Delegation of W Bracken to Clarington Joint Committee
October 25, 2021

St. Marys Cement's application to amend their current ECA to install an "Ultimate Cell Continuous Combustion Unit" in the cement kiln in Bowmanville

(ERO 019-4320)

Supporting Information Document

BCX
ENVIRONMENTAL
CONSULTING

August 12, 2021
BCX File: 1003-01.64

Ministry of the Environment and Climate Change
Client Services and Permissions Branch
135 St. Clair Avenue West, 1st Floor
Toronto, Ontario
M4V 1P5

RE: ST. MARYS CEMENT INC (CANADA) – BOWMANVILLE CEMENT PLANT ENVIRONMENTALLY INSIGNIFICANT AMENDMENT –ECA #6729-BYRJEP

On behalf of St. Marys Cement Inc. (Canada) [SMC], BCX Environmental Consulting (BCX) is pleased to submit an application and supporting documentation for an environmentally insignificant amendment to SMC's Environmental Compliance Approval #6729-BYRJEP dated March 31, 2021, for their Bowmanville cement plant (Attachment B).

The Facility is proposing to install an Ultimate Cell Continuous Combustion (UC3) Unit as part of the "Cement Kiln". The purpose of the UC3 unit is to optimize the combustion environment in the kiln by creating an oxygen rich environment. The installation of the UC3 system is not expected to increase air emissions from the facility for the maximum air emissions scenarios. Equipment information on the UC3 system and air emissions data/case studies for cement plants using the UC3 systems is included as an appendix to the Emission Inventory and Dispersion Modelling Report (Attachment D) to support that this is an environmentally insignificant change from an air quality perspective.

Page 93 of Supporting Information Document states UC3 Technology will "promote complete combustion of alternative fuels"

The Proposed UC3 System

The proposed UC3 system will use a Proton Exchange Membrane (PEM) electrolysis system and is designed to optimize combustion in the kiln. The UC3 system will integrate an automatic electrolyte production unit which will produce hydrogen (H_2) and oxygen (O_2) using fresh water through an electrolysis process. These gases will then be introduced in the air transport pipes, which transfers the gases to the fuel injection points, ending in the burning zone of the kiln (see Figure 1).

When H_2 and O_2 enter the kiln, the significant amount of thermal energy in the kiln will transform these gases into highly reactive hydroxy (OH) radicals. The OH radicals will react with carbon monoxide (CO) inside the kiln to promote complete combustion. In addition, heat generated from the consumption of CO will improve the combustion efficiency of the fuels (conventional/ALCF) in the kiln, clinker quality and process stability.

Optimizing the kiln combustion efficiency using this technology will also promote complete combustion of the low carbon alternative fuels thereby providing added assurance that alternative fuels can be consistently fed and combusted at the approved maximum rate. The addition of this technology will not reduce the residence times, temperatures or residual oxygen levels in the kiln system. Supporting information on this technology is presented in Appendix B.

The amount of heat generated from H_2 produced by the UC3 unit is insignificant relative to the overall kiln heat input (i.e. less than 0.016% of the total kiln heat input). As such, H_2 generated from the unit is not acting or intended to act as a fuel.

https://en.wikipedia.org/wiki/Carbon_monoxide

Reaction results in more carbon dioxide (CO_2) emissions and ozone; but demonstration study done without these units installed so did not measure UC3 emission impacts; Any additional GHG emissions/impacts should also be monitored and accounted for in future

Role in ground level ozone formation [edit]

Main article: Ground level ozone

Carbon monoxide is, along with aldehydes, part of the series of cycles of chemical reactions that form photochemical smog. It reacts with hydroxyl radical ($^{\bullet}OH$) to produce a radical intermediate $^{\bullet}HOCO$, which transfers rapidly its radical hydrogen to O_2 to form peroxy radical ($HO_2^{\bullet}$) and carbon dioxide (CO_2).[34] Peroxy radical subsequently reacts with nitrogen oxide (NO) to form nitrogen dioxide (NO_2) and hydroxyl radical. NO_2 gives $O(^3P)$ via photolysis, thereby forming O_3 following reaction with O_2. Since hydroxyl radical is formed during the formation of NO_2, the balance of the sequence of chemical reactions starting with carbon monoxide and leading to the formation of ozone is:

$$CO + 2O_2 + h\nu \rightarrow CO_2 + O_3$$

(where hν refers to the photon of light absorbed by the NO_2 molecule in the sequence)

Although the creation of NO_2 is the critical step leading to low level ozone formation, it also increases this ozone in another, somewhat mutually exclusive way, by reducing the quantity of NO that is available to react with ozone.[35]

Appendix C Contains “UC3 Emissions Data”
7-page Document authored by UC3 Manufacturer

UTiS

UC3 Technology impacts

UTiS

SUSTAINABLE COMBUSTION SYSTEMS

Contains many anecdotal comments, but Supporting Scientific Evidence/Information and Underlying Documents are Missing; Nothing Provided to Verify Claims for Metals, Dioxins/Furans

3.2 Impacts on emissions

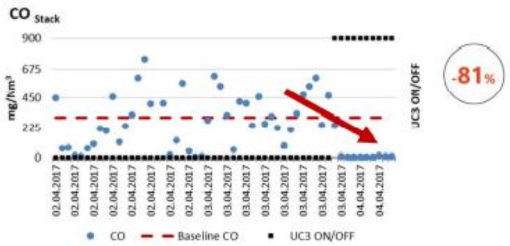
With a wide application of the technology in more than 50 cements plants, it's consistent that the UC3 technology does not aggravate the level of atmospheric emissions, and in most cases, it even decreased its levels (as the explained below).

From the extended operation of the UC3 technology in these plants, it was not detected any changes in other emissions profile, such as metals, dioxins and furans.

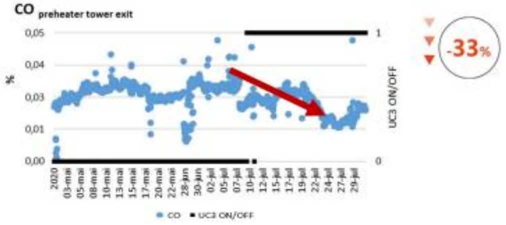
UTiS Claims CO, NOx, SO2 emissions reduced, but very limited data provided is not referenced, no underlying docs provided making claims unverifiable

- For example, for reduced CO claim, the following graphs provided, but underlying information, facility information for case study not provided, making it untraceable

Case study 1



Case study 2



BCX Report (page 1 of pdf) Relies on UTiS Doc to Support Assertion That UC3 installation is “environmentally insignificant amendment” and therefore “exempt from EBR requirements”

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Important Sections/Information Redacted in ESDM Section of Document
Here Kiln Stack Emissions (Appendix F, page 168 of pdf); ALCF Tonnages Redacted

Calculation Sheet 1 - Kiln Stack Emissions

The maximum of the 2018 source testing results for conventional fuel, woody biomass fuels (96 tonne of woody material/day) and alternative fuel (ALCF-2019) (demonstration trial 2) (287 tonnes/day) was determined for each contaminant.
To determine the maximum emissions scenario, emission factors (g/tonne of fuel input) were first derived from the 2018 source testing results for conventional fuel, woody biomass fuels and alternative fuel substitution (ALCF-2019) (demonstration trial 2). Emission rates were then estimated using these emission factors and the proposed fuel consumption rates. The methodology is detailed below.
With respect to PM, NO_x, SO_2, NH_3 and CO, kiln stack emissions are dominated by conditions of the kiln system and associated air pollution control equipment. As such, emissions are not expected to change with a higher fuel substitution rate and, therefore, the emission rates from the 2018 source test were used.

Source Testing ER of CF only (g/s) = EF_{CF} x Fuel Consumption$_{CF,AST}$ (tonne/day) x (day/24hr) x (1hr/3600s)
EF_{CF} (g/tonne) = Source Testing ER of CF only (g/s) x (3600s/hr) x (24hr/day)/Fuel Consumption $_{CF,AST}$

Source Testing ER of Woody Biomass Fuel (g/s) = EF_{CF} (g/tonne) x Fuel Consumption$_{CF,B}$ (tonne/day) x (1day/24hr) x (1hr/3600) + EF_{LCF} (g/tonne) x Fuel Consumption$_{LCF,B}$ (tonne/day) x (1day/24hr) x (1hr/3600)
EF_{LCF} = [Source Testing ER of LCF (g/s) - EF_{CF} (g/tonne) x Fuel Consumption$_{CF,BST}$ (tonne/day) x (1day/24hr) x (1hr/3600)] / [Fuel Consumption$_{LCF,BST}$ (tonne/day) x (1day/24hr) x (1hr/3600)]

Source Testing ER of ALCF-2019 (g/s) = EF_{CF} (g/tonne) x Fuel Consumption$_{CF,C}$ (tonne/day) x (1day/24hr) x (1hr/3600) + EF_{ALCF} (g/tonne) x Fuel Consumption$_{ALCF,C}$ (tonne/day) x (1day/24hr) x (1hr/3600)
EF_{ALCF} = [Source Testing ER of ALCF (g/s) - EF_{CF} (g/tonne) x Fuel Consumption$_{CF,CST}$ (tonne/day) x (1day/24hr) x (1hr/3600)] / [Fuel Consumption$_{ALCF,CST}$ (tonne/day) x (1day/24hr) x (1hr/3600)]

Prorated ER of CF only (g/s) = EF_{CF} x Fuel Consumption $_{CF,AP}$ (tonne/day) x (day/24hr) x (1hr/3600s)
Prorated ER of Woody Biomass Fuel (g/s) = EF_{CF} (g/tonne) x Fuel Consumption$_{CF,BP}$ (tonne/day) x (1day/24hr) x (1hr/3600) + EF_{LCF} (g/tonne) x Fuel Consumption$_{LCF,BP}$ (tonne/day) x (1day/24hr) x (1hr/3600)
Prorated ER of ALCF-2019 (g/s) = EF_{CF} (g/tonne) x Fuel Consumption$_{CF,CP}$ (tonne/day) x (1day/24hr) x (1hr/3600) + EF_{ALCF} (g/tonne) x Fuel Consumption$_{ALCF,CP}$ (tonne/day) x (1day/24hr) x (1hr/3600)
Modelled ER (g/s) = Maximum of the above three ER (g/s)

Scenario	Source Testing Fuel Consumption (tonnes/day)			Proposed Fuel Consumption (tonnes/day)		
	Conventional Fuel	Woody Biomass Fuel	ALCF-2019	Conventional Fuel	Woody Biomass Fuel	ALCF-2019
Conventional Fuel Only	[redacted]					
Conventional Fuel + Woody Biomass Fuel						
Conventional Fuel + ALCF-2019						

Scenario Coding Example: BST - Conventional Fuel + Woody Biomass Fuel, Source Testing; BP - Conventional Fuel + Woody Biomass, Proposed

Contaminant	CAS Number	2018 Source Testing Data						Prorating Methodology				Modelled Emission Rate (g/s)	Emission Technique	Data Quality
		Conventional Fuel (Oct 2018)	Conventional Fuel (Dec 2018)	Woody Biomass Fuel (Dec 2018)	ALCF-2019 (Dec 2018)	Maximum Emission Rate (Source Testing)	Conventional Fuel (Average of Oct&Dec 2018)	Emission Factors (g/tonne) Conventional Fuel (EF_{CF})	Emission Factors (g/tonne) Woody Biomass Fuel (EF_{LCF})	Emission Factors (g/tonne) ALCF-2019 (EF_{ALCF})	Maximum Emission Rate (Proposed) (g/s)			
Particulate														
PM	PM	2.02E+00	4.12E+00	1.22E+00	4.17E+00	4.17E+00	3.07E+00	-	-	-	4.17E+00	4.17E+00	V-ST	Above-Average
Combustion Gases														
Nitrogen Oxides	10102-44-0	8.94E+01	9.73E+01	9.36E+01	8.67E+01	9.73E+01	9.33E+01	-	-	-	9.73E+01	9.73E+01	V-ST	Above-Average
Sulphur Dioxide	7446-09-5	1.37E+02	1.14E+02	1.42E+02	1.69E+02	1.69E+02	1.26E+02	-	-	-	1.69E+02	1.69E+02	V-ST	Above-Average
Carbon Monoxide	630-08-0	1.19E+02	7.49E+01	N.D.	1.00E+02	1.19E+02	9.67E+01	-	-	-	1.19E+02	1.19E+02	V-ST	Above-Average
Ammonia														
Ammonia	7664-41-7	5.95E+00	4.06E+00	5.30E+00	5.22E+00	5.95E+00	5.01E+00	-	-	-	5.95E+00	5.95E+00	V-ST	Above-Average
Hydrogen Chloride														
Hydrogen Chloride	7647-01-0	1.45E+00	6.03E-01	1.10E+00	1.67E+00	1.67E+00	1.03E+00	1.46E+02	1.85E+02	2.54E+02	1.90E+00	1.90E+00	EC	Above-Average

Appendix H on page 225 of pdf Completely redated

Appendix H

Material Composition Information

[redacted]

ERO Comments Due This Friday, October 29th

- Please ensure Clarington comments
- Timing of this application is questionable, coming right after approval to burn 400 tonnes/day of expanded wastes
- Insufficient information and documentation provided
- Also concerns with lack of details on flammability and explosion risk with H_2 and O_2
- All CO_2 and GHG emissions must be accounted for
- Impact on GHGs should have been assessed
- No sidestepping of reporting by asserting Hydrogen not a fuel