




MTO GHG Reduction Initiative - Webinar

Aug. 22nd, 2018

Housekeeping

- 45 minute webinar with 15 minutes Q & A
- All attendees are muted
- Questions? Use  **GoTo**Webinar 'Questions' Pane
- Webinar will be recorded and a link will be posted on the Concrete Ontario website: www.ConcreteOntario.org



Presenters

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- Mike Stanzel has been Technical Services Manager for Lehigh Cement (via Essroc Italcementi) in Ontario since 2010.
- He holds a Bachelor of Science in Chemical Engineering from Queen's University.
- He has prior experience in cement quality and operations, with 17 years of experience in the industry.
- He is a member on CSA A3000, Associate Member on CSA A23.1, and member of ACI.

Greenhouse Gas Reduction (GHG) Initiative

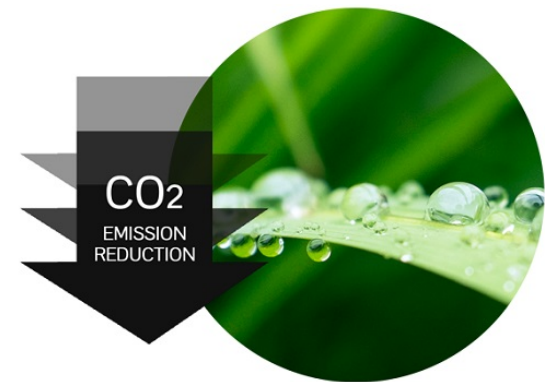
Agenda

1. Background
2. GHG Reduction Initiatives (10% and 20%)
3. Materials contributing to a GHG reduction
4. Specifics of each initiative
5. Considerations and Limitations
6. Summary & Questions

Greenhouse Gas Reduction (GHG) Initiative

Background

- Cement is an essential ingredient in concrete
- Concrete is an indispensable construction material in building our communities and infrastructure and is the most robust, reliable, widely-used, and sustainable building material available
- GHG emission, climate change, and environmental impact are real life concerns
- The government agencies have been mandated to support initiatives to reduce these impacts by industry



Greenhouse Gas Reduction (GHG) Initiative

Background

- To combat climate change, the MTO implemented a Greenhouse Gas Reduction (GHG) Initiative in January 2018
- Introducing two special provisions that would serve as amendments to OPSS 1350.PROV (Nov. '16).
 - 10% GHG Reduction - Standard
 - 20% GHG Reduction - Demonstration
- No matter the GHG reduction that is being pursued, it is still expected that the material selection and concrete mix design will be optimized to ensure that **concrete performance requirements continue to be met.**

Greenhouse Gas Reduction (GHG) Initiative

Basis

- The purpose of these amendments is to use available resources at specified replacement levels to achieve a GHG reduction of 10% or 20% over a “basic” mix.
- Applicable materials include:
 1. Portland Limestone Cement
 2. Supplementary Cementitious Materials
 3. Limestone filler
 - Does not include optimised combined aggregate gradations, admixtures, or other materials or innovations, etc.

Greenhouse Gas Reduction (GHG) Initiative

Materials – PLC's

■ Portland Limestone Cements:

- Cement manufactured with up to 15% limestone
- Similar performance to regular Portland cements (workability, strength, durability, etc.)
- Reduces GHG by approximately 10% over conventional Portland cements (calcination and fuel consumption)
- Finer particle size and improved particle packing to enhance reaction rate, reduce porosity, and establish nucleation sites to promote hydration
- Forms carbo-aluminates during hydration to further reduce porosity
- Enhances slag activity due to stabilisation of sulfo-aluminate and sulfo-ferrite phases



Greenhouse Gas Reduction (GHG) Initiative

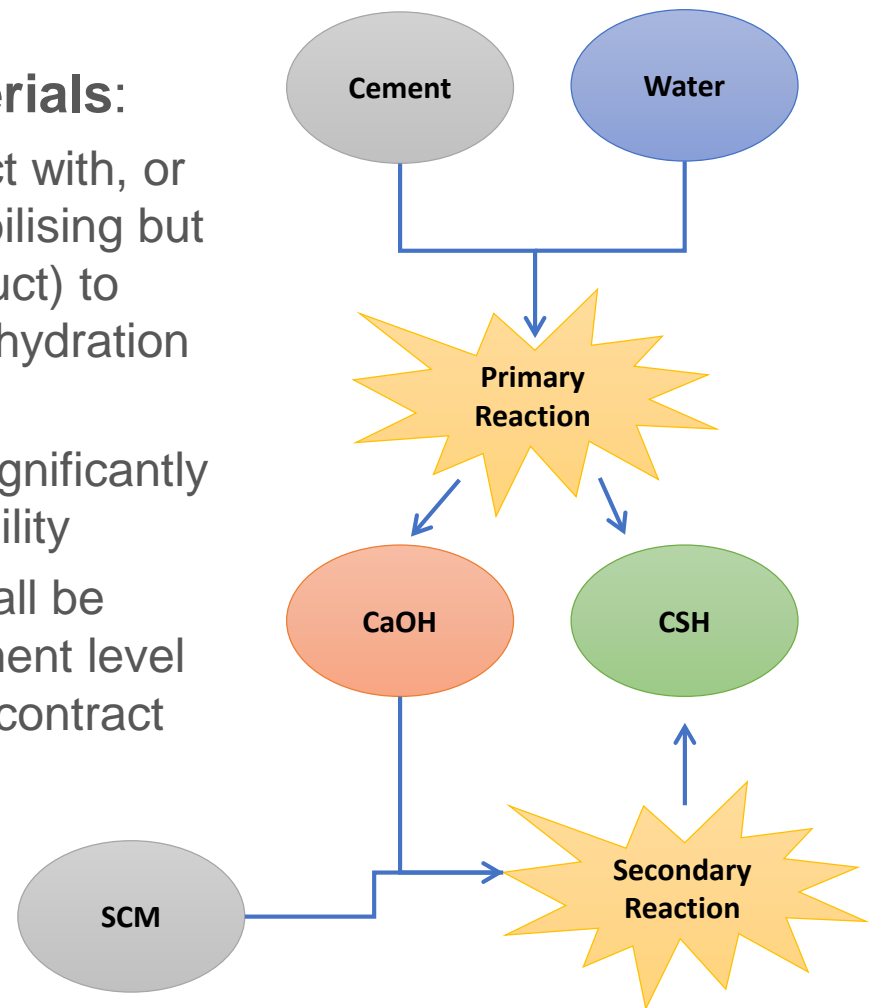
Materials – PLC's

- **Portland Limestone Cements:**
 - Falls under CSA A3001, OPSS 1350, recognised NBC, etc.
 - Considered to provide a 10% GHG reduction
 - Must be on the MTO DSM List
 - May not be used in a sulphate environment (note this is in MTO works only – it is allowed under CSA A23.1 as long as you meet sulphate expansion requirements)
 - May not use limestone filler with Portland Limestone Cements

Greenhouse Gas Reduction (GHG) Initiative

Materials – SCM's

- **Supplementary Cementing Materials:**
 - Industrial by-products which react with, or in the presence of, CaOH (a stabilising but relatively inert hydration by-product) to form more C-S-H gel (the active hydration reaction product)
 - Higher later age strengths and significantly improved durability and permeability
 - Use of each individual SCM's shall be limited to the maximum replacement level for the material permitted by the contract
 - Fly Ash = 10%
 - Slag = 25%



Greenhouse Gas Reduction (GHG) Initiative

Materials – SCM's

- **Supplementary Cementing Materials:**
 - Falls under CSA A3001 and OPSS 1350
 - Slag and Fly ash will be considered a direct replacement for GU cement in the mix design and the replacement percentage considered as a direct GHG reduction
 - For 20% GHG Projects only, silica fume cement counts as an 8% reduction
 - Must be on MTO DSM List
 - Existing limits on SCM's still apply

Greenhouse Gas Reduction (GHG) Initiative

Materials – Limestone filler

- **Limestone Fillers:**
 - Limestone powder used as an aggregate to reduce the “paste demand” of the concrete and thereby reduce the cement content
 - Falls under CSA A23.1 Annex L, L2, A3001 4.4.3, and OPSS 1002 mineral filler



Greenhouse Gas Reduction (GHG) Initiative

Materials – Limestone filler

- **Limestone Fillers:**

- May not be used with Portland Limestone Cements
- Restricted to a maximum of 15% of the cement mass
- May not be included in the w/cm ratio
- May not be used in a sulphate environment
- Example uses – SCC, low strength pump mix, etc. where powder volume is needed but not necessarily the strength

Greenhouse Gas Reduction (GHG) Initiative

Materials – Limestone filler

■ Limestone Filler Calculation Methods:

- CO₂ must be calculated based on the cement reduction of a previously utilized MTO concrete mix design
- For example if your previously utilized mix design contained 355 kg/m³ of GU cement:
 - The Maximum amount of limestone filler = $355 \times 0.15 = 53 \text{ kg/m}^3$
 - If you add 53 kg of limestone filler you are able to reduce your cement content to 315 kg/m³ and then your cement reduction is:
 - $(355 - 315)/355 \times 100 = 11.3\%$
 - If the w/cm maximum is 0.45, then your corresponding maximum water would be $315 \times 0.45 = 141.75 \text{ L}$

Greenhouse Gas Reduction (GHG) Initiative

MTO GHG Reduction Initiatives

- What's required for the 10% and 20% GHG reduction initiatives?
- How do we achieve the 10% and 20% GHG reductions?
- What considerations and limitations are present?



Greenhouse Gas Reduction (GHG) Initiative

10% GHG Reduction Initiative

- The 10% GHG reduction is applicable to **all MTO contracts** and will be the basis of the initiative
- To achieve at least a 10% GHG reduction, the use of one or a combination of the following options is required:
 1. Use of Portland Limestone Cement (counts as 10% reduction)
 2. Use of Slag or Fly ash to replace at least 10% of the cement content of the mix
 3. Use of limestone filler to reduce the cement content of the mix by at least 10% through enhanced particle packing, optimized aggregate gradation, or other means. May not be used with Portland Limestone Cements.

Greenhouse Gas Reduction (GHG) Initiative

20% GHG Reduction Initiative

- The 20% GHG reduction is classified as an “**enhanced reduction**” and will only be used for demonstration contracts
- To achieve at least a 20% GHG reduction, the use of one or a combination of the following options is required:
 1. Use of Supplementary Cementing Materials (Slag, Fly ash, or Silica Fume) to replace at least 20% of the cement content of the mix
 2. Use of Portland Limestone Cement and minimum 10% Supplementary Cementing Materials
 3. A combination of the use of limestone filler and Supplementary Cementing Materials to ensure that 20% of the cement content of the mix is replaced and reduced. May not be used with Portland Limestone Cements.

Greenhouse Gas Reduction (GHG) Initiative

20% GHG Reduction Initiative

- **Contract 2017-2034** – Highway 401 Bridge Rehabilitation at Highway 404
- **Contract 2017-2035** – Bridge Rehabilitation at Highway 401/403/410 Interchange EB
- **Contract 2017-2036** – Bridge Rehabilitation at Highway 401/403/410 Interchange WB
- **Contract 2017-2011** – Baldwin Street Parking Lot, Whitby
- **Contract 2017-3025** – Highway 7 / Perth Line 26 Roundabout
- **Contract 2017-4xxx** – Nicholas St. Underpass Replacement, Highway 417

Greenhouse Gas Reduction (GHG) Initiative Considerations

Some of the critical factors that should be considered:

- GU cement and GUL may not be interchanged in the same component. Once one material is selected it must be used to complete that component.
- The GHG reduction limit (either 10% or 20%) must be met on each and every individual concrete mix design submitted on the project. This is not based on an “average GHG reduction for the project”.
- A High Early Strength Portland limestone cement (HEL) is not readily available in the Ontario marketplace. As such, applications such as fast-track concrete that require the use of high early strength cement will have to achieve the GHG reduction limits by utilizing either SCM’s or limestone filler.

Greenhouse Gas Reduction (GHG) Initiative Limitations

Some basic limitations to keep in mind include:

- Slag shall be limited to a maximum of 25% by mass of the total cementing material (OPSS.PROV 1350)
- Fly Ash shall be limited to a maximum of 10%, except for Silica Fume overlays and HPC where up to 25% is permitted (OPSS.PROV 1350)
- A mixture of Slag and Fly ash up to 25%, except the amount of Fly ash shall not exceed 10% (Restriction of 10% Fly ash not applicable to Silica Fume overlays and HPC) (OPSS.PROV 1350)
- Limestone filler shall be restricted to a maximum of 15% of the cement by mass. Limestone filler is not included in the w/cm ratio.
- Portland Limestone Cement or limestone filler shall not be used in concrete exposed to a sulphate environment.

Greenhouse Gas Reduction (GHG) Initiative

Limitations

Applications where the concrete producer should request an exemption:

Early Strength Development:

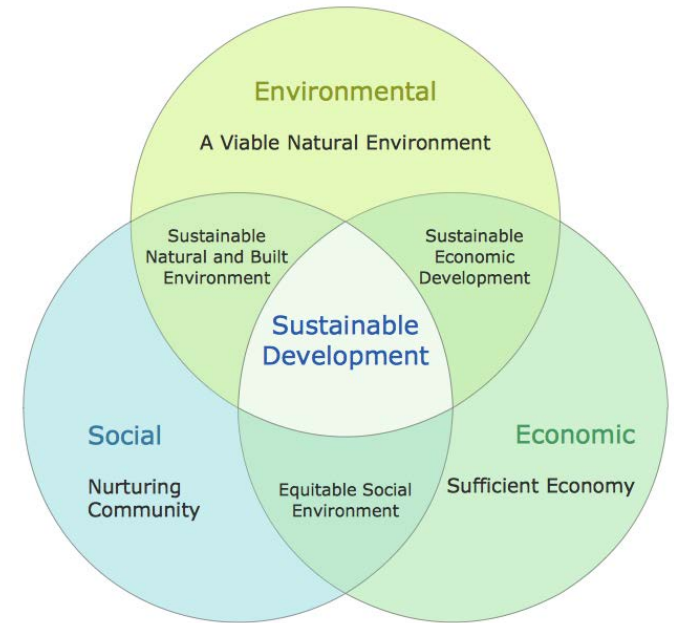
- Fast Track Concrete
- Specialty items where early strength may be required



Primary Objective – Reduce the CO₂ contribution of the mix design --- request an exemption for any application where you are not reducing GHG's!

Greenhouse Gas Reduction (GHG) Initiative Summary

- 10% standard and 20% demonstration reduction targets
 - Portland Limestone Cement = 10% reduction
 - SCM's = reduction equivalent to replacement percentage (Slag and/or Fly ash for both, or silica fume on 20% reduction only)
 - Limestone fillers = must quantify cement reduction
- Concrete must still meet all performance requirements
- All material requirements and maximum replacement levels apply



Greenhouse Gas Reduction (GHG) Initiative

Moving forward...

- Moving forward, the MTO will be updating Form A and B mix design submission documents to allow the concrete producer to clearly indicate the GHG reductions achieved with each concrete mix design.
- Concrete Ontario's mix design intellectual property requirements still apply in this process, and any mix proportion information should only be provided on the Form B mix design submission that is protected under the existing memorandum of understanding between the MTO and RMCAO.

Questions?



Upcoming Webinars

1. **September 19** – Structural Shotcrete Applications
2. **October 23** – MTO Specification Updates
3. **November 14** – Concrete Chute Secondary Restraint Methods
4. **December 12** – Seasonal Loads
5. **January 17** – Preparing for MOE plant inspections
6. **February 20** – Ground Glass as a Supplementary Cementing Material