	11800
350 FLUIDO CON RETARDANTE Y TEMPERATURA ECOPACT	138	0.249	762	8.5e-05	1.8	0.00489	11800

b) Inventory Metrics:

Indicator/L CI Metric	TPE	RE	NRE	NR R	RR	WD P	LFW	LFHW	CBW C	CWWC	CH W	CNH W
Unit	MJ-Eq	MJ-Eq	MJ-Eq	kg	m3	m3	kg waste	kg waste	m3	m3	kg	kg
Minimum	12300	340	12000	317	0.00562	7.75	133	0.00963	0.2	0.000898	0	7.66
Maximum	13200	362	12800	339	0.00614	7.93	138	0.0102	0.205	0.000898	0	7.66
Mean	12800	353	12500	329	0.00593	7.82	136	0.00995	0.203	0.000898	0	7.66
Median	13000	358	12600	332	0.00595	7.85	137	0.01	0.205	0.000898	0	7.66
350 BOMBA ECOPACT	12900	354	12500	333	0.00594	7.75	137	0.01	0.2	0.000898	0	7.66
350 BOMBA CON RETARDANTE ECOPACT	13000	360	12600	332	0.00596	7.75	137	0.01	0.2	0.000898	0	7.66
350 BOMBA CON	13000	358	12600	333	0.00589	7.75	137	0.01	0.2	0.000898	0	7.66



TEMPERATURA ECOPACT												
350 BOMBA CON RETARDANTE Y TEMPERATURA ECOPACT	12900	359	12600	331	0.00613	7.75	137	0.01	0.2	0.000898	0	7.66
350 SEMIFLUIDO ECOPACT	12300	340	12000	317	0.00562	7.93	133	0.00964	0.205	0.000898	0	7.66
350 SEMIFLUIDO CON RETARDANTE ECOPACT	12400	340	12000	318	0.00569	7.88	133	0.00964	0.205	0.000898	0	7.66
350 SEMIFLUIDO CON TEMPERATURA ECOPACT	12400	344	12000	318	0.0058	7.88	133	0.00964	0.205	0.000898	0	7.66
350 SEMIFLUIDO CON RETARDANTE Y TEMPERATURA ECOPACT	12300	340	12000	318	0.00577	7.8	133	0.00963	0.205	0.000898	0	7.66
350 FLUIDO ECOPACT	13200	361	12800	339	0.00604	7.85	138	0.0102	0.205	0.000898	0	7.66
350 FLUIDO CON RETARDANTE ECOPACT	13200	362	12800	338	0.0061	7.85	138	0.0102	0.205	0.000898	0	7.66
350 FLUIDO CON TEMPERATURA ECOPACT	13200	360	12800	338	0.00614	7.85	138	0.0102	0.205	0.000898	0	7.66
350 FLUIDO CON RETARDANTE Y TEMPERATURA ECOPACT	13100	362	12800	338	0.00613	7.85	138	0.0102	0.205	0.000898	0	7.66



Mix designs: 41 to 45 MPa

Table 15: Total life cycle (across modules in scope) impact results for Mix designs: 41 to 45MPa, assuming the geometric mean point values on a per 1 m³ of concrete basis.

a) Midpoint Impact Categories:

Indicator/LCI Metric	AP	EP	GWP	ODP	PCOP	ADPe	ADPf
Unit	moles of H ⁺ -Eq	kg N	kg CO ₂ -Eq	kg CFC-11-Eq	kg NO _x -Eq	kg Sb-Eq	MJ, net calorific value
Minimum	130	0.234	710	7.95e-05	1.69	0.00455	11000
Maximum	133	0.239	729	8.16e-05	1.73	0.00467	11300
Mean	132	0.237	723	8.09e-05	1.72	0.00463	11200
Median	133	0.239	729	8.16e-05	1.73	0.00467	11300
420 BOMBA ECOPACT	130	0.234	710	7.95e-05	1.69	0.00455	11000
420 BOMBA CON RETARDANTE ECOPACT	130	0.234	710	7.95e-05	1.69	0.00455	11000
420 BOMBA CON TEMPERATURA ECOPACT	130	0.234	710	7.95e-05	1.69	0.00455	11000
420 BOMBA CON RETARDANTE Y TEMPERATURA ECOPACT	130	0.234	710	7.95e-05	1.69	0.00455	11000
420 SEMIFLUIDO ECOPACT	133	0.239	729	8.16e-05	1.73	0.00467	11300
420 SEMIFLUIDO CON RETARDANTE ECOPACT	133	0.239	729	8.16e-05	1.73	0.00467	11300
420 SEMIFLUIDO CON TEMPERATURA ECOPACT	133	0.239	729	8.16e-05	1.73	0.00467	11300
420 SEMIFLUIDO CON RETARDANTE Y TEMPERATURA ECOPACT	133	0.239	729	8.16e-05	1.73	0.00467	11300
420 FLUIDO ECOPACT	133	0.239	729	8.16e-05	1.73	0.00467	11300
420 FLUIDO CON RETARDANTE ECOPACT	133	0.239	729	8.16e-05	1.73	0.00467	11300
420 FLUIDO CON TEMPERATURA ECOPACT	133	0.239	729	8.16e-05	1.73	0.00467	11300
420 FLUIDO CON RETARDANTE Y TEMPERATURA ECOPACT	133	0.239	729	8.16e-05	1.73	0.00467	11300



b) Inventory Metrics:

Indicator/L CI Metric	TPE	RE	NRE	NR R	RR	WD P	LFW	LFHW	CBW C	CWWC	CH W	CNH W
Unit	MJ- Eq	MJ - Eq	MJ- Eq	kg	m3	m3	kg wast e	kg waste	m3	m3	kg	kg
Minimum	1220 0	33 5	1190 0	314	0.005 69	7.94	132	0.0095 6	0.2	0.0008 98	0	7.66
Maximum	1260 0	35 0	1230 0	324	0.0059 4	8	135	0.0097 9	0.2	0.0008 98	0	7.66
Mean	1250 0	34 4	1210 0	320	0.0058 2	7.96	134	0.0097 1	0.2	0.0008 98	0	7.66
Median	1260 0	34 6	1220 0	323	0.0058 3	7.94	135	0.0097 9	0.2	0.0008 98	0	7.66
ECOPACT	1220 0	33 5	1190 0	315	0.0057 1	8	132	0.0095 6	0.2	0.0008 98	0	7.66
420 BOMBA CON RETARDANT E ECOPACT	1230 0	34 0	1190 0	314	0.0057 5	8	132	0.0095 6	0.2	0.0008 98	0	7.66
420 BOMBA CON TEMPERATU RA ECOPACT	1220 0	33 7	1190 0	314	0.0057 2	8	132	0.0095 6	0.2	0.0008 98	0	7.66
420 BOMBA CON RETARDANT E Y TEMPERATU RA ECOPACT	1220 0	34 0	1190 0	315	0.005 69	8	132	0.0095 6	0.2	0.0008 98	0	7.66
420 SEMIFLUIDO ECOPACT	1260 0	35 0	1220 0	323	0.0058 2	7.94	135	0.0097 9	0.2	0.0008 98	0	7.66
420 SEMIFLUIDO CON RETARDANT E ECOPACT	1260 0	34 6	1230 0	322	0.0059 4	7.94	135	0.0097 9	0.2	0.0008 98	0	7.66
420 SEMIFLUIDO CON TEMPERATU RA ECOPACT	1260 0	34 5	1220 0	323	0.0057 3	7.94	135	0.0097 9	0.2	0.0008 98	0	7.66
420 SEMIFLUIDO CON RETARDANT E Y	1260 0	34 7	1230 0	323	0.0058 7	7.94	135	0.0097 9	0.2	0.0008 98	0	7.66



TEMPERATURA ECOPACT												
420 FLUIDO ECOPACT	12500	350	12300	324	0.00591	7.94	135	0.00979	0.2	0.000898	0	7.66
420 FLUIDO CON RETARDANTE ECOPACT	12600	348	12200	323	0.00594	7.94	135	0.00979	0.2	0.000898	0	7.66
420 FLUIDO CON TEMPERATURA ECOPACT	12600	347	12200	323	0.00593	7.94	135	0.00979	0.2	0.000898	0	7.66
420 FLUIDO CON RETARDANTE Y TEMPERATURA ECOPACT	12600	346	12200	324	0.00584	7.94	135	0.00979	0.2	0.000898	0	7.66

ADDITIONAL ENVIRONMENTAL INFO

No regulated substances of very high concern are utilized on site.

REFERENCES

ASTM Standards:

- ASTM A36/A36M Standard Specification for Carbon Structural Steel
- ASTM A108 Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished
- ASTM A123/A123M Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- ASTM A153/A153M Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
- ASTM A184 Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement
- ASTM A307 Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength
- ASTM A416/A416M Standard Specification for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete
- ASTM A555/A555M Standard Specification for General Requirements for Stainless Steel Wire and Wire Rods
- ASTM A615/A615M Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
- ASTM A666 Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar



- ASTM A706/A706M Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement
- ASTM A767/A767M Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement
- ASTM A775/A775M Standard Specification for Epoxy-Coated Steel Reinforcing Bars
- ASTM A820/A820M Standard Specification for Steel Fibers for Fiber-Reinforced Concrete
- ASTM A884/A884M Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement
- ASTM A934/A934M Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars
- ASTM A1064/A1064M Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
- ASTM C33/C33M Standard Specification for Concrete Aggregates
- ASTM C94 Standard Specification for Ready-Mixed Concrete
- ASTM C150/C150M Standard Specification for Portland Cement
- ASTM C260/C260M Standard Specification for Air-Entraining Admixtures for Concrete
- ASTM C595 Standard Specification for Blended Hydraulic Cements
- ASTM C618 Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
- ASTM C979/C979M Standard Specification for Pigments for Integrally Colored Concrete
- ASTM C989/C989M Standard Specification for Slag Cement for Use in Concrete and Mortars
- ASTM C1017/C1017M Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
- ASTM C1116/C1116M Standard Specification for Fiber-Reinforced Concrete
- ASTM C1157/C1157M Standard Performance Specification for Hydraulic Cement
- ASTM C1240 Standard Specification for Silica Fume Used in Cementitious Mixtures
- ASTM C1602/C1602M Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete
- ASTM G109 Standard Test Method for Determining Effects of Chemical Admixtures on Corrosion of Embedded Steel Reinforcement in Concrete Exposed to Chloride Environments
- ASTM C330/C330M Standard Specification for Lightweight Aggregates for Structural Concrete
- ASTM C494/C494M Standard Specification for Chemical Admixtures for Concrete

CSA Standards:

- CAN/CGSB-1.40 Anticorrosive Structural Steel Alkyd Primer
- CAN/CSA G30.18 Carbon steel bars for concrete reinforcement
- CAN/CSA A3000 Cementitious Materials Compendium
- CAN/CSA G40.20/G40.21 General requirements for rolled or welded structural quality steel / Structural quality steel
- CAN/CSA A23.1/A23.2 Concrete Materials and Methods of Concrete Construction/Test methods and Standard Practices for Concrete



- CAN/CSA A23.4 Precast concrete - Materials and construction
- CSA S806 Design and construction of building structures with fiber-reinforced polymers

ISO Standards:

- ISO 6707-1: 2014 Buildings and Civil Engineering Works - Vocabulary - Part 1: General Terms
- ISO 14021:1999 Environmental Labels and Declarations - Self-declared Environmental Claims (Type II Environmental Labeling)
- ISO 14025:2006 Environmental Labels and Declarations - Type III Environmental Declarations - Principles and Procedures
- ISO 14040:2006 Environmental Management - Life Cycle Assessment - Principles and Framework
- ISO 14044:2006 Environmental Management - Life Cycle Assessment - Requirements and Guidelines
- ISO 14067:2018 Greenhouse Gases - Carbon Footprint of Products - Requirements and Guidelines for Quantification
- ISO 14050:2009 Environmental Management - Vocabulary
- ISO 21930:2017 Sustainability in Building Construction - Environmental Declaration of Building Products

EN Standards:

- EN 16757 Sustainability of construction works - Environmental product declarations - Product Category Rules for concrete and concrete elements.
- EN 15804 Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products.

Other References:

- US EPA Waste Reduction Model (WARM), Fly Ash
Chapter: <http://epa.gov/climatechange/wycd/waste/downloads/fly-ash-chapter10-28-10.pdf>
- American Concrete Institute (ACI) 211: Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.
- ACI 318-14 Building Code Requirements for Structural Concrete and Commentary. American Concrete Institute. Farmington Hills, MI, USA available at <https://www.concrete.org/store/>
- Mather, B & Ozyildirim, C. (2002). SP-1(02) : Concrete Primer. American Concrete Institute: SP0102. American Concrete Institute. Farmington Hills, MI, USA available at <https://www.concrete.org/store/>
- NSF International (February 2019). Product Category Rules (PCR) for ISO 14025 Type III Environmental Product Declarations (EPDs) of Concrete v1.2.
- Product Category Rules for Preparing an Environmental Product Declaration for Precast Concrete (UN CPC 37550), ASTM International, March 2015. https://www.astm.org/CERTIFICATION/DOCS/266.PCR_for_Precast_Concrete.pdf



- USGBC LEED v4 for Building Design and Construction, 11 Jan 2019 available at <https://www.usgbc.org/resources/pcr-committee-process-resources-part-b>
- USGBC PCR Committee Process & Resources: Part B, USGBC, 7 July 2017 available at <https://www.usgbc.org/resources/pcr-committee-process-resources-part-b>.

