

# Contempra™ / Portland Limestone Cement (PLC) and its use in Lower Carbon Intensity Concrete



*Ken Carrusca, P.Eng.  
Cement Association of Canada*

# Contempra™ / PLC

- **Background on cement making**
- **What is Contempra & why use it?**
- **Extensive research and testing**
- **Use of PLC in Europe**
- **BC marketplace and projects**

# Contemptra™ / PLC

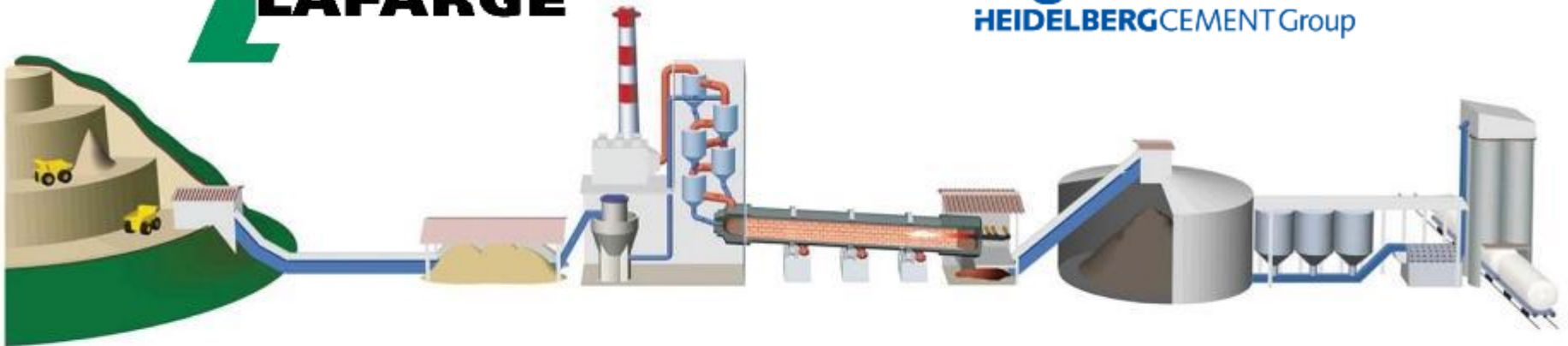
- **Background on cement making**
- What is Contemptra & why use it?
- Extensive research and testing
- Use of PLC in Europe
- BC marketplace and projects



# Cement Manufacturing



**Lehigh Hanson**  
HEIDELBERGCEMENT Group



## Quarrying

Limestone and small amounts of sand and clay are extracted, usually from a quarry located near the cement manufacturing plant.

## Raw Materials Preparation

The extracted materials are analyzed, blended with additional mineral components depending on the type of limestone available, and finely ground for further processing.

## Clinker Production

The materials are heated in a kiln reaching a temperature of  $1,470^{\circ}\text{C}$ . The heat transforms the materials into a molten product called clinker, which is then rapidly cooled.

## Cement Grinding and Distribution

The clinker is stored and then finely ground. Gypsum is added to control setting time, along with supplementary cementing materials, such as fly ash or slag, to obtain a fine powder called cement, with the desired properties of strength and chemical resistance.

**contempra**  
Cement engineered for a better tomorrow

Up to 15% unprocessed limestone finely inter-ground with clinker to produce Contempra™ / Portland Limestone Cement.

# Cement Manufacturing Process

- **Thermal and chemical reactions**
- **Energy intensive process**
  - **Combustion emissions**
  - **Process emissions**

# Cement and Concrete in BC

- **Cement Manufacturing Plants**
  - Lafarge in Richmond and Lehigh Hanson in Delta
- **Concrete Operations**
  - 135 ready-mixed concrete batch facilities
  - 17 precast concrete producers
- **Jobs and Investment**
  - More than 2000 direct and indirect BC jobs
  - Over \$3 billion of investment in the economy

# Contempra™ / PLC

- Background on cement making
- **What is Contempra & why use it?**
- Extensive research and testing
- Use of PLC in Europe
- BC marketplace and projects

# Contempra™ / Portland Limestone Cement / PLC ?

- Contempra™
- Portland-Limestone Cement or PLC
- CSA Cement Types
  - GU – General Use Cement
  - GUL – Portland-Limestone Cement
- EcoCem



# Background



Cement  
Association  
of Canada

Association  
Canadienne  
du Ciment

## Portland-Limestone Cement

A new category of cement is entering the Canadian market. **Portland-limestone cement (PLC)**, used successfully in Europe for over 25 years, will be available in Canada in 2010.

### What Is Portland-Limestone Cement (PLC)?

While regular portland cement may contain up to 5% limestone, PLC is manufactured by intergrinding portland cement clinker with between 6% and 15% limestone. The clinker used to make PLC is the same clinker that is used to manufacture regular portland cement. The performance of PLC is dependent on the high quality of the limestone. In recognition of this fact, limestone used in PLC is tested for calcium carbonate content, clay content and total organic carbon content. The 15% limestone limit applied to PLC in Canada is well below the maximum limit of 35% permitted in European standards. PLC performance specifications are similar to those of regular portland cement in that PLC must meet the same CSA A3001 physical requirements as regular portland cement.

The CSA A3001-08 Standard lists the four types of PLC as follows.

#### 4.1 Types

The naming practice for portland cement, blended hydraulic cement, and portland-limestone cement shall be as follows:

Portland cement type	Blended hydraulic cement type*	Portland-limestone cement type†	Name‡
GU	GUb	GU	General use cement
MS	MSb	—	Moderate sulphate-resistant cement
SH	SHb	MSL	Moderate heat of hydration cement
HE	HEb	HSL	High early-strength cement
LH	LHb	LH	Low heat of hydration cement
HS	HSb	—	High sulphate-resistant cement

\*The suffix "b" indicates that the product is a blended hydraulic cement.

†The suffix "L" indicates that the product is portland-limestone cement.

‡Portland-limestone cements should not be used in an environment subjected to sulphate exposure as defined in Table 3 of CAN/CSA-A23.1.

§See Annex C for information on previous naming conventions.

"Reproduced with the permission of Canadian Standards Association from "CSA A3001-08 Cementitious Materials for Use in Concrete" which is copyrighted by Canadian Standards Association, 5000 Spectrum Way, Suite 100, Mississauga, ON L4W 5N6. While use of this material has been authorized, CSA shall not be responsible for the manner in which the information is presented, nor for any interpretations thereof."

Note that PLC is not available in either moderate or high sulphate-resistant designations.

### How Does It Work?

PLC is manufactured in Canada by intergrinding regular cement clinker with up to 15% limestone. The limestone, being a softer material, is ground more finely than the clinker; however, both the clinker and the limestone in PLC are more finely ground than regular portland cement. Both the size and distribu-



Cement  
Association  
of Canada

# Backgrounder



Cement  
Association  
of Canada

Association  
Canadienne  
du Ciment

## Portland-Limestone Cement

A new category of cement is  
**Portland-limestone cement**  
for over 25 years, will be avail

### What Is Portland-Limestone

While regular portland cement  
ufactured by intergrinding port  
15% limestone. The clinker used  
to manufacture regular portland  
dent on the high quality of the  
stone used in PLC is tested for  
total organic carbon content. T  
Canada is well below the maxi  
dards. PLC performance specifi  
cement in that PLC must meet  
regular portland cement.

The CSA A3001-08 Standard li

#### 4.1 Types

The naming practice for portland c  
shall be as follows:

Portland cement type	Blended hydraulic cement type
GU	GUh
MS	MSb
SH	SHb
HE	HEb
UH	UHb
HS	HSb

\*The suffix "b" indicates that the  
†The suffix "h" indicates that the  
‡Portland-limestone cement is  
defined in Table 3 of CAN/CSA-  
§See Annex C for information on

"Reproduced with the permission of Can  
Materials for Use in Concrete" which is co  
Suite 100, Mississauga, ON L4W 5N6. W  
ble for the manner in which the inform

Note that PLC is not availab  
designations.

### How Does It Work?

PLC is manufactured in Can  
up to 15% limestone. The li  
finely than the clinker; how  
more finely ground than re



## EcoCem™PLC is here!

EcoCem™PLC is Lehigh's Portland Limestone  
Cement that meets CSA's Type GUh specification.  
EcoCem™PLC is an environmentally responsible cement  
that delivers excellent performance along with a lower  
carbon footprint. This made in BC cement reduces  
greenhouse emissions and supports our local  
economy at the same time.

## The EcoCem™PLC Advantage

### Lehigh Cement's Commitment to Sustainability

Lehigh Cement is committed to delivering sustainable building  
materials which positively contribute to the welfare of society  
and to this environment — during and after our lifetime. Cement  
and concrete products already contribute to sustainable buildings  
and communities across British Columbia. Concrete structures  
are safe, energy-efficient, durable and cost-effective.

As the next step in its commitment to sustainability, Lehigh  
Cement has developed EcoCem™PLC, a new portland limestone  
cement that provides excellent performance but has a lower  
environmental impact than normal Type GU portland cement.

### Lowering Emissions

Climate change and clean air are important to the people of  
British Columbia and they are important to Lehigh Cement.  
The process of converting raw minerals into cement produces  
emissions, and reducing these emissions is central to Lehigh's  
commitment to sustainability. Manufacturing EcoCem™PLC can  
result in up to a 10% reduction in emissions when compared  
to normal Type GU portland cement. With EcoCem™PLC, Lehigh  
and its customers now have an effective

### Green Building and LEED®

British Columbia has approved the use of portland limestone  
cement in its building code. This opportunity now exists to  
be on the leading edge of sustainable construction by using  
EcoCem™PLC, an environmentally friendly cement for concrete  
production. In combination with available supplementary  
cementing materials (SCMs), EcoCem™PLC allows the production  
of concrete with the lowest carbon footprint possible.

There are currently no LEED® Credits specific to the use  
of EcoCem™PLC; however it may contribute toward points  
available in LEED® Canada NC 1.0 and 2009. Because it is locally  
manufactured, EcoCem™PLC dramatically reduces the emissions  
associated with the transportation of cementing materials.

### Performance

The performance of EcoCem™PLC is similar to normal Type GU  
portland cement. Concrete produced with EcoCem™PLC achieves  
higher earlier strengths and considerable longer term strengths  
(see graph). In testing with a



Cement  
Association  
of Canada



# Backgrounder



Cement  
Association  
of Canada

Association  
Canadienne  
du Ciment

## Portland-Limestone Cement

A new category of cement is  
**Portland-limestone cement**  
for over 25 years, will be avail

### What Is Portland-Limestone

While regular portland cement  
ufactured by intergrinding port  
15% limestone. The clinker used  
to manufacture regular portland  
dent on the high quality of the  
stone used in PLC is tested for  
total organic carbon content. T  
Canada is well below the maxim  
dards. PLC performance specifi  
cement in that PLC must meet  
regular portland cement.

The CSA A3001-08 Standard li

#### 4.1 Types

The naming practice for portland c  
shall be as follows:

Portland cement type	Blended hydraulic cement type
GU	GUH
MS	MSH
SH	SHH
HE	HEH
UH	UHH
HS	HSB

\*The suffix "S" indicates that the  
1 The suffix "L" indicates that the  
Portland-limestone cement is  
defined in Table 3 of CAN/CSA-  
1 See Annex C for information on

"Reproduced with the permission of Can  
Materials for Use in Concrete" which is co  
Suite 100, Mississauga, ON L4W 5N6. W  
ble for the manner in which the inform

Note that PLC is not available  
designations.

### How Does It Work?

PLC is manufactured in Can  
up to 15% limestone. The li  
finely than the clinker; how  
more finely ground than re



## EcoCem™ PLC is here!

EcoCem™ PLC is Lehigh's Portland Limestone  
Cement that meets CSA's Type GUH specification.  
EcoCem™ PLC is an environmentally responsible cement  
that delivers excellent performance along with a lower  
carbon footprint. This made in BC cement reduces  
greenhouse emissions and supports our local  
economy at the same time.

## The EcoCem™ PLC Advantage

### Lehigh Cement's Commitment to Sustainability

Lehigh Cement is committed to delivering sustainable building  
materials which positively contribute to the welfare of society  
and to this environment — during and after our lifetime. Cement  
and concrete products already contribute to sustainable buildings  
and communities across British Columbia. Concrete structures  
are safe, energy-efficient, durable and cost-effective.

As the next step in its commitment to sustainability, Lehigh  
Cement has developed EcoCem™ PLC, a new portland limestone  
cement that provides excellent performance but has a lower  
environmental impact than normal Type GU portland cement.

### Lowering Emissions

Climate change and clean air are important to the people of  
British Columbia and they are important to Lehigh Cement.  
The process of converting raw minerals into cement produces  
emissions, and reducing those emissions is central to Lehigh's  
commitment to sustainability. Manufacturing EcoCem™ PLC can  
result in up to a 10% reduction in emissions when compared  
to normal Type GU portland cement. With EcoCem™ PLC, Lehigh  
and its customers now have an effective

### Green Building

British Colum  
cement in its  
be on the lea  
EcoCem™ PLC,  
production. In  
cementing ma  
of concrete will  
There are cure  
of EcoCem™ PLC  
available in LEED  
manufactured, Ec  
associated with t

### Performance

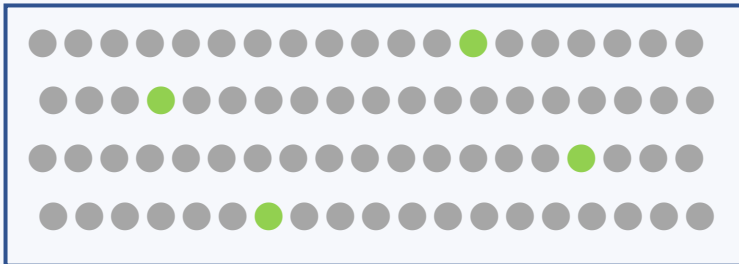
The performance  
portland cement. C  
higher earlier streng  
Issa graph). In test



# What is Contempra™ ?

- Contempra is made by inter-grinding regular clinker with up to 15% limestone, while regular cement contains 5% limestone
- **Contempra is a finer ground product than regular cement**

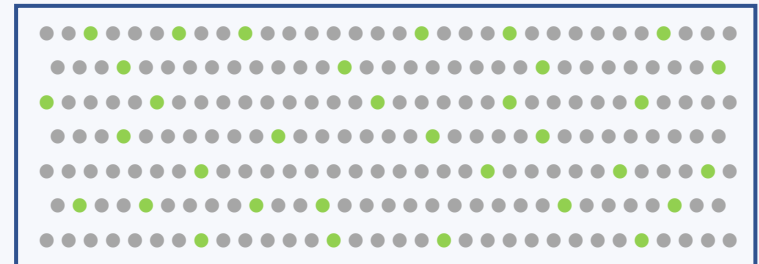
***Regular Portland Cement***



● = *ground clinker, precursor to cement*

● = *limestone (5%)*

***Contempra / Portland Limestone Cement***



● = *finely ground clinker*

● = *finely ground limestone (15%)*



# CSA 3000-08

Defines Portland-limestone cement as a product obtained by:

- Inter-grinding portland cement clinker and limestone, to which the various forms of calcium sulphate, water, and processing additions may be added at the option of the manufacturer.

Notes:

- (1) *Limestone is designated with the suffix L. Its proportion is indicated in Clause 4.3.1.*
- (2) *Portland-limestone cement may be produced by inter-grinding or blending, or a combination of both. The attainment of a homogeneous blend, in the dry state, of any two or more fine materials is important. Appropriate equipment and controls should be provided by the manufacturer.*

# Contemptra™ / PLC

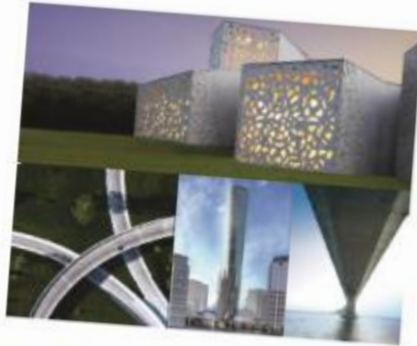
- Background on cement making
- **What is Contemptra & why use it?**
- Extensive performance testing
- Use of PLC in Europe
- BC marketplace and projects

Environmental Product Declaration (EPD)

Revised Version 1.1

# GENERAL USE (GU) AND PORTLAND-LIMESTONE (GUL) CEMENTS

Cement Association of Canada



The Cement Association of Canada (CAC) is pleased to present this Canadian and CAC member industry average environmental product declaration (EPD) for General Use (GU) and Portland-Limestone (GUL) Cements. This EPD was developed in compliance with CAN/CSA-ISO 14025 and has been verified by François Charron Doucet, Groupe AGÉCO.

The EPD includes life cycle assessment (LCA) results for the product stage or cradle-to-gate manufacture of GU and GUL cements as produced in Canada by CAC members in 2014. It is intended for business-to-business communication.

For more information about Cement Association of Canada, please go to [www.cement.ca](http://www.cement.ca).



Environmental  
Product  
Declaration

CSA Group Registered  
Based on ISO 14025  
and Other Requirements  
For more information visit  
[csaregistrars.ca/epd](http://csaregistrars.ca/epd)

#5357-9431  
March 2016-2021

Table 3: LCA Results –Type GU one metric ton – absolute basis

Category Indicator	Unit	Total	A1 Raw Material Supply	A2 Transport	A3 Manufacturing
<b>TRACI v.2.1 Category Indicators</b>					
Global warming potential, GWP	kg CO <sub>2</sub> eq.	940.5	17.9	9.0	913.6
Acidification potential, AP	kg SO <sub>2</sub> eq.	3.7	0.14	0.1	3.5
Eutrophication potential, EP	kg N eq.	0.07	0.06	0.004	0.3
Smog creation potential, POCP	kg O <sub>3</sub> eq.	62.9	2.6	2.2	58.1
Ozone depletion potential, ODP	kg CFC-11 eq.	9.8E-06	1.9E-06	1.8E-08	7.8E-06
<b>Total primary energy consumption</b>					
Non-renewable fossil, PENR-fossil	MJ (HHV)	5594	258	122.4	5213.8
Non-renewable nuclear, PENR-nuclear	MJ (HHV)	586	38	1.5	546.7
Renewable (solar, wind, hydroelectric, and geothermal), PER-HWSG	MJ (HHV)	249	33	0.2	216.5
Renewable (biomass), PER-biomass	MJ (HHV)	481	453	0.03	27.9
<b>Material resources consumption</b>					
Non-renewable material resources, NRMR	kg	1490	1489.0	0.0008	0.6
Renewable material resources, RMR	kg	25	24.2	0.0013	1.3
Net fresh water, NFW	l	1793	116	1	1676
<b>Waste generated</b>					
Hazardous waste generated, HW	kg	0.09	0.004	0	0.09
Non-hazardous waste generated, NHW	kg	0.97	0.01	0	0.96

Table 4: LCA Results – Type GUL one metric ton – absolute basis

Category Indicator	Unit	Total	A1 Raw Material Supply	A2 Transport	A3 Manufacturing
<b>TRACI v.2.1 Category Indicators</b>					
Global warming potential, GWP	kg CO <sub>2</sub> eq.	855.6	17.4	8.3	829.9
Acidification potential, AP	kg SO <sub>2</sub> eq.	3.4	0.13	0.1	3.2
Eutrophication potential, EP	kg N eq.	0.38	0.05	0.004	0.3
Smog creation potential, POCP	kg O <sub>3</sub> eq.	57.4	2.5	2.1	52.8
Ozone depletion potential, ODP	kg CFC-11 eq.	9.0E-06	1.9E-06	1.6E-08	7.2E-06
<b>Total primary energy consumption</b>					
Non-renewable fossil, PENR-fossil	MJ (HHV)	5111	251	112.7	4747.3
Non-renewable nuclear, PENR-nuclear	MJ (HHV)	555	37	1.5	516.1
Renewable (solar, wind, hydroelectric, and geothermal), PER-HWSG	MJ (HHV)	237	32	0.2	204.7
Renewable (biomass), PER-biomass	MJ (HHV)	480	453	0.03	26.4
<b>Material resources consumption</b>					
Non-renewable material resources, NRMR	kg	1444	1443.2	0.0008	0.4
Renewable material resources, RMR	kg	25.2	24.2	0.0013	1.0
Net fresh water, NFW	l	1672	112	1	1559
<b>Waste generated</b>					
Hazardous waste generated, HW	kg	0.09	0.003	0	0.09
Non-hazardous waste generated, NHW	kg	0.97	0.01	0	0.96



**Table 3: LCA Results –Type GU one metric ton – absolute basis**

Category Indicator	Unit	Total	A1 Raw Material Supply	A2 Transport	A3 Manufacturing
<b>TRACI v.2.1 Category Indicators</b>					
Global warming potential, GWP	kg CO <sub>2</sub> eq.	940.5	17.9	9.0	913.6
Acidification potential, AP	kg SO <sub>2</sub> eq.	0.7	0.16	0.1	3.5
Eutrophication potential, EP	kg N eq.	0.3	0.05	0.004	0.3

**Table 4: LCA Results – Type GUL one metric ton – absolute basis**

Category Indicator	Unit	Total	A1 Raw Material Supply	A2 Transport	A3 Manufacturing
<b>TRACI v.2.1 Category Indicators</b>					
Global warming potential, GWP	kg CO <sub>2</sub> eq.	855.6	17.4	8.3	829.9
Acidification potential, AP	kg SO <sub>2</sub> eq.	0.4	0.15	0.1	3.2
Eutrophication potential, EP	kg N eq.	0.38	0.05	0.004	0.3
Smog creation potential, POCP	kg O <sub>3</sub> eq.	57.4	2.5	2.1	52.8
Ozone depletion potential, ODP	kg CFC-11 eq.	9.0E-06	1.9E-06	1.6E-08	7.2E-06

# Environmental Product Declaration



CRMCA Member Industry-Wide EPD for Canadian  
**READY-MIXED CONCRETE**



## Concrete EPDs

- Valid from January 6, 2017 to January 6, 2022
- Participation of all Provincial associations, including BCRMCA
- 125 concrete mix designs!
- Both GU and GUL

**Table 8. Summary Results (A1-A3): 31-35 MPa ready mixed concrete product, per cubic meter**

Indicator/LCI Metric	GWP	ODP	AP	EP	POCP	PEC	NRE	RE	NRM	RM	CBW	CWW	TW	CHW	CNHW
Unit (equivalent)	kg CO <sub>2</sub>	kg CFC-11	kg SO <sub>2</sub>	kg N	kg O <sub>3</sub>	MJ	MJ	MJ	kg	kg	m <sup>3</sup>	m <sup>3</sup>	m <sup>3</sup>	kg	kg
Minimum	260.49	3.69E-06	1.23	0.13	22.07	2558.11	2338.42	202.24	2244.44	6.41	0.16	0.14	0.95	0.86	8.94
Maximum	449.79	6.40E-06	1.95	0.20	35.25	3745.89	3412.16	333.73	2576.75	10.84	0.16	0.14	1.30	0.90	9.12
#39-35 GU with air 0-14% FA/SC	449.79	5.37E-06	1.95	0.20	35.25	3745.89	3412.16	333.73	2509.04	10.84	0.16	0.14	1.30	0.87	9.12
#40-35 GU without air 0-14% FA/SC	386.61	4.76E-06	1.69	0.17	30.85	3279.16	2993.18	285.98	2576.75	9.18	0.16	0.14	1.20	0.87	9.05
#41-35 Industry Average Benchmark	417.05	5.42E-06	1.85	0.19	33.37	3537.46	3229.68	307.77	2438.20	9.95	0.16	0.14	1.24	0.88	9.08
#42-35 GU with air 15-29% FA	403.68	4.88E-06	1.76	0.18	32.11	3406.28	3108.47	297.81	2405.27	9.61	0.16	0.14	1.21	0.87	9.07
#43-35 GUL with air 15-29% FA	362.81	4.59E-06	1.57	0.17	27.56	3229.64	2936.63	293.00	2388.81	9.69	0.16	0.14	1.17	0.87	9.07
#44-35 GU without air 15-29% FA	347.87	4.35E-06	1.54	0.16	28.20	2993.85	2738.06	255.79	2490.00	8.15	0.16	0.14	1.12	0.86	9.01
#45-35 GUL without air 15-29% FA	313.52	4.10E-06	1.37	0.14	24.38	2845.30	2593.54	251.75	2475.70	8.22	0.16	0.14	1.08	0.86	9.01
#46-35 GU with air 30-40% FA	353.84	4.36E-06	1.56	0.16	28.71	3039.14	2780.16	258.98	2293.08	8.29	0.16	0.14	1.12	0.86	9.02
#47-35 GUL with air 30-40% FA	318.82	4.10E-06	1.40	0.15	24.81	2887.92	2633.06	254.86	2279.66	8.35	0.16	0.14	1.08	0.86	9.02
#48-35 GU without air 30-40% FA	305.99	3.90E-06	1.37	0.14	25.35	2685.42	2462.25	223.16	2396.23	7.04	0.16	0.14	1.04	0.86	8.97
#49-35 GUL without air 30-40% FA	276.55	3.69E-06	1.23	0.13	22.07	2558.11	2338.42	219.70	2383.97	7.09	0.16	0.14	1.01	0.86	8.97
#50-35 GU with air 25-34% SC	364.06	6.11E-06	1.76	0.18	30.87	3249.29	2984.22	265.08	2327.80	8.48	0.16	0.14	1.12	0.90	9.02
#51-35 GUL with air 25-34% SC	329.36	5.86E-06	1.59	0.17	27.01	3099.43	2838.43	261.00	2314.53	8.54	0.16	0.14	1.08	0.90	9.02
#52-35 GU without air 25-34% SC	314.59	5.38E-06	1.53	0.16	27.16	2862.04	2633.75	228.29	2425.43	7.20	0.16	0.14	1.04	0.89	8.97
#53-35 GUL without air 25-34% SC	285.41	5.16E-06	1.39	0.15	23.92	2735.87	2511.02	224.86	2413.28	7.25	0.16	0.14	1.01	0.89	8.97
#54-35 GU with air 35-50% SC	329.77	6.40E-06	1.68	0.18	29.11	3050.66	2813.04	237.62	2255.30	7.54	0.16	0.14	1.04	0.90	8.98
#55-35 GUL with air 35-50% SC	299.71	6.18E-06	1.54	0.17	25.77	2920.92	2686.83	234.09	2244.44	7.59	0.16	0.14	1.01	0.90	8.98
#56-35 GU without air 35-50% SC	285.78	5.62E-06	1.47	0.15	25.69	2695.19	2489.98	205.21	2364.90	6.41	0.16	0.14	0.98	0.89	8.94
#57-35 GUL without air 35-50% SC	260.49	5.44E-06	1.35	0.15	22.88	2585.84	2383.61	202.24	2354.37	6.45	0.16	0.14	0.95	0.89	8.94

Table 8. Summary Results (A1-A3)
Indicator/LCI Metric
Unit (equivalent)
Minimum
Maximum
#39-35 GU with air 0-14% FA/SC
#40-35 GU without air 0-14% FA/SC
#41-35 Industry Average Benchmark
#42-35 GU with air 15-29% FA
#43-35 GUL with air 15-29% FA
#44-35 GU without air 15-29% FA
#45-35 GUL without air 15-29% FA
#46-35 GU with air 30-40% FA
#47-35 GUL with air 30-40% FA
#48-35 GU without air 30-40% FA
#49-35 GUL without air 30-40% FA
#50-35 GU with air 25-34% SC
#51-35 GUL with air 25-34% SC
#52-35 GU without air 25-34% SC
#53-35 GUL without air 25-34% SC
#54-35 GU with air 35-50% SC
#55-35 GUL with air 35-50% SC
#56-35 GU without air 35-50% SC
#57-35 GUL without air 35-50% SC

**Table 8. Summary Results (A1-A3): 31-35 MPa re**

Indicator/LCI Metric	GWP	ODP
Unit (equivalent)	kg CO <sub>2</sub>	kg CFC-11
Minimum	260.49	3.69E-06
Maximum	449.79	6.40E-06
#39-35 GU with air 0-14% FA/SC	449.79	5.37E-06
#40-35 GU without air 0-14% FA/SC	386.61	4.76E-06
#41-35 Industry Average Benchmark	417.05	5.42E-06
#42-35 GU with air 15-29% FA	403.68	4.88E-06
#43-35 GUL with air 15-29% FA	362.81	4.59E-06
#44-35 GU without air 15-29% FA	347.87	4.35E-06
#45-35 GUL without air 15-29% FA	313.52	4.10E-06
#46-35 GU with air 30-40% FA	353.84	4.36E-06
#47-35 GUL with air 30-40% FA	318.82	4.10E-06
#48-35 GU without air 30-40% FA	305.99	3.90E-06
#49-35 GUL without air 30-40% FA	276.55	3.69E-06



# Calculation of CO<sub>2</sub> Reduction

- For example:
  - GU = 403.68 kg CO<sub>2</sub> / cubic meter of concrete
  - GUL = 362.81 kg CO<sub>2</sub> / cubic meter of concrete
  - Reduction of 403.68 – 362.81 = **40.87 kg CO<sub>2</sub> per cubic meter**
- Using **30,000 m<sup>3</sup> of GUL / PLC / Contempra / EcoCem concrete:**
  - 30,000 m<sup>3</sup> x 40.87 kg CO<sub>2</sub>/m<sup>3</sup> = 1,226,100 kg = **1,226 tonnes CO<sub>2</sub>**
  - Equivalent to **taking 260 cars\*** off the road for a year!

*\*US EPA: one car generates 4.7 metric tonnes of CO<sub>2</sub> per year*

# Why should we use Contempra™ / PLC?

- Can reduce GHG emissions by 1 million tonnes of CO<sub>2</sub> (eq) per year across Canada
- Equivalent to taking 210,000 cars off the road or the planting of 25 million trees a year
- Contempra reflects the industry's continued commitment to sustainable development and a better environment

# Contempra™ / PLC

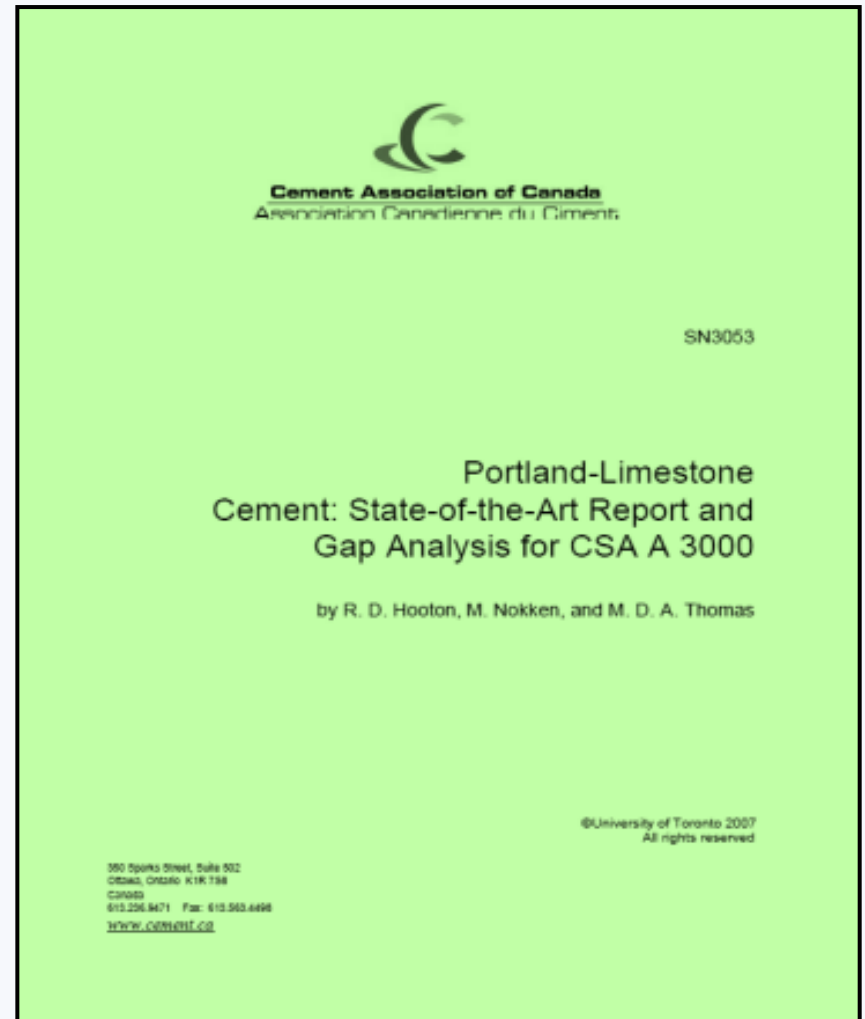
- Background on cement making
- What is Contempra & why use it?
- **Extensive research and testing**
- Use of PLC in Europe
- BC marketplace and projects

# Extensive Research and Testing

1: Literature Review

2: Prototypes and Trials

3: Extensive Testing





# 1. Literature Review, May 2007

- Results reported in the literature appeared to be affected by the quality and particle size distribution of the limestone
- Variances also resulted depending on whether the limestone was inter-ground, blended, or added at the mixer
- Proper interpretation of the data was carried out to fully investigate these effects

## 2. Prototypes and Trials

- Various Canadian cement companies produced prototypes of Contempra cement at their plants
- Chemical and physical analyses were performed with those products
- Concrete performance and durability tests were carried out at universities and CAC member companies

### 3. Extensive Testing

- Tests carried out with Canadian materials confirmed findings of the literature review and European experience
- After optimization, the prototype concrete demonstrated equivalent strength to that achieved with regular cement
- Field trials in the climates of Ontario, Quebec and Nova Scotia over two winters established that Contempra produces concrete with a durability equivalent to that from regular cement

# Adopted in Canadian Building Codes

- Included in CSA A3001 and A23.1 standards under the name Portland-limestone cement, and referenced in the 2010 National Building Code of Canada
- Approved for use in British Columbia, Manitoba, Ontario, Quebec and Nova Scotia
- Not yet used in high sulphate exposure environments, but additional testing has been carried out and changes to CSA requirements are pending



# Contemptra™ / PLC

- Background on cement making
- What is Contemptra & why use it?
- Extensive research and testing
- **Use of PLC in Europe**
- BC marketplace and projects

# Track Record in Europe

- Used in Europe for over 25 years in a variety of applications and exposure conditions
- Known as Portland-Limestone Cement
- 20% limestone used in popular European cement products
- Up to **35% limestone** content is allowed

# Contempra™ / PLC

- Background on cement making
- What is Contempra & why use it?
- Extensive research and testing
- Use in Europe
- **BC marketplace and projects**



# Telus Garden Development

- ❖ West Georgia and Seymour, Vancouver
- ❖ \$750 million project
- ❖ 1 million square feet
- ❖ LEED Platinum
- ❖ **60,000 m<sup>3</sup> of concrete**, of which about 55% was PLC
- ❖ **avoided ~ 1,300 tonnes of CO<sub>2eq</sub>**  
**(taking 287cars\* off the road for a year)**

*Image: Nicolas Blachette*



# Solo District Willingdon and Lougheed, Burnaby

- ❖ Mixed commercial, office, residential
- ❖ 2 towers, with the taller being 48-storeys high
- ❖ **90,000 m<sup>3</sup>** of concrete of which 75% was PLC
- ❖ 33,000 tonnes of cement
- ❖ **avoided ~ 2,750 tonnes of CO<sub>2eq</sub>**  
**(taking 590 cars\* off the road for a year)**

*Image: Chris Dikeakos Architects*



# Vancouver House Pacific and Howe

- ❖ 52 storey, 600,000 square foot tower
- ❖ Vertical and horizontal post-tensioned concrete
- ❖ Features twisting and overhanging floors
- ❖ **20,000 m<sup>3</sup>** concrete so far, 80% of which is PLC including high early strength, low shrinkage for post-tensioned slabs
- ❖ **avoided ~ 654 tonnes of CO<sub>2eq</sub> so far**  
**(taking 139 cars\* off the road for a year)**

# Wall Centre False Creek (originally Vancouver Playhouse)

- ❖ first Lafarge project completed with Contempra
- ❖ three 13 - 15 storey residential towers
- ❖ **30,000 m<sup>3</sup>** of 100% Contempra concrete
- ❖ **avoided ~ 1,226 tonnes of CO<sub>2eq</sub>**  
**(taking 260 cars\* off the road for a year)**



# The Mark 1372 Seymour

- ❖ Located at north end of Granville Street Bridge
- ❖ 41 storey tower with 302 suites
- ❖ LEED Gold
- ❖ **35,000 m<sup>3</sup> of 100% Contempra concrete**
- ❖ **avoided ~ 1,430 tonnes of CO<sub>2eq</sub>**  
**(taking 304 cars\* off the road for a year)**



# Trump International Hotel & Tower 1151 West Georgia, Vancouver

- ❖ Owned by Holborn Group
- ❖ Conceptual design by Arthur Erickson; similar to the “Turning Torso” in Malmö, Sweden
- ❖ 63-storey, 187.8 metre / 616 foot tower  
(2<sup>nd</sup> to Shangri-La at 201.2 m / 660 feet)
- ❖ LEED Silver
- ❖ **35,000 m<sup>3</sup> of 100% Contempra based concrete**
- ❖ **avoided ~ 1,430 tonnes of CO<sub>2eq</sub>**  
**(taking 204 cars\* off the road for a year)**

# Teck Acute Care Centre BC Children's Hospital, Vancouver

- ❖ 640,000 square feet over 8 floors
- ❖ 231 private patient rooms
- ❖ LEED Gold
- ❖ 35,000 m<sup>3</sup> of concrete of which 73% was PLC
- ❖ 9,600 tonnes of cement
- ❖ avoided ~ 1,040 tonnes of CO<sub>2eq</sub>  
(taking 222 cars\* off the road for a year)

Image: HDR / CEI

# PLC in Public Sector Infrastructure

## *Promoting use of Low Carbon and Renewable Materials in Infrastructure*

*“Approving use of Portland-limestone cement in public sector infrastructure. This material reduces GHG emissions associated with existing cement manufacturing by approximately 10 per cent, while producing concrete with similar strength and durability. This cement has been popular in Europe for over 25 years now, but is new to Canada.”*

*BC Climate Leadership Plan  
August 19, 2016*

# In conclusion, Contemptra / PLC:

- Has an extensive proven track record
- Can reduce GHG emissions by up to 10% when compared to regular cement
- Produces concrete with a equivalent strength and durability to that made with regular cement
- Included in the CSA cement and concrete standards
- Available from local cement / concrete producers in BC
- BC Public Sector should adopt PLC as the preferred option for concrete infrastructure



# Thank you!



**Cement  
Association  
of Canada**

*Ken Carrusca, P.Eng.*  
*Vice President, Environment & Marketing*  
**Cement Association of Canada**

*KCarrusca@Cement.ca*  
*(604) 839-6627*  
*@KenCarrusca*