ENVIRONMENTAL PRODUCT DECLARATION

Environmental Product Declaration for concrete products produced by **HOLCIM EL SALVADOR AT SANTA ANA** facility in Santa Ana, El Salvador.

HOLCIM

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 Rul (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 ☐ ; External X Third Party Verifier Geoffrey Guest, Certified 3rd Party Verifier under the International EPD Program (www.environdec.com), CSA Group (www.csaregistries.ca)
Date of Issue:	09 February 2023
Period of Validity:	5 years; valid until 09 February 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 concrete facility in San Miguel, 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	H2O 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	H2O 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	H2O 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	H2O 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

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	H2O 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
GU Cement	cement, unspecified	1	0	0	0
Fiber	polypropylene, granulate	1	0	0	0.05
Water	tap water	1	0	0	0.05
Gravel	gravel, crushed	1	0	0	0.05
River sand 1	sand	1	0	0	0.05
River sand 2	sand	1	0	0	0.05
Additives	chemical, organic	1	0	0	0.05

SYSTEM BOUNDARIES

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

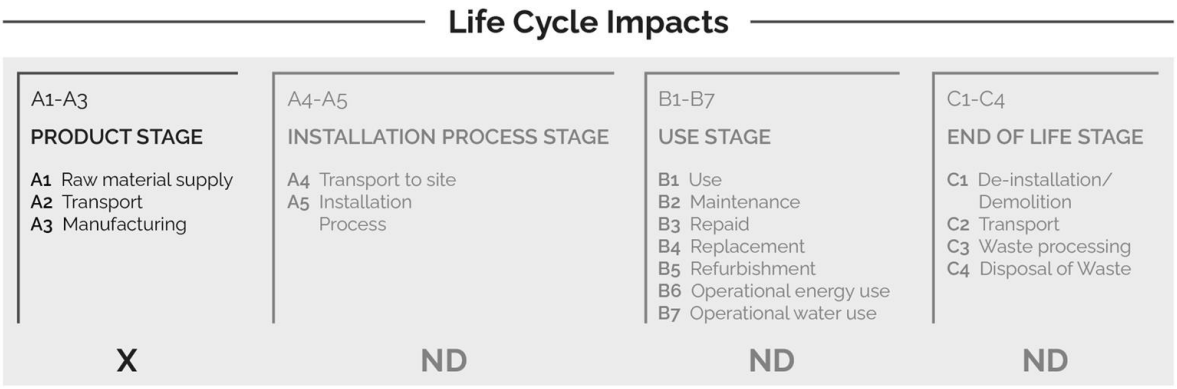

Figure 1: **General life cycle phases for consideration in a construction works system.**

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.

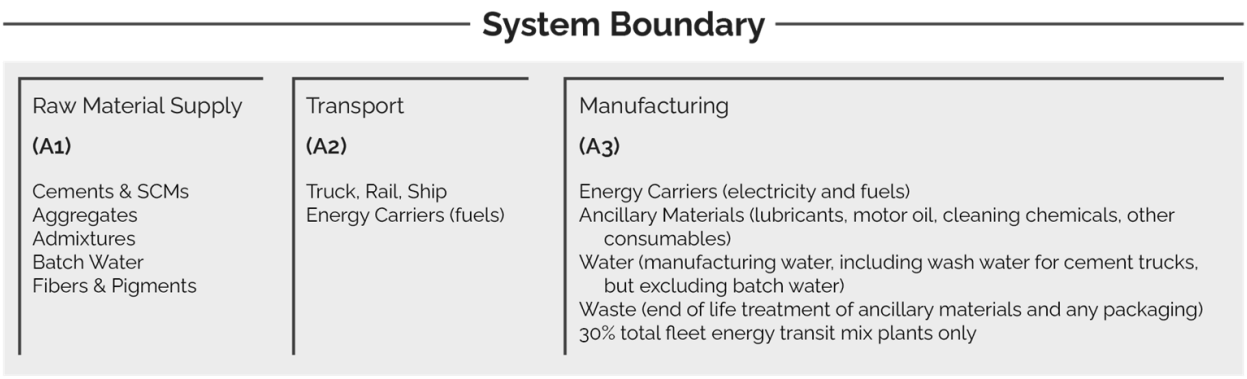

Figure 2: **General system inputs considered in the product system and categorized by modules in scope**

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 Santa Rosa 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 9: **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
Fiber	polypropylene production, granulate/polypropylene, granulate/RoW/kg	ecoinvent v3.8	San Salvador	v3.8 in 2021	3	3	3	3	3
Water	tap water production, conventional with biological treatment/tap water/RoW/kg	ecoinvent v3.8	Santa Tecla	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

GU Cement	Cemento Fuerte Industria	Progam Operator: Labeling Sustainability-EPD ID: ae8c3b6d-1972-4402-b184-115794c37a67	Santa Ana	21 July 2023	3	3	3	3	3
River sand 1	sand quarry operation, extraction from river bed/sand/BR/kg; Note: modifications made (see ecoinvent activity changes table)	ecoinvent v3.8	Santa Tecla	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	Santa Tecla	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 CO2-Eq**	**kg CFC-11-Eq**	**kg NOx-Eq**	**kg Sb-Eq**	**MJ, net calorific value**
Minimum	68.1	0.115	355	4.01e-05	0.911	0.00228	5560
Maximum	78.3	0.132	408	4.59e-05	1.04	0.00265	6450
Mean	73	0.123	381	4.29e-05	0.974	0.00245	5980
Median	72	0.121	372	4.22e-05	0.964	0.0024	5840
100 BOMBA ECOPACT	68.1	0.115	355	4.01e-05	0.911	0.00228	5560
100 BOMBA CON TEMPERATURA ECOPACT	68.1	0.115	355	4.01e-05	0.911	0.00228	5560
100 BOMBA CON RETARDANTE ECOPACT	68.2	0.115	356	4.01e-05	0.913	0.00229	5580
100 BOMBA CON RETARDANTE Y TEMPERATURA ECOPACT	68.2	0.115	356	4.01e-05	0.913	0.00229	5580
100 BOMBA CON FIBRA ECOPACT	70.5	0.118	370	4.14e-05	0.942	0.00238	5800

100 BOMBA CON FIBRA Y RETARDANTE ECOPACT	70.6	0.119	370	4.15e-05	0.943	0.00238	5820
100 BOMBA CON FRIBRA Y TEMPERATURA ECOPACT	70.5	0.118	370	4.14e-05	0.942	0.00238	5800
100 DIRECTO ECOPACT	69.4	0.117	359	4.07e-05	0.93	0.0023	5610
100 DIRECTO CON TEMPERATURA ECOPACT	69.4	0.117	359	4.07e-05	0.93	0.0023	5610
100 DIRECTO CON RETARDANTE ECOPACT	71.9	0.121	372	4.22e-05	0.963	0.00239	5830
100 DIRECTO CON RETARDANTE Y TEMPERATURA ECOPACT	71.9	0.121	372	4.22e-05	0.963	0.00239	5830
100 DIRECTO CON FIBRA ECOPACT	72	0.121	373	4.22e-05	0.964	0.0024	5850
100 DIRECTO CON FIBRA Y RETARDANTE ECOPACT	72.2	0.121	374	4.22e-05	0.966	0.0024	5870
100 DIRECTO CON FRIBRA Y TEMPERATURA ECOPACT	72	0.121	373	4.22e-05	0.964	0.0024	5850
140 DIRECTO ECOPACT	77.7	0.131	407	4.56e-05	1.03	0.00264	6420
140 DIRECTO CON RETARDANTE ECOPACT	77.7	0.131	407	4.56e-05	1.03	0.00264	6430
140 DIRECTO CON TEMPERATURA ECOPACT	77.7	0.131	407	4.56e-05	1.03	0.00264	6420
140 DIRECTO CON RETARDANTE Y TEMPERATURA ECOPACT	77.7	0.131	407	4.56e-05	1.03	0.00264	6430
140 BOMBA ECOPACT	78.2	0.131	408	4.59e-05	1.04	0.00264	6440
140 BOMBA CON RETARDANTE ECOPACT	78.3	0.132	408	4.59e-05	1.04	0.00265	6450
140 BOMBA CON TEMPERATURA ECOPACT	78.2	0.131	408	4.59e-05	1.04	0.00264	6440
140 BOMBA CON RETARDANTE Y	78.3	0.132	408	4.59e-05	1.04	0.00265	6450

TEMPERATURA ECOPACT							

b) Inventory Metrics:

Indicator/LCI Metric	TPE	RE	NRE	NRR	RR	WDP	LFW	LFHW	CBWC	CWWC	CHW	CNHW
Unit	MJ-Eq	MJ-Eq	MJ-Eq	kg	m3	m3	kg waste	kg waste	m3	m3	kg	kg
Minimum	6180	173	6000	158	0.0029	10.6	52.3	0.0049	0.178	4.83e-05	0.0753	0
Maximum	7190	202	7000	184	0.00344	12	60.5	0.0056	0.189	4.83e-05	0.0753	0
Mean	6660	187	6470	170	0.00316	11.4	56.5	0.00525	0.185	4.83e-05	0.0753	0
Median	6500	182	6310	166	0.00308	11.8	56.4	0.0052	0.184	4.83e-05	0.0753	0
100 BOMBA ECOPACT	6180	173	6010	159	0.0029	12	52.3	0.0049	0.184	4.83e-05	0.0753	0
100 BOMBA CON TEMPERATURA ECOPACT	6190	175	6000	158	0.00294	12	52.3	0.0049	0.184	4.83e-05	0.0753	0
100 BOMBA CON RETARDANTE ECOPACT	6210	174	6070	159	0.00296	12	52.4	0.00491	0.184	4.83e-05	0.0753	0
100 BOMBA CON RETARDANTE Y TEMPERATURA ECOPACT	6220	175	6050	159	0.00291	12	52.4	0.00491	0.184	4.83e-05	0.0753	0
100 BOMBA CON FIBRA ECOPACT	6450	180	6310	166	0.00306	12	53.9	0.00506	0.189	4.83e-05	0.0753	0
100 BOMBA CON FIBRA Y RETARDANTE ECOPACT	6500	182	6270	166	0.0031	12	54	0.00507	0.189	4.83e-05	0.0753	0
100 BOMBA CON FRIBRA Y TEMPERATURA ECOPACT	6450	180	6280	165	0.00308	12	53.9	0.00506	0.189	4.83e-05	0.0753	0
100 DIRECTO ECOPACT	6240	174	6050	160	0.00297	11.4	54.8	0.00502	0.178	4.83e-05	0.0753	0
100 DIRECTO CON	6250	176	6060	160	0.00294	11.4	54.8	0.00502	0.178	4.83e-05	0.0753	0

TEMPERATURA ECOPACT												
100 DIRECTO CON RETARDANTE ECOPACT	6500	182	6300	166	0.00309	11.8	56.4	0.0052	0.178	4.83e-05	0.0753	0
100 DIRECTO CON RETARDANTE Y TEMPERATURA ECOPACT	6490	182	6290	166	0.00306	11.8	56.4	0.0052	0.178	4.83e-05	0.0753	0
100 DIRECTO CON FIBRA ECOPACT	6500	181	6310	167	0.00308	11.8	56.5	0.0052	0.189	4.83e-05	0.0753	0
100 DIRECTO CON FIBRA Y RETARDANTE ECOPACT	6520	183	6350	168	0.00314	11.8	56.6	0.00521	0.184	4.83e-05	0.0753	0
100 DIRECTO CON FRIBRA Y TEMPERATURA ECOPACT	6520	183	6310	167	0.00308	11.8	56.5	0.0052	0.189	4.83e-05	0.0753	0
140 DIRECTO ECOPACT	7140	200	6950	183	0.00335	10.6	59.6	0.00555	0.184	4.83e-05	0.0753	0
140 DIRECTO CON RETARDANTE ECOPACT	7150	201	6960	183	0.00338	10.6	59.7	0.00555	0.184	4.83e-05	0.0753	0
140 DIRECTO CON TEMPERATURA ECOPACT	7150	202	6930	183	0.00341	10.6	59.6	0.00555	0.184	4.83e-05	0.0753	0
140 DIRECTO CON RETARDANTE Y TEMPERATURA ECOPACT	7140	200	6950	183	0.00341	10.6	59.7	0.00555	0.184	4.83e-05	0.0753	0
140 BOMBA ECOPACT	7160	201	6990	184	0.00336	10.9	60.5	0.0056	0.189	4.83e-05	0.0753	0
140 BOMBA CON RETARDANTE ECOPACT	7180	200	7000	183	0.00338	10.9	60.5	0.0056	0.189	4.83e-05	0.0753	0
140 BOMBA CON TEMPERATURA ECOPACT	7180	200	6970	183	0.0034	10.9	60.5	0.0056	0.189	4.83e-05	0.0753	0
140 BOMBA CON	7190	200	6950	183	0.00344	10.9	60.5	0.0056	0.189	4.83e-05	0.0753	0

RETARDANTE Y TEMPERATURA ECOPACT												

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 CO2-Eq	kg CFC-11-Eq	kg NOx-Eq	kg Sb-Eq	MJ, net calorific value
Minimum	81.5	0.137	427	4.77e-05	1.08	0.00278	6760
Maximum	85.2	0.143	445	4.97e-05	1.13	0.0029	7060
Mean	83.3	0.14	436	4.87e-05	1.1	0.00284	6900
Median	83.8	0.141	437	4.9e-05	1.11	0.00285	6920
180 BOMBA ECOPACT	81.5	0.137	427	4.77e-05	1.08	0.00278	6760
180 BOMBA CON TEMPERATURA ECOPACT	81.5	0.137	427	4.77e-05	1.08	0.00278	6760
180 BOMBA CON RETARDANTE ECOPACT	81.7	0.137	428	4.78e-05	1.08	0.00279	6780
180 BOMBA CON RETARDANTE Y TEMPERATURA ECOPACT	81.6	0.137	428	4.78e-05	1.08	0.00279	6780
180 BOMBA CON FIBRA ECOPACT	83.9	0.141	441	4.91e-05	1.11	0.00287	6990
180 BOMBA CON FIBRA Y RETARDANTE ECOPACT	84	0.141	442	4.91e-05	1.11	0.00288	7010
180 BOMBA CON FRIBRA Y TEMPERATURA ECOPACT	83.9	0.141	441	4.91e-05	1.11	0.00287	6990
180 DIRECTO ECOPACT	82.6	0.139	430	4.83e-05	1.1	0.00279	6790
180 DIRECTO CON TEMPERATURA ECOPACT	82.6	0.139	430	4.83e-05	1.1	0.00279	6790
180 DIRECTO CON RETARDANTE ECOPACT	83.8	0.141	437	4.9e-05	1.11	0.00285	6920

180 DIRECTO CON RETARDANTE Y TEMPERATURA ECOPACT	83.8	0.141	437	4.9e-05	1.11	0.00285	6920
180 DIRECTO CON FIBRA ECOPACT	85	0.143	444	4.96e-05	1.13	0.00289	7030
180 DIRECTO CON FIBRA Y RETARDANTE ECOPACT	85.2	0.143	445	4.97e-05	1.13	0.0029	7060
180 DIRECTO CON FRIBRA Y TEMPERATURA ECOPACT	85	0.143	444	4.96e-05	1.13	0.00289	7030

b) Inventory Metrics:

Indicator/LCI Metric	**TPE**	**RE**	**NRE**	**NRR**	**RR**	**WDP**	**LFW**	**LFHW**	**CBWC**	**CWWC**	**CHW**	**CNHW**
Unit	**MJ-Eq**	**MJ-Eq**	**MJ-Eq**	**kg**	**m3**	**m3**	**kg waste**	**kg waste**	**m3**	**m3**	**kg**	**kg**
Minimum	7520	210	7290	192	0.00355	10.2	61.6	0.00578	0.178	4.83e-05	0.0753	0
Maximum	7870	220	7630	201	0.00374	11	65.3	0.00604	0.189	4.83e-05	0.0753	0
Mean	7680	215	7470	197	0.00366	10.5	63.4	0.00591	0.184	4.83e-05	0.0753	0
Median	7690	216	7480	197	0.00366	10.5	63.4	0.00593	0.184	4.83e-05	0.0753	0
180 BOMBA ECOPACT	7520	212	7320	192	0.00355	11	61.6	0.00578	0.184	4.83e-05	0.0753	0
180 BOMBA CON TEMPERATURA ECOPACT	7520	210	7290	193	0.00362	11	61.6	0.00578	0.184	4.83e-05	0.0753	0
180 BOMBA CON RETARDANTE ECOPACT	7550	211	7340	194	0.00362	10.8	61.7	0.00579	0.184	4.83e-05	0.0753	0
180 BOMBA CON RETARDANTE Y TEMPERATURA ECOPACT	7540	212	7350	193	0.00359	10.6	61.7	0.00578	0.184	4.83e-05	0.0753	0
180 BOMBA CON FIBRA ECOPACT	7770	219	7580	199	0.00371	10.6	63.1	0.00593	0.189	4.83e-05	0.0753	0
180 BOMBA CON FIBRA Y	7800	217	7610	200	0.00362	10.6	63.2	0.00594	0.189	4.83e-05	0.0753	0

RETARDANTE ECOPACT												
180 BOMBA CON FRIBRA Y TEMPERATURA ECOPACT	7780	218	7520	199	0.00373	10.6	63.1	0.00593	0.189	4.83e-05	0.0753	0
180 DIRECTO ECOPACT	7570	212	7360	194	0.00366	10.4	63.7	0.00588	0.178	4.83e-05	0.0753	0
180 DIRECTO CON TEMPERATURA ECOPACT	7550	214	7390	193	0.00364	10.4	63.7	0.00588	0.178	4.83e-05	0.0753	0
180 DIRECTO CON RETARDANTE ECOPACT	7700	215	7490	197	0.00369	10.2	64.5	0.00596	0.178	4.83e-05	0.0753	0
180 DIRECTO CON RETARDANTE Y TEMPERATURA ECOPACT	7680	216	7480	197	0.00365	10.2	64.5	0.00596	0.178	4.83e-05	0.0753	0
180 DIRECTO CON FIBRA ECOPACT	7840	218	7620	200	0.00374	10.3	65.2	0.00603	0.189	4.83e-05	0.0753	0
180 DIRECTO CON FIBRA Y RETARDANTE ECOPACT	7870	219	7630	201	0.00373	10.3	65.3	0.00604	0.189	4.83e-05	0.0753	0
180 DIRECTO CON FRIBRA Y TEMPERATURA ECOPACT	7820	220	7610	200	0.00374	10.3	65.2	0.00603	0.189	4.83e-05	0.0753	0

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 CO2-Eq**	**kg CFC-11-Eq**	**kg NOx-Eq**	**kg Sb-Eq**	**MJ, net calorific value**
Minimum	92.4	0.156	492	5.46e-05	1.22	0.0032	7750
Maximum	132	0.222	694	7.77e-05	1.72	0.00451	10900
Mean	99.9	0.169	536	5.91e-05	1.31	0.0035	8470
Median	98.8	0.166	529	5.82e-05	1.3	0.00346	8390

210 DIRECTO ECOPACT	96.4	0.162	508	5.67e-05	1.27	0.0033	7980
210 DIRECTO CON TEMPERATURA ECOPACT	96.4	0.162	508	5.67e-05	1.27	0.0033	7980
210 DIRECTO CON RETARDANTE ECOPACT	96.5	0.162	509	5.67e-05	1.27	0.0033	8000
210 DIRECTO CON RETARDANTE Y TEMPERATURA ECOPACT	96.5	0.162	509	5.67e-05	1.27	0.0033	8000
210 DIRECTO CON FIBRA ECOPACT	98.8	0.166	522	5.8e-05	1.3	0.00339	8220
210 DIRECTO CON FIBRA Y RETARDANTE ECOPACT	98.9	0.166	523	5.81e-05	1.3	0.0034	8240
210 DIRECTO CON FRIBRA Y TEMPERATURA ECOPACT	98.8	0.166	522	5.8e-05	1.3	0.00339	8220
210 BOMBA ECOPACT	93.5	0.158	495	5.51e-05	1.23	0.00322	7810
210 BOMBA CON TEMPERATURA ECOPACT	93.5	0.158	495	5.51e-05	1.23	0.00322	7810
210 BOMBA CON RETARDANTE ECOPACT	92.8	0.156	494	5.47e-05	1.22	0.00322	7810
210 BOMBA CON RETARDANTE Y TEMPERATURA ECOPACT	92.8	0.156	494	5.47e-05	1.22	0.00322	7810
210 BOMBA CON FIBRA ECOPACT	96	0.161	509	5.65e-05	1.26	0.00332	8050
210 BOMBA CON FIBRA Y RETARDANTE ECOPACT	95.3	0.16	508	5.6e-05	1.25	0.00332	8050
210 BOMBA CON FRIBRA Y TEMPERATURA ECOPACT	96	0.161	509	5.65e-05	1.26	0.00332	8050
210 BOMBA PP ECOPACT	92.4	0.156	492	5.46e-05	1.22	0.0032	7750
210 BOMBA PP CON TEMPERATURA ECOPACT	92.4	0.156	492	5.46e-05	1.22	0.0032	7750
210 SEMIFLUIDO ECOPACT	98.5	0.166	526	5.81e-05	1.29	0.00343	8310

210 SEMIFLUIDO CON TEMPERATURA ECOPACT	98.5	0.166	526	5.81e-05	1.29	0.00343	8310
210 SEMIFLUIDO CON RETARDANTE ECOPACT	98.7	0.166	527	5.82e-05	1.29	0.00344	8340
210 SEMIFLUIDO CON RETARDANTE Y TEMPERATURA ECOPACT	98.7	0.166	527	5.82e-05	1.29	0.00344	8340
210 SEMIFLUIDO CON FIBRA ECOPACT	99.1	0.167	528	5.83e-05	1.3	0.00345	8360
210 SEMIFLUIDO CON FIBRA Y RETARDANTE ECOPACT	99.3	0.167	529	5.84e-05	1.3	0.00346	8390
210 SEMIFLUIDO CON FRIBRA Y TEMPERATURA ECOPACT	99.1	0.167	528	5.83e-05	1.3	0.00345	8360
210 SEMIFLUIDO 3/8 ECOPACT	103	0.174	564	6.14e-05	1.34	0.00368	8910
210 SEMIFLUIDO 3/8 CON RETARDANTE ECOPACT	104	0.176	571	6.21e-05	1.35	0.00373	9040
210 SEMIFLUIDO 3/8 CON TEMPERATURA ECOPACT	103	0.174	564	6.14e-05	1.34	0.00368	8910
210 SEMIFLUIDO 3/8 CON RETARDANTE Y TEMPERATURA ECOPACT	104	0.176	571	6.21e-05	1.35	0.00373	9040
210 FLUIDO ECOPACT	98.1	0.166	530	5.81e-05	1.29	0.00346	8390
210 FLUIDO CON TEMPERATURA ECOPACT	98.1	0.166	530	5.81e-05	1.29	0.00346	8390
210 FLUIDO CON RETARDANTE ECOPACT	98.3	0.166	530	5.82e-05	1.29	0.00347	8410
210 FLUIDO CON RETARDANTE Y TEMPERATURA ECOPACT	98.3	0.166	530	5.82e-05	1.29	0.00347	8410
210 FLUIDO CON FIBRA ECOPACT	99.4	0.168	537	5.88e-05	1.3	0.00351	8530
210 FLUIDO CON FIBRA Y RETARDANTE ECOPACT	99.6	0.168	538	5.89e-05	1.3	0.00352	8550

210 FLUIDO CON FRIBRA Y TEMPERATURA ECOPACT	99.6	0.168	538	5.89e-05	1.3	0.00352	8550
210 FLUIDO 3/8 ECOPACT	106	0.18	583	6.33e-05	1.38	0.00381	9210
210 FLUIDO 3/8 CON RETARDANTE ECOPACT	106	0.18	584	6.34e-05	1.38	0.00381	9230
210 FLUIDO 3/8 CON TEMPERATURA ECOPACT	106	0.18	583	6.33e-05	1.38	0.00381	9210
210 FLUIDO 3/8 CON RETARDANTE Y TEMPERATURA ECOPACT	106	0.18	584	6.34e-05	1.38	0.00381	9230
210 LANZADO ECOPACT	105	0.179	584	6.33e-05	1.37	0.0038	9190
210 LANZADO CON TEMPERATURA ECOPACT	105	0.179	584	6.33e-05	1.37	0.0038	9190
210 PERMEABLE ECOPACT	132	0.222	694	7.77e-05	1.72	0.00451	10900
245 DIRECTO ECOPACT	102	0.171	537	5.98e-05	1.34	0.00349	8450
245 BOMBA ECOPACT	101	0.171	540	5.98e-05	1.33	0.00352	8520
250 DIRECTO ECOPACT	102	0.171	537	5.98e-05	1.34	0.00349	8450
250 BOMBA ECOPACT	101	0.171	540	5.98e-05	1.33	0.00352	8520

b) Inventory Metrics:

Indicator/LCI Metric	**TPE**	**RE**	**NRE**	**NRR**	**RR**	**WDP**	**LFW**	**LFHW**	**CBWC**	**CWWC**	**CHW**	**CNHW**
Unit	**MJ-Eq**	**MJ-Eq**	**MJ-Eq**	**kg**	**m3**	**m3**	**kg waste**	**kg waste**	**m3**	**m3**	**kg**	**kg**
Minimum	8630	241	8400	221	0.00408	1.01	69.2	0.00654	0.105	4.83e-05	0.0753	0
Maximum	12100	344	11700	310	0.00575	12.6	109	0.00946	0.205	4.83e-05	0.0753	0
Mean	9430	264	9170	242	0.00446	10.2	74.1	0.00703	0.189	4.83e-05	0.0753	0
Median	9350	261	9060	239	0.00442	9.91	73.4	0.00696	0.189	4.83e-05	0.0753	0
210 DIRECTO ECOPACT	8880	253	8610	228	0.00421	9.13	74.4	0.00685	0.178	4.83e-05	0.0753	0

210 DIRECTO CON TEMPERATURA ECOPACT	8900	250	8630	228	0.00423	9.13	74.4	0.00685	0.178	4.83e-05	0.0753	0
210 DIRECTO CON RETARDANTE ECOPACT	8860	252	8640	228	0.00424	9.13	74.5	0.00686	0.178	4.83e-05	0.0753	0
210 DIRECTO CON RETARDANTE Y TEMPERATURA ECOPACT	8890	251	8640	229	0.00425	9.13	74.5	0.00686	0.178	4.83e-05	0.0753	0
210 DIRECTO CON FIBRA ECOPACT	9160	256	8900	235	0.00436	8.94	76	0.007	0.189	4.83e-05	0.0753	0
210 DIRECTO CON FIBRA Y RETARDANTE ECOPACT	9210	258	8920	235	0.00429	8.94	76.1	0.00701	0.189	4.83e-05	0.0753	0
210 DIRECTO CON FRIBRA Y TEMPERATURA ECOPACT	9160	256	8890	235	0.00429	8.94	76	0.007	0.189	4.83e-05	0.0753	0
210 BOMBA ECOPACT	8690	244	8440	223	0.0041	9.8	71.6	0.00665	0.184	4.83e-05	0.0753	0
210 BOMBA CON TEMPERATURA ECOPACT	8660	243	8460	223	0.00415	9.8	71.6	0.00665	0.184	4.83e-05	0.0753	0
210 BOMBA CON RETARDANTE ECOPACT	8730	243	8470	223	0.00417	10.4	69.2	0.00654	0.189	4.83e-05	0.0753	0
210 BOMBA CON RETARDANTE Y TEMPERATU	8690	241	8440	223	0.00414	10.4	69.2	0.00654	0.189	4.83e-05	0.0753	0

RA ECOPACT												
210 BOMBA CON FIBRA ECOPACT	9020	251	8740	230	0.00422	9.82	73	0.0068	0.189	4.83e-05	0.0753	0
210 BOMBA CON FIBRA Y RETARDANTE ECOPACT	8960	252	8730	229	0.00429	10.4	70.6	0.00669	0.189	4.83e-05	0.0753	0
210 BOMBA CON FRIBRA Y TEMPERATURA ECOPACT	8930	250	8700	230	0.00423	9.82	73	0.0068	0.189	4.83e-05	0.0753	0
210 BOMBA PP ECOPACT	8640	243	8420	221	0.00412	10.3	69.7	0.00655	0.184	4.83e-05	0.0753	0
210 BOMBA PP CON TEMPERATURA ECOPACT	8630	243	8400	221	0.00408	10.3	69.7	0.00655	0.184	4.83e-05	0.0753	0
210 SEMIFLUIDO ECOPACT	9250	260	8990	237	0.00438	9.89	73.4	0.00693	0.189	4.83e-05	0.0753	0
210 SEMIFLUIDO CON TEMPERATURA ECOPACT	9230	259	8990	238	0.00442	9.89	73.4	0.00693	0.189	4.83e-05	0.0753	0
210 SEMIFLUIDO CON RETARDANTE ECOPACT	9280	259	9040	238	0.00434	9.89	73.5	0.00694	0.189	4.83e-05	0.0753	0
210 SEMIFLUIDO CON RETARDANTE Y TEMPERATURA ECOPACT	9300	261	9030	238	0.00438	9.89	73.5	0.00694	0.189	4.83e-05	0.0753	0
210 SEMIFLUIDO CON FIBRA ECOPACT	9330	261	9010	238	0.00436	9.9	74.1	0.00697	0.2	4.83e-05	0.0753	0
210 SEMIFLUIDO CON FIBRA	9360	259	9060	239	0.00442	9.91	74.2	0.00699	0.2	4.83e-05	0.0753	0

Y RETARDANTE ECOPACT												
210 SEMIFLUIDO CON FRIBRA Y TEMPERATURA ECOPACT	9330	261	9050	238	0.00435	9.9	74.1	0.00697	0.2	4.83e-05	0.0753	0
210 SEMIFLUIDO 3/8 ECOPACT	9890	277	9640	255	0.0046	11.6	72.5	0.00717	0.2	4.83e-05	0.0753	0
210 SEMIFLUIDO 3/8 CON RETARDANTE ECOPACT	10100	279	9790	258	0.0047	11.6	73.3	0.00725	0.2	4.83e-05	0.0753	0
210 SEMIFLUIDO 3/8 CON TEMPERATURA ECOPACT	9920	276	9670	254	0.00466	11.6	72.5	0.00717	0.2	4.83e-05	0.0753	0
210 SEMIFLUIDO 3/8 CON RETARDANTE Y TEMPERATURA ECOPACT	10000	280	9780	258	0.00473	11.6	73.3	0.00725	0.2	4.83e-05	0.0753	0
210 FLUIDO ECOPACT	9350	261	9060	239	0.00442	11.4	70.8	0.00687	0.194	4.83e-05	0.0753	0
210 FLUIDO CON TEMPERATURA ECOPACT	9360	261	9100	239	0.00439	11.4	70.8	0.00687	0.194	4.83e-05	0.0753	0
210 FLUIDO CON RETARDANTE ECOPACT	9360	263	9090	240	0.00447	11.4	70.9	0.00688	0.194	4.83e-05	0.0753	0
210 FLUIDO CON RETARDANTE Y TEMPERATURA ECOPACT	9360	261	9140	239	0.00445	11.4	70.9	0.00688	0.194	4.83e-05	0.0753	0

210 FLUIDO CON FIBRA ECOPACT	9540	266	9230	242	0.00442	11.4	71.7	0.00695	0.194	4.83e-05	0.0753	0
210 FLUIDO CON FIBRA Y RETARDANTE ECOPACT	9500	263	9260	244	0.00448	11.3	71.8	0.00696	0.194	4.83e-05	0.0753	0
210 FLUIDO CON FRIBRA Y TEMPERATURA ECOPACT	9520	266	9280	243	0.00448	11.3	71.8	0.00696	0.194	4.83e-05	0.0753	0
210 FLUIDO 3/8 ECOPACT	10200	284	10000	262	0.00481	11.6	74.4	0.00737	0.205	4.83e-05	0.0753	0
210 FLUIDO 3/8 CON RETARDANTE ECOPACT	10300	287	9980	264	0.00484	11.6	74.4	0.00738	0.205	4.83e-05	0.0753	0
210 FLUIDO 3/8 CON TEMPERATURA ECOPACT	10300	284	9930	262	0.00478	11.6	74.4	0.00737	0.205	4.83e-05	0.0753	0
210 FLUIDO 3/8 CON RETARDANTE Y TEMPERATURA ECOPACT	10300	288	9970	263	0.00488	11.6	74.4	0.00738	0.205	4.83e-05	0.0753	0
210 LANZADO ECOPACT	10200	286	9910	263	0.00478	12.6	73.2	0.00734	0.184	4.83e-05	0.0753	0
210 LANZADO CON TEMPERATURA ECOPACT	10300	285	9960	263	0.00481	12.6	73.2	0.00734	0.184	4.83e-05	0.0753	0
210 PERMEABLE ECOPACT	12100	344	11700	310	0.00575	1.01	109	0.00946	0.105	4.83e-05	0.0753	0
245 DIRECTO ECOPACT	9410	267	9120	242	0.00452	8.36	78.7	0.00722	0.184	4.83e-05	0.0753	0
245 BOMBA ECOPACT	9500	266	9190	243	0.00449	9.31	76.6	0.00716	0.189	4.83e-05	0.0753	0

250 DIRECTO ECOPACT	9420	266	9200	241	0.00449	8.36	78.7	0.00722	0.184	4.83e-05	0.0753	0
250 BOMBA ECOPACT	9490	264	9230	243	0.00451	9.31	76.6	0.00716	0.189	4.83e-05	0.0753	0

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 CO2-Eq**	**kg CFC-11-Eq**	**kg NOx-Eq**	**kg Sb-Eq**	**MJ, net calorific value**
Minimum	110	0.186	585	6.51e-05	1.44	0.0038	9190
Maximum	134	0.227	729	7.99e-05	1.75	0.00477	11500
Mean	117	0.198	633	6.95e-05	1.52	0.00414	10000
Median	114	0.194	618	6.79e-05	1.5	0.00404	9770
280 DIRECTO ECOPACT	110	0.186	585	6.51e-05	1.44	0.0038	9190
280 DIRECTO CON TEMPERATURA ECOPACT	110	0.186	585	6.51e-05	1.44	0.0038	9190
280 DIRECTO CON RETARDANTE ECOPACT	110	0.186	585	6.51e-05	1.44	0.0038	9190
280 DIRECTO CON RETARDANTE Y TEMPERATURA ECOPACT	110	0.186	585	6.51e-05	1.44	0.0038	9190
280 DIRECTO CON FIBRA ECOPACT	111	0.188	592	6.58e-05	1.46	0.00385	9330
280 DIRECTO CON FIBRA Y RETARDANTE ECOPACT	111	0.188	593	6.58e-05	1.46	0.00386	9330
280 DIRECTO CON FRIBRA Y TEMPERATURA ECOPACT	111	0.188	592	6.58e-05	1.46	0.00385	9330
280 BOMBA ECOPACT	114	0.192	610	6.73e-05	1.49	0.00398	9620
280 BOMBA CON TEMPERATURA ECOPACT	114	0.192	610	6.73e-05	1.49	0.00398	9620
280 BOMBA CON RETARDANTE ECOPACT	114	0.192	610	6.73e-05	1.49	0.00398	9630

280 BOMBA CON RETARDANTE Y TEMPERATURA ECOPACT	114	0.192	610	6.73e-05	1.49	0.00398	9630
280 BOMBA CON FIBRA ECOPACT	115	0.194	617	6.8e-05	1.5	0.00404	9760
280 BOMBA CON FIBRA Y RETARDANTE ECOPACT	115	0.194	618	6.81e-05	1.5	0.00404	9770
280 BOMBA CON FRIBRA Y TEMPERATURA ECOPACT	115	0.194	617	6.8e-05	1.5	0.00404	9760
280 BOMBA PP ECOPACT	112	0.19	606	6.66e-05	1.47	0.00396	9560
280 BOMBA PP CON TEMPERATURA ECOPACT	112	0.19	606	6.66e-05	1.47	0.00396	9560
280 SEMIFLUIDO ECOPACT	112	0.19	609	6.67e-05	1.46	0.00398	9620
280 SEMIFLUIDO CON TEMPERATURA ECOPACT	112	0.19	609	6.67e-05	1.46	0.00398	9620
280 SEMIFLUIDO CON RETARDANTE ECOPACT	112	0.19	610	6.67e-05	1.47	0.00399	9640
280 SEMIFLUIDO CON RETARDANTE Y TEMPERATURA ECOPACT	112	0.19	610	6.67e-05	1.47	0.00399	9640
280 SEMIFLUIDO CON FIBRA ECOPACT	114	0.192	617	6.74e-05	1.48	0.00404	9760
280 SEMIFLUIDO CON FIBRA Y RETARDANTE ECOPACT	114	0.192	617	6.74e-05	1.48	0.00404	9770
280 SEMIFLUIDO CON FRIBRA Y TEMPERATURA ECOPACT	114	0.192	617	6.74e-05	1.48	0.00404	9760
280 SEMIFLUIDO 3/8 ECOPACT	119	0.202	650	7.11e-05	1.55	0.00425	10300
280 SEMIFLUIDO 3/8 CON RETARDANTE ECOPACT	121	0.204	658	7.19e-05	1.57	0.0043	10400
280 SEMIFLUIDO 3/8 CON TEMPERATURA ECOPACT	119	0.202	650	7.11e-05	1.55	0.00425	10300
280 SEMIFLUIDO 3/8 CON RETARDANTE Y	121	0.204	658	7.19e-05	1.57	0.0043	10400

TEMPERATURA ECOPACT							
280 FLUIDO ECOPACT	114	0.193	621	6.78e-05	1.48	0.00406	9820
280 FLUIDO CON TEMPERATURA ECOPACT	114	0.193	621	6.78e-05	1.48	0.00406	9820
280 FLUIDO CON RETARDANTE ECOPACT	115	0.195	629	6.85e-05	1.5	0.00411	9940
280 FLUIDO CON RETARDANTE Y TEMPERATURA ECOPACT	115	0.195	629	6.85e-05	1.5	0.00411	9940
280 FLUIDO CON FIBRA ECOPACT	115	0.195	629	6.84e-05	1.5	0.00412	9950
280 FLUIDO CON FIBRA Y RETARDANTE ECOPACT	115	0.195	629	6.85e-05	1.5	0.00412	9970
280 FLUIDO CON FRIBRA Y TEMPERATURA ECOPACT	115	0.195	629	6.84e-05	1.5	0.00412	9950
280 FLUIDO 3/8 ECOPACT	124	0.209	676	7.37e-05	1.6	0.00442	10700
280 FLUIDO 3/8 CON RETARDANTE ECOPACT	124	0.21	676	7.38e-05	1.61	0.00443	10700
280 FLUIDO 3/8 CON TEMPERATURA ECOPACT	124	0.209	676	7.37e-05	1.6	0.00442	10700
280 FLUIDO 3/8 CON RETARDANTE Y TEMPERATURA ECOPACT	124	0.21	676	7.38e-05	1.61	0.00443	10700
280 LANZADO ECOPACT	120	0.204	669	7.23e-05	1.56	0.00435	10500
280 LANZADO CON TEMPERATURA ECOPACT	120	0.204	668	7.2e-05	1.55	0.00435	10500
300 BOMBA ECOPACT	134	0.227	728	7.98e-05	1.74	0.00476	11500
300 BOMBA CON RETARDANTE ECOPACT	134	0.227	729	7.99e-05	1.75	0.00477	11500
300 BOMBA CON TEMPERATURA ECOPACT	134	0.227	728	7.98e-05	1.74	0.00476	11500
300 BOMBA CON RETARDANTE Y	134	0.227	729	7.99e-05	1.75	0.00477	11500

TEMPERATURA ECOPACT							

b) Inventory Metrics:

Indicator/LCI Metric	TPE	RE	NRE	NRR	RR	WDP	LFW	LFHW	CBWC	CWWC	CHW	CNHW
Unit	MJ-Eq	MJ-Eq	MJ-Eq	kg	m3	m3	kg waste	kg waste	m3	m3	kg	kg
Minimum	10200	288	9900	262	0.00483	7.2	81.7	0.00785	0.184	4.83e-05	0.0753	0
Maximum	12800	362	12500	328	0.00608	13.1	101	0.00945	0.205	4.83e-05	0.0753	0
Mean	11100	312	10800	285	0.00527	9.06	86.7	0.00821	0.198	4.83e-05	0.0753	0
Median	10900	306	10600	279	0.00514	9.04	86.3	0.00803	0.2	4.83e-05	0.0753	0
280 DIRECTO ECOPACT	10200	289	9920	263	0.00489	7.64	86.3	0.00785	0.184	4.83e-05	0.0753	0
280 DIRECTO CON TEMPERATURA ECOPACT	10300	288	9960	263	0.00484	7.64	86.3	0.00785	0.184	4.83e-05	0.0753	0
280 DIRECTO CON RETARDANTE ECOPACT	10200	289	9900	262	0.00483	7.64	86.3	0.00785	0.184	4.83e-05	0.0753	0
280 DIRECTO CON RETARDANTE Y TEMPERATURA ECOPACT	10200	288	9960	262	0.00491	7.64	86.3	0.00785	0.184	4.83e-05	0.0753	0
280 DIRECTO CON FIBRA ECOPACT	10400	292	10100	266	0.00494	7.66	87.2	0.00794	0.189	4.83e-05	0.0753	0
280 DIRECTO CON FIBRA Y RETARDANTE ECOPACT	10400	293	10000	266	0.00493	7.66	87.2	0.00794	0.189	4.83e-05	0.0753	0
280 DIRECTO	10400	292	10100	266	0.00498	7.66	87.2	0.00794	0.189	4.83e-05	0.0753	0

CON FRIBRA Y TEMPERATURA ECOPACT												
280 BOMBA ECOPACT	10700	299	10500	274	0.00511	8.21	86.3	0.00803	0.2	4.83e-05	0.0753	0
280 BOMBA CON TEMPERATURA ECOPACT	10700	300	10400	275	0.00512	8.21	86.3	0.00803	0.2	4.83e-05	0.0753	0
280 BOMBA CON RETARDANTE ECOPACT	10700	303	10400	274	0.00511	8.2	86.4	0.00804	0.194	4.83e-05	0.0753	0
280 BOMBA CON RETARDANTE Y TEMPERATURA ECOPACT	10700	300	10400	275	0.00511	8.2	86.4	0.00804	0.194	4.83e-05	0.0753	0
280 BOMBA CON FIBRA ECOPACT	10900	307	10600	279	0.00514	8.22	87.2	0.00811	0.2	4.83e-05	0.0753	0
280 BOMBA CON FIBRA Y RETARDANTE ECOPACT	10900	304	10600	279	0.00521	8.22	87.3	0.00812	0.2	4.83e-05	0.0753	0
280 BOMBA CON FRIBRA Y TEMPERATURA ECOPACT	10900	306	10600	277	0.00513	8.22	87.2	0.00811	0.2	4.83e-05	0.0753	0
280 BOMBA PP ECOPACT	10600	299	10400	273	0.00511	9.06	83.8	0.0079	0.2	4.83e-05	0.0753	0
280 BOMBA PP CON TEMPERATURA ECOPACT	10600	299	10400	272	0.00507	9.06	83.8	0.0079	0.2	4.83e-05	0.0753	0
280 SEMIFLUIDO ECOPACT	10700	301	10400	274	0.00504	10	81.7	0.00785	0.2	4.83e-05	0.0753	0
280 SEMIFLUIDO CON TEMPERATU	10700	300	10400	274	0.00506	10	81.7	0.00785	0.2	4.83e-05	0.0753	0

RA ECOPACT												
280 SEMIFLUIDO CON RETARDANTE ECOPACT	10700	300	10500	276	0.00511	10	81.7	0.00786	0.2	4.83e-05	0.0753	0
280 SEMIFLUIDO CON RETARDANTE Y TEMPERATURA ECOPACT	10800	300	10400	275	0.00506	10	81.7	0.00786	0.2	4.83e-05	0.0753	0
280 SEMIFLUIDO CON FIBRA ECOPACT	10900	302	10500	278	0.00512	10	82.4	0.00793	0.205	4.83e-05	0.0753	0
280 SEMIFLUIDO CON FIBRA Y RETARDANTE ECOPACT	10900	305	10600	279	0.00511	10	82.5	0.00793	0.205	4.83e-05	0.0753	0
280 SEMIFLUIDO CON FRIBRA Y TEMPERATURA ECOPACT	10900	303	10500	279	0.00513	10	82.4	0.00793	0.205	4.83e-05	0.0753	0
280 SEMIFLUIDO 3/8 ECOPACT	11400	322	11100	293	0.00539	9.06	87.8	0.00837	0.2	4.83e-05	0.0753	0
280 SEMIFLUIDO 3/8 CON RETARDANTE ECOPACT	11600	325	11200	297	0.00552	9.07	88.6	0.00846	0.2	4.83e-05	0.0753	0
280 SEMIFLUIDO 3/8 CON TEMPERATURA ECOPACT	11400	320	11100	293	0.00536	9.06	87.8	0.00837	0.2	4.83e-05	0.0753	0
280 SEMIFLUIDO 3/8 CON RETARDANTE Y	11600	323	11200	296	0.00552	9.07	88.6	0.00846	0.2	4.83e-05	0.0753	0

TEMPERATURA ECOPACT												
280 FLUIDO ECOPACT	10900	306	10600	281	0.00521	10.4	81.9	0.00795	0.2	4.83e-05	0.0753	0
280 FLUIDO CON TEMPERATURA ECOPACT	11000	306	10600	280	0.00514	10.4	81.9	0.00795	0.2	4.83e-05	0.0753	0
280 FLUIDO CON RETARDANTE ECOPACT	11000	308	10800	283	0.00525	10.5	82.7	0.00803	0.2	4.83e-05	0.0753	0
280 FLUIDO CON RETARDANTE Y TEMPERATURA ECOPACT	11100	312	10800	283	0.00523	10.5	82.7	0.00803	0.2	4.83e-05	0.0753	0
280 FLUIDO CON FIBRA ECOPACT	11100	310	10800	284	0.00519	10.5	82.5	0.00802	0.205	4.83e-05	0.0753	0
280 FLUIDO CON FIBRA Y RETARDANTE ECOPACT	11100	310	10800	284	0.00517	10.5	82.6	0.00802	0.205	4.83e-05	0.0753	0
280 FLUIDO CON FRIBRA Y TEMPERATURA ECOPACT	11200	309	10800	285	0.00521	10.5	82.5	0.00802	0.205	4.83e-05	0.0753	0
280 FLUIDO 3/8 ECOPACT	11900	334	11600	305	0.00556	9.01	90.1	0.00864	0.2	4.83e-05	0.0753	0
280 FLUIDO 3/8 CON RETARDANTE ECOPACT	11900	333	11600	305	0.00555	9.02	90.1	0.00865	0.2	4.83e-05	0.0753	0
280 FLUIDO 3/8 CON TEMPERATURA ECOPACT	11900	334	11500	305	0.00557	9.01	90.1	0.00864	0.2	4.83e-05	0.0753	0
280 FLUIDO 3/8 CON RETARDANTE Y TEMPERATU	11900	333	11600	304	0.00561	9.02	90.1	0.00865	0.2	4.83e-05	0.0753	0

RA ECOPACT												
280 LANZADO ECOPACT	11700	328	11400	299	0.00558	13.1	83.2	0.00835	0.2	4.83e-05	0.0753	0
280 LANZADO CON TEMPERATURA ECOPACT	11700	330	11300	300	0.00547	11.8	82.7	0.0083	0.2	4.83e-05	0.0753	0
300 BOMBA ECOPACT	12800	362	12400	327	0.00606	7.2	101	0.00944	0.2	4.83e-05	0.0753	0
300 BOMBA CON RETARDANTE ECOPACT	12800	359	12500	328	0.00608	7.2	101	0.00945	0.2	4.83e-05	0.0753	0
300 BOMBA CON TEMPERATURA ECOPACT	12800	360	12400	327	0.00608	7.2	101	0.00944	0.2	4.83e-05	0.0753	0
300 BOMBA CON RETARDANTE Y TEMPERATURA ECOPACT	12800	360	12500	328	0.00601	7.2	101	0.00945	0.2	4.83e-05	0.0753	0

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 CO2-Eq**	**kg CFC-11-Eq**	**kg NOx-Eq**	**kg Sb-Eq**	**MJ, net calorific value**
Minimum	130	0.22	707	7.74e-05	1.69	0.00462	11100
Maximum	138	0.234	753	8.21e-05	1.79	0.00493	11900
Mean	135	0.228	733	8.01e-05	1.75	0.0048	11600
Median	136	0.23	740	8.08e-05	1.76	0.00484	11600
350 BOMBA ECOPACT	136	0.23	739	8.08e-05	1.76	0.00483	11600
350 BOMBA CON RETARDANTE ECOPACT	136	0.23	740	8.09e-05	1.76	0.00484	11700

350 BOMBA CON TEMPERATURA ECOPACT	136	0.23	739	8.08e-05	1.76	0.00483	11600
350 BOMBA CON RETARDANTE Y TEMPERATURA ECOPACT	136	0.23	740	8.09e-05	1.76	0.00484	11700
350 SEMIFLUIDO ECOPACT	130	0.22	707	7.74e-05	1.69	0.00462	11100
350 SEMIFLUIDO CON RETARDANTE ECOPACT	130	0.22	707	7.74e-05	1.69	0.00463	11200
350 SEMIFLUIDO CON TEMPERATURA ECOPACT	130	0.22	707	7.74e-05	1.69	0.00462	11100
350 SEMIFLUIDO CON RETARDANTE Y TEMPERATURA ECOPACT	130	0.22	707	7.74e-05	1.69	0.00463	11200
350 FLUIDO ECOPACT	138	0.233	752	8.21e-05	1.79	0.00492	11900
350 FLUIDO CON RETARDANTE ECOPACT	138	0.234	753	8.21e-05	1.79	0.00493	11900
350 FLUIDO CON TEMPERATURA ECOPACT	138	0.233	752	8.21e-05	1.79	0.00492	11900
350 FLUIDO CON RETARDANTE Y TEMPERATURA ECOPACT	138	0.234	753	8.21e-05	1.79	0.00493	11900

b) Inventory Metrics:

Indicator/LCI Metric	**TPE**	**RE**	**NRE**	**NRR**	**RR**	**WDP**	**LFW**	**LFHW**	**CBWC**	**CWWC**	**CHW**	**CNHW**
Unit	**MJ-Eq**	**MJ-Eq**	**MJ-Eq**	**kg**	**m3**	**m3**	**kg waste**	**kg waste**	**m3**	**m3**	**kg**	**kg**
Minimum	12400	348	12000	318	0.00586	7.72	96.8	0.00913	0.2	4.83e-05	0.0753	0
Maximum	13300	374	12900	340	0.00628	7.9	102	0.00964	0.205	4.83e-05	0.0753	0
Mean	12900	362	12500	330	0.00612	7.8	99.9	0.00943	0.203	4.83e-05	0.0753	0
Median	13000	365	12600	332	0.00615	7.83	101	0.00951	0.205	4.83e-05	0.0753	0
350 BOMBA ECOPACT	13000	365	12600	333	0.0062	7.72	101	0.00951	0.2	4.83e-05	0.0753	0
350 BOMBA CON	13000	364	12600	332	0.00611	7.73	101	0.00952	0.2	4.83e-05	0.0753	0

RETARDANTE ECOPACT												
350 BOMBA CON TEMPERATURA ECOPACT	13000	366	12600	332	0.00614	7.72	101	0.00951	0.2	4.83e-05	0.0753	0
350 BOMBA CON RETARDANTE Y TEMPERATURA ECOPACT	12900	365	12600	333	0.00616	7.73	101	0.00952	0.2	4.83e-05	0.0753	0
350 SEMIFLUIDO ECOPACT	12400	348	12100	318	0.0061	7.9	96.8	0.00913	0.205	4.83e-05	0.0753	0
350 SEMIFLUIDO CON RETARDANTE ECOPACT	12400	349	12100	318	0.00586	7.86	96.8	0.00913	0.205	4.83e-05	0.0753	0
350 SEMIFLUIDO CON TEMPERATURA ECOPACT	12400	348	12000	318	0.00592	7.86	96.8	0.00913	0.205	4.83e-05	0.0753	0
350 SEMIFLUIDO CON RETARDANTE Y TEMPERATURA ECOPACT	12500	352	12100	319	0.0059	7.78	96.8	0.00913	0.205	4.83e-05	0.0753	0
350 FLUIDO ECOPACT	13200	374	12800	339	0.00619	7.83	102	0.00964	0.205	4.83e-05	0.0753	0
350 FLUIDO CON RETARDANTE ECOPACT	13300	372	12900	340	0.00627	7.83	102	0.00964	0.205	4.83e-05	0.0753	0
350 FLUIDO CON TEMPERATURA ECOPACT	13200	373	12800	338	0.00628	7.83	102	0.00964	0.205	4.83e-05	0.0753	0
350 FLUIDO CON RETARDANTE Y TEMPERATURA ECOPACT	13200	372	12900	340	0.00627	7.83	102	0.00964	0.205	4.83e-05	0.0753	0

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 CO2-Eq**	**kg CFC-11-Eq**	**kg NOx-Eq**	**kg Sb-Eq**	**MJ, net calorific value**
Minimum	129	0.219	701	7.68e-05	1.68	0.00458	11100
Maximum	133	0.224	721	7.89e-05	1.72	0.00472	11400
Mean	131	0.222	714	7.82e-05	1.71	0.00467	11300
Median	132	0.224	720	7.88e-05	1.72	0.00471	11400
420 BOMBA ECOPACT	129	0.219	701	7.68e-05	1.68	0.00458	11100
420 BOMBA CON RETARDANTE ECOPACT	129	0.219	701	7.68e-05	1.68	0.00459	11100
420 BOMBA CON TEMPERATURA ECOPACT	129	0.219	701	7.68e-05	1.68	0.00458	11100
420 BOMBA CON RETARDANTE Y TEMPERATURA ECOPACT	129	0.219	701	7.68e-05	1.68	0.00458	11100
420 SEMIFLUIDO ECOPACT	132	0.224	720	7.88e-05	1.72	0.00471	11400
420 SEMIFLUIDO CON RETARDANTE ECOPACT	133	0.224	720	7.88e-05	1.72	0.00472	11400
420 SEMIFLUIDO CON TEMPERATURA ECOPACT	132	0.224	720	7.88e-05	1.72	0.00471	11400
420 SEMIFLUIDO CON RETARDANTE Y TEMPERATURA ECOPACT	133	0.224	720	7.88e-05	1.72	0.00472	11400
420 FLUIDO ECOPACT	132	0.224	720	7.88e-05	1.72	0.00471	11400
420 FLUIDO CON RETARDANTE ECOPACT	133	0.224	721	7.89e-05	1.72	0.00472	11400
420 FLUIDO CON TEMPERATURA ECOPACT	132	0.224	720	7.88e-05	1.72	0.00471	11400
420 FLUIDO CON RETARDANTE Y TEMPERATURA ECOPACT	133	0.224	721	7.89e-05	1.72	0.00472	11400

b) Inventory Metrics:

Indicator/LCI Metric	TPE	RE	NRE	NRR	RR	WDP	LFW	LFHW	CBWC	CWWC	CHW	CNHW
Unit	MJ-Eq	MJ-Eq	MJ-Eq	kg	m3	m3	kg waste	kg waste	m3	m3	kg	kg
Minimum	12300	344	12000	315	0.00579	7.92	96.4	0.00907	0.2	4.83e-05	0.0753	0
Maximum	12700	360	12400	326	0.00612	7.98	98.4	0.00929	0.2	4.83e-05	0.0753	0
Mean	12600	353	12200	322	0.00595	7.94	97.7	0.00921	0.2	4.83e-05	0.0753	0
Median	12600	354	12300	324	0.00595	7.92	98.3	0.00928	0.2	4.83e-05	0.0753	0
420 BOMBA ECOPACT	12300	347	12000	316	0.00579	7.98	96.4	0.00907	0.2	4.83e-05	0.0753	0
420 BOMBA CON RETARDANTE ECOPACT	12300	344	12000	316	0.00587	7.98	96.4	0.00908	0.2	4.83e-05	0.0753	0
420 BOMBA CON TEMPERATURA ECOPACT	12300	347	12000	315	0.00582	7.98	96.4	0.00907	0.2	4.83e-05	0.0753	0
420 BOMBA CON RETARDANTE Y TEMPERATURA ECOPACT	12300	348	12000	315	0.0058	7.98	96.4	0.00907	0.2	4.83e-05	0.0753	0
420 SEMIFLUIDO ECOPACT	12600	353	12300	324	0.0059	7.92	98.3	0.00928	0.2	4.83e-05	0.0753	0
420 SEMIFLUIDO CON RETARDANTE ECOPACT	12700	356	12300	325	0.00612	7.92	98.4	0.00929	0.2	4.83e-05	0.0753	0
420 SEMIFLUIDO CON TEMPERATURA ECOPACT	12700	355	12300	324	0.00591	7.92	98.3	0.00928	0.2	4.83e-05	0.0753	0
420 SEMIFLUIDO CON RETARDANTE Y TEMPERATURA ECOPACT	12700	356	12300	324	0.00608	7.92	98.4	0.00929	0.2	4.83e-05	0.0753	0

420 FLUIDO ECOPACT	12700	354	12300	324	0.00604	7.92	98.3	0.00928	0.2	4.83e-05	0.0753	0
420 FLUIDO CON RETARDANTE ECOPACT	12700	360	12400	325	0.00604	7.92	98.4	0.00929	0.2	4.83e-05	0.0753	0
420 FLUIDO CON TEMPERATURA ECOPACT	12600	356	12300	324	0.00599	7.92	98.3	0.00928	0.2	4.83e-05	0.0753	0
420 FLUIDO CON RETARDANTE Y TEMPERATURA ECOPACT	12700	358	12300	326	0.00601	7.92	98.4	0.00929	0.2	4.83e-05	0.0753	0

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.