REPORT

Carbon Dioxide Emission Intensity Report

Lehigh Hanson Materials Limited

Accurate as of August 2022

Submitted to:

Lehigh Hanson Materials Limited

1370 Highway 49
Picton, ON
K0K 2T0

Submitted by:

Golder Associates Ltd.

1931 Robertson Road, Ottawa, Ontario, K2H 5B7, Canada

+1 613 592 9600

2148080301

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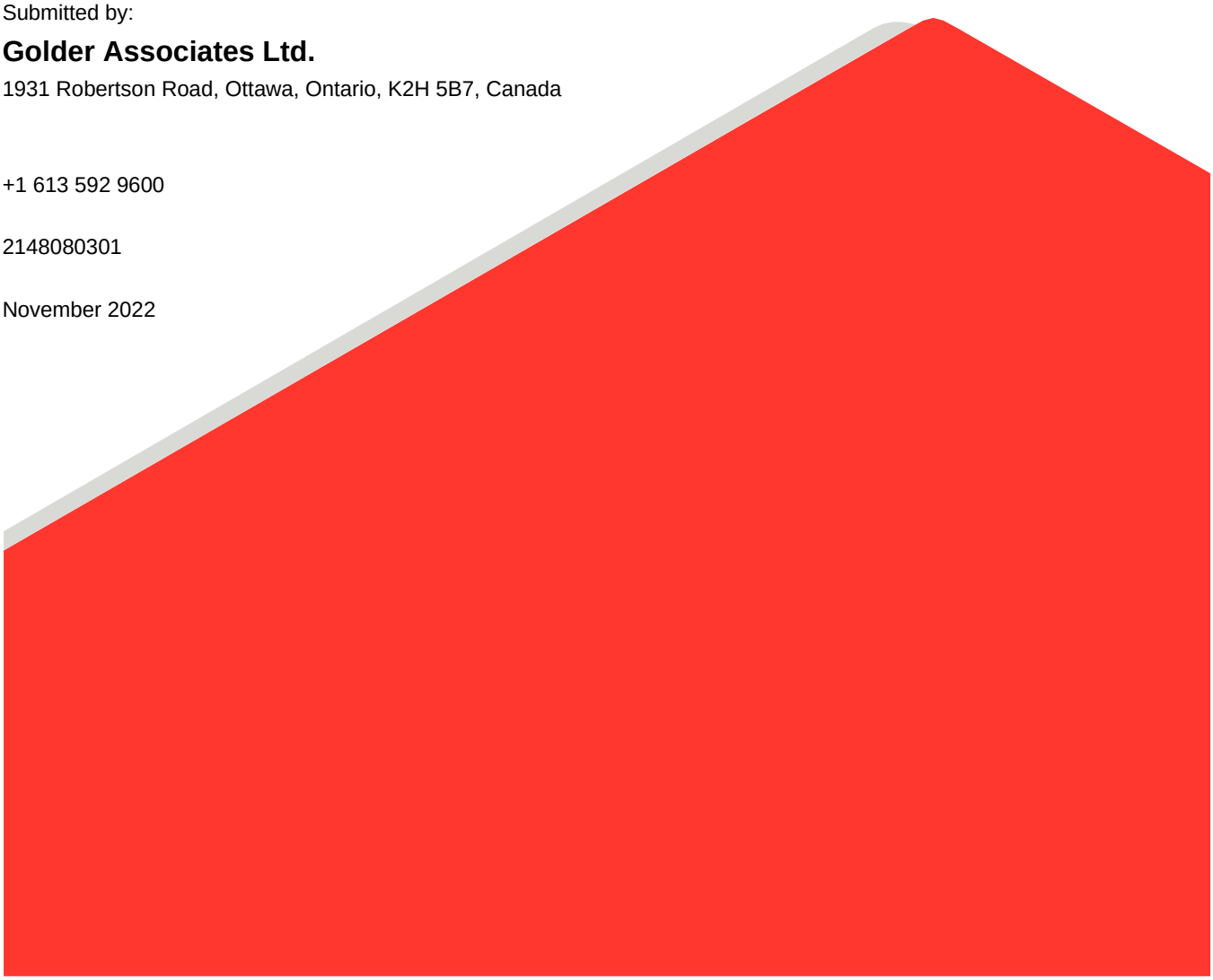

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1.0 INTRODUCTION

Lehigh Hanson Materials Ltd. (Lehigh) is undertaking efforts to use Alternative Low Carbon Fuels (ALCFs) to supplement part of the fossil fuels required to make portland cement at their Picton Cement Plant (the Site). ALCFs are in use in many cement plants all over the world and represent a proven technology to reduce greenhouse gas emissions. The Site is located at 1370 Hwy 49, Picton, Ontario and currently operates with Environmental Compliance Approval (ECA) for air and noise, #0073-BHGQHC, issued October 31, 2019.

Golder Associates Ltd. (Golder) was retained by Lehigh to prepare an application under Part II.1 of the Ontario Environmental Protection Act (EPA) to amend the existing ECA to allow for a Non-Demonstration (Permanent) Project to use ALCFs at the Site, satisfying Ontario Regulation (O. Reg.) 79/15 (as amended by O. Reg. 54/21 and 824/21) (the ECA Amendment Application). The Site Location is illustrated in Figure 1.

Figure 1:Site Location and Property Boundary

This carbon dioxide (CO_2) intensity report has been prepared to satisfy section 11 of O. Reg. 79/15.

1.1 Purpose and Scope

The purpose of this report is to demonstrate that the CO_2 emission intensities of the proposed ALCFs are less than the CO_2 emission intensity of the conventional fuels (coal and petroleum coke [petcoke]) currently used at the Site as required by O. Reg. 79/15.

The CO_2 emission intensity is a form of measurement that allows different fuel types to be compared and is an indicator of the amount of CO_2, which is a greenhouse gas (GHG), that is emitted into the atmosphere when the fuel is combusted. A lower CO_2 emission intensity value means that a given material will release less CO_2.

- As part of the ECA Amendment Application, Lehigh is requesting approval for the following:
  - An ALCF daily throughput of up to 200 tonnes per day, which may include the following materials:
  - Construction & Demolition (C&D) Materials; including but not limited to primarily wood material with minor amounts of non-recyclable paper and plastic.

  - Industrial, Commercial, and Institutional (IC&I) Materials; including but not limited to primarily non-recyclable paper, plastic and textiles wood material, and tire fibre and fluff.
  - The combustible fraction of non-recyclable household waste (commonly referred to as Refuse Derived Fuel [RDF]).
  - Discarded treated seed.
- Installation of new conveyance and storage equipment for ALCF at the site using enclosed containers and buildings.

The Site will target approximately 33% thermal replacement by using mixtures of ALCFs to replace coal and petcoke.

The above noted ALCFs would meet the following criteria to satisfy the fuel requirements of O. Reg. 79/15:

- be used as mixtures of non-recyclable and non-odorous materials;
- not be derived from or composed of any material set out in Schedule 1 of O. Reg. 79/15;
- wholly derived from or composed of materials that are biomass, municipal waste, or a combination of both;
- have a high heat value of at least 10 megajoules per kilogram (MJ/kg).

2.0 SITE DESCRIPTION

The Site produces portland cement by combining materials containing calcium carbonate (limestone), silica (sand), alumina (bauxite) and iron oxide at high temperatures to produce cement clinker. The clinker is subsequently ground with finishing materials such as gypsum and limestone to produce cement. The Site has a maximum permitted production rate of 163 tonnes per hour (tph) of clinker from kiln 4, and is seeking an annual production rate of 1.4 million tonnes of clinker. The site operates 24 hours per day, 7 days a week, 12 months per year with the exception of scheduled plant shut-downs.

The primary North American Industrial Classification System (NAICS) code for the Site is 327310 (cement manufacturing).

2.1 Portland Cement Production Process

2.1.1 Raw Material / Conventional Fuel Delivery and Storage

A quarry is located adjacent to the cement plant in which raw materials (limestone and shale) are extracted. Limestone from the quarry is loaded onto trucks and travels under Highway 49 via a tunnel, where the limestone is unloaded directly into the primary crusher or unloaded for temporary storage.

Limestone makes up the majority of the raw materials within cement manufacturing, which is quarried on site. Other raw materials include, gypsum (anhydride and crude), silica, iron, alumina, and blended additives, which are shipped to the Site.

Conventional solid fuels (coal and petcoke) are delivered by boat and stockpiled on the shore of the Site.

2.1.2 ALCF Delivery and Storage (Proposed)

ALCFs will be delivered by enclosed trucks, which would enter the proposed fuel storage building. To minimize potential for fugitive emissions from the unloading of the ALCFs once received at the Facility, material will be unloaded directly from the truck into the ALCF building.

2.1.3 Raw Material Processing and Clinker Production

Once the limestone experiences primary crushing, the material is conveyed in an enclosed building to the secondary crushers. After the secondary crushers, the material is then either conveyed for storage or directly to the raw mills where it is blended with other additives (silica, iron, alumina and other additives). The raw milling process allows for further comminution while drying the materials via use of kiln exhaust gases. The blended material is milled to the appropriate particle size to form the raw meal prior to conveyance to the kiln.

2.1.4 Fuel Preparation

Conventional solid fuels are fed to the fuel milling system from the stockpiles. Combustion Emissions are directed to an electrostatic precipitator and exhausted through the Kiln 4 main stack. Milled conventional fuel (fuel meal) is fed to the kiln burners.

Once the Site is approved to use ALCFs, the pre-processed (particle sizing and blending) ALCF materials will be received to site via truck transport and unloaded into the appropriate stockpiles within the enclosed storage / feeding building. A series of proportioning feeders will allow for the various ALCF's to be proportioned as required to create the desired ALCF blend. A wheeled loader operating within the enclosed storage building will load the proportioning feeders from stock.

The proportioning feeders unload onto an enclosed drag conveyor feeding the blended ALCF's into a metal separator, passes through a de-lumper and finally a disk screen separating any potential oversized material from being transported to the kiln ALCF dosing system by way of the tube conveyor.

The fuel preparation and handling system will include the following:

1) An enclosed storage / material handling building with segregated stock storage and a series of proportioning weigh feeders
2) An enclosed in-feed drag conveyor feeding to a de-lumper
3) A drum or belt magnetic separator
4) A disk screen to control the ALCF particle size fraction being fed to the dosing system
5) An enclosed conveyor to transfer materials to the hopper for the ALCF kiln dosing system.
6) An ALCF kiln dosing system, electronically controlled, and specifically designed to handle light and low bulk density materials, feeding the material pneumatically to the main kiln burner

2.1.5 Clinker Production

Calcination (Preheater Tower and Kiln)

The purpose of the kiln is to convert the raw meal into clinker through a process referred to as pyroprocessing (i.e., heating the material to temperatures greater than 1400˚C). The high temperatures of the kiln cause the ingredients in the raw meal to form clinker.

Kiln 4 is a preheater style kiln equipped with an electrostatic precipitator (ESP) that currently relies on a fuel mixture of coal and petcoke and some natural gas. The rotation speed of the kiln is controlled to gradually move the raw materials towards the burning zone (flame end and outlet of clinker) which provides a long residence time ensuring complete combustion/calcination.

The first step in the clinker manufacturing process is to convey the raw meal from the raw meal storage to the top of the preheater tower where heat exchange between the raw meal and hot kiln gases allows for the calcination process; the liberation of CO_2 from the calcium carbonate (limestone) produces the active ingredient in the chemical process – Lime (CaO). Fuel addition located at the kiln riser utilizes approximately 25% of the thermal load requirement and is used to manage the temperatures in the pre-heat tower and concurrently the degree of calcination.

Once the raw meal completes the preheating stage, it enters the inlet of the kiln (feed end) of the sloped rotary kiln for direct firing. The fuel for the kiln, the remaining 75% of the thermal load, is introduced at the lower end (outlet of clinker) of the kiln which is equipped with a burner (flame end). This design creates a counter-current flow with the raw meal and the fuel combustion gases. As the kiln turns, the raw meal is conveyed towards the flame end and the fuel combustion gases are exhausted through the preheater through an evaporative cooling gas conditioning tower, the vertical raw mills and then to dust collection in the ESP. The fuel combustion gases in the kiln will reach temperatures in excess of 1,800˚C.

To manage the volatile cycle of some compounds in the kiln, Lehigh employs a bypass stack. Under normal operating conditions, approximately 97% of the flue gases from the kiln pass through the pre-heater and raw mill and are exhausted through the ESP and Kiln 4 main stack, while the remaining 3% of the kiln flue gases goes through the bypass system (i.e., “bypassing” the preheater, raw mills and the ESP on the Kiln 4 main stack). The purpose of the bypass system is to remove volatile components (e.g., chlorine) from the kiln system as they accumulate in a volatile cycle, changing state from gas to solid at temperatures within the kiln and pre-heat tower. The bypass utilizes a quench fan condensing the volatile components into the bypass kiln dust. The chemical reactions and physical processes under high temperatures and with a long residence time transform the raw meal into clinker. The high temperatures, long residence times and the oxidizing atmosphere in the kiln system result in the complete destruction of the organic components of the fuels (conventional/ALCF) and raw materials. The clinker formed inside the kiln retains the majority of the inorganic components of the fuels and raw materials including heavy metals. The active ingredient, lime, produced in the pre-heater tower and kiln is an inherent scrubber capturing volatile compounds and forming them into clinker compounds.

The Site also uses a Selective Non-Catalytic NO_x Reduction (SNCR) ammonia solution injection system to reduce NO_x emissions and employs hydrated lime injection to reduce SO_2 emissions from the kiln 4 stack.

Continuous Emissions Monitoring for the Kiln System

The Site uses a continuous emissions monitoring (CEM) system to monitor emissions from the main stack and bypass stack on kiln 4, including nitrogen oxides (NO_x), sulphur dioxide (SO_2), carbon monoxide (CO) and opacity at all times. At this time, Kiln 3 is not in operation and is removed from the ECA Amendment Application.

Clinker Cooling

Once the clinker exits the kiln, it is rapidly cooled by passing ambient air across the product in the clinker cooler. Part of this pre-heated air is directed into the kiln for use as combustion air.

Once the clinker has cooled, it is conveyed to the clinker storage hall. Overhead cranes transport clinker and other additives to the Cement Mills where the materials are ground to form cement.

2.1.6 Cement Production

At the Cement Mill, the clinker undergoes grinding and blending with other materials (e.g., limestone, gypsum, grinding aid) to produce the various grades of cement. The finished cement is stored in one of several cement silos. The cement may be loaded onto barge for marine transport, on trucks to be sent off site or conveyed to be packaged in the Cement Packaging Area.

The Site is currently undergoing a conversion of its clinker storage dome to a finished cement storage dome, which will be equipped with various enclosed conveyance equipment (including pneumatic conveyance) and dust collection.

2.1.7 Conventional Fuels

The thermal requirements of the cement manufacturing process at the Site have been provided by the combustion of coal and petcoke. Historically, natural gas is utilized for the kiln pre-heating requirements. While natural gas may also be utilized for clinker production, the evaluation of ALCFs as defined in O. Reg. 79/15 considers the replacement of coal or petcoke with ALCFs. Fuel fed to the main kiln burner is a combination of coal and petcoke. Fuel fed to the auxiliary riser burner is primarily coal.

While the Site is also undertaking efforts to be able to utilize natural gas on the auxiliary riser burner, the ALCFs would be utilized in conjunction with coal / petcoke on the main burner.

3.0 ALTERNATIVE LOW-CARBON FUELS

As part of the ECA Amendment Application, the Site is proposing to utilize up to 200 tonnes per day of ALCFs. Lehigh is seeking approval for the use of ALCFs from the material baskets described in Table 1.

Table 1: Proposed ALCF Material Baskets and Example Fuels

ALCF Material Basket	Example of ALCFs
Construction & Demolition (C&D) By-Products	Primarily but not limited to wood material with minor amounts of non-recyclable paper and plastic
Industrial, Commercial and Institutional Materials (IC&I)	Primarily but not limited to non-recyclable paper, plastic and textiles but including wood material, and tire fibre and fluff
Combustible Fraction of Non-Recyclable Waste (Refuse Derived Fuel [RDF])	Non-recyclable household waste
Discarded Treated Seed	Plastic coated corn kernels

It is anticipated that the ALCF materials will be blended at the Site prior to their combustion in the kiln. The proportion of individual ALCF materials will depend on availability of material which would result in different amount of required coal or petcoke to achieve the total required heat input for clinker production.

4.0 CARBON DIOXIDE EMISSION INTENSITY CALCULATIONS

In accordance with O. Reg. 79/15, the CO_2 emission intensity calculations must be based on chemical analysis data of the conventional fuel and proposed ALCFs. The sections below describe the sampling requirements, chemical analysis results and carbon dioxide emission intensity calculations.

It should be noted chemical analysis results are based on the chemical analysis data that were obtained for the purposes of the ALCF Application under O. Reg. 79/15. As the carbon content of ALCFs may vary depending on the fuel supplier, the Site has developed and will implement a fuel testing program to regularly monitor the carbon content of the ALCF used at the Site. Further details of the testing program are provided in the *Alternative Low Carbon Fuel Handling Procedures and Testing Manual*, Version 1.0, dated October 2022.

4.1 Fuel Sampling

4.1.1 Conventional Fuel Sampling

Samples of coal and petcoke were submitted for chemical analysis to estimate the total carbon content and high heat value. CO_2 emission intensity calculations are accurate as of August 2022.

Samples are required to meet the following criteria listed in Section 9(3) of O. Reg. 79/15:

a) only include samples taken and analysed during the most recent six-month period during which the facility was operating before the determination is made;

b) include at least one sample taken and analysed during each month of the six-month period mentioned in clause (a);

c) not include any samples taken more than 36 months before the determination is made; and

d) be representative of the coal or coke in the place of which alternative low-carbon fuel is proposed to be combusted.

At the time of finalization of this report, the available data for coal and petcoke are from samples collected between January and June 2022. In total, there is at least one sample of coal and petcoke for each month between January and June.

In accordance with O. Reg. 79/15, only prescribed chemical analysis methods were used to estimate the total carbon content and high heat value of each fuel. The chemical analysis methods and sampling results are summarized in Table A1 in Appendix A. A copy of the conventional fuel chemical analysis data is provided in Appendix B.

4.1.2 ALCF Sampling

Samples of the ALCF materials were obtained from potential suppliers of ALCFs currently available for the Site. The materials were submitted for chemical analysis to estimate the biological carbon content, total carbon content and high heat value of each ALCF material. The chemical analysis methods and sampling results are summarized in Table A2 in Appendix A. A copy of the ALCF chemical analysis data is provided in Appendix B.

These samples met the following criteria listed in Section 10(2) of O. Reg. 79/15:

1) Only samples taken within 36 months before the determination is made shall be used.

2) One of the following methods shall be applied:

   i. Analysis in accordance with a prescribed chemical analysis method of at least one sample of the fuel.

   ii. Analysis in accordance with a prescribed chemical analysis method of at least one sample of each of the individual materials that the fuel is composed of or derived from, using a weighted average of the carbon content and high heat value of the individual materials.

The number of samples analyzed must provide results that are sufficiently representative of the fuel or individual materials and must allow for adequate characterization of the fuel or individual materials.

Biological carbon content data for the ALCF samples were obtained from analytical testing using the ASTM D 6866 “Standard Test Methods for Determining the Biobased Content of Solid, Liquid, and Gaseous Samples Using Radiocarbon Analysis” biobased carbon testing methodology required by O. Reg. 79/15. This data is required in order to determine the non-biological carbon content of the ALCFs, which is the carbon content of the portion of the ALCF that is not composed of or derived from biomass or organic matter (excluding peat or peat derivatives).

4.2 Sample Calculations

4.2.1 Conventional Fuel Sample Calculation

The following formula was used to calculate the carbon dioxide emission intensity for each conventional fuel sampling result. An example calculation is presented below using the chemical analysis results for coal sample FUEL220125-04.

$$\textbf{Carbon dioxide emission intensity } \left[\frac{\textbf{kg } CO_2}{\textbf{MJ}}\right]$$

$$= \text{Total carbon content } [\%] \times \text{C to } CO_2 \text{ conversion } \left[\frac{\text{kg } CO_2}{\text{kg C}}\right] \div \text{High heat value } \left[\frac{\text{MJ}}{\text{kg fuel}}\right]$$

Where:

$$\textbf{Total carbon content} = 61.40\% \text{ (value from chemical analysis result for sample FUEL220125} - 04)$$

$$\textbf{C to } \boldsymbol{CO_2} \textbf{ conversion} = 3.67$$

$$\textbf{High heat value} = 25.06 \ \frac{MJ}{kg} \text{ (value from chemical analysis result for sample FUEL220125} - 04)$$

Therefore:

$$\text{Carbon dioxide emission intensity} = 61.40\% \times 3.67 \ \frac{\text{kg } CO_2}{\text{kg C}} \times \frac{1}{25.06} \frac{\text{kg fuel}}{\text{MJ}}$$

$$\text{Carbon dioxide emission intensity} = 0.0899 \ \frac{\text{kg } CO_2}{\text{MJ}}$$

4.2.2 ALCF Example Calculation

In accordance with O. Reg. 79/15, the following formula was used to calculate the carbon dioxide emission intensity for each ALCF sampling result. An example calculation is presented below using the chemical analysis results for C&D sample AF294.

$$\textbf{Carbon dioxide emission intensity } \left[\frac{\textbf{kg } CO_2}{\textbf{MJ}}\right]$$

$$= \text{Non} - \text{biological carbon content } [\%] \times \text{C to } CO_2 \text{ conversion } \left[\frac{\text{kg } CO_2}{\text{kg C}}\right] \div \text{High heat value } \left[\frac{\text{MJ}}{\text{kg fuel}}\right]$$

Where:

$$\textbf{Non} - \textbf{biological carbon content } [\%] = \textbf{Total carbon content } [\%] \times (\textbf{100}\% - \textbf{Biological carbon content } [\%])$$

$$\textbf{Total carbon content} = \textbf{41.19}\% \ (\textbf{value from chemical analysis result for sample AF294})$$

$$\textbf{Biological carbon content} = \textbf{79}\% \ (\textbf{value from chemical analysis result for sample AF294})$$

$$\textbf{C to } CO_2 \textbf{ conversion} = \textbf{3.67}$$

$$\textbf{High heat value} = \textbf{17.40} \ \frac{\textbf{MJ}}{\textbf{kg}} \ \textbf{value from chemical analysis result for sample AF294})$$

Therefore:

$$\textbf{Non} - \textbf{biological carbon content} = \textbf{41.19}\% \times (\textbf{100}\% - \textbf{79}\%)$$

$$\textbf{Non} - \textbf{biological carbon content} = \textbf{8.65}\%$$

And,

$$\text{Carbon dioxide emission intensity} = 8.65\% \times 3.67 \ \frac{\text{kg } CO_2}{\text{kg C}} \times \frac{1}{17.40} \ \frac{\text{kg fuel}}{\text{MJ}}$$

$$\text{Carbon dioxide emission intensity} = 0.0182 \ \frac{\text{kg } CO_2}{\text{MJ}}$$

4.3 Summary of Assessment

4.3.1 Conventional Fuel Assessment

CO_2 emission intensity values were calculated for each coal and petcoke sampling result, as presented in Appendix B. Detailed sample calculations for the fuels are presented in Appendix C.

The average CO_2 Emission Intensities of the conventional fuels, presented in Appendix A Table A1, are 0.0902 kg CO_2/MJ for coal and 0.0907 kg CO_2/MJ for petcoke.

The average High Heat Values, based on the results presented in Appendix A Table A1, are 28.12 MJ/kg for coal and 33.16 MJ/kg for petcoke.

The Facility typically requires an annual heat input of 2,784,000 GJ/year to meet market demand of approximately 700,000 tonnes of clinker per year. This equates to a net heat consumption of 3.9 to 4.0 GJ/ tonne of clinker. Based on the average High Heat Values of coal and petcoke, and assuming a fuel split of 46% coal and 54% petcoke (the split on these fuels varies from 35% to 65%), the maximum conventional fuel input is estimated at 90,293 tonnes/year.

4.3.2 ALCFs Assessment

The CO_2 emission intensity values were calculated for each ALCF material, as presented in Table A2 in Appendix A. Detailed sample calculations for the ALCFs are provided in Appendix B. The average CO_2 emission intensities for each ALCF material basket are presented in Table 2.

Table 2: Estimated Reductions in CO_2 Emission Intensity with Use of ALCFs

ALCF Basket	C&D	IC&I	RDF	Discarded Treated Seed
Average CO_2 Emission Intensity [kg CO_2/MJ]	0.0175	0.0512	0.0611	0.000
Percent Reduction in CO_2 Emission Intensity Compared to Petcoke	81%	44%	33%	100%

The results demonstrate that the ALCFs have significantly lower CO_2 emission intensity values in comparison to conventional fuel. For example, the average carbon dioxide emission intensity value of C&D represents a decrease of approximately 81% when compared to the carbon dioxide emission intensity of petcoke. Combustion of discarded treated seed results in 100% decrease in carbon dioxide emission intensity when compared to the carbon dioxide emission intensity of petcoke.

4.3.3 Use of ALCFs and Conventional Fuel

It is anticipated that the ALCF materials will be blended at the Site prior to their combustion in the kiln. The proportion of individual ALCF materials will depend on availability of material and will result in different overall CO_2 emission intensity of the ALCFs as well as different amounts of required coal and petcoke to achieve the required heat input.

As the Site will be blending ALCF materials into a mixture prior to their use in the kiln, the overall High Heat Value of the blended ALCF materials will vary depending on the proportion of ALCF materials in the mixture which are difficult to predict. This also impacts the variability in required amounts of conventional fuel to supplement ALCFs and achieve the required heat input.

A scenario assessment was conducted where it was assumed that a blend of 70% IC&I, 25% C&D and 5% seed would be used in the kiln (ALCF Blend). Please note the values presented in this report are based on the data available at the time of writing and the following assumptions:

- an example scenario of a petcoke and coal consumption split of 54% and 46%, respectively;
- an assumed typical heat demand that is associated with producing approximately 700,000 tonnes of clinker; and
- not including the thermal heat from the consumption of natural gas.

The following information was used for this scenario assessment, with results presented in Table 3:

Typical Annual Required Heat Input =	2,784,000	GJ/year
Maximum Thermal Replacement with ALCFs =	33%	thermal replacement
Maximum Required Heat Input from ALCFs =	918,720	GJ/year

Table 3: Required Amount of Conventional Fuel When Using An ALCF Blend at 33% Thermal Replacement

Parameter[1]	Baseline (46% coal, 54% petcoke)	With ALCFs		Change from Baseline
		Conventional Fuel (46% coal, 54% petcoke)	ALCF Blend	
HHV, Calorific Value [MJ/kg]	30.83	30.83	22.77	decrease in HHV
Heat Input [GJ/year]	2,784,000	1,865,280	918,720	no change
Required Amount of Fuel [tonnes/year]	90,293	60,496	40,356	10,560 tonnes increase in total fuel consumed 29,797 tonnes reduction in conventional fuels used
Overall CO_2 Emission Intensity [kg CO_2/MJ]	0.0905	0.0905	0.0402	decrease in overall CO2 emission intensity due
CO_2 Emissions from Combustion [tonnes]	251,964	168,816	36,920	46,228 tonnes reduction in CO_2 emissions

Blending the proposed ALCF materials will result in a variable amount of coal and petcoke in place of which ALCFs would be combusted at the Site. The amount of conventional fuels required to achieve the desired maximum heat input will vary depending on the composition of the ALCF blend used day to day, and the amount of clinker produced. In this example, ALCFs would displace 29,797 tonnes (or 33%) of conventional fuels per year and would reduce CO_2 emissions by an estimated 46,228 tonnes annually. Please note the values (e.g., HHVs, heat input demands) presented in this report may differ from other technical studies included with the ECA Amendment Application for the use of ALCFs (e.g., ESDM Report). This is due to the CO_2 Emission Intensity Report presented an annual CO_2 emission reduction based on a range of estimated CO_2 emission intensities of a typical fuel mix, while the ESDM report assesses daily worst-case air emissions from a maximum use of 200 tonnes per day of any of the ALCFs.

5.0 CONCLUSION

Lehigh is undertaking efforts to use ALCFs to supplement part of the fossil fuels required to make portland cement at their Picton Cement Plant. The results of this CO_2 emission intensity report support this strategy, with estimated ALCF CO_2 emission intensity values lower than the values for conventional fuels. This report was prepared in accordance with the requirements outlined in Section 11 in O. Reg. 79/15.

The results presented in this report are solely based on the chemical analysis data that was obtained for the purposes of the ECA Amendment Application under O. Reg. 79/15. The Site plans to develop and implement a fuel testing program to regularly monitor the composition and CO_2 emission intensity of the ALCFs to be used at the Site.

[1] The estimated values presented were calculated as a weighted average of sampled data for coal, petcoke, IC&I, C&D and seed, based on the proportions of each fuel assumed for this illustrative scenario, e.g. ALCF Blend weighted average parameters were calculated based on 70% IC&I, 25% C&D and 5% seed, etc.

6.0 LIMITATIONS OF REPORT

6.1 Standard of Care

Golder Associates Ltd., a member of WSP has prepared this report in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering and science professions currently practicing under similar conditions in the jurisdiction in which the services are provided, subject to the time limits and physical constraints applicable to this report. No other warranty, expressed or implied is made.

6.2 Basis and Use of the Report

This carbon dioxide emission intensity report was prepared for the exclusive use of Lehigh and once finalized, is intended to fulfil Ministry data requirements for an alternative low carbon fuels (ALCF) Application for a Non-Demonstration (Permanent) Project under Ontario Regulation (O. Reg.) 79/15 (as amended by O. Reg. 54/21 and 824/21). The report is based on fuel samples collected and analyzed between January 2022 and July 2022 (for conventional fuels, ICI, RDF and seed), samples of C&D collected and analyzed between February 2020 and April 2022. The calculations made to determine the carbon dioxide emission intensities of the fuels followed the formulas and procedures outlined in O. Reg. 79/15.

The information, recommendations and opinions expressed in this report are for the sole benefit of Lehigh, subject to the limitations and purposes described herein. Use of or reliance on this report by others is prohibited and is without responsibility to Golder Associates Ltd., a member of WSP. The report, all plans, data, drawings and other documents as well as all electronic media prepared by Golder Associates Ltd. are considered its professional work product and shall remain the copyright property of Golder Associates Ltd. If Lehigh gives, lend, sell, or otherwise make available the report or any portion thereof to any other party, it does so at its own risk and liability. Lehigh acknowledges that electronic media is susceptible to unauthorized modification, deterioration and incompatibility and therefore Lehigh cannot rely upon the electronic media versions of Golder Associates Ltd.'s report or other work products.

When evaluating the Facility and developing this report, Golder Associates Ltd. has relied on information provided by Lehigh, the regulatory authorities, and others. Golder Associates Ltd. has acted in good faith and accepts no responsibility for any deficiencies, misstatements, or inaccuracies contained in this report resulting from omissions, misinterpretations or falsifications by those who provided us with information.

While ensuring that the report was prepared in general conformance with regulatory and guideline requirements, Golder Associates Ltd. cannot guarantee that it will be accepted in its entirety by the Ministry or other regulatory body.

Physical sampling of atmospheric emission sources was not completed as part of the scope of work.

7.0 LICENSED ENGINEERING PRACTITIONER STATEMENT

Ontario Regulation 79/15 requires that this Carbon Dioxide Intensity Report be prepared by a licensed engineering practitioner (LEP) as part of an ALCF approval application.

As the LEP who prepared this Carbon Dioxide Intensity Report, I confirm that, in accordance with Section 11.(1) of Ontario Regulation 79/15,

i) the carbon dioxide emission intensities of the coal or coke and of the alternative low carbon fuel have been determined in accordance with Ontario Regulation 79/15, and

ii) the carbon dioxide emission intensity of the alternative low-carbon fuel proposed to be combusted is less than the carbon dioxide emission intensity of the coal or coke in the place of which the alternative low-carbon fuel is proposed to be combusted.

Bonnie Field (Choi), P.Eng., 100219538

8.0 PROPONENT STATEMENT

Ontario Regulation 79/15 requires that this Carbon Dioxide Intensity Report be certified by the proponent or a person who is authorized by the proponent.

By signing below, Nick Papanicolaou, Environmental Manager of the Lehigh Picton Cement Plant, certifies that the information given to the licensed engineering practitioner to prepare the report is complete and accurate.

Nov 23rd, 2022.

Nick Papanicolaou, Environmental Manager, Lehigh Hanson Materials Ltd., Picton Facility

Signature Page

Golder Associates Ltd.

Bonnie Field, B.Sc., B.A.Sc., P.Eng.
Air Quality Engineer

Jamie McEvoy, P.Eng.
Senior Air Quality Engineer

BSF/JDM/ca

https://golderassociates.sharepoint.com/sites/150044e/lehighlowcarbonfuelsecaontario/shared documents/draft eca application (internal master)/att 2 - co2 intensity report/21480803-r-rev0 lehigh picton co2 emission intensity report_23nov2022.docx

APPENDIX A

Appended Tables

Table A1: Conventional Fuel Sampling Results and CO_2 Emission Intensity Calculation

Conventional Fuel			**Coal**								**Average**	**Petcoke**						**Average**
Client Sample ID			FUEL220125-04	FUEL220131-06	FUEL220228-02	FUEL220527-04	FUEL220430-04	FUEL220527-03	FUEL220531-05	FUEL220630-03		FUEL220131-05	FUEL220228-01	FUEL220331-03	FUEL220430-03	FUEL220531-04	FUEL220630-02	
Date of Sample Collection			January 25, 2022	January 31, 2022	February 28, 2022	March 31, 2022	April 30, 2022	April 30, 2022	May 31, 2022	June 30, 2022		January 31, 2022	February 28, 2022	March 31, 2022	April 30, 2022	May 31, 2022	June 30, 2022	
Test	ASTM Method	Unit	Results									Results						
HHV, Calorific Value, As Received	ASTM D5865	BTU/lb	10773	12051	12312	12394	13092	12278	11902	11919	**12090**	14627	13359	14370	14493	14245	14446	**14257**
		MJ/kg	25.06	28.03	28.64	28.83	30.45	28.56	27.68	27.72	**28.12**	34.02	31.07	33.42	33.71	33.13	33.60	**33.16**
Carbon, As Received	ASTM D5373	% wt.	61.40	68.20	70.40	71.03	75.20	70.97	67.96	68.03	**69.15**	83.76	77.71	82.71	83.70	81.24	82.75	**81.98**
CO_2 Emission Intensity		kg CO_2/MJ	0.0899	0.0893	0.0902	0.0904	0.0906	0.0912	0.0901	0.0901	**0.0902**	0.0904	0.0918	0.0908	0.0911	0.0900	0.0904	**0.0907**

Table A2: ALCF Sampling Results and CO_2 Emission Intensity Calculation

ALCF Basket			Construction & Demolition (C&D) By-Products										Industrial, Commercial and Institutional Materials (IC&I)		Refuse Derived Fuel (RDF)	Discarded Treated Seed
Supplier ID			AF294	AF222	AF239	AF247	AF271	AF331	AF374	AF387	AF390	C&D - GFL Toronto	Buffalo Fuels Sample #2	July 7, 2022 - Min-Tech Campbellford	EDM-RDF	Plastic Corn Kernal Sample
ALCF Material			Wood waste, light plastics									Biomass (wood)	Non-recyclable plastic, paper and cellulose		Non-recyclable household waste	Plastic coated corn kernels
Date of Sample Collection			September 18, 2020	February 13, 2020	April 10, 2020	May 15, 2020	July 10, 2020	April 15, 2021	September 2, 2021	October 21, 2021	November 3, 2021	April 8, 2022	March 15, 2022	July 7, 2022	April 29, 2022	July 6, 2022
Test	ASTM Method	Unit	Results													
HHV, Calorific Value, As Received	E711	BTU/lb	7480	6323	5354	6461	5646	7387	7738	6532	6365	7988	10045	12220	9339	6254
		MJ/kg	17.40	14.71	12.45	15.03	13.13	17.18	18.00	15.19	14.80	18.58	23.36	28.42	21.72	14.55
Carbon, As Received	D5373	% wt.	41.19	37.36	30.70	32.03	33.30	40.73	45.12	39.31	33.84	46.07	53.13	60.75	45.80	35.20
Biological Carbon	D6866	% of C	79	100	80	79	90	44	68	77	85	100	30	44	21	100
Non-Biological Carbon	—	% wt	8.65	0	6.14	6.73	3.33	22.81	14.44	9.04	5.08	0.00	37.19	34.02	36.18	0
CO_2 Emission Intensity		kg CO_2/MJ	0.0182	0.0000	0.0181	0.0164	0.0093	0.0487	0.0294	0.0218	0.0126	0.0000	0.0584	0.0439	0.0611	0.0000

APPENDIX B

Chemical Analysis Results

Sampling Results for Conventional Fuel

Plant	Sample Code	Product Type	Source	Profile	Start Time	End Time	Remarks	Total Moisture as Rcvd	Vol Mtr Dry
								(%)	(%)
Picton Cement Plant	FUEL220125-04	Coal	monthly composite	All Tests	2022-01-18 11:57	2022-01-18 11:58	lab#1077009	12.84	32.41
Picton Cement Plant	FUEL220131-06	Coal	monthly composite	All Tests	2022-01-31 10:45	2022-01-31 10:46	jan composite	1.68	29.16
Picton Cement Plant	FUEL220228-02	Coal	monthly composite	All Tests	2022-02-28 10:49	2022-02-28 10:50	feb composite	1.50	28.67
Picton Cement Plant	FUEL220527-04	Coal	monthly composite	All Tests	2022-03-31 10:09	2022-03-31 10:10	coal march composite	1.64	29.61
Picton Cement Plant	FUEL220430-04	Coal	monthly composite	All Tests	2022-04-30 10:03	2022-04-30 10:04	coal main april comp	1.45	23.30
Picton Cement Plant	FUEL220527-03	Coal	monthly composite	All Tests	2022-04-30 10:04	2022-04-30 10:05	auxillary coal april B comp	1.71	29.25
Picton Cement Plant	FUEL220531-06	Coal	monthly composite	All Tests	2022-05-31 12:18	2022-05-31 12:19	auxillary burner	2.14	29.75
Picton Cement Plant	FUEL220531-05	Coal	monthly composite	All Tests	2022-05-31 12:29	2022-05-31 12:30		1.97	29.50
Picton Cement Plant	FUEL220630-03	Coal	monthly composite	All Tests	2022-06-30 16:05	2022-06-30 16:06	Auxillary burner June	1.89	28.62

Plant	Sample Code	Product Type	Source	Profile	Start Time	End Time	Remarks	Vol Mtr AR	Fixed Carbon AR	FC Dry
								(%)	(%)	(%)
Picton Cement Plant	FUEL220125-04	Coal	monthly composite	All Tests	2022-01-18 11:57	2022-01-18 11:58	lab#1077009	28.25	43.76	50.21
Picton Cement Plant	FUEL220131-06	Coal	monthly composite	All Tests	2022-01-31 10:45	2022-01-31 10:46	jan composite	28.67	52.93	53.83
Picton Cement Plant	FUEL220228-02	Coal	monthly composite	All Tests	2022-02-28 10:49	2022-02-28 10:50	feb composite	28.24	54.96	55.80
Picton Cement Plant	FUEL220527-04	Coal	monthly composite	All Tests	2022-03-31 10:09	2022-03-31 10:10	coal march composite	29.12	54.27	55.17
Picton Cement Plant	FUEL220430-04	Coal	monthly composite	All Tests	2022-04-30 10:03	2022-04-30 10:04	coal main april comp	22.96	64.56	65.51
Picton Cement Plant	FUEL220527-03	Coal	monthly composite	All Tests	2022-04-30 10:04	2022-04-30 10:05	auxillary coal april B comp	28.75	53.80	54.74
Picton Cement Plant	FUEL220531-06	Coal	monthly composite	All Tests	2022-05-31 12:18	2022-05-31 12:19	auxillary burner	29.11	51.20	52.32
Picton Cement Plant	FUEL220531-05	Coal	monthly composite	All Tests	2022-05-31 12:29	2022-05-31 12:30		28.92	51.31	52.34
Picton Cement Plant	FUEL220630-03	Coal	monthly composite	All Tests	2022-06-30 16:05	2022-06-30 16:06	Auxillary burner June	28.08	50.70	51.68

Plant	Sample Code	Product Type	Source	Profile	Start Time	End Time	Remarks	Sulfur as Rcvd	Sulfur Dry Basis	Pyritic Sulfur AR
								(%)	(%)	(%)
Picton Cement Plant	FUEL220125-04	Coal	monthly composite	All Tests	2022-01-18 11:57	2022-01-18 11:58	lab#1077009	1.52	1.74	0.49
Picton Cement Plant	FUEL220131-06	Coal	monthly composite	All Tests	2022-01-31 10:45	2022-01-31 10:46	jan composite	2.17	2.21	0.30
Picton Cement Plant	FUEL220228-02	Coal	monthly composite	All Tests	2022-02-28 10:49	2022-02-28 10:50	feb composite	2.60	2.64	0.54
Picton Cement Plant	FUEL220527-04	Coal	monthly composite	All Tests	2022-03-31 10:09	2022-03-31 10:10	coal march composite	2.53	2.57	0.47
Picton Cement Plant	FUEL220430-04	Coal	monthly composite	All Tests	2022-04-30 10:03	2022-04-30 10:04	coal main april comp	3.82	3.88	0.51
Picton Cement Plant	FUEL220527-03	Coal	monthly composite	All Tests	2022-04-30 10:04	2022-04-30 10:05	auxillary coal april B comp	2.42	2.46	0.51
Picton Cement Plant	FUEL220531-06	Coal	monthly composite	All Tests	2022-05-31 12:18	2022-05-31 12:19	auxillary burner	2.13	2.18	
Picton Cement Plant	FUEL220531-05	Coal	monthly composite	All Tests	2022-05-31 12:29	2022-05-31 12:30		2.08	2.12	
Picton Cement Plant	FUEL220630-03	Coal	monthly composite	All Tests	2022-06-30 16:05	2022-06-30 16:06	Auxillary burner June	2.07	2.11	0.63

Plant	Sample Code	Product Type	Source	Profile	Start Time	End Time	Remarks	Sulfide Sulfur AR	Organic Sulfur AR	Cl Dry Basis
								(%)	(%)	(ppm)
Picton Cement Plant	FUEL220125-04	Coal	monthly composite	All Tests	2022-01-18 11:57	2022-01-18 11:58	lab#1077009	0.23	1.02	1070.00
Picton Cement Plant	FUEL220131-06	Coal	monthly composite	All Tests	2022-01-31 10:45	2022-01-31 10:46	jan composite	0.26	1.65	927.00
Picton Cement Plant	FUEL220228-02	Coal	monthly composite	All Tests	2022-02-28 10:49	2022-02-28 10:50	feb composite	0.26	1.84	401.00
Picton Cement Plant	FUEL220527-04	Coal	monthly composite	All Tests	2022-03-31 10:09	2022-03-31 10:10	coal march composite	0.22	1.88	826.00
Picton Cement Plant	FUEL220430-04	Coal	monthly composite	All Tests	2022-04-30 10:03	2022-04-30 10:04	coal main april comp	3.24	0.13	215.00
Picton Cement Plant	FUEL220527-03	Coal	monthly composite	All Tests	2022-04-30 10:04	2022-04-30 10:05	auxillary coal april B comp	0.22	1.73	215.00
Picton Cement Plant	FUEL220531-06	Coal	monthly composite	All Tests	2022-05-31 12:18	2022-05-31 12:19	auxillary burner			495.00
Picton Cement Plant	FUEL220531-05	Coal	monthly composite	All Tests	2022-05-31 12:29	2022-05-31 12:30				403.00
Picton Cement Plant	FUEL220630-03	Coal	monthly composite	All Tests	2022-06-30 16:05	2022-06-30 16:06	Auxillary burner June	0.16	1.32	1029.00

Plant	Sample Code	Product Type	Source	Profile	Start Time	End Time	Remarks	Hg Dry Basis	Carbon as Rcvd	Carbon Dry Basis
								(ppm)	(%)	(%)
Picton Cement Plant	FUEL220125-04	Coal	monthly composite	All Tests	2022-01-18 11:57	2022-01-18 11:58	lab#1077009	0.12	61.40	70.45
Picton Cement Plant	FUEL220131-06	Coal	monthly composite	All Tests	2022-01-31 10:45	2022-01-31 10:46	jan composite		68.20	69.37
Picton Cement Plant	FUEL220228-02	Coal	monthly composite	All Tests	2022-02-28 10:49	2022-02-28 10:50	feb composite	0.14	70.40	71.47
Picton Cement Plant	FUEL220527-04	Coal	monthly composite	All Tests	2022-03-31 10:09	2022-03-31 10:10	coal march composite	0.12	71.03	72.21
Picton Cement Plant	FUEL220430-04	Coal	monthly composite	All Tests	2022-04-30 10:03	2022-04-30 10:04	coal main april comp	0.08	75.20	76.31
Picton Cement Plant	FUEL220527-03	Coal	monthly composite	All Tests	2022-04-30 10:04	2022-04-30 10:05	auxillary coal april B comp	0.11	70.97	72.20
Picton Cement Plant	FUEL220531-06	Coal	monthly composite	All Tests	2022-05-31 12:18	2022-05-31 12:19	auxillary burner	0.12	68.04	69.53
Picton Cement Plant	FUEL220531-05	Coal	monthly composite	All Tests	2022-05-31 12:29	2022-05-31 12:30		0.13	67.96	69.33
Picton Cement Plant	FUEL220630-03	Coal	monthly composite	All Tests	2022-06-30 16:05	2022-06-30 16:06	Auxillary burner June	0.12	68.03	69.34

Plant	Sample Code	Product Type	Source	Profile	Start Time	End Time	Remarks	Hydrogen as Rcvd	Hydrogen Dry Basis
								(%)	(%)
Picton Cement Plant	FUEL220125-04	Coal	monthly composite	All Tests	2022-01-18 11:57	2022-01-18 11:58	lab#1077009	4.18	4.80
Picton Cement Plant	FUEL220131-06	Coal	monthly composite	All Tests	2022-01-31 10:45	2022-01-31 10:46	jan composite	4.79	4.87
Picton Cement Plant	FUEL220228-02	Coal	monthly composite	All Tests	2022-02-28 10:49	2022-02-28 10:50	feb composite	4.71	4.78
Picton Cement Plant	FUEL220527-04	Coal	monthly composite	All Tests	2022-03-31 10:09	2022-03-31 10:10	coal march composite	4.78	4.86
Picton Cement Plant	FUEL220430-04	Coal	monthly composite	All Tests	2022-04-30 10:03	2022-04-30 10:04	coal main april comp	4.56	4.63
Picton Cement Plant	FUEL220527-03	Coal	monthly composite	All Tests	2022-04-30 10:04	2022-04-30 10:05	auxillary coal april B comp	4.74	4.82
Picton Cement Plant	FUEL220531-06	Coal	monthly composite	All Tests	2022-05-31 12:18	2022-05-31 12:19	auxillary burner	4.85	4.96
Picton Cement Plant	FUEL220531-05	Coal	monthly composite	All Tests	2022-05-31 12:29	2022-05-31 12:30		4.81	4.91
Picton Cement Plant	FUEL220630-03	Coal	monthly composite	All Tests	2022-06-30 16:05	2022-06-30 16:06	Auxillary burner June	4.76	4.85

Plant	Sample Code	Product Type	Source	Profile	Start Time	End Time	Remarks	Nitrogen as Rcvd	Nitrogen Dry Basis
								(%)	(%)
Picton Cement Plant	FUEL220125-04	Coal	monthly composite	All Tests	2022-01-18 11:57	2022-01-18 11:58	lab#1077009	1.24	1.42
Picton Cement Plant	FUEL220131-06	Coal	monthly composite	All Tests	2022-01-31 10:45	2022-01-31 10:46	jan composite	1.46	1.49
Picton Cement Plant	FUEL220228-02	Coal	monthly composite	All Tests	2022-02-28 10:49	2022-02-28 10:50	feb composite	1.51	1.53
Picton Cement Plant	FUEL220527-04	Coal	monthly composite	All Tests	2022-03-31 10:09	2022-03-31 10:10	coal march composite	1.51	1.54
Picton Cement Plant	FUEL220430-04	Coal	monthly composite	All Tests	2022-04-30 10:03	2022-04-30 10:04	coal main april comp	1.43	1.45
Picton Cement Plant	FUEL220527-03	Coal	monthly composite	All Tests	2022-04-30 10:04	2022-04-30 10:05	auxillary coal april B comp	1.38	1.40
Picton Cement Plant	FUEL220531-06	Coal	monthly composite	All Tests	2022-05-31 12:18	2022-05-31 12:19	auxillary burner	1.45	1.48
Picton Cement Plant	FUEL220531-05	Coal	monthly composite	All Tests	2022-05-31 12:29	2022-05-31 12:30		1.41	1.44
Picton Cement Plant	FUEL220630-03	Coal	monthly composite	All Tests	2022-06-30 16:05	2022-06-30 16:06	Auxillary burner June	1.37	1.40

Plant	Sample Code	Product Type	Source	Profile	Start Time	End Time	Remarks	Oxygen as Rcvd	Oxygen Dry Basis	Ash as Rcvd
								(%)	(%)	(%)
Picton Cement Plant	FUEL220125-04	Coal	monthly composite	All Tests	2022-01-18 11:57	2022-01-18 11:58	lab#1077009	3.67	4.21	15.15
Picton Cement Plant	FUEL220131-06	Coal	monthly composite	All Tests	2022-01-31 10:45	2022-01-31 10:46	jan composite	4.98	5.05	16.72
Picton Cement Plant	FUEL220228-02	Coal	monthly composite	All Tests	2022-02-28 10:49	2022-02-28 10:50	feb composite	3.98	4.05	15.30
Picton Cement Plant	FUEL220527-04	Coal	monthly composite	All Tests	2022-03-31 10:09	2022-03-31 10:10	coal march composite	3.54	3.60	14.97
Picton Cement Plant	FUEL220430-04	Coal	monthly composite	All Tests	2022-04-30 10:03	2022-04-30 10:04	coal main april comp	2.51	2.54	11.03
Picton Cement Plant	FUEL220527-03	Coal	monthly composite	All Tests	2022-04-30 10:04	2022-04-30 10:05	auxillary coal april B comp	3.04	3.11	15.74
Picton Cement Plant	FUEL220531-06	Coal	monthly composite	All Tests	2022-05-31 12:18	2022-05-31 12:19	auxillary burner	3.84	3.92	17.55
Picton Cement Plant	FUEL220531-05	Coal	monthly composite	All Tests	2022-05-31 12:29	2022-05-31 12:30		3.97	4.04	17.80
Picton Cement Plant	FUEL220630-03	Coal	monthly composite	All Tests	2022-06-30 16:05	2022-06-30 16:06	Auxillary burner June	2.55	2.60	19.33

Plant	Sample Code	Product Type	Source	Profile	Start Time	End Time	Remarks	Ash Dry Basis	HHV AR	HHV Dry	HHV AR
								(%)	(BTU/lb)	(BTU/lb)	(kJ/kg)
Picton Cement Plant	FUEL220125-04	Coal	monthly composite	All Tests	2022-01-18 11:57	2022-01-18 11:58	lab#1077009	17.38	10773	14960	25058
Picton Cement Plant	FUEL220131-06	Coal	monthly composite	All Tests	2022-01-31 10:45	2022-01-31 10:46	jan composite	17.01	12051	14769	28031
Picton Cement Plant	FUEL220228-02	Coal	monthly composite	All Tests	2022-02-28 10:49	2022-02-28 10:50	feb composite	15.53	12312	14797	28638
Picton Cement Plant	FUEL220527-04	Coal	monthly composite	All Tests	2022-03-31 10:09	2022-03-31 10:10	coal march composite	15.22	12394	14863	28828
Picton Cement Plant	FUEL220430-04	Coal	monthly composite	All Tests	2022-04-30 10:03	2022-04-30 10:04	coal main april comp	11.19	13092	14959	30452
Picton Cement Plant	FUEL220527-03	Coal	monthly composite	All Tests	2022-04-30 10:04	2022-04-30 10:05	auxillary coal april B comp	16.01	12278	14873	28559
Picton Cement Plant	FUEL220531-06	Coal	monthly composite	All Tests	2022-05-31 12:18	2022-05-31 12:19	auxillary burner	17.93	11910	14829	27703
Picton Cement Plant	FUEL220531-05	Coal	monthly composite	All Tests	2022-05-31 12:29	2022-05-31 12:30		18.16	11902	14835	27684
Picton Cement Plant	FUEL220630-03	Coal	monthly composite	All Tests	2022-06-30 16:05	2022-06-30 16:06	Auxillary burner June	19.70	11919	15130	27724

Plant	Sample Code	Product Type	Source	Profile	Start Time	End Time	Remarks	HHV Dry	LHV AR	LHV Dry Basis	LHV AR
								(kJ/kg)	(BTU/lb)	(BTU/lb)	(kJ/kg)
Picton Cement Plant	FUEL220125-04	Coal	monthly composite	All Tests	2022-01-18 11:57	2022-01-18 11:58	lab#1077009	34797	10199	12360	23723
Picton Cement Plant	FUEL220131-06	Coal	monthly composite	All Tests	2022-01-31 10:45	2022-01-31 10:46	jan composite	34353	11587	12257	26953
Picton Cement Plant	FUEL220228-02	Coal	monthly composite	All Tests	2022-02-28 10:49	2022-02-28 10:50	feb composite	34418	11859	12499	27584
Picton Cement Plant	FUEL220527-04	Coal	monthly composite	All Tests	2022-03-31 10:09	2022-03-31 10:10	coal march composite	34571	11932	12601	27755
Picton Cement Plant	FUEL220430-04	Coal	monthly composite	All Tests	2022-04-30 10:03	2022-04-30 10:04	coal main april comp	34795	12654	13285	29432
Picton Cement Plant	FUEL220527-03	Coal	monthly composite	All Tests	2022-04-30 10:04	2022-04-30 10:05	auxillary coal april B comp	34595	11819	12492	27492
Picton Cement Plant	FUEL220531-06	Coal	monthly composite	All Tests	2022-05-31 12:18	2022-05-31 12:19	auxillary burner	34492	11434	12170	26595
Picton Cement Plant	FUEL220531-05	Coal	monthly composite	All Tests	2022-05-31 12:29	2022-05-31 12:30		34506	11432	12141	26591
Picton Cement Plant	FUEL220630-03	Coal	monthly composite	All Tests	2022-06-30 16:05	2022-06-30 16:06	Auxillary burner June	35192	11456	12149	26647

Plant	Sample Code	Product Type	Source	Profile	Start Time	End Time	Remarks	LHV Dry	LHV Dry Basis	Hg
								(kJ/kg)	(kcal/kg)	(ppm)
Picton Cement Plant	FUEL220125-04	Coal	monthly composite	All Tests	2022-01-18 11:57	2022-01-18 11:58	lab#1077009	28749		
Picton Cement Plant	FUEL220131-06	Coal	monthly composite	All Tests	2022-01-31 10:45	2022-01-31 10:46	jan composite	28510		
Picton Cement Plant	FUEL220228-02	Coal	monthly composite	All Tests	2022-02-28 10:49	2022-02-28 10:50	feb composite	29073		
Picton Cement Plant	FUEL220527-04	Coal	monthly composite	All Tests	2022-03-31 10:09	2022-03-31 10:10	coal march composite	29310		
Picton Cement Plant	FUEL220430-04	Coal	monthly composite	All Tests	2022-04-30 10:03	2022-04-30 10:04	coal main april comp	30901		
Picton Cement Plant	FUEL220527-03	Coal	monthly composite	All Tests	2022-04-30 10:04	2022-04-30 10:05	auxillary coal april B comp	29056		
Picton Cement Plant	FUEL220531-06	Coal	monthly composite	All Tests	2022-05-31 12:18	2022-05-31 12:19	auxillary burner	28307		
Picton Cement Plant	FUEL220531-05	Coal	monthly composite	All Tests	2022-05-31 12:29	2022-05-31 12:30		28240		
Picton Cement Plant	FUEL220630-03	Coal	monthly composite	All Tests	2022-06-30 16:05	2022-06-30 16:06	Auxillary burner June	28259		

Plant	Sample Code	Product Type	Source	Profile	Start Time	End Time	Remarks	Total Moisture as Rcvd	Vol Mtr Dry	Vol Mtr AR
								(%)	(%)	(%)
Picton Cement Plant	FUEL220131-05	Coke	monthly composite	All Tests	2022-01-31 10:43	2022-01-31 10:44	january composite	0.72	14.28	14.18
Picton Cement Plant	FUEL220228-01	Coke	monthly composite	All Tests	2022-02-28 10:47	2022-02-28 10:48	feb composite	1.00	20.89	20.68
Picton Cement Plant	FUEL220331-03	Coke	monthly composite	All Tests	2022-03-31 10:06	2022-03-31 10:07	main coke marchcomp	0.91	15.96	15.81
Picton Cement Plant	FUEL220430-03	Coke	monthly composite	All Tests	2022-04-30 10:00	2022-04-30 10:01	april cole comp	0.85	14.36	14.24
Picton Cement Plant	FUEL220531-04	Coke	monthly composite	All Tests	2022-05-31 12:27	2022-05-31 12:28		1.32	15.68	15.47
Picton Cement Plant	FUEL220630-02	Coke	monthly composite	All Tests	2022-06-30 16:03	2022-06-30 16:04	main burner june	0.83	13.27	13.16

Plant	Sample Code	Product Type	Source	Profile	Start Time	End Time	Remarks	Fixed Carbon AR	FC Dry	Sulfur as Rcvd	Sulfur Dry Basis
								(%)	(%)	(%)	(%)
Picton Cement Plant	FUEL220131-05	Coke	monthly composite	All Tests	2022-01-31 10:43	2022-01-31 10:44	january composite	82.36	82.96	6.28	6.33
Picton Cement Plant	FUEL220228-01	Coke	monthly composite	All Tests	2022-02-28 10:47	2022-02-28 10:48	feb composite	69.16	69.86	4.56	4.61
Picton Cement Plant	FUEL220331-03	Coke	monthly composite	All Tests	2022-03-31 10:06	2022-03-31 10:07	main coke marchcomp	79.39	80.11	6.20	6.26
Picton Cement Plant	FUEL220430-03	Coke	monthly composite	All Tests	2022-04-30 10:00	2022-04-30 10:01	april cole comp	81.85	82.55	6.09	6.14
Picton Cement Plant	FUEL220531-04	Coke	monthly composite	All Tests	2022-05-31 12:27	2022-05-31 12:28		78.34	79.38	6.11	6.19
Picton Cement Plant	FUEL220630-02	Coke	monthly composite	All Tests	2022-06-30 16:03	2022-06-30 16:04	main burner june	81.38	82.06	6.31	6.36

Plant	Sample Code	Product Type	Source	Profile	Start Time	End Time	Remarks	Pyritic Sulfur AR	Sulfide Sulfur AR	Organic Sulfur AR
								(%)	(%)	(%)
Picton Cement Plant	FUEL220131-05	Coke	monthly composite	All Tests	2022-01-31 10:43	2022-01-31 10:44	january composite	0.08	0.06	6.19
Picton Cement Plant	FUEL220228-01	Coke	monthly composite	All Tests	2022-02-28 10:47	2022-02-28 10:48	feb composite	0.41	0.19	4.01
Picton Cement Plant	FUEL220331-03	Coke	monthly composite	All Tests	2022-03-31 10:06	2022-03-31 10:07	main coke marchcomp	0.10	0.05	6.11
Picton Cement Plant	FUEL220430-03	Coke	monthly composite	All Tests	2022-04-30 10:00	2022-04-30 10:01	april cole comp	0.10	0.04	6.00
Picton Cement Plant	FUEL220531-04	Coke	monthly composite	All Tests	2022-05-31 12:27	2022-05-31 12:28				
Picton Cement Plant	FUEL220630-02	Coke	monthly composite	All Tests	2022-06-30 16:03	2022-06-30 16:04	main burner june	0.64	0.03	5.69

Plant	Sample Code	Product Type	Source	Profile	Start Time	End Time	Remarks	Cl Dry Basis	Hg Dry Basis	Carbon as Rcvd	Carbon Dry Basis
								(ppm)	(ppm)	(%)	(%)
Picton Cement Plant	FUEL220131-05	Coke	monthly composite	All Tests	2022-01-31 10:43	2022-01-31 10:44	january composite	200.00	0.02	83.76	81.37
Picton Cement Plant	FUEL220228-01	Coke	monthly composite	All Tests	2022-02-28 10:47	2022-02-28 10:48	feb composite	200.00	0.06	77.71	78.50
Picton Cement Plant	FUEL220331-03	Coke	monthly composite	All Tests	2022-03-31 10:06	2022-03-31 10:07	main coke marchcomp	200.00	0.03	82.71	83.47
Picton Cement Plant	FUEL220430-03	Coke	monthly composite	All Tests	2022-04-30 10:00	2022-04-30 10:01	april cole comp	200.00	0.03	83.70	84.42
Picton Cement Plant	FUEL220531-04	Coke	monthly composite	All Tests	2022-05-31 12:27	2022-05-31 12:28		200.00	0.03	81.24	82.33
Picton Cement Plant	FUEL220630-02	Coke	monthly composite	All Tests	2022-06-30 16:03	2022-06-30 16:04	main burner june	661.00	0.02	82.75	83.44

Plant	Sample Code	Product Type	Source	Profile	Start Time	End Time	Remarks	Hydrogen as Rcvd	Hydrogen Dry Basis	Nitrogen as Rcvd
								(%)	(%)	(%)
Picton Cement Plant	FUEL220131-05	Coke	monthly composite	All Tests	2022-01-31 10:43	2022-01-31 10:44	january composite	3.95	3.98	1.49
Picton Cement Plant	FUEL220228-01	Coke	monthly composite	All Tests	2022-02-28 10:47	2022-02-28 10:48	feb composite	3.98	4.02	1.46
Picton Cement Plant	FUEL220331-03	Coke	monthly composite	All Tests	2022-03-31 10:06	2022-03-31 10:07	main coke marchcomp	3.93	3.97	1.49
Picton Cement Plant	FUEL220430-03	Coke	monthly composite	All Tests	2022-04-30 10:00	2022-04-30 10:01	april cole comp	3.50	3.53	1.59
Picton Cement Plant	FUEL220531-04	Coke	monthly composite	All Tests	2022-05-31 12:27	2022-05-31 12:28		3.77	3.82	1.52
Picton Cement Plant	FUEL220630-02	Coke	monthly composite	All Tests	2022-06-30 16:03	2022-06-30 16:04	main burner june	3.37	3.40	1.58

Plant	Sample Code	Product Type	Source	Profile	Start Time	End Time	Remarks	Nitrogen Dry Basis	Oxygen as Rcvd	Oxygen Dry Basis	Ash as Rcvd
								(%)	(%)	(%)	(%)
Picton Cement Plant	FUEL220131-05	Coke	monthly composite	All Tests	2022-01-31 10:43	2022-01-31 10:44	january composite	1.50	1.06	1.06	2.74
Picton Cement Plant	FUEL220228-01	Coke	monthly composite	All Tests	2022-02-28 10:47	2022-02-28 10:48	feb composite	1.47	2.13	2.15	9.16
Picton Cement Plant	FUEL220331-03	Coke	monthly composite	All Tests	2022-03-31 10:06	2022-03-31 10:07	main coke marchcomp	1.50	0.87	0.87	3.89
Picton Cement Plant	FUEL220430-03	Coke	monthly composite	All Tests	2022-04-30 10:00	2022-04-30 10:01	april cole comp	1.60	1.21	1.22	3.06
Picton Cement Plant	FUEL220531-04	Coke	monthly composite	All Tests	2022-05-31 12:27	2022-05-31 12:28		1.54	1.17	1.18	4.87
Picton Cement Plant	FUEL220630-02	Coke	monthly composite	All Tests	2022-06-30 16:03	2022-06-30 16:04	main burner june	1.59	0.53	0.54	4.63

Plant	Sample Code	Product Type	Source	Profile	Start Time	End Time	Remarks	Ash Dry Basis	HHV AR	HHV Dry	HHV AR
								(%)	(BTU/lb)	(BTU/lb)	(kJ/kg)
Picton Cement Plant	FUEL220131-05	Coke	monthly composite	All Tests	2022-01-31 10:43	2022-01-31 10:44	january composite	2.76	14627	15151	34022
Picton Cement Plant	FUEL220228-01	Coke	monthly composite	All Tests	2022-02-28 10:47	2022-02-28 10:48	feb composite	9.25	13359	14869	31073
Picton Cement Plant	FUEL220331-03	Coke	monthly composite	All Tests	2022-03-31 10:06	2022-03-31 10:07	main coke marchcomp	3.93	14370	15095	33425
Picton Cement Plant	FUEL220430-03	Coke	monthly composite	All Tests	2022-04-30 10:00	2022-04-30 10:01	april cole comp	3.09	14493	15083	33711
Picton Cement Plant	FUEL220531-04	Coke	monthly composite	All Tests	2022-05-31 12:27	2022-05-31 12:28		4.94	14245	15186	33134
Picton Cement Plant	FUEL220630-02	Coke	monthly composite	All Tests	2022-06-30 16:03	2022-06-30 16:04	main burner june	4.67	14446	15281	33601

Plant	Sample Code	Product Type	Source	Profile	Start Time	End Time	Remarks	HHV Dry	LHV AR	LHV Dry Basis	LHV AR
								(kJ/kg)	(BTU/lb)	(BTU/lb)	(kJ/kg)
Picton Cement Plant	FUEL220131-05	Coke	monthly composite	All Tests	2022-01-31 10:43	2022-01-31 10:44	january composite	35241	14256	14733	33160
Picton Cement Plant	FUEL220228-01	Coke	monthly composite	All Tests	2022-02-28 10:47	2022-02-28 10:48	feb composite	34585	12981	13494	30194
Picton Cement Plant	FUEL220331-03	Coke	monthly composite	All Tests	2022-03-31 10:06	2022-03-31 10:07	main coke marchcomp	35111	13998	14502	32560
Picton Cement Plant	FUEL220430-03	Coke	monthly composite	All Tests	2022-04-30 10:00	2022-04-30 10:01	april cole comp	35083	14162	14617	32940
Picton Cement Plant	FUEL220531-04	Coke	monthly composite	All Tests	2022-05-31 12:27	2022-05-31 12:28		35323	13882	14436	32290
Picton Cement Plant	FUEL220630-02	Coke	monthly composite	All Tests	2022-06-30 16:03	2022-06-30 16:04	main burner june	35544	14127	14567	32859

Plant	Sample Code	Product Type	Source	Profile	Start Time	End Time	Remarks	LHV Dry	LHV Dry Basis	Hg
								(kJ/kg)	(kcal/kg)	(ppm)
Picton Cement Plant	FUEL220131-05	Coke	monthly composite	All Tests	2022-01-31 10:43	2022-01-31 10:44	january composite	34269		
Picton Cement Plant	FUEL220228-01	Coke	monthly composite	All Tests	2022-02-28 10:47	2022-02-28 10:48	feb composite	31387		
Picton Cement Plant	FUEL220331-03	Coke	monthly composite	All Tests	2022-03-31 10:06	2022-03-31 10:07	main coke marchcomp	33732		
Picton Cement Plant	FUEL220430-03	Coke	monthly composite	All Tests	2022-04-30 10:00	2022-04-30 10:01	april cole comp	33999		
Picton Cement Plant	FUEL220531-04	Coke	monthly composite	All Tests	2022-05-31 12:27	2022-05-31 12:28		33578		
Picton Cement Plant	FUEL220630-02	Coke	monthly composite	All Tests	2022-06-30 16:03	2022-06-30 16:04	main burner june	33883		

Sampling Results for ALCFs

Beta Analytic Inc
4985 SW 74 Court
Miami, Florida 33155
Tel: 305-667-5167
Fax: 305-663-0964
info@betalabservices.com

ISO/IEC 17025:2005-Accredited Testing Laboratory

June 11, 2020

Eileen Jang
Lehigh Hanson Materials Limited
PO Box 950
Delta
British Colombia, V4K 3S6
Canada

Dear Ms. Jang

Please find enclosed your radiocarbon (C14) report for the material recently submitted. The result is reported as “% Biogenic Carbon”. This indicates the percentage carbon from “renewable” (biomass or animal by-product) sources versus petroleum (or otherwise fossil) sources . For reference, 100 % Biogenic Carbon indicates that a material is entirely sourced from plants or animal by-products and 0 % Biogenic Carbon indicates that a material did not contain any carbon from plants or animal by-products. A value in between represents a mixture of natural and fossil sources.

The analytical measurement is cited as “percent modern carbon (pMC)”. This is the percentage of C14 measured in the sample relative to a modern reference standard (NIST 4990C). The % Biogenic Carbon content is calculated from pMC by applying a small adjustment factor for C14 in carbon dioxide in air today. It is important to note is that all internationally recognized standards using C14 assume that the plant or biomass feedstocks were obtained from natural environments.

Reported results are accredited to ISO/IEC 17025:2005 Testing Accreditation PJLA #59423 standards and all chemistry was performed here in our laboratory and counted in our own accelerators in Miami, Florida.

The international standard method utilized for this analysis is cited on your report. The report also indicates if the result is relative to total carbon (TC) or only total organic carbon (TOC). When interpreting the results, please consider any communications you may have had with us regarding the analysis. If you have any questions please contact us. We welcome your inquiries.

Sincerely,

Chris Patrick
Digital signature on file

Chris Patrick
Vice President of Laboratory Operations

Beta Analytic Inc
4985 SW 74 Court
Miami, Florida 33155
Tel: 305-667-5167
Fax: 305-663-0964
info@betalabservices.com

ISO/IEC 17025:2005-Accredited Testing Laboratory

Summary of Results - % Biogenic Carbon Content
ASTM D6866-20 Method B (AMS)

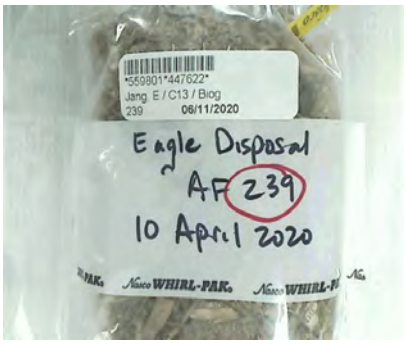
Certificate Number: 447622559801110143

Validation: Chris Patrick
Digital signature on file

Submitter	Eileen Jang
Company	Lehigh Hanson Materials Limited
Date Received	June 02, 2020
Date Reported	June 11, 2020
Submitter Label	AF239 Eagle Disposal

RESULT: 80 % Biogenic Carbon Content (as a fraction of total carbon)

Laboratory Number	Beta-559801
Percent modern carbon (pMC)	79.90 +/- 0.18 pMC
Atmospheric adjustment factor (REF)	100.0; = pMC/1.000



Package received - labeling COC


View of content (1mm x 1mm scale)


3609.7mg analyzed (1mm x 1mm scale)

Disclosures: All work was done at Beta Analytic in its own chemistry lab and AMSs. No subcontractors were used. Beta's chemistry laboratory and AMS do not react or measure artificial C 14 used in biomedical and environmental AMS studies. Beta is a C14 tracer-free facility. Validating quality assurance is verified with a Quality Assurance report posted separately to the web library containing the PDF downloadable copy of this report.

Precision on the RESULT is cited as +/- 3% (absolute). The cited precision on the analytical measure (pMC) is 1 sigma (1 relative standard deviation). The reported result only applies to the analyzed material. The accuracy of the RESULT relies on the measured carbon in the analyzed material having been in recent equilibrium with CO2 in the air and/or from fossil carbon (from living more than 40,000 years ago such as petroleum or coal. The RESULT only applies to relative carbon content, not to relative mass content. The RESULT is calculated by adjusting pMC by the applicable "Atmospheric adjustment factor (REF)" cited in this report.

Beta Analytic Inc
4985 SW 74 Court
Miami, Florida 33155
Tel: 305-667-5167
Fax: 305-663-0964
info@betalabservices.com

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Summary of Results - % Biogenic Carbon Content
ASTM D6866-20 Method B (AMS)

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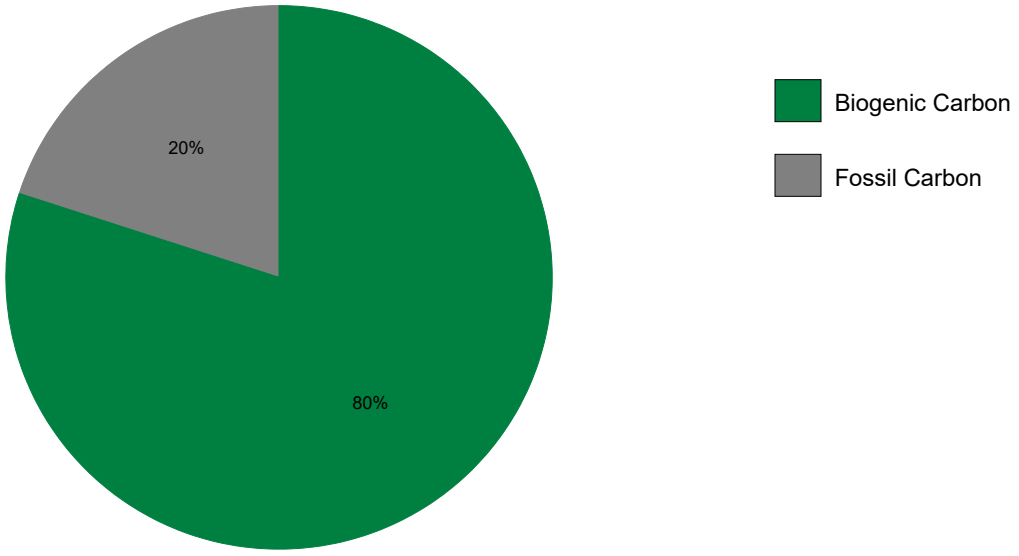

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Miami, Florida 33155
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info@betalabservices.com

% Biogenic Carbon Content ASTM D6866-20 Method B (AMS)

Explanation of Results

The result was obtained using the radiocarbon isotope (also known as Carbon-14, C14 or 14C), a naturally occurring isotope of carbon that is radioactive and decays in such a way that there is none left after about 45,000 years following the death of a plant or animal. Its most common use is radiocarbon dating by archaeologists. An industrial application was also developed to determine if consumer products and CO2 emissions were sourced from plants/biomass or from materials such as petroleum or coal (fossil-based). By 2003 there was growing demand for a standardized methodology for applying Carbon-14 testing within the regulatory environment. The first of these standards was ASTM D6866-04, which was written with the assistance of Beta Analytic. Since ASTM was largely viewed as a US standard, European stakeholders soon began demanding an equivalent CEN standard while global stakeholders called for ISO standardization.

The analytical procedures for measuring radiocarbon content using the different standards are identical. The only difference is the reporting format. Results are usually reported using the standardized terminology “% biobased carbon”. Only ASTM D6866 uses the term “% biogenic carbon” when the result represents all carbon present (Total Carbon) rather than just the organic carbon (Total Organic Carbon). The terms “% biobased carbon” and “% biogenic carbon” are now the standard units in regulatory and industrial applications, replacing obscure units of measure historically reported by radiocarbon dating laboratories e.g. disintegrations per minute per gram (dpm/g) or radiocarbon age.

The result was obtained by measuring the ratio of radiocarbon in the material relative to a National Institute of Standards and Technology (NIST) modern reference standard (SRM 4990C). This ratio was calculated as a percentage and is reported as percent modern carbon (pMC). The value obtained relative to the NIST standard is normalized to the year 1950 AD so an adjustment was required to calculate a carbon source value relative to today. This factor is listed on the report sheet as the terminology “REF”.

Interpretation and application of the results is straightforward. A value of 100% biobased or biogenic carbon would indicate that 100% of the carbon came from plants or animal by-products (biomass) living in the natural environment and a value of 0% would mean that all of the carbon was derived from petrochemicals, coal and other fossil sources. A value between 0-100% would indicate a mixture. The higher the value, the greater the proportion of naturally sourced components in the material.

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Miami, Florida 33155
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ISO/IEC 17025:2005-Accredited Testing Laboratory

August 17, 2020

Eileen Jang
Lehigh Hanson Materials Limited
PO Box 950
Delta
British Colombia, V4K 3S6
Canada

Dear Ms. Jang

Please find enclosed your radiocarbon (C14) report for the material recently submitted. The result is reported as “% Biogenic Carbon”. This indicates the percentage carbon from “renewable” (biomass or animal by-product) sources versus petroleum (or otherwise fossil) sources . For reference, 100 % Biogenic Carbon indicates that a material is entirely sourced from plants or animal by-products and 0 % Biogenic Carbon indicates that a material did not contain any carbon from plants or animal by-products. A value in between represents a mixture of natural and fossil sources.

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Reported results are accredited to ISO/IEC 17025:2005 Testing Accreditation PJLA #59423 standards and all chemistry was performed here in our laboratory and counted in our own accelerators in Miami, Florida.

The international standard method utilized for this analysis is cited on your report. The report also indicates if the result is relative to total carbon (TC) or only total organic carbon (TOC). When interpreting the results, please consider any communications you may have had with us regarding the analysis. If you have any questions please contact us. We welcome your inquiries.

Sincerely,

Digital signature on file

Ronald E. Hatfield President

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Miami, Florida 33155
Tel: 305-667-5167
Fax: 305-663-0964
info@betalabservices.com

ISO/IEC 17025:2005-Accredited Testing Laboratory

Summary of Results - % Biogenic Carbon Content
ASTM D6866-20 Method B (AMS)

Certificate Number: 453363565413111707

Validation:

Submitter	Eileen Jang
Company	Lehigh Hanson Materials Limited
Date Received	August 07, 2020
Date Reported	August 17, 2020
Submitter Label	AF 247 Eagle Disposal

RESULT: 79 % Biogenic Carbon Content (as a fraction of total carbon)

Laboratory Number	Beta-565413
Percent modern carbon (pMC)	79.47 +/- 0.25 pMC
Atmospheric adjustment factor (REF)	100.0; = pMC/1.000

Package received - labeling COC


View of content (1mm x 1mm scale)


3088.6mg analyzed (1mm x 1mm scale)

Disclosures: All work was done at Beta Analytic in its own chemistry lab and AMSs. No subcontractors were used. Beta's chemistry laboratory and AMS do not react or measure artificial C 14 used in biomedical and environmental AMS studies. Beta is a C14 tracer-free facility. Validating quality assurance is verified with a Quality Assurance report posted separately to the web library containing the PDF downloadable copy of this report.

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Beta Analytic Inc
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Miami, Florida 33155
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Fax: 305-663-0964
info@betalabservices.com

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Summary of Results - % Biogenic Carbon Content
ASTM D6866-20 Method B (AMS)

Certificate Number: 453363565413111707

Validation:

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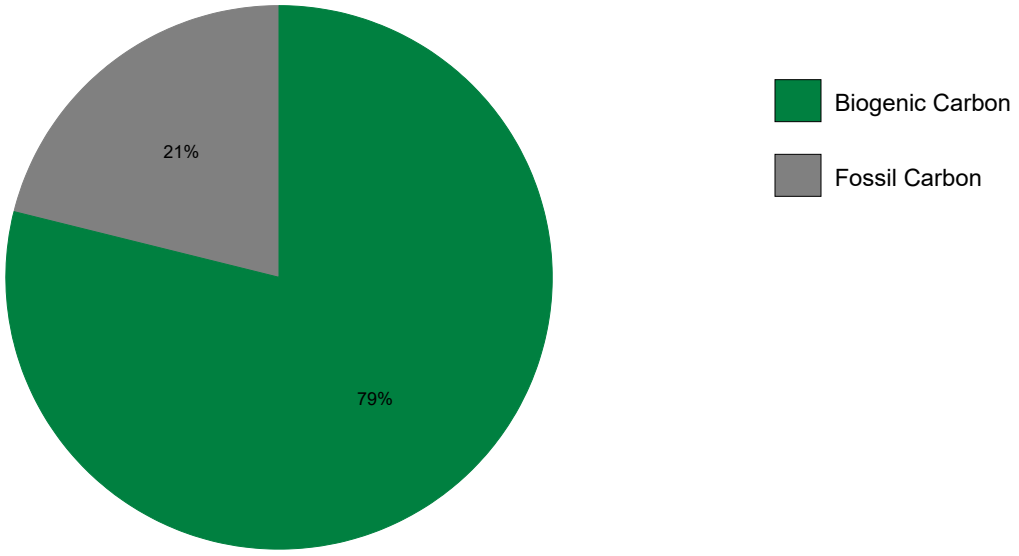

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% Biogenic Carbon Content ASTM D6866-20 Method B (AMS)

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Beta Analytic
TESTING LABORATORY

Beta Analytic Inc
4985 SW 74 Court
Miami, Florida 33155
Tel: 305-667-5167
Fax: 305-663-0964
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ISO/IEC 17025:2005-Accredited Testing Laboratory

Quality Assurance Report

This report provides the results of reference materials used to validate radiocarbon analyses prior to reporting. Known-value reference materials were analyzed quasi-simultaneously with the unknowns. Results are reported as expected values vs measured values. Reported values are calculated relative to NIST SRM-4990B and corrected for isotopic fractionation. Results are reported using the direct analytical measure percent modern carbon (pMC) with one relative standard deviation. Agreement between expected and measured values is taken as being within 2 sigma agreement (error x 2) to account for total laboratory error.

Report Date: August 17, 2020
Submitter: Ms. Eileen Jang

QA MEASUREMENTS

Reference 1

Expected Value:	0.45 +/- 0.04 pMC
Measured Value:	0.44 +/- 0.02 pMC
Agreement:	Accepted

Reference 2

Expected Value:	96.69 +/- 0.50 pMC
Measured Value:	97.57 +/- 0.29 pMC
Agreement:	Accepted

Reference 3

Expected Value:	129.41 +/- 0.06 pMC
Measured Value:	129.46 +/- 0.35 pMC
Agreement:	Accepted

COMMENT: All measurements passed acceptance tests.

Validation: Digital signature on file

Date: August 17, 2020

Beta Analytic Inc
4985 SW 74 Court
Miami, Florida 33155
Tel: 305-667-5167
Fax: 305-663-0964
info@betalabservices.com

ISO/IEC 17025:2005-Accredited Testing Laboratory

August 17, 2020

Eileen Jang
Lehigh Hanson Materials Limited
PO Box 950
Delta
British Colombia, V4K 3S6
Canada

Dear Ms. Jang

Please find enclosed your radiocarbon (C14) report for the material recently submitted. The result is reported as “% Biogenic Carbon”. This indicates the percentage carbon from “renewable” (biomass or animal by-product) sources versus petroleum (or otherwise fossil) sources . For reference, 100 % Biogenic Carbon indicates that a material is entirely sourced from plants or animal by-products and 0 % Biogenic Carbon indicates that a material did not contain any carbon from plants or animal by-products. A value in between represents a mixture of natural and fossil sources.

The analytical measurement is cited as “percent modern carbon (pMC)”. This is the percentage of C14 measured in the sample relative to a modern reference standard (NIST 4990C). The % Biogenic Carbon content is calculated from pMC by applying a small adjustment factor for C14 in carbon dioxide in air today. It is important to note is that all internationally recognized standards using C14 assume that the plant or biomass feedstocks were obtained from natural environments.

Reported results are accredited to ISO/IEC 17025:2005 Testing Accreditation PJLA #59423 standards and all chemistry was performed here in our laboratory and counted in our own accelerators in Miami, Florida.

The international standard method utilized for this analysis is cited on your report. The report also indicates if the result is relative to total carbon (TC) or only total organic carbon (TOC). When interpreting the results, please consider any communications you may have had with us regarding the analysis. If you have any questions please contact us. We welcome your inquiries.

Sincerely,

Digital signature on file

Ronald E. Hatfield President

Beta Analytic Inc
4985 SW 74 Court
Miami, Florida 33155
Tel: 305-667-5167
Fax: 305-663-0964
info@betalabservices.com

ISO/IEC 17025:2005-Accredited Testing Laboratory

Summary of Results - % Biogenic Carbon Content
ASTM D6866-20 Method B (AMS)

Certificate Number: 453369565419111707

Validation:

Submitter	Eileen Jang
Company	Lehigh Hanson Materials Limited
Date Received	August 07, 2020
Date Reported	August 17, 2020
Submitter Label	AF 271 Eagle Disposal

RESULT: 90 % Biogenic Carbon Content (as a fraction of total carbon)

Laboratory Number	Beta-565419
Percent modern carbon (pMC)	90.43 +/- 0.26 pMC
Atmospheric adjustment factor (REF)	100.0; = pMC/1.000

Package received - labeling COC


View of content (1mm x 1mm scale)


3677.7mg analyzed (1mm x 1mm scale)

Disclosures: All work was done at Beta Analytic in its own chemistry lab and AMSs. No subcontractors were used. Beta's chemistry laboratory and AMS do not react or measure artificial C 14 used in biomedical and environmental AMS studies. Beta is a C14 tracer-free facility. Validating quality assurance is verified with a Quality Assurance report posted separately to the web library containing the PDF downloadable copy of this report.

Precision on the RESULT is cited as +/- 3% (absolute). The cited precision on the analytical measure (pMC) is 1 sigma (1 relative standard deviation). The reported result only applies to the analyzed material. The accuracy of the RESULT relies on the measured carbon in the analyzed material having been in recent equilibrium with CO_2 in the air and/or from fossil carbon (from living more than 40,000 years ago such as petroleum or coal. The RESULT only applies to relative carbon content, not to relative mass content. The RESULT is calculated by adjusting pMC by the applicable "Atmospheric adjustment factor (REF)" cited in this report.

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Summary of Results - % Biogenic Carbon Content
ASTM D6866-20 Method B (AMS)

Certificate Number: 453369565419111707

Validation:

Submitter	Eileen Jang
Company	Lehigh Hanson Materials Limited
Date Received	August 07, 2020
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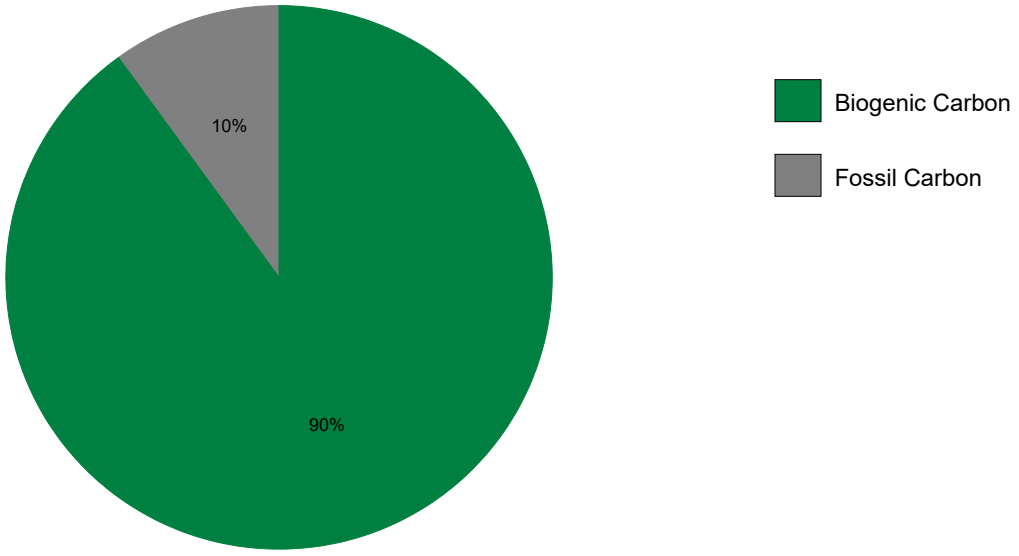

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% Biogenic Carbon Content ASTM D6866-20 Method B (AMS)

Explanation of Results

The result was obtained using the radiocarbon isotope (also known as Carbon-14, C14 or 14C), a naturally occurring isotope of carbon that is radioactive and decays in such a way that there is none left after about 45,000 years following the death of a plant or animal. Its most common use is radiocarbon dating by archaeologists. An industrial application was also developed to determine if consumer products and CO2 emissions were sourced from plants/biomass or from materials such as petroleum or coal (fossil-based). By 2003 there was growing demand for a standardized methodology for applying Carbon-14 testing within the regulatory environment. The first of these standards was ASTM D6866-04, which was written with the assistance of Beta Analytic. Since ASTM was largely viewed as a US standard, European stakeholders soon began demanding an equivalent CEN standard while global stakeholders called for ISO standardization.

The analytical procedures for measuring radiocarbon content using the different standards are identical. The only difference is the reporting format. Results are usually reported using the standardized terminology “% biobased carbon”. Only ASTM D6866 uses the term “% biogenic carbon” when the result represents all carbon present (Total Carbon) rather than just the organic carbon (Total Organic Carbon). The terms “% biobased carbon” and “% biogenic carbon” are now the standard units in regulatory and industrial applications, replacing obscure units of measure historically reported by radiocarbon dating laboratories e.g. disintegrations per minute per gram (dpm/g) or radiocarbon age.

The result was obtained by measuring the ratio of radiocarbon in the material relative to a National Institute of Standards and Technology (NIST) modern reference standard (SRM 4990C). This ratio was calculated as a percentage and is reported as percent modern carbon (pMC). The value obtained relative to the NIST standard is normalized to the year 1950 AD so an adjustment was required to calculate a carbon source value relative to today. This factor is listed on the report sheet as the terminology “REF”.

Interpretation and application of the results is straightforward. A value of 100% biobased or biogenic carbon would indicate that 100% of the carbon came from plants or animal by-products (biomass) living in the natural environment and a value of 0% would mean that all of the carbon was derived from petrochemicals, coal and other fossil sources. A value between 0-100% would indicate a mixture. The higher the value, the greater the proportion of naturally sourced components in the material.

Beta Analytic
TESTING LABORATORY

Beta Analytic Inc
4985 SW 74 Court
Miami, Florida 33155
Tel: 305-667-5167
Fax: 305-663-0964
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ISO/IEC 17025:2005-Accredited Testing Laboratory

Quality Assurance Report

This report provides the results of reference materials used to validate radiocarbon analyses prior to reporting. Known-value reference materials were analyzed quasi-simultaneously with the unknowns. Results are reported as expected values vs measured values. Reported values are calculated relative to NIST SRM-4990B and corrected for isotopic fractionation. Results are reported using the direct analytical measure percent modern carbon (pMC) with one relative standard deviation. Agreement between expected and measured values is taken as being within 2 sigma agreement (error x 2) to account for total laboratory error.

Report Date: August 17, 2020
Submitter: Ms. Eileen Jang

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Expected Value:	129.41 +/- 0.06 pMC
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Agreement:	Accepted

COMMENT: All measurements passed acceptance tests.

Validation: Digital signature on file

Date: August 17, 2020

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4985 SW 74th Court
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ISO/IEC 17025:2017-Accredited Testing Laboratory

October 30, 2020

Eileen Jang
Lehigh Hanson Materials Limited
PO Box 950
Delta
British Colombia, V4K 3S6
Canada

Dear Ms. Jang

Please find enclosed your radiocarbon (C14) report for the material recently submitted. The result is reported as “% Biogenic Carbon”. This indicates the percentage carbon from “renewable” (biomass or animal by-product) sources versus petroleum (or otherwise fossil) sources . For reference, 100 % Biogenic Carbon indicates that a material is entirely sourced from plants or animal by-products and 0 % Biogenic Carbon indicates that a material did not contain any carbon from plants or animal by-products. A value in between represents a mixture of natural and fossil sources.

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Sincerely,

Digital signature on file

Ronald E. Hatfield President

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4985 SW 74th Court
Miami, FL 33155 USA
Tel: 305-667-5167
Fax: 305-663-0964
info@betalabservices.com

ISO/IEC 17025:2017-Accredited Testing Laboratory

Summary of Results - % Biogenic Carbon Content
ASTM D6866-20 Method B (AMS)

Certificate Number: 460582572441113660

Validation:

Submitter	Eileen Jang
Company	Lehigh Hanson Materials Limited
Date Received	October 26, 2020
Date Reported	October 30, 2020
Submitter Label	AF 294 Eagle Disposal

RESULT: 79 % Biogenic Carbon Content (as a fraction of total carbon)

Laboratory Number	Beta-572441
Percent modern carbon (pMC)	79.37 +/- 0.23 pMC
Atmospheric adjustment factor (REF)	100.0; = pMC/1.000

Package received - labeling COC


View of content (1mm x 1mm scale)


3393.9mg analyzed (1mm x 1mm scale)

Disclosures: All work was done at Beta Analytic in its own chemistry lab and AMSs. No subcontractors were used. Beta's chemistry laboratory and AMS do not react or measure artificial C 14 used in biomedical and environmental AMS studies. Beta is a C14 tracer-free facility. Validating quality assurance is verified with a Quality Assurance report posted separately to the web library containing the PDF downloadable copy of this report.

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4985 SW 74th Court
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ISO/IEC 17025:2017-Accredited Testing Laboratory

Summary of Results - % Biogenic Carbon Content
ASTM D6866-20 Method B (AMS)

Certificate Number: 460582572441113660

Validation:

Submitter	Eileen Jang
Company	Lehigh Hanson Materials Limited
Date Received	October 26, 2020
Date Reported	October 30, 2020
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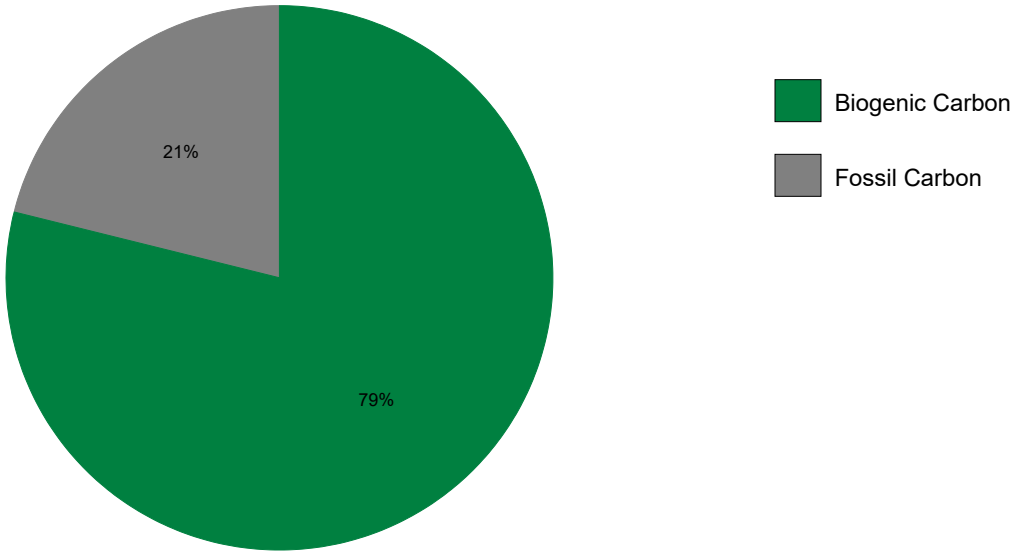

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% Biogenic Carbon Content ASTM D6866-20 Method B (AMS)

Explanation of Results

The result was obtained using the radiocarbon isotope (also known as Carbon-14, C14 or 14C), a naturally occurring isotope of carbon that is radioactive and decays in such a way that there is none left after about 45,000 years following the death of a plant or animal. Its most common use is radiocarbon dating by archaeologists. An industrial application was also developed to determine if consumer products and CO2 emissions were sourced from plants/biomass or from materials such as petroleum or coal (fossil-based). By 2003 there was growing demand for a standardized methodology for applying Carbon-14 testing within the regulatory environment. The first of these standards was ASTM D6866-04, which was written with the assistance of Beta Analytic. Since ASTM was largely viewed as a US standard, European stakeholders soon began demanding an equivalent CEN standard while global stakeholders called for ISO standardization.

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ISO/IEC 17025:2017-Accredited Testing Laboratory

August 21, 2021

Eileen Jang
Lehigh Hanson Materials Limited
PO Box 950
Delta
British Colombia, V4K 3S6
Canada

Dear Ms. Jang

Please find enclosed your radiocarbon (C14) report for the material recently submitted. The result is reported as “% Biogenic Carbon”. This indicates the percentage carbon from “renewable” (biomass or animal by-product) sources versus petroleum (or otherwise fossil) sources . For reference, 100 % Biogenic Carbon indicates that a material is entirely sourced from plants or animal by-products and 0 % Biogenic Carbon indicates that a material did not contain any carbon from plants or animal by-products. A value in between represents a mixture of natural and fossil sources.

The analytical measurement is cited as “percent modern carbon (pMC)”. This is the percentage of C14 measured in the sample relative to a modern reference standard (NIST 4990C). The % Biogenic Carbon content is calculated from pMC by applying a small adjustment factor for C14 in carbon dioxide in air today. It is important to note is that all internationally recognized standards using C14 assume that the plant or biomass feedstocks were obtained from natural environments.

Reported results are accredited to ISO/IEC 17025:2017 Testing Accreditation PJLA #59423 standards and all chemistry was performed here in our laboratory and counted in our own accelerators in Miami, Florida.

The international standard method utilized for this analysis is cited under Summary of Results. The standard version used is the latest available as of the date reported (unless otherwise noted). The report also indicates if the result is relative to total carbon (TC) or only total organic carbon (TOC). When interpreting the results, please consider any communications you may have had with us regarding the analysis. If you have any questions please contact us. We welcome your inquiries.

Sincerely,

Digital signature on file

Ronald E. Hatfield President

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ISO/IEC 17025:2017-Accredited Testing Laboratory

Summary of Results - % Biogenic Carbon Content
ASTM D6866-21 Method B (AMS)

Certificate Number: 489082600493121518

Validation:

Submitter	Eileen Jang
Company	Lehigh Hanson Materials Limited
Date Received	August 16, 2021
Date Reported	August 21, 2021
Submitter Label	AF331 Eagle Disposal

RESULT: 44 % Biogenic Carbon Content (as a fraction of total carbon)

Laboratory Number	Beta-600493
Percent modern carbon (pMC)	43.78 +/- 0.13 pMC
Atmospheric adjustment factor (REF)	100.0; = pMC/1.000

Package received - labeling COC


View of content (1mm x 1mm scale)


3666.4mg analyzed (1mm x 1mm scale)

Disclosures: All work was done at Beta Analytic in its own chemistry lab and AMSs. No subcontractors were used. Beta's chemistry laboratory and AMS do not react or measure artificial C 14 used in biomedical and environmental AMS studies. Beta is a C14 tracer-free facility. Validating quality assurance is verified with a Quality Assurance report posted separately to the web library containing the PDF downloadable copy of this report.

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ISO/IEC 17025:2017-Accredited Testing Laboratory

Summary of Results - % Biogenic Carbon Content
ASTM D6866-21 Method B (AMS)

Certificate Number: 489082600493121518

Validation:

Submitter	Eileen Jang
Company	Lehigh Hanson Materials Limited
Date Received	August 16, 2021
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Submitter Label	AF331 Eagle Disposal

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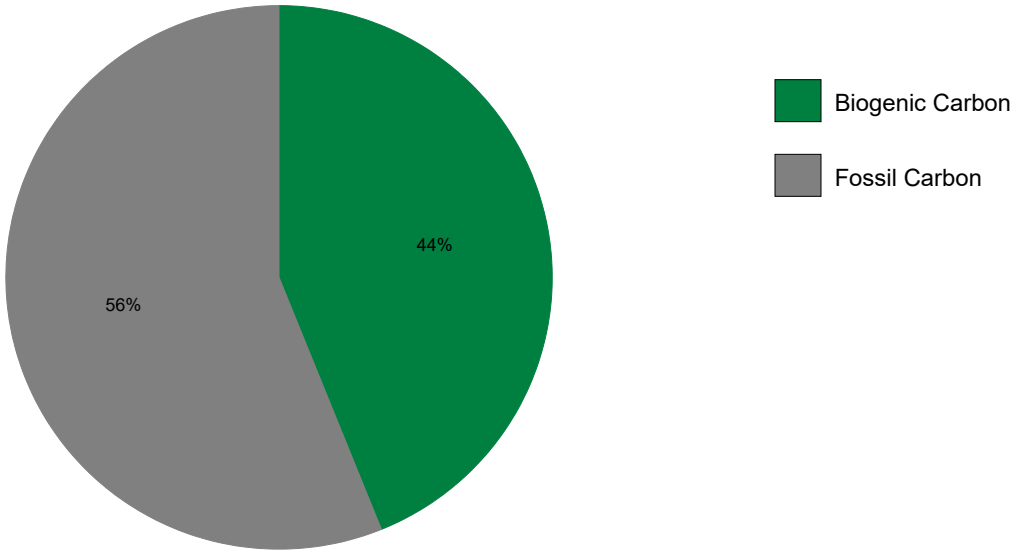

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% Biogenic Carbon Content ASTM D6866-21 Method B (AMS)

Explanation of Results

The result was obtained using the radiocarbon isotope (also known as Carbon-14, C14 or 14C), a naturally occurring isotope of carbon that is radioactive and decays in such a way that there is none left after about 45,000 years following the death of a plant or animal. Its most common use is radiocarbon dating by archaeologists. An industrial application was also developed to determine if consumer products and CO2 emissions were sourced from plants/biomass or from materials such as petroleum or coal (fossil-based). By 2003 there was growing demand for a standardized methodology for applying Carbon-14 testing within the regulatory environment. The first of these standards was ASTM D6866-04, which was written with the assistance of Beta Analytic. Since ASTM was largely viewed as a US standard, European stakeholders soon began demanding an equivalent CEN standard while global stakeholders called for ISO standardization.

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Quality Assurance Report

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Report Date: August 23, 2021
Submitter: Ms. Eileen Jang

QA MEASUREMENTS

Reference 1	
Expected Value:	0.44 +/- 0.10 pMC
Measured Value:	0.44 +/- 0.03 pMC
Agreement:	Accepted
Reference 2	
Expected Value:	96.69 +/- 0.50 pMC
Measured Value:	96.77 +/- 0.29 pMC
Agreement:	Accepted
Reference 3	
Expected Value:	129.41 +/- 0.06 pMC
Measured Value:	129.42 +/- 0.35 pMC
Agreement:	Accepted

COMMENT: All measurements passed acceptance tests.

Validation: Digital signature on file

Date: August 23, 2021

Beta Analytic, Inc.
4985 SW 74th Court
Miami, FL 33155 USA
Tel: 305-667-5167
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ISO/IEC 17025:2017-Accredited Testing Laboratory

February 08, 2022

Eileen Jang
Lehigh Hanson Materials Limited
PO Box 950
Delta
British Colombia, V4K 3S6
Canada

Dear Ms. Jang

Please find enclosed your radiocarbon (C14) report for the material recently submitted. The result is reported as “% Biogenic Carbon”. This indicates the percentage carbon from “renewable” (biomass or animal by-product) sources versus petroleum (or otherwise fossil) sources . For reference, 100 % Biogenic Carbon indicates that a material is entirely sourced from plants or animal by-products and 0 % Biogenic Carbon indicates that a material did not contain any carbon from plants or animal by-products. A value in between represents a mixture of natural and fossil sources.

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Sincerely,

Chris Patrick
Digital signature on file

Chris Patrick
Vice President of Laboratory Operations

Beta Analytic, Inc.
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info@betalabservices.com

ISO/IEC 17025:2017-Accredited Testing Laboratory

Summary of Results - % Biogenic Carbon Content
ASTM D6866-21 Method B (AMS)

Certificate Number: 506791617992126240

Validation: Chris Patrick
Digital signature on file

Submitter	Eileen Jang
Company	Lehigh Hanson Materials Limited
Date Received	January 31, 2022
Date Reported	February 08, 2022
Submitter Label	AF374 Revolution

RESULT: 68 % Biogenic Carbon Content (as a fraction of total carbon)

Laboratory Number	Beta-617992
Percent modern carbon (pMC)	68.13 +/- 0.25 pMC
Atmospheric adjustment factor (REF)	100.0; = pMC/1.000

Package received - labeling COC


View of content (1mm x 1mm scale)


3233.2mg analyzed (1mm x 1mm scale)

Disclosures: All work was done at Beta Analytic in its own chemistry lab and AMSs. No subcontractors were used. Beta's chemistry laboratory and AMS do not react or measure artificial C 14 used in biomedical and environmental AMS studies. Beta is a C14 tracer-free facility. Validating quality assurance is verified with a Quality Assurance report posted separately to the web library containing the PDF downloadable copy of this report.

Precision on the RESULT is cited as +/- 3% (absolute). The cited precision on the analytical measure (pMC) is 1 sigma (1 relative standard deviation). The reported result only applies to the analyzed material. The accuracy of the RESULT relies on the measured carbon in the analyzed material having been in recent equilibrium with CO_2 in the air and/or from fossil carbon (more than 40,000 years old) such as petroleum or coal. The RESULT only applies to relative carbon content, not to relative mass content. The RESULT is calculated by adjusting pMC by the applicable "Atmospheric adjustment factor (REF)" cited in this report

Beta Analytic, Inc.
4985 SW 74th Court
Miami, FL 33155 USA
Tel: 305-667-5167
Fax: 305-663-0964
info@betalabservices.com

ISO/IEC 17025:2017-Accredited Testing Laboratory

Summary of Results - % Biogenic Carbon Content
ASTM D6866-21 Method B (AMS)

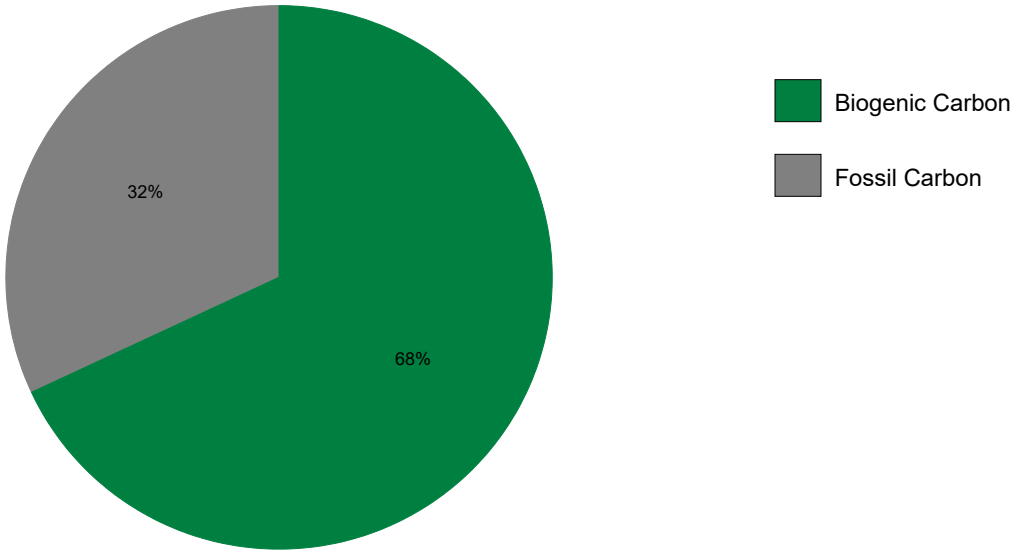
Certificate Number: 506791617992126240

Validation: Chris Patrick
Digital signature on file

Submitter	Eileen Jang
Company	Lehigh Hanson Materials Limited
Date Received	January 31, 2022
Date Reported	February 08, 2022
Submitter Label	AF374 Revolution

RESULT: 68 % Biogenic Carbon Content (as a fraction of total carbon)

Laboratory Number	Beta-617992
Percent modern carbon (pMC)	68.13 +/- 0.25 pMC
Atmospheric adjustment factor (REF)	100.0; = pMC/1.000



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% Biogenic Carbon Content ASTM D6866-21 Method B (AMS)

Explanation of Results

The result was obtained using the radiocarbon isotope (also known as Carbon-14, C14 or 14C), a naturally occurring isotope of carbon that is radioactive and decays in such a way that there is none left after about 45,000 years following the death of a plant or animal. Its most common use is radiocarbon dating by archaeologists. An industrial application was also developed to determine if consumer products and CO2 emissions were sourced from plants/biomass or from materials such as petroleum or coal (fossil-based). By 2003 there was growing demand for a standardized methodology for applying Carbon-14 testing within the regulatory environment. The first of these standards was ASTM D6866-04, which was written with the assistance of Beta Analytic. Since ASTM was largely viewed as a US standard, European stakeholders soon began demanding an equivalent CEN standard while global stakeholders called for ISO standardization.

The analytical procedures for measuring radiocarbon content using the different standards are identical. The only difference is the reporting format. Results are usually reported using the standardized terminology “% biobased carbon”. Only ASTM D6866 uses the term “% biogenic carbon” when the result represents all carbon present (Total Carbon) rather than just the organic carbon (Total Organic Carbon). The terms “% biobased carbon” and “% biogenic carbon” are now the standard units in regulatory and industrial applications, replacing obscure units of measure historically reported by radiocarbon dating laboratories e.g. disintegrations per minute per gram (dpm/g) or radiocarbon age.

The result was obtained by measuring the ratio of radiocarbon in the material relative to a National Institute of Standards and Technology (NIST) modern reference standard (SRM 4990C). This ratio was calculated as a percentage and is reported as percent modern carbon (pMC). The value obtained relative to the NIST standard is normalized to the year 1950 AD so an adjustment was required to calculate a carbon source value relative to today. This factor is listed on the report sheet as the terminology “REF”.

Interpretation and application of the results is straightforward. A value of 100% biobased or biogenic carbon would indicate that 100% of the carbon came from plants or animal by-products (biomass) living in the natural environment and a value of 0% would mean that all of the carbon was derived from petrochemicals, coal and other fossil sources. A value between 0-100% would indicate a mixture. The higher the value, the greater the proportion of naturally sourced components in the material.

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ISO/IEC 17025:2017-Accredited Testing Laboratory

Quality Assurance Report

This report provides the results of reference materials used to validate radiocarbon analyses prior to reporting. Known-value reference materials were analyzed quasi-simultaneously with the unknowns. Results are reported as expected values vs measured values. Reported values are calculated relative to NISTSRM-1990C and corrected for isotopic fractionation. Results are reported using the direct analytical measure percent modern carbon (pMC) with one relative standard deviation. Agreement between expected and measured values is taken as being within 2 sigma agreement (error x 2) to account for total laboratory error.

Report Date: February 09, 2022
Submitter: Ms. Eileen Jang

QA MEASUREMENTS

Reference 1

Expected Value:	129.41 +/- 0.06 pMC
Measured Value:	129.44 +/- 0.40 pMC
Agreement:	Accepted

Reference 2

Expected Value:	96.69 +/- 0.50 pMC
Measured Value:	96.60 +/- 0.34 pMC
Agreement:	Accepted

Reference 3

Expected Value:	0.42 +/- 0.04 pMC
Measured Value:	0.42 +/- 0.03 pMC
Agreement:	Accepted

COMMENT: All measurements passed acceptance tests.

Validation: Chris Patrick
Digital signature on file

Date: February 09, 2022

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Miami, FL 33155 USA
Tel: 305-667-5167
Fax: 305-663-0964
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ISO/IEC 17025:2017-Accredited Testing Laboratory

February 08, 2022

Eileen Jang
Lehigh Hanson Materials Limited
PO Box 950
Delta
British Colombia, V4K 3S6
Canada

Dear Ms. Jang

Please find enclosed your radiocarbon (C14) report for the material recently submitted. The result is reported as “% Biogenic Carbon”. This indicates the percentage carbon from “renewable” (biomass or animal by-product) sources versus petroleum (or otherwise fossil) sources . For reference, 100 % Biogenic Carbon indicates that a material is entirely sourced from plants or animal by-products and 0 % Biogenic Carbon indicates that a material did not contain any carbon from plants or animal by-products. A value in between represents a mixture of natural and fossil sources.

The analytical measurement is cited as “percent modern carbon (pMC)”. This is the percentage of C14 measured in the sample relative to a modern reference standard (NIST 4990C). The % Biogenic Carbon content is calculated from pMC by applying a small adjustment factor for C14 in carbon dioxide in air today. It is important to note is that all internationally recognized standards using C14 assume that the plant or biomass feedstocks were obtained from natural environments.

Reported results are accredited to ISO/IEC 17025:2017 Testing Accreditation PJLA #59423 standards and all chemistry was performed here in our laboratory and counted in our own accelerators in Miami, Florida.

The international standard method utilized for this analysis is cited under Summary of Results. The standard version used is the latest available as of the date reported (unless otherwise noted). The report also indicates if the result is relative to total carbon (TC) or only total organic carbon (TOC). When interpreting the results, please consider any communications you may have had with us regarding the analysis. If you have any questions please contact us. We welcome your inquiries.

Sincerely,

Chris Patrick
Digital signature on file

Chris Patrick
Vice President of Laboratory Operations

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4985 SW 74th Court
Miami, FL 33155 USA
Tel: 305-667-5167
Fax: 305-663-0964
info@betalabservices.com

ISO/IEC 17025:2017-Accredited Testing Laboratory

Summary of Results - % Biogenic Carbon Content
ASTM D6866-21 Method B (AMS)

Certificate Number: 506794617995126240

Validation: Chris Patrick
Digital signature on file

Submitter	Eileen Jang
Company	Lehigh Hanson Materials Limited
Date Received	January 31, 2022
Date Reported	February 08, 2022
Submitter Label	AF387 Revolution

RESULT: 77 % Biogenic Carbon Content (as a fraction of total carbon)

Laboratory Number	Beta-617995
Percent modern carbon (pMC)	76.63 +/- 0.28 pMC
Atmospheric adjustment factor (REF)	100.0; = pMC/1.000

Package received - labeling COC


View of content (1mm x 1mm scale)


3030.6mg analyzed (1mm x 1mm scale)

Disclosures: All work was done at Beta Analytic in its own chemistry lab and AMSs. No subcontractors were used. Beta's chemistry laboratory and AMS do not react or measure artificial C 14 used in biomedical and environmental AMS studies. Beta is a C14 tracer-free facility. Validating quality assurance is verified with a Quality Assurance report posted separately to the web library containing the PDF downloadable copy of this report.

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Summary of Results - % Biogenic Carbon Content
ASTM D6866-21 Method B (AMS)

Certificate Number: 506794617995126240

Validation: Chris Patrick
Digital signature on file

Submitter	Eileen Jang
Company	Lehigh Hanson Materials Limited
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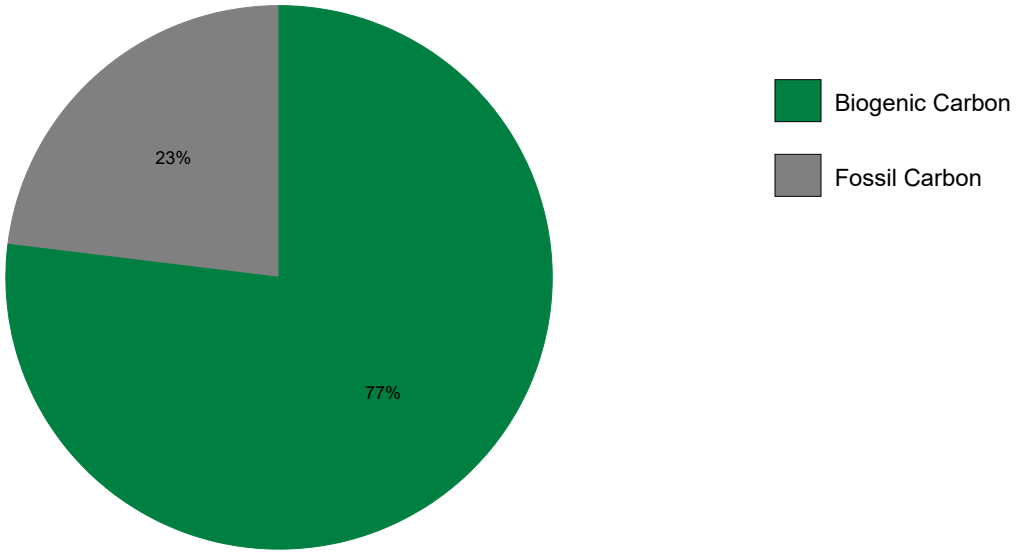

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% Biogenic Carbon Content ASTM D6866-21 Method B (AMS)

Explanation of Results

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Report Date: February 09, 2022
Submitter: Ms. Eileen Jang

QA MEASUREMENTS

Reference 1

Expected Value:	129.41 +/- 0.06 pMC
Measured Value:	129.44 +/- 0.40 pMC
Agreement:	Accepted

Reference 2

Expected Value:	96.69 +/- 0.50 pMC
Measured Value:	96.60 +/- 0.34 pMC
Agreement:	Accepted

Reference 3

Expected Value:	0.42 +/- 0.04 pMC
Measured Value:	0.42 +/- 0.03 pMC
Agreement:	Accepted

COMMENT: All measurements passed acceptance tests.

Validation: Chris Patrick
Digital signature on file

Date: February 09, 2022

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February 08, 2022

Eileen Jang
Lehigh Hanson Materials Limited
PO Box 950
Delta
British Colombia, V4K 3S6
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Dear Ms. Jang

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Sincerely,

Chris Patrick
Digital signature on file

Chris Patrick
Vice President of Laboratory Operations

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Miami, FL 33155 USA
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ISO/IEC 17025:2017-Accredited Testing Laboratory

Summary of Results - % Biogenic Carbon Content
ASTM D6866-21 Method B (AMS)

Certificate Number: 506795617996126240

Validation: Chris Patrick
Digital signature on file

Submitter	Eileen Jang
Company	Lehigh Hanson Materials Limited
Date Received	January 31, 2022
Date Reported	February 08, 2022
Submitter Label	AF390 Revolution

RESULT: 85 % Biogenic Carbon Content (as a fraction of total carbon)

Laboratory Number	Beta-617996
Percent modern carbon (pMC)	85.28 +/- 0.3 pMC
Atmospheric adjustment factor (REF)	100.0; = pMC/1.000

Package received - labeling COC


View of content (1mm x 1mm scale)


3067.1mg analyzed (1mm x 1mm scale)

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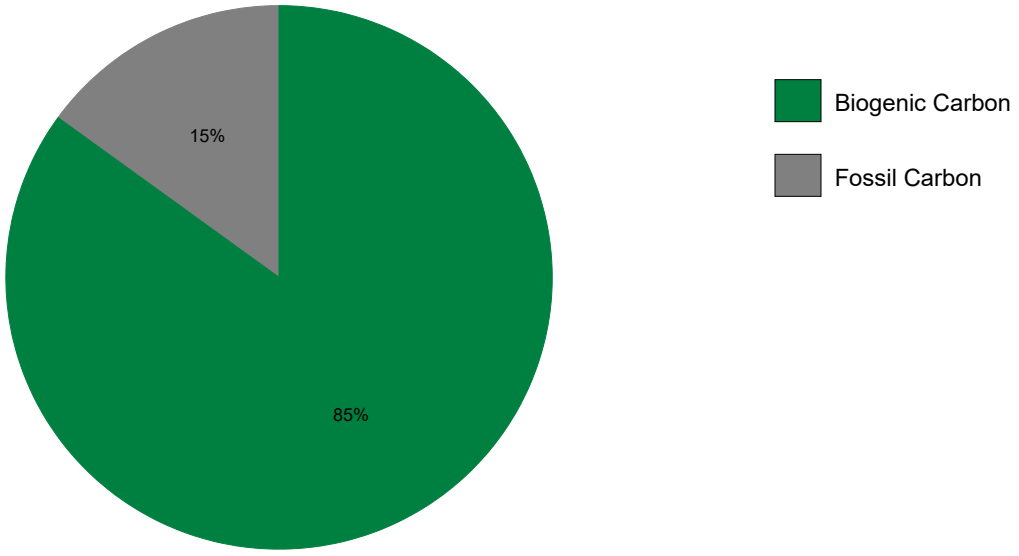

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% Biogenic Carbon Content ASTM D6866-21 Method B (AMS)

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Report Date: February 09, 2022
Submitter: Ms. Eileen Jang

QA MEASUREMENTS

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Expected Value:	129.41 +/- 0.06 pMC
Measured Value:	129.44 +/- 0.40 pMC
Agreement:	Accepted

Reference 2

Expected Value:	96.69 +/- 0.50 pMC
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Expected Value:	0.42 +/- 0.04 pMC
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Agreement:	Accepted

COMMENT: All measurements passed acceptance tests.

Validation: Chris Patrick
Digital signature on file

Date: February 09, 2022

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ISO/IEC 17025:2017-Accredited Testing Laboratory

October 30, 2020

Eileen Jang
Lehigh Hanson Materials Limited
PO Box 950
Delta
British Colombia, V4K 3S6
Canada

Dear Ms. Jang

Please find enclosed your radiocarbon (C14) report for the material recently submitted. The result is reported as “% Biogenic Carbon”. This indicates the percentage carbon from “renewable” (biomass or animal by-product) sources versus petroleum (or otherwise fossil) sources . For reference, 100 % Biogenic Carbon indicates that a material is entirely sourced from plants or animal by-products and 0 % Biogenic Carbon indicates that a material did not contain any carbon from plants or animal by-products. A value in between represents a mixture of natural and fossil sources.

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Sincerely,

Digital signature on file

Ronald E. Hatfield President

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info@betalabservices.com

ISO/IEC 17025:2017-Accredited Testing Laboratory

Summary of Results - % Biogenic Carbon Content
ASTM D6866-20 Method B (AMS)

Certificate Number: 460582572441113660

Validation:

Submitter	Eileen Jang
Company	Lehigh Hanson Materials Limited
Date Received	October 26, 2020
Date Reported	October 30, 2020
Submitter Label	AF 294 Eagle Disposal

RESULT: 79 % Biogenic Carbon Content (as a fraction of total carbon)

Laboratory Number	Beta-572441
Percent modern carbon (pMC)	79.37 +/- 0.23 pMC
Atmospheric adjustment factor (REF)	100.0; = pMC/1.000

Package received - labeling COC


View of content (1mm x 1mm scale)


3393.9mg analyzed (1mm x 1mm scale)

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Certificate Number: 460582572441113660

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Submitter	Eileen Jang
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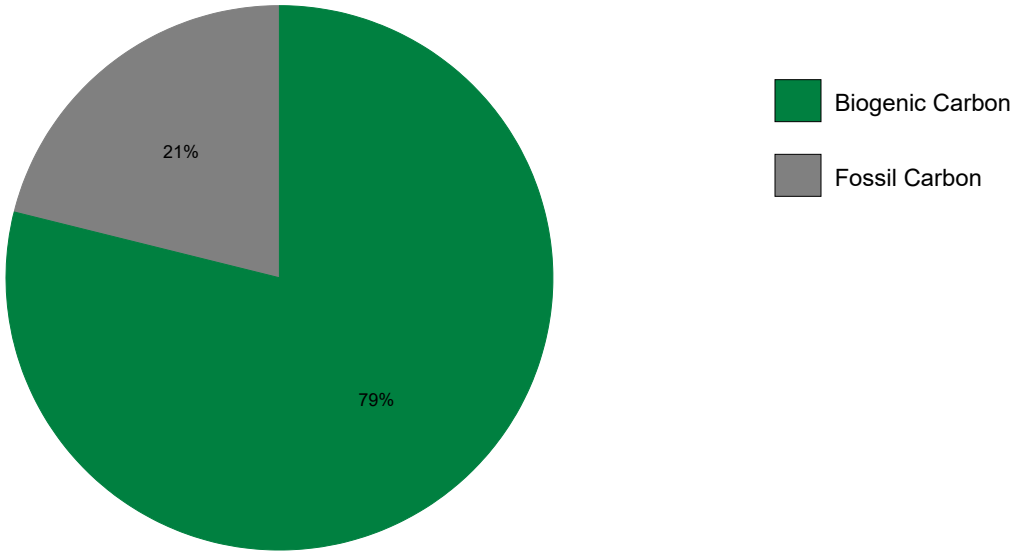
Atmospheric adjustment factor (REF)	100.0; = pMC/1.000



Precision on the RESULT is cited as +/- 3% (absolute). The cited precision on the analytical measure (pMC) is 1 sigma (1 relative standard deviation). The reported result only applies to the analyzed material. The accuracy of the RESULT relies on the measured carbon in the analyzed material having been in recent equilibrium with CO_2 in the air and/or from fossil carbon (from living more than 40,000 years ago such as petroleum or coal. The RESULT only applies to relative carbon content, not to relative mass content. The RESULT is calculated by adjusting pMC by the applicable "Atmospheric adjustment factor (REF)" cited in this report.

Beta Analytic, Inc.
4985 SW 74th Court
Miami, FL 33155 USA
Tel: 305-667-5167
Fax: 305-663-0964
info@betalabservices.com

% Biogenic Carbon Content ASTM D6866-20 Method B (AMS)

Explanation of Results

The result was obtained using the radiocarbon isotope (also known as Carbon-14, C14 or 14C), a naturally occurring isotope of carbon that is radioactive and decays in such a way that there is none left after about 45,000 years following the death of a plant or animal. Its most common use is radiocarbon dating by archaeologists. An industrial application was also developed to determine if consumer products and CO2 emissions were sourced from plants/biomass or from materials such as petroleum or coal (fossil-based). By 2003 there was growing demand for a standardized methodology for applying Carbon-14 testing within the regulatory environment. The first of these standards was ASTM D6866-04, which was written with the assistance of Beta Analytic. Since ASTM was largely viewed as a US standard, European stakeholders soon began demanding an equivalent CEN standard while global stakeholders called for ISO standardization.

The analytical procedures for measuring radiocarbon content using the different standards are identical. The only difference is the reporting format. Results are usually reported using the standardized terminology “% biobased carbon”. Only ASTM D6866 uses the term “% biogenic carbon” when the result represents all carbon present (Total Carbon) rather than just the organic carbon (Total Organic Carbon). The terms “% biobased carbon” and “% biogenic carbon” are now the standard units in regulatory and industrial applications, replacing obscure units of measure historically reported by radiocarbon dating laboratories e.g. disintegrations per minute per gram (dpm/g) or radiocarbon age.

The result was obtained by measuring the ratio of radiocarbon in the material relative to a National Institute of Standards and Technology (NIST) modern reference standard (SRM 4990C). This ratio was calculated as a percentage and is reported as percent modern carbon (pMC). The value obtained relative to the NIST standard is normalized to the year 1950 AD so an adjustment was required to calculate a carbon source value relative to today. This factor is listed on the report sheet as the terminology “REF”.

Interpretation and application of the results is straightforward. A value of 100% biobased or biogenic carbon would indicate that 100% of the carbon came from plants or animal by-products (biomass) living in the natural environment and a value of 0% would mean that all of the carbon was derived from petrochemicals, coal and other fossil sources. A value between 0-100% would indicate a mixture. The higher the value, the greater the proportion of naturally sourced components in the material.

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Miami, FL 33155 USA
Tel: 305-667-5167
Fax: 305-663-0964
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ISO/IEC 17025:2017-Accredited Testing Laboratory

May 11, 2022

Jasper van de Wetering
Lehigh Hanson
7777 Ross Road
Delta
V4G 1B8
Canada

Dear Mr. Wetering

Please find enclosed your radiocarbon (C14) report for the material recently submitted. The result is reported as “% Biogenic Carbon”. This indicates the percentage carbon from “renewable” (biomass or animal by-product) sources versus petroleum (or otherwise fossil) sources . For reference, 100 % Biogenic Carbon indicates that a material is entirely sourced from plants or animal by-products and 0 % Biogenic Carbon indicates that a material did not contain any carbon from plants or animal by-products. A value in between represents a mixture of natural and fossil sources.

The analytical measurement is cited as “percent modern carbon (pMC)”. This is the percentage of C14 measured in the sample relative to a modern reference standard (NIST 4990C). The % Biogenic Carbon content is calculated from pMC by applying a small adjustment factor for C14 in carbon dioxide in air today. It is important to note is that all internationally recognized standards using C14 assume that the plant or biomass feedstocks were obtained from natural environments.

Reported results are accredited to ISO/IEC 17025:2017 Testing Accreditation PJLA #59423 standards and all chemistry was performed here in our laboratory and counted in our own accelerators in Miami, Florida.

The international standard method utilized for this analysis is cited under Summary of Results. The standard version used is the latest available as of the date reported (unless otherwise noted). The report also indicates if the result is relative to total carbon (TC) or only total organic carbon (TOC). When interpreting the results, please consider any communications you may have had with us regarding the analysis. If you have any questions please contact us. We welcome your inquiries.

Sincerely,

Digital signature on file

Ronald E. Hatfield President

Beta Analytic, Inc.
4985 SW 74th Court
Miami, FL 33155 USA
Tel: 305-667-5167
Fax: 305-663-0964
info@betalabservices.com

ISO/IEC 17025:2017-Accredited Testing Laboratory

Summary of Results - % Biogenic Carbon Content
ASTM D6866-22 Method B (AMS)

Certificate Number: 515578626666128752

Validation:

Submitter	Jasper van de Wetering
Company	Lehigh Hanson
Date Received	May 05, 2022
Date Reported	May 11, 2022
Submitter Label	EDM RDF

RESULT: 21 % Biogenic Carbon Content (as a fraction of total carbon)

Laboratory Number	Beta-626666
Percent modern carbon (pMC)	20.88 +/- 0.1 pMC
Atmospheric adjustment factor (REF)	100.0; = pMC/1.000

Package received - labeling COC

View of content

3140.8mg analyzed (1mm x 1mm scale)

Disclosures: All work was done at Beta Analytic in its own chemistry lab and AMSs. No subcontractors were used. Beta's chemistry laboratory and AMS do not react or measure artificial C 14 used in biomedical and environmental AMS studies. Beta is a C14 tracer-free facility. Validating quality assurance is verified with a Quality Assurance report posted separately to the web library containing the PDF downloadable copy of this report.

Precision on the RESULT is cited as +/- 3% (absolute). The cited precision on the analytical measure (pMC) is 1 sigma (1 relative standard deviation). The reported result only applies to the analyzed material. The accuracy of the RESULT relies on the measured carbon in the analyzed material having been in recent equilibrium with CO_2 in the air and/or from fossil carbon (more than 40,000 years old) such as petroleum or coal. The RESULT only applies to relative carbon content, not to relative mass content. The RESULT is calculated by adjusting pMC by the applicable "Atmospheric adjustment factor (REF)" cited in this report

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ISO/IEC 17025:2017-Accredited Testing Laboratory

Summary of Results - % Biogenic Carbon Content
ASTM D6866-22 Method B (AMS)

Certificate Number: 515578626666128752

Validation:

Submitter	Jasper van de Wetering
Company	Lehigh Hanson
Date Received	May 05, 2022
Date Reported	May 11, 2022
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RESULT: 21 % Biogenic Carbon Content (as a fraction of total carbon)

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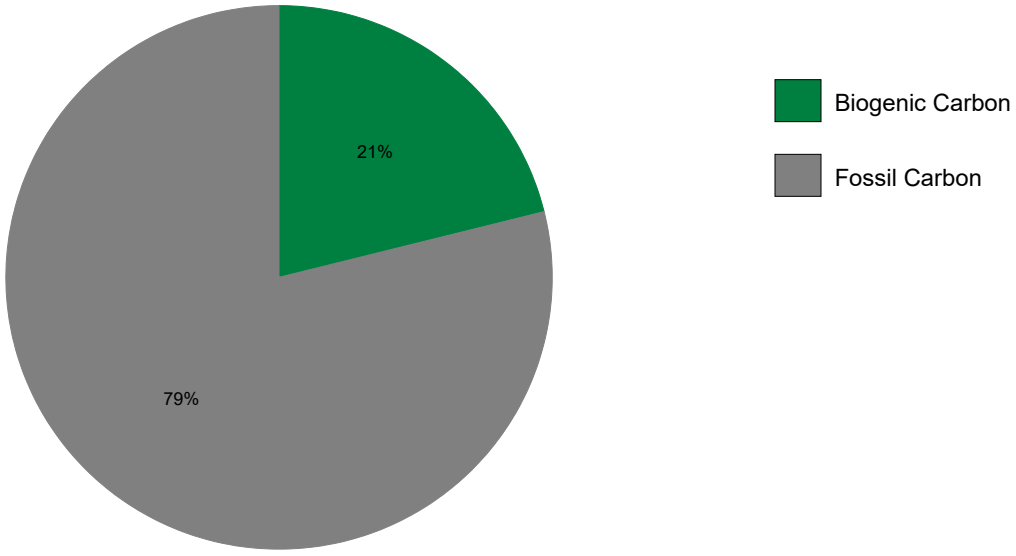

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% Biogenic Carbon Content ASTM D6866-22 Method B (AMS)

Explanation of Results

The result was obtained using the radiocarbon isotope (also known as Carbon-14, C14 or 14C), a naturally occurring isotope of carbon that is radioactive and decays in such a way that there is none left after about 45,000 years following the death of a plant or animal. Its most common use is radiocarbon dating by archaeologists. An industrial application was also developed to determine if consumer products and CO2 emissions were sourced from plants/biomass or from materials such as petroleum or coal (fossil-based). By 2003 there was growing demand for a standardized methodology for applying Carbon-14 testing within the regulatory environment. The first of these standards was ASTM D6866-04, which was written with the assistance of Beta Analytic. Since ASTM was largely viewed as a US standard, European stakeholders soon began demanding an equivalent CEN standard while global stakeholders called for ISO standardization.

The analytical procedures for measuring radiocarbon content using the different standards are identical. The only difference is the reporting format. Results are usually reported using the standardized terminology “% biobased carbon”. Only ASTM D6866 uses the term “% biogenic carbon” when the result represents all carbon present (Total Carbon) rather than just the organic carbon (Total Organic Carbon). The terms “% biobased carbon” and “% biogenic carbon” are now the standard units in regulatory and industrial applications, replacing obscure units of measure historically reported by radiocarbon dating laboratories e.g. disintegrations per minute per gram (dpm/g) or radiocarbon age.

The result was obtained by measuring the ratio of radiocarbon in the material relative to a National Institute of Standards and Technology (NIST) modern reference standard (SRM 4990C). This ratio was calculated as a percentage and is reported as percent modern carbon (pMC). The value obtained relative to the NIST standard is normalized to the year 1950 AD so an adjustment was required to calculate a carbon source value relative to today. This factor is listed on the report sheet as the terminology “REF”.

Interpretation and application of the results is straightforward. A value of 100% biobased or biogenic carbon would indicate that 100% of the carbon came from plants or animal by-products (biomass) living in the natural environment and a value of 0% would mean that all of the carbon was derived from petrochemicals, coal and other fossil sources. A value between 0-100% would indicate a mixture. The higher the value, the greater the proportion of naturally sourced components in the material.

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ISO/IEC 17025:2017-Accredited Testing Laboratory

Quality Assurance Report

This report provides the results of reference materials used to validate radiocarbon analyses prior to reporting. Known-value reference materials were analyzed quasi-simultaneously with the unknowns. Results are reported as expected values vs measured values. Reported values are calculated relative to NISTSRM-1990C and corrected for isotopic fractionation. Results are reported using the direct analytical measure percent modern carbon (pMC) with one relative standard deviation. Agreement between expected and measured values is taken as being within 2 sigma agreement (error x 2) to account for total laboratory error.

Report Date: May 11, 2022
Submitter: Mr. Jasper van de Wetering

QA MEASUREMENTS

Reference 1	
Expected Value:	0.42 +/- 0.04 pMC
Measured Value:	0.42 +/- 0.04 pMC
Agreement:	Accepted
Reference 2	
Expected Value:	96.69 +/- 0.50 pMC
Measured Value:	97.53 +/- 0.28 pMC
Agreement:	Accepted
Reference 3	
Expected Value:	129.41 +/- 0.06 pMC
Measured Value:	129.44 +/- 0.35 pMC
Agreement:	Accepted

COMMENT: All measurements passed acceptance tests.

Validation: Digital signature on file

Date: May 11, 2022

Beta Analytic, Inc.
4985 SW 74th Court
Miami, FL 33155 USA
Tel: 305-667-5167
Fax: 305-663-0964
info@betalabservices.com

ISO/IEC 17025:2017-Accredited Testing Laboratory

May 04, 2022

Vanessa Pilon
Lehigh Cement
1370 Highway 49
Picton
K0K 2T0
Canada

Dear Ms. Pilon

Please find enclosed your radiocarbon (C14) report for the material recently submitted. The result is reported as “% Biogenic Carbon”. This indicates the percentage carbon from “renewable” (biomass or animal by-product) sources versus petroleum (or otherwise fossil) sources . For reference, 100 % Biogenic Carbon indicates that a material is entirely sourced from plants or animal by-products and 0 % Biogenic Carbon indicates that a material did not contain any carbon from plants or animal by-products. A value in between represents a mixture of natural and fossil sources.

The analytical measurement is cited as “percent modern carbon (pMC)”. This is the percentage of C14 measured in the sample relative to a modern reference standard (NIST 4990C). The % Biogenic Carbon content is calculated from pMC by applying a small adjustment factor for C14 in carbon dioxide in air today. It is important to note is that all internationally recognized standards using C14 assume that the plant or biomass feedstocks were obtained from natural environments.

Reported results are accredited to ISO/IEC 17025:2017 Testing Accreditation PJLA #59423 standards and all chemistry was performed here in our laboratory and counted in our own accelerators in Miami, Florida.

The international standard method utilized for this analysis is cited under Summary of Results. The standard version used is the latest available as of the date reported (unless otherwise noted). The report also indicates if the result is relative to total carbon (TC) or only total organic carbon (TOC). When interpreting the results, please consider any communications you may have had with us regarding the analysis. If you have any questions please contact us. We welcome your inquiries.

Sincerely,

Digital signature on file

Ronald E. Hatfield President

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4985 SW 74th Court
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Tel: 305-667-5167
Fax: 305-663-0964
info@betalabservices.com

ISO/IEC 17025:2017-Accredited Testing Laboratory

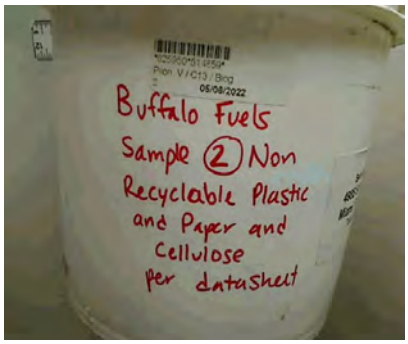
Summary of Results - % Biogenic Carbon Content
ASTM D6866-22 Method B (AMS)

Certificate Number: 514859625950128543

Validation:

Submitter	Vanessa Pilon
Company	Lehigh Cement
Date Received	April 27, 2022
Date Reported	May 04, 2022
Submitter Label	Buffalo Fuels Sample 2 Non Recyclable Plastic and Paper and Cellulose
RESULT:	30 % Biogenic Carbon Content (as a fraction of total carbon)

Laboratory Number	Beta-625950
Percent modern carbon (pMC)	29.80 +/- 0.11 pMC
Atmospheric adjustment factor (REF)	100.0; = pMC/1.000



Package received - labeling COC


View of content


3091.0mg analyzed (1mm x 1mm scale)

Disclosures: All work was done at Beta Analytic in its own chemistry lab and AMSs. No subcontractors were used. Beta's chemistry laboratory and AMS do not react or measure artificial C 14 used in biomedical and environmental AMS studies. Beta is a C14 tracer-free facility. Validating quality assurance is verified with a Quality Assurance report posted separately to the web library containing the PDF downloadable copy of this report.

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ISO/IEC 17025:2017-Accredited Testing Laboratory

Summary of Results - % Biogenic Carbon Content
ASTM D6866-22 Method B (AMS)

Certificate Number: 514859625950128543

Validation:

Submitter	Vanessa Pilon
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Date Received	April 27, 2022
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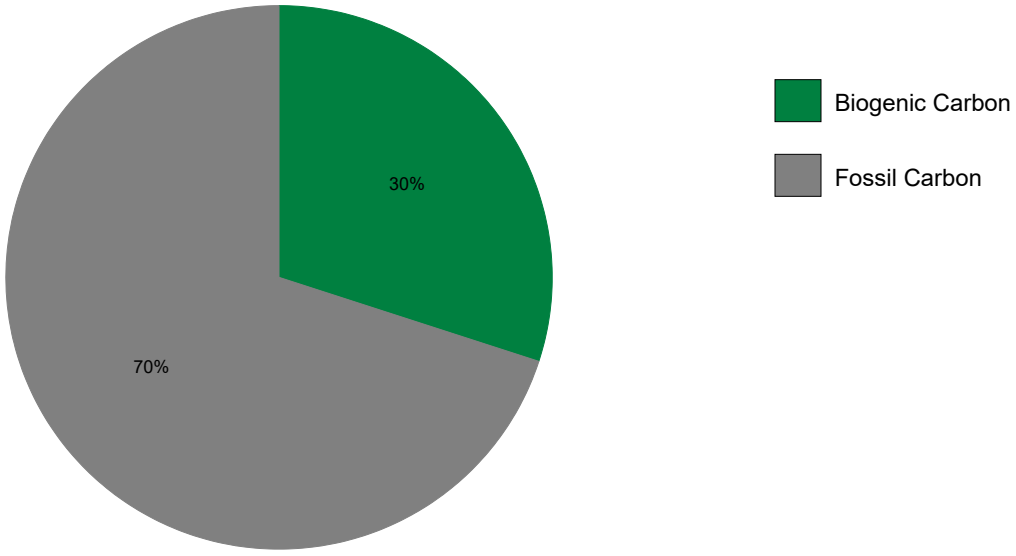

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% Biogenic Carbon Content ASTM D6866-22 Method B (AMS)

Explanation of Results

The result was obtained using the radiocarbon isotope (also known as Carbon-14, C14 or 14C), a naturally occurring isotope of carbon that is radioactive and decays in such a way that there is none left after about 45,000 years following the death of a plant or animal. Its most common use is radiocarbon dating by archaeologists. An industrial application was also developed to determine if consumer products and CO2 emissions were sourced from plants/biomass or from materials such as petroleum or coal (fossil-based). By 2003 there was growing demand for a standardized methodology for applying Carbon-14 testing within the regulatory environment. The first of these standards was ASTM D6866-04, which was written with the assistance of Beta Analytic. Since ASTM was largely viewed as a US standard, European stakeholders soon began demanding an equivalent CEN standard while global stakeholders called for ISO standardization.

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ISO/IEC 17025:2017-Accredited Testing Laboratory

Quality Assurance Report

This report provides the results of reference materials used to validate radiocarbon analyses prior to reporting. Known-value reference materials were analyzed quasi-simultaneously with the unknowns. Results are reported as expected values vs measured values. Reported values are calculated relative to NISTSRM-1990C and corrected for isotopic fractionation. Results are reported using the direct analytical measure percent modern carbon (pMC) with one relative standard deviation. Agreement between expected and measured values is taken as being within 2 sigma agreement (error x 2) to account for total laboratory error.

Report Date: May 04, 2022
Submitter: Ms. Vanessa Pilon

QA MEASUREMENTS

Reference 1

Expected Value:	129.41 +/- 0.06 pMC
Measured Value:	129.30 +/- 0.37 pMC
Agreement:	Accepted

Reference 2

Expected Value:	0.42 +/- 0.04 pMC
Measured Value:	0.42 +/- 0.04 pMC
Agreement:	Accepted

Reference 3

Expected Value:	96.69 +/- 0.50 pMC
Measured Value:	96.35 +/- 0.29 pMC
Agreement:	Accepted

COMMENT: All measurements passed acceptance tests.

Validation: Digital signature on file

Date: May 04, 2022

Beta Analytic, Inc.
4985 SW 74th Court
Miami, FL 33155 USA
Tel: 305-667-5167
Fax: 305-663-0964
info@betalabservices.com

ISO/IEC 17025:2017-Accredited Testing Laboratory

July 31, 2022

Vanessa Pilon
Lehigh Cement
1370 Highway 49
Picton
K0K 2T0
Canada

Dear Ms. Pilon

Please find enclosed your radiocarbon (C14) report for the material recently submitted. The result is reported as “% Biobased Carbon”. This indicates the percentage carbon from “natural” (plant or animal by-product) sources versus “synthetic” (petrochemical) sources . For reference, 100 % Biobased Carbon indicates that a material is entirely sourced from plants or animal by-products and 0 % Biobased Carbon indicates that a material did not contain any carbon from plants or animal by-products. A value in between represents a mixture of natural and fossil sources.

The analytical measurement is cited as “percent modern carbon (pMC)”. This is the percentage of C14 measured in the sample relative to a modern reference standard (NIST 4990C). The % Biobased Carbon content is calculated from pMC by applying a small adjustment factor for C14 in carbon dioxide in air today. It is important to note is that all internationally recognized standards using C14 assume that the plant or biomass feedstocks were obtained from natural environments.

Reported results are accredited to ISO/IEC 17025:2017 Testing Accreditation PJLA #59423 standards and all chemistry was performed here in our laboratory and counted in our own accelerators in Miami, Florida.

The international standard method utilized for this analysis is cited under Summary of Results. The standard version used is the latest available as of the date reported (unless otherwise noted). The report also indicates if the result is relative to total carbon (TC) or only total organic carbon (TOC). When interpreting the results, please consider any communications you may have had with us regarding the analysis. If you have any questions please contact us. We welcome your inquiries.

Sincerely,

Chris Patrick
Digital signature on file

Chris Patrick
Vice President of Laboratory Operations

Beta Analytic, Inc.
4985 SW 74th Court
Miami, FL 33155 USA
Tel: 305-667-5167
Fax: 305-663-0964
info@betalabservices.com

ISO/IEC 17025:2017-Accredited Testing Laboratory

Summary of Results - % Biobased Carbon Content
ASTM D6866-22 Method B (AMS) TOC

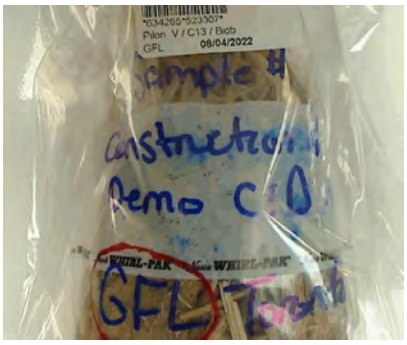
Certificate Number: 523307634265131259

Validation: Chris Patrick
Digital signature on file

Submitter	Vanessa Pilon
Company	Lehigh Cement
Date Received	July 26, 2022
Date Reported	July 31, 2022
Submitter Label	Sample C&D; Construction & Demolition; GFL, Toronto

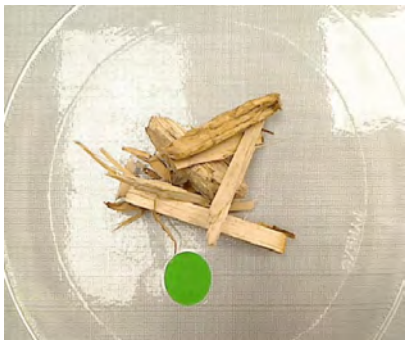
RESULT: 100 % Biobased Carbon Content (as a fraction of total organic carbon)

Laboratory Number	Beta-634265
Percent modern carbon (pMC)	113.08 +/- 0.22 pMC
Atmospheric adjustment factor (REF)	100.0; = pMC/[1/(100.0/112)]



Package received - labeling COC


View of content


3971.6mg analyzed (1mm x 1mm scale)

Disclosures: All work was done at Beta Analytic in its own chemistry lab and AMSs. No subcontractors were used. Beta's chemistry laboratory and AMS do not react or measure artificial C 14 used in biomedical and environmental AMS studies. Beta is a C14 tracer-free facility. Validating quality assurance is verified with a Quality Assurance report posted separately to the web library containing the PDF downloadable copy of this report.

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Summary of Results - % Biobased Carbon Content
ASTM D6866-22 Method B (AMS) TOC

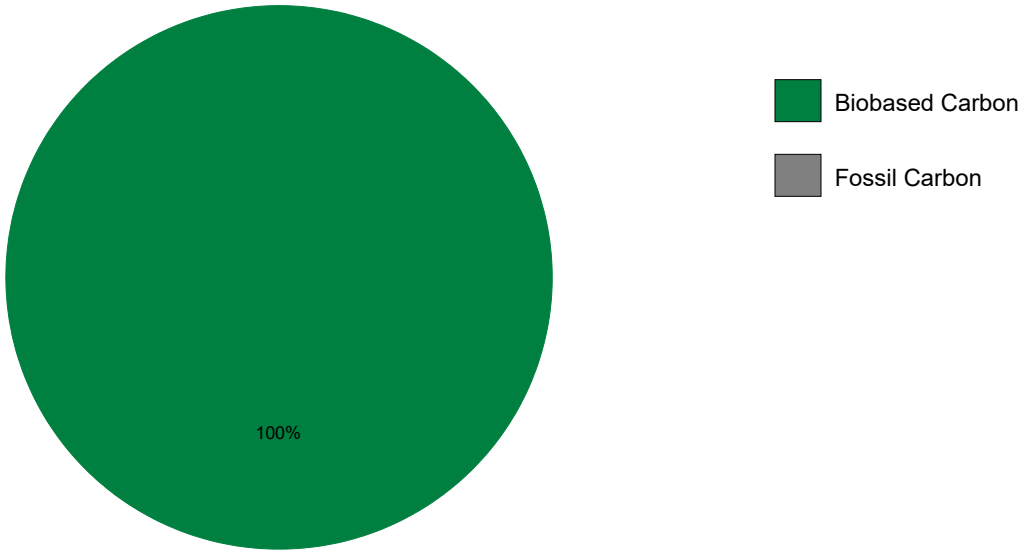
Certificate Number: 523307634265131259

Validation: Chris Patrick
Digital signature on file

Submitter	Vanessa Pilon
Company	Lehigh Cement
Date Received	July 26, 2022
Date Reported	July 31, 2022
Submitter Label	Sample C&D; Construction & Demolition; GFL, Toronto

RESULT: 100 % Biobased Carbon Content (as a fraction of total organic carbon)

Laboratory Number	Beta-634265
Percent modern carbon (pMC)	113.08 +/- 0.22 pMC
Atmospheric adjustment factor (REF)	100.0; = pMC/[1/(100.0/112)]



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% Biobased Carbon Content ASTM D6866-22 Method B (AMS) TOC

Explanation of Results

The result was obtained using the radiocarbon isotope (also known as Carbon-14, C14 or 14C), a naturally occurring isotope of carbon that is radioactive and decays in such a way that there is none left after about 45,000 years following the death of a plant or animal. Its most common use is radiocarbon dating by archaeologists. An industrial application was also developed to determine if consumer products and CO2 emissions were sourced from plants/biomass or from materials such as petroleum or coal (fossil-based). By 2003 there was growing demand for a standardized methodology for applying Carbon-14 testing within the regulatory environment. The first of these standards was ASTM D6866-04, which was written with the assistance of Beta Analytic. Since ASTM was largely viewed as a US standard, European stakeholders soon began demanding an equivalent CEN standard while global stakeholders called for ISO standardization.

The analytical procedures for measuring radiocarbon content using the different standards are identical. The only difference is the reporting format. Results are usually reported using the standardized terminology “% biobased carbon”. Only ASTM D6866 uses the term “% biogenic carbon” when the result represents all carbon present (Total Carbon) rather than just the organic carbon (Total Organic Carbon). The terms “% biobased carbon” and “% biogenic carbon” are now the standard units in regulatory and industrial applications, replacing obscure units of measure historically reported by radiocarbon dating laboratories e.g. disintegrations per minute per gram (dpm/g) or radiocarbon age.

The result was obtained by measuring the ratio of radiocarbon in the material relative to a National Institute of Standards and Technology (NIST) modern reference standard (SRM 4990C). This ratio was calculated as a percentage and is reported as percent modern carbon (pMC). The value obtained relative to the NIST standard is normalized to the year 1950 AD so an adjustment was required to calculate a carbon source value relative to today. This factor is listed on the report sheet as the terminology “REF”.

Interpretation and application of the results is straightforward. A value of 100% biobased or biogenic carbon would indicate that 100% of the carbon came from plants or animal by-products (biomass) living in the natural environment and a value of 0% would mean that all of the carbon was derived from petrochemicals, coal and other fossil sources. A value between 0-100% would indicate a mixture. The higher the value, the greater the proportion of naturally sourced components in the material.

Beta Analytic, Inc.
4985 SW 74th Court
Miami, FL 33155 USA
Tel: 305-667-5167
Fax: 305-663-0964
info@betalabservices.com

ISO/IEC 17025:2017-Accredited Testing Laboratory

Quality Assurance Report

This report provides the results of reference materials used to validate radiocarbon analyses prior to reporting. Known-value reference materials were analyzed quasi-simultaneously with the unknowns. Results are reported as expected values vs measured values. Reported values are calculated relative to NISTSRM-1990C and corrected for isotopic fractionation. Results are reported using the direct analytical measure percent modern carbon (pMC) with one relative standard deviation. Agreement between expected and measured values is taken as being within 2 sigma agreement (error x 2) to account for total laboratory error.

Report Date: August 05, 2022
Submitter: Ms. Vanessa Pilon

QA MEASUREMENTS

Reference 1

Expected Value:	129.41 +/- 0.06 pMC
Measured Value:	129.35 +/- 0.35 pMC
Agreement:	Accepted

Reference 2

Expected Value:	0.44 +/- 0.04
Measured Value:	0.43 +/- 0.04 pMC
Agreement:	Accepted

Reference 3

Expected Value:	96.69 +/- 0.50 pMC
Measured Value:	97.70 +/- 0.29 pMC
Agreement:	Accepted

COMMENT: All measurements passed acceptance tests.

Validation: Chris Patrick
Digital signature on file

Date: August 05, 2022

Beta Analytic, Inc.
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Miami, FL 33155 USA
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info@betalabservices.com

ISO/IEC 17025:2017-Accredited Testing Laboratory

August 08, 2022

Vanessa Pilon
Lehigh Cement
1370 Highway 49
Picton
K0K 2T0
Canada

Dear Ms. Pilon

Please find enclosed your radiocarbon (C14) report for the material recently submitted. The result is reported as “% Biobased Carbon”. This indicates the percentage carbon from “natural” (plant or animal by-product) sources versus “synthetic” (petrochemical) sources . For reference, 100 % Biobased Carbon indicates that a material is entirely sourced from plants or animal by-products and 0 % Biobased Carbon indicates that a material did not contain any carbon from plants or animal by-products. A value in between represents a mixture of natural and fossil sources.

The analytical measurement is cited as “percent modern carbon (pMC)”. This is the percentage of C14 measured in the sample relative to a modern reference standard (NIST 4990C). The % Biobased Carbon content is calculated from pMC by applying a small adjustment factor for C14 in carbon dioxide in air today. It is important to note is that all internationally recognized standards using C14 assume that the plant or biomass feedstocks were obtained from natural environments.

Reported results are accredited to ISO/IEC 17025:2017 Testing Accreditation PJLA #59423 standards and all chemistry was performed here in our laboratory and counted in our own accelerators in Miami, Florida.

The international standard method utilized for this analysis is cited under Summary of Results. The standard version used is the latest available as of the date reported (unless otherwise noted). The report also indicates if the result is relative to total carbon (TC) or only total organic carbon (TOC). When interpreting the results, please consider any communications you may have had with us regarding the analysis. If you have any questions please contact us. We welcome your inquiries.

Sincerely,

Ronald E. Hatfield President

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ISO/IEC 17025:2017-Accredited Testing Laboratory

Summary of Results - % Biobased Carbon Content
ASTM D6866-22 Method B (AMS) TOC

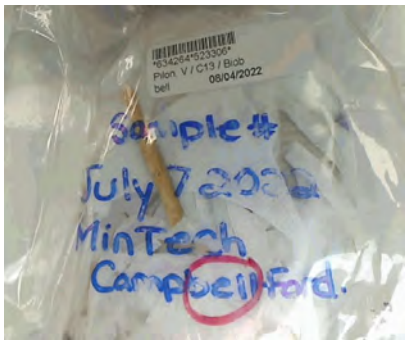
Certificate Number: 523306634264131259

Validation:

Submitter	Vanessa Pilon
Company	Lehigh Cement
Date Received	July 26, 2022
Date Reported	August 08, 2022
Submitter Label	Sample July 7, 2022; Min-Tech Campbellford

RESULT: 44 % Biobased Carbon Content (as a fraction of total organic carbon)

Laboratory Number	Beta-634264
Percent modern carbon (pMC)	44.09 +/- 0.18 pMC
Atmospheric adjustment factor (REF)	100.0; = pMC/1.000



Package received - labeling COC


View of content


5131.1mg analyzed (1mm x 1mm scale)

Disclosures: All work was done at Beta Analytic in its own chemistry lab and AMSs. No subcontractors were used. Beta's chemistry laboratory and AMS do not react or measure artificial C 14 used in biomedical and environmental AMS studies. Beta is a C14 tracer-free facility. Validating quality assurance is verified with a Quality Assurance report posted separately to the web library containing the PDF downloadable copy of this report.

Precision on the RESULT is cited as +/- 3% (absolute). The cited precision on the analytical measure (pMC) is 1 sigma (1 relative standard deviation). The reported result only applies to the analyzed material. The accuracy of the RESULT relies on the measured carbon in the analyzed material having been in recent equilibrium with CO_2 in the air and/or from fossil carbon (more than 40,000 years old) such as petroleum or coal. The RESULT only applies to relative carbon content, not to relative mass content. The RESULT is calculated by adjusting pMC by the applicable "Atmospheric adjustment factor (REF)" cited in this report

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Summary of Results - % Biobased Carbon Content
ASTM D6866-22 Method B (AMS) TOC

Certificate Number: 523306634264131259

Validation:

Submitter	Vanessa Pilon
Company	Lehigh Cement
Date Received	July 26, 2022
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Submitter Label	Sample July 7, 2022; Min-Tech Campbellford

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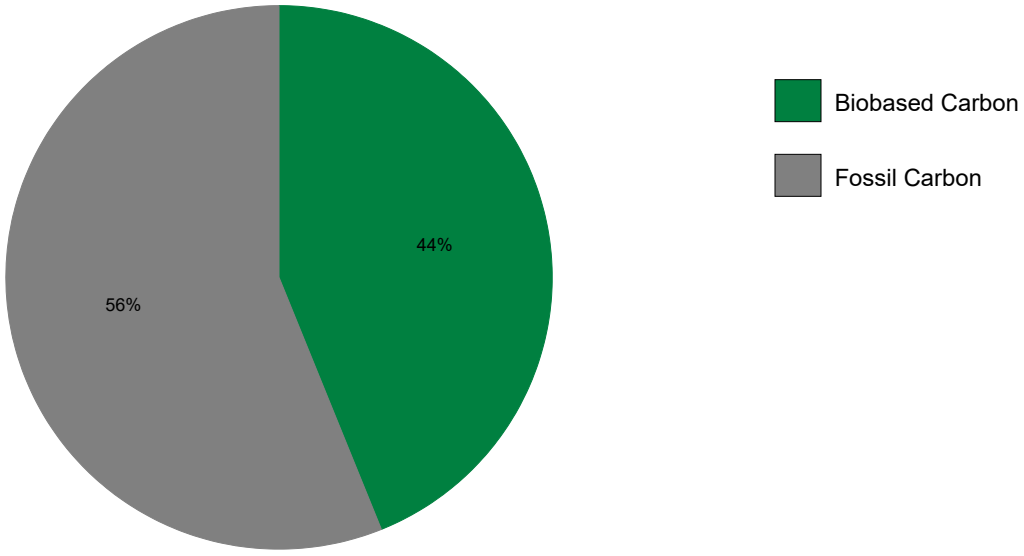

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% Biobased Carbon Content ASTM D6866-22 Method B (AMS) TOC

Explanation of Results

The result was obtained using the radiocarbon isotope (also known as Carbon-14, C14 or 14C), a naturally occurring isotope of carbon that is radioactive and decays in such a way that there is none left after about 45,000 years following the death of a plant or animal. Its most common use is radiocarbon dating by archaeologists. An industrial application was also developed to determine if consumer products and CO2 emissions were sourced from plants/biomass or from materials such as petroleum or coal (fossil-based). By 2003 there was growing demand for a standardized methodology for applying Carbon-14 testing within the regulatory environment. The first of these standards was ASTM D6866-04, which was written with the assistance of Beta Analytic. Since ASTM was largely viewed as a US standard, European stakeholders soon began demanding an equivalent CEN standard while global stakeholders called for ISO standardization.

The analytical procedures for measuring radiocarbon content using the different standards are identical. The only difference is the reporting format. Results are usually reported using the standardized terminology “% biobased carbon”. Only ASTM D6866 uses the term “% biogenic carbon” when the result represents all carbon present (Total Carbon) rather than just the organic carbon (Total Organic Carbon). The terms “% biobased carbon” and “% biogenic carbon” are now the standard units in regulatory and industrial applications, replacing obscure units of measure historically reported by radiocarbon dating laboratories e.g. disintegrations per minute per gram (dpm/g) or radiocarbon age.

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Quality Assurance Report

This report provides the results of reference materials used to validate radiocarbon analyses prior to reporting. Known-value reference materials were analyzed quasi-simultaneously with the unknowns. Results are reported as expected values vs measured values. Reported values are calculated relative to NISTSRM-1990C and corrected for isotopic fractionation. Results are reported using the direct analytical measure percent modern carbon (pMC) with one relative standard deviation. Agreement between expected and measured values is taken as being within 2 sigma agreement (error x 2) to account for total laboratory error.

Report Date: August 08, 2022
Submitter: Ms. Vanessa Pilon

QA MEASUREMENTS

Reference 1

Expected Value:	0.44 +/- 0.04
Measured Value:	0.44 +/- 0.04 pMC
Agreement:	Accepted

Reference 2

Expected Value:	96.69 +/- 0.50 pMC
Measured Value:	97.12 +/- 0.29 pMC
Agreement:	Accepted

Reference 3

Expected Value:	129.41 +/- 0.06 pMC
Measured Value:	129.43 +/- 0.35 pMC
Agreement:	Accepted

COMMENT: All measurements passed acceptance tests.

Validation: Digital signature on file

Date: August 08, 2022

Beta Analytic
TESTING LABORATORY

Beta Analytic, Inc.
4985 SW 74th Court
Miami, FL 33155 USA
Tel: 305-667-5167
Fax: 305-663-0964
info@betalabservices.com

ISO/IEC 17025:2017-Accredited Testing Laboratory

July 14, 2022

Vanessa Pilon
Lehigh Cement
1370 Highway 49
Picton
K0K 2T0
Canada

Dear Ms. Pilon

Please find enclosed your radiocarbon (C14) report for the material recently submitted. The result is reported as “% Biobased Carbon”. This indicates the percentage carbon from “natural” (plant or animal by-product) sources versus “synthetic” (petrochemical) sources . For reference, 100 % Biobased Carbon indicates that a material is entirely sourced from plants or animal by-products and 0 % Biobased Carbon indicates that a material did not contain any carbon from plants or animal by-products. A value in between represents a mixture of natural and fossil sources.

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Reported results are accredited to ISO/IEC 17025:2017 Testing Accreditation PJLA #59423 standards and all chemistry was performed here in our laboratory and counted in our own accelerators in Miami, Florida.

The international standard method utilized for this analysis is cited under Summary of Results. The standard version used is the latest available as of the date reported (unless otherwise noted). The report also indicates if the result is relative to total carbon (TC) or only total organic carbon (TOC). When interpreting the results, please consider any communications you may have had with us regarding the analysis. If you have any questions please contact us. We welcome your inquiries.

Sincerely,

Ronald E. Hatfield President

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ISO/IEC 17025:2017-Accredited Testing Laboratory

Summary of Results - % Biobased Carbon Content
ASTM D6866-22 Method B (AMS) TOC

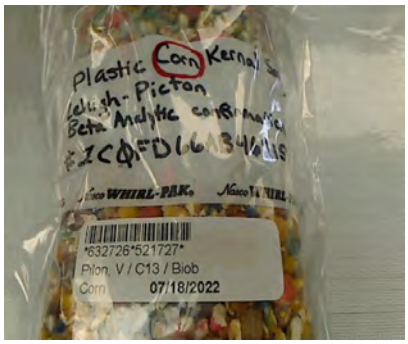
Certificate Number: 521727632726130705

Validation:

Submitter	Vanessa Pilon
Company	Lehigh Cement
Date Received	July 07, 2022
Date Reported	July 14, 2022
Submitter Label	Plastic Corn Kernal Sample

RESULT: 100 % Biobased Carbon Content (as a fraction of total organic carbon)

Laboratory Number	Beta-632726
Percent modern carbon (pMC)	100.15 +/- 0.29 pMC
Atmospheric adjustment factor (REF)	100.0; = pMC/1.000



Package received - labeling COC


View of content (1mm x 1mm scale)


3921.5mg analyzed (1mm x 1mm scale)

Disclosures: All work was done at Beta Analytic in its own chemistry lab and AMSs. No subcontractors were used. Beta's chemistry laboratory and AMS do not react or measure artificial C 14 used in biomedical and environmental AMS studies. Beta is a C14 tracer-free facility. Validating quality assurance is verified with a Quality Assurance report posted separately to the web library containing the PDF downloadable copy of this report.

Precision on the RESULT is cited as +/- 3% (absolute). The cited precision on the analytical measure (pMC) is 1 sigma (1 relative standard deviation). The reported result only applies to the analyzed material. The accuracy of the RESULT relies on the measured carbon in the analyzed material having been in recent equilibrium with CO_2 in the air and/or from fossil carbon (more than 40,000 years old) such as petroleum or coal. The RESULT only applies to relative carbon content, not to relative mass content. The RESULT is calculated by adjusting pMC by the applicable "Atmospheric adjustment factor (REF)" cited in this report

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ISO/IEC 17025:2017-Accredited Testing Laboratory

Summary of Results - % Biobased Carbon Content
ASTM D6866-22 Method B (AMS) TOC

Certificate Number: 521727632726130705

Validation:

Submitter	Vanessa Pilon
Company	Lehigh Cement
Date Received	July 07, 2022
Date Reported	July 14, 2022
Submitter Label	Plastic Corn Kernal Sample

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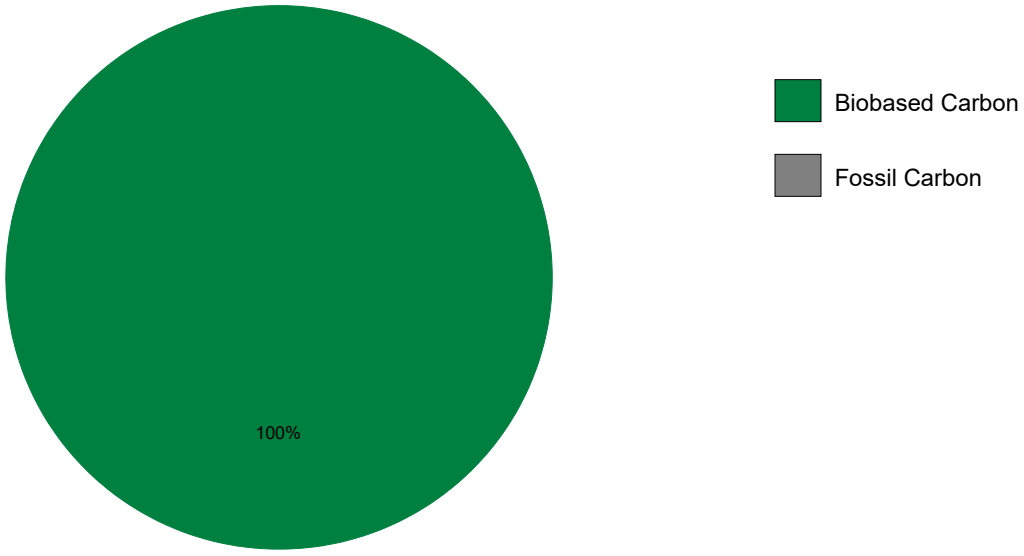

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% Biobased Carbon Content ASTM D6866-22 Method B (AMS) TOC

Explanation of Results

The result was obtained using the radiocarbon isotope (also known as Carbon-14, C14 or 14C), a naturally occurring isotope of carbon that is radioactive and decays in such a way that there is none left after about 45,000 years following the death of a plant or animal. Its most common use is radiocarbon dating by archaeologists. An industrial application was also developed to determine if consumer products and CO2 emissions were sourced from plants/biomass or from materials such as petroleum or coal (fossil-based). By 2003 there was growing demand for a standardized methodology for applying Carbon-14 testing within the regulatory environment. The first of these standards was ASTM D6866-04, which was written with the assistance of Beta Analytic. Since ASTM was largely viewed as a US standard, European stakeholders soon began demanding an equivalent CEN standard while global stakeholders called for ISO standardization.

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Quality Assurance Report

This report provides the results of reference materials used to validate radiocarbon analyses prior to reporting. Known-value reference materials were analyzed quasi-simultaneously with the unknowns. Results are reported as expected values vs measured values. Reported values are calculated relative to NISTSRM-1990C and corrected for isotopic fractionation. Results are reported using the direct analytical measure percent modern carbon (pMC) with one relative standard deviation. Agreement between expected and measured values is taken as being within 2 sigma agreement (error x 2) to account for total laboratory error.

Report Date: July 14, 2022
Submitter: Ms. Vanessa Pilon

QA MEASUREMENTS

Reference 1

Expected Value:	0.42 +/- 0.04 pMC
Measured Value:	0.42 +/- 0.04 pMC
Agreement:	Accepted

Reference 2

Expected Value:	129.41 +/- 0.06 pMC
Measured Value:	129.18 +/- 0.39 pMC
Agreement:	Accepted

Reference 3

Expected Value:	96.69 +/- 0.50 pMC
Measured Value:	97.30 +/- 0.30 pMC
Agreement:	Accepted

COMMENT: All measurements passed acceptance tests.

Validation: Digital signature on file

Date: July 14, 2022

Beta Analytic Inc
4985 SW 74 Court
Miami, Florida 33155
Tel: 305-667-5167
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ISO/IEC 17025:2005-Accredited Testing Laboratory

June 11, 2020

Eileen Jang
Lehigh Hanson Materials Limited
PO Box 950
Delta
British Colombia, V4K 3S6
Canada

Dear Ms. Jang

Please find enclosed your radiocarbon (C14) report for the material recently submitted. The result is reported as “% Biogenic Carbon”. This indicates the percentage carbon from “renewable” (biomass or animal by-product) sources versus petroleum (or otherwise fossil) sources . For reference, 100 % Biogenic Carbon indicates that a material is entirely sourced from plants or animal by-products and 0 % Biogenic Carbon indicates that a material did not contain any carbon from plants or animal by-products. A value in between represents a mixture of natural and fossil sources.

The analytical measurement is cited as “percent modern carbon (pMC)”. This is the percentage of C14 measured in the sample relative to a modern reference standard (NIST 4990C). The % Biogenic Carbon content is calculated from pMC by applying a small adjustment factor for C14 in carbon dioxide in air today. It is important to note is that all internationally recognized standards using C14 assume that the plant or biomass feedstocks were obtained from natural environments.

Reported results are accredited to ISO/IEC 17025:2005 Testing Accreditation PJLA #59423 standards and all chemistry was performed here in our laboratory and counted in our own accelerators in Miami, Florida.

The international standard method utilized for this analysis is cited on your report. The report also indicates if the result is relative to total carbon (TC) or only total organic carbon (TOC). When interpreting the results, please consider any communications you may have had with us regarding the analysis. If you have any questions please contact us. We welcome your inquiries.

Sincerely,

Chris Patrick
Digital signature on file

Chris Patrick
Vice President of Laboratory Operations

Beta Analytic Inc
4985 SW 74 Court
Miami, Florida 33155
Tel: 305-667-5167
Fax: 305-663-0964
info@betalabservices.com

ISO/IEC 17025:2005-Accredited Testing Laboratory

Summary of Results - % Biogenic Carbon Content
ASTM D6866-20 Method B (AMS)

Certificate Number: 447620559799110143

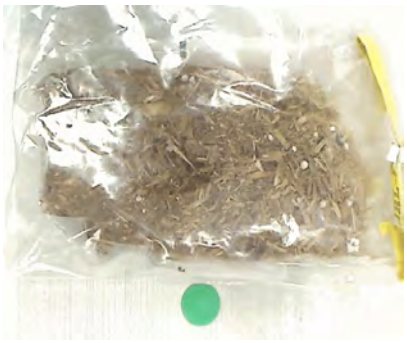
Validation: Chris Patrick
Digital signature on file

Submitter	Eileen Jang
Company	Lehigh Hanson Materials Limited
Date Received	June 02, 2020
Date Reported	June 11, 2020
Submitter Label	AF222 Eagle Disposal

RESULT: 100 % Biogenic Carbon Content (as a fraction of total carbon)

Laboratory Number	Beta-559799
Percent modern carbon (pMC)	99.57 +/- 0.21 pMC
Atmospheric adjustment factor (REF)	100.0; = pMC/1.000

Package received - labeling COC


View of content (1mm x 1mm scale)


3472.9mg analyzed (1mm x 1mm scale)

Disclosures: All work was done at Beta Analytic in its own chemistry lab and AMSs. No subcontractors were used. Beta's chemistry laboratory and AMS do not react or measure artificial C 14 used in biomedical and environmental AMS studies. Beta is a C14 tracer-free facility. Validating quality assurance is verified with a Quality Assurance report posted separately to the web library containing the PDF downloadable copy of this report.

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ISO/IEC 17025:2005-Accredited Testing Laboratory

Summary of Results - % Biogenic Carbon Content
ASTM D6866-20 Method B (AMS)

Certificate Number: 447620559799110143

Validation: Chris Patrick
Digital signature on file

Submitter	Eileen Jang
Company	Lehigh Hanson Materials Limited
Date Received	June 02, 2020
Date Reported	June 11, 2020
Submitter Label	AF222 Eagle Disposal

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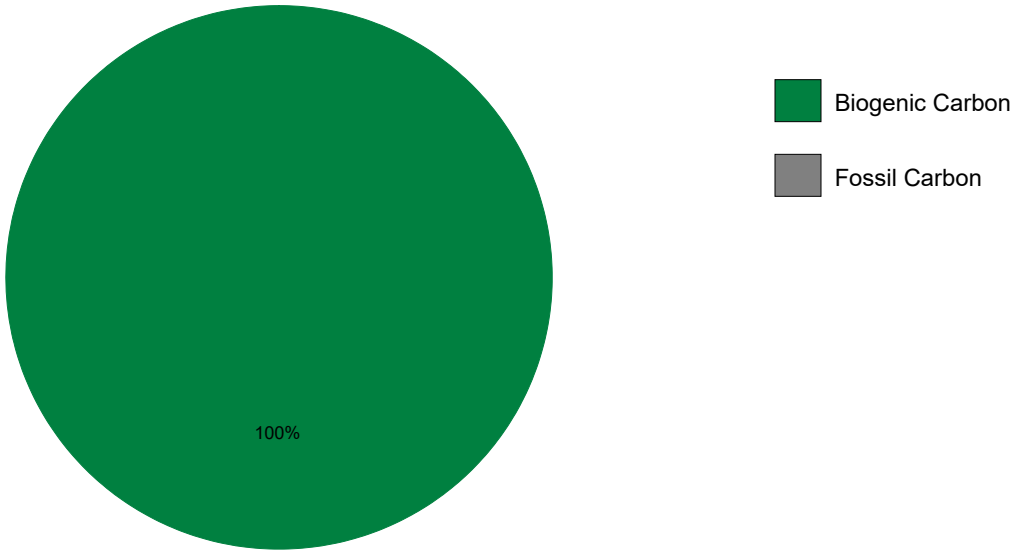

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% Biogenic Carbon Content ASTM D6866-20 Method B (AMS)

Explanation of Results

The result was obtained using the radiocarbon isotope (also known as Carbon-14, C14 or 14C), a naturally occurring isotope of carbon that is radioactive and decays in such a way that there is none left after about 45,000 years following the death of a plant or animal. Its most common use is radiocarbon dating by archaeologists. An industrial application was also developed to determine if consumer products and CO2 emissions were sourced from plants/biomass or from materials such as petroleum or coal (fossil-based). By 2003 there was growing demand for a standardized methodology for applying Carbon-14 testing within the regulatory environment. The first of these standards was ASTM D6866-04, which was written with the assistance of Beta Analytic. Since ASTM was largely viewed as a US standard, European stakeholders soon began demanding an equivalent CEN standard while global stakeholders called for ISO standardization.

The analytical procedures for measuring radiocarbon content using the different standards are identical. The only difference is the reporting format. Results are usually reported using the standardized terminology “% biobased carbon”. Only ASTM D6866 uses the term “% biogenic carbon” when the result represents all carbon present (Total Carbon) rather than just the organic carbon (Total Organic Carbon). The terms “% biobased carbon” and “% biogenic carbon” are now the standard units in regulatory and industrial applications, replacing obscure units of measure historically reported by radiocarbon dating laboratories e.g. disintegrations per minute per gram (dpm/g) or radiocarbon age.

The result was obtained by measuring the ratio of radiocarbon in the material relative to a National Institute of Standards and Technology (NIST) modern reference standard (SRM 4990C). This ratio was calculated as a percentage and is reported as percent modern carbon (pMC). The value obtained relative to the NIST standard is normalized to the year 1950 AD so an adjustment was required to calculate a carbon source value relative to today. This factor is listed on the report sheet as the terminology “REF”.

Interpretation and application of the results is straightforward. A value of 100% biobased or biogenic carbon would indicate that 100% of the carbon came from plants or animal by-products (biomass) living in the natural environment and a value of 0% would mean that all of the carbon was derived from petrochemicals, coal and other fossil sources. A value between 0-100% would indicate a mixture. The higher the value, the greater the proportion of naturally sourced components in the material.

G and C COAL ANALYSIS LAB., INC.

1341 HOFFMAN HOLLOW RD.
SUMMERVILLE, PA 15864
(814) 849-2559
FAX (814) 849-8878

RECEIVED FROM:

LEHIGH CEMENT COMPANY-PICTON
P.O. BOX 620
PICTON, ONTAR K0K 2T0

LAB NO. 1077548
SAMPLED 03/15/22
RECEIVED 03/16/22
REPORTED 04/20/22

SAMPLE MARKED:

BUFFALO FUELS SAMPLE #2
NON-RECYCLABLE PLASTIC PAPER
AND CELLULOSE

ANALYSIS REPORT

	AS RECEIVED	DRY BASIS
% Moisture	7.29	
% Ash	12.35	13.32
% Sulfur	0.42	0.45
B.T.U.	10,045	10,835
BTU (Moisture-ash free)	12,500	
% Volatile Matter	63.94	68.97
% Fixed Carbon	16.42	17.71

0.42 Lbs. Sul./mil. BTU
12.29 Lbs. Ash./mil. BTU

THE ABOVE ANALYTICAL RESULTS WERE OBTAINED FOLLOWING ASTM PROCEDURES.

G&C COAL ANALYSIS LAB., INC.

APPROVED BY _____

G and C Coal Analysis Lab., Inc.

1341 Hoffman Hollow Road
Summerville, Pa 15864
814-849-2559
Fax: 814-849-8878

Received From:

LEHIGH CEMENT COMPANY-PICTON
P.O. BOX 620
PICTON, ONTAR K0K 2T0

G&C Lab#: 1077548

Date Sampled: 03/15/22

Date Received: 03/16/22

Date Reported: 04/20/22

Sample Marked:
BUFFALO FUELS SAMPLE #2
AND CELLULOSE

NON-RECYCLABLE PLASTIC PAPER

Procedure used following ASTM Method D-5373-21

	ULTIMATE ANALYSIS As Received	Dry Basis
% CARBON	53.13	57.31
% HYDROGEN	8.03	8.66
% NITROGEN	1.15	1.24
% Oxygen (by Difference)	17.63	19.02
% Ash	12.35	13.32
% Sulfur	0.42	0.45
% Total Moisture	7.29	

*Hydrogen and Oxygen do not include the Hydrogen and Oxygen from the Moisture

The above analytical results were obtained following ASTM procedures.

G & C COAL ANALYSIS LAB., INC.

APPROVED BY _____

G and C Coal Analysis Lab., Inc.

1341 Hoffman Hollow Road
Summerville, Pa 15864
814-849-2559
Fax: 814-849-8878

Received From:

LEHIGH CEMENT COMPANY - PICTON
P.O. BOX 620
PICTON, ONTAR KOK 2TO

Received Date: 03/15/22

Report Date: 04/13/22

Lab Number: 1077548

Sample Marked:
Buffalo Fuels Sample #2
Non-Recyclable Plastic Paper
And Cellulose

MINERAL ANALYSIS OF THE ASH

SiO2	35.34	%
Al2O2	7.21	%
TiO2	1.19	%
Fe2O3	17.12	%
CaO	17.27	%
MgO	4.13	%
Na2O	1.55	%
K2O	0.60	%
P2O5	0.40	%

Analysis except SO3 obtained by Clark Testing using Method 13-014/13-010 (XRF)

SO3	19.88	%

Analyzed by G&C Lab using a LECO CS300

(ASTM D-2492-12)

Sulfur Forms

Sulfate	%
Organic	%
Inorganic	%
Total	%

The above analytical results were obtained following ASTM procedures.

G & C COAL ANALYSIS LAB., INC.

APPROVED BY _____

Eagle Disposal			**As Fired Basis**							
			Net HV	Moisture	GHV	GHV	Ash	Volatile Matter	Sulfur	Chlorine
Sample Date	**AF Sample ID**	**Description**	**GJ/tonne**	[%]	GJ/tonne	[btu/lb]	[%]	[%]	[%]	%
13-Feb-20	AF222	PEF (Wood waste, dirt, light plastics)	**13.08**	25.53	14.71	6323	1.04		0.04	0.0367
10-Apr-20	AF239	PEF (Wood waste, dirt, light plastics)	**10.81**	33.91	12.45	5354	8.07		0.19	0.0791
15-May-20	AF247	PEF (Wood waste, dirt, light plastics)	**13.45**	30.06	15.03	6461	10.09		0.18	0.0813
10-Jul-20	AF271	PEF (Wood waste, dirt, light plastics)	**11.68**	23.93	13.13	5646	11.96	51.15	0.2	0.0608
15-Apr-21	AF331	PEF (Wood waste, dirt, light plastics)	**15.74**	15.07	17.18	7387	4.69	65.57	0.11	0.1082
02-Sep-21	AF373	PEF (Wood waste, dirt, light plastics)	**14.1**	24.41	15.63	6721	8.13	56.24	0.17	0.0491
21-Oct-21	AF386	PEF (Wood waste, dirt, light plastics)	**12.96**	28.2	14.56	6261	11.95	49.74	0.16	0.1007
03-Nov-21	AF391	PEF (Wood waste, dirt, light plastics)	**14.76**	20.7	16.27	6995	10.29	59.55	0.07	0.0549

Eagle Disposal			As Received Basis (Actually as fired)							
			Moisture	Ash	Sulphur	Carbon	Hydrogen	Nitrogen	Oxygen	
Sample Date	**AF Sample ID**	**Description**	[%]	[%]	[%]	[%]	[%]	[%]	[%]	Total
13-Feb-20	AF222	PEF (Wood waste, dirt, light plastics)	25.53	1.04	0.04	37.36	4.63	0.34	31.06	**100.0**
10-Apr-20	AF239	PEF (Wood waste, dirt, light plastics)	33.91	8.07	0.19	30.7	3.75	0.74	22.64	**100.0**
15-May-20	AF247	PEF (Wood waste, dirt, light plastics)	30.06	10.09	0.18	32.03	3.89	0.67	23.08	**100.0**
10-Jul-20	AF271	PEF (Wood waste, dirt, light plastics)	23.93	11.96	0.2	33.3	4	0.85	25.76	**100.0**
15-Apr-21	AF331	PEF (Wood waste, dirt, light plastics)	15.07	4.69	0.11	40.73	4.94	0.34	34.12	**100.0**
02-Sep-21	AF373	PEF (Wood waste, dirt, light plastics)	24.41	8.13	0.17	36.07	4.31	0.68	26.23	**100.0**
21-Oct-21	AF386	PEF (Wood waste, dirt, light plastics)	28.2	11.95	0.16	34.71	4.23	0.43	20.32	**100.0**
03-Nov-21	AF391	PEF (Wood waste, dirt, light plastics)	20.7	10.29	0.07	37.53	4.63	0.86	25.92	**100.0**

Eagle Disposal			Dry Basis									
			GHV(dry)	NHV(dry)	Chlorine	Carbon	Hydrogen	Nitrogen	Sulphur	Ash	Oxygen	
Sample Date	**AF Sample ID**	**Description**	GJ/tonne	GJ/tonne	[%]	[%]	[%]	[%]	[%]	[%]	[%]	Total
13-Feb-20	AF222	PEF (Wood waste, dirt, light plastics)	19.8	18.40	0.0493	50.17	6.22	0.46	0.05	1.40	41.71	**100**
10-Apr-20	AF239	PEF (Wood waste, dirt, light plastics)	18.8	17.61	0.1197	46.45	5.67	1.12	0.29	12.21	34.26	**100**
15-May-20	AF247	PEF (Wood waste, dirt, light plastics)	21.5	20.28	0.1163	45.80	5.56	0.96	0.26	14.43	33.00	**100**
10-Jul-20	AF271	PEF (Wood waste, dirt, light plastics)	17.3	16.12	0.0799	43.78	5.26	1.12	0.26	15.72	33.86	**100**
15-Apr-21	AF331	PEF (Wood waste, dirt, light plastics)	20.2	18.97	0.1274	47.96	5.82	0.40	0.13	5.52	40.17	**100**
02-Sep-21	AF373	PEF (Wood waste, dirt, light plastics)	20.7	19.45	0.065	47.72	5.70	0.90	0.22	10.76	34.70	**100**
21-Oct-21	AF386	PEF (Wood waste, dirt, light plastics)	20.3	19.01	0.1403	48.34	5.89	0.60	0.22	16.64	28.30	**100**
03-Nov-21	AF391	PEF (Wood waste, dirt, light plastics)	20.5	19.25	0.0692	47.33	5.84	1.08	0.09	12.98	32.69	**100**

Parameters:	unit	***Biomass/Wood + RDF*** **Construction & Demolition C&D (GFL, Toronto)**
Biogenic/Biobased Carbon	%	100
Fossil Carbon	%	0
Flash Point	°C	278
Heating Value (ARB)	BTU/lb	7988
Heating Value (DB)	BTU/lb	8550
Heating Value (Moisture-Ash Free)	BTU/lb	8663
Proximate Analysis		
Moisture	%	6.57
Ash (ARB)	%	0.22
Ash (DB)	%	1.31
Sulfur(ARB)	%	0.12
Sulfur(DB)	%	0.13
Vol Matter (ARB)	%	75.99
Vol Matter (DB)	%	81.33
Fixed Carbon (non-volatile carbon) (ARB)	%	16.22
Fixed Carbon (non-volatile carbon) (DB)	%	17.36
Lbs. Sulfur/mil. BTU		0.15
Lbs. Ash/mil. BTU		1.53
Ultimate Analysis		
Carbon (ARB)	%	46.07
Carbon (DB)	%	49.31
Hydrogen (ARB)	%	5.80
Hydrogen (DB)	%	6.21
Nitrogen (ARB)	%	0.38
Nitrogen (DB)	%	0.41
Oxygen (ARB)	%	39.84
Oxygen (DB)	%	42.63
Forms of Sulfur		
Sulfate	%	0.02
Organic	%	0.11
Pyritic	%	0.00
Carbonates		
(analysis performed by)		
CaCO3	%	
MgCO3	%	
Oxides - Mineral Chemistry of Ash Residue		
(analysis performed by)		***SGS Denver***
Method		Borate Fusion/XRF

Parameters:	unit	***Biomass/Wood + RDF*** Construction & Demolition C&D (GFL, Toronto)
CaO	%	31.01
SiO2	%	26.06
Al2O3	%	6.29
Fe2O3	%	3.58
K2O	%	6.69
Na2O	%	3.33
MgO	%	7.5
TiO2	%	2.8
P2O5	%	1.31
ZnO	%	
Mn2O3	%	
SO3	%	7.11
V2O5	%	
NiO	%	
SrO	%	0.1
BaO	%	0.19
MnO2	%	0.66
LOI	%	
Total	%	96.63
Other/Chemical		
T-Alk	%	
Sulfide S-	%	
Cl	%	
Cl (AD)	%	0.001872
F	%	
Mercury	ppm	<0.010
pH		
Total Water	%	
Free Water	%	
Total Organic Carbon	%	
Total Inorganic Carbon	%	

Revolution			**As Fired Basis**							
			Net HV	Moisture	GHV	GHV	Ash	Volatile Matter	Sulfur	Chlorine
Sample Date	**AF Sample ID**	**Description**	**GJ/tonne**	[%]	GJ/tonne	[btu/lb]	[%]	[%]	[%]	%
02-Sep-21	AF374	PEF	**16.42**	13.37	18.00	7738	3.25	69.89	0.05	0.0431
21-Oct-21	AF387	PEF	**13.44**	25.73	15.19	6532	8.57	56.4	0.11	0.0787
03-Nov-21	AF390	PEF	**13.14**	28.08	14.80	6365	7.97	53.86	0.08	0.1267

Revolution				**As Received Basis (Actually as fired)**							
				Moisture	Ash	Sulphur	Carbon	Hydrogen	Nitrogen	Oxygen	
Sample Date	**AF Sample ID**	**Description**		[%]	[%]	[%]	[%]	[%]	[%]	[%]	Total
02-Sep-21	AF374	PEF		13.37	3.25	0.05	45.12	5.81	0.53	31.87	**100.0**
21-Oct-21	AF387	PEF		25.73	8.57	0.11	39.31	5.23	0.34	20.71	**100.0**
03-Nov-21	AF390	PEF		28.08	7.97	0.08	33.84	4.54	0.41	25.08	**100.0**

Revolution			**Dry Basis**									
			GHV(dry)	NHV(dry)	Chlorine	Carbon	Hydrogen	Nitrogen	Sulphur	Ash	Oxygen	
Sample Date	**AF Sample ID**	**Description**	GJ/tonne	GJ/tonne	[%]	[%]	[%]	[%]	[%]	[%]	[%]	Total
02-Sep-21	AF374	PEF	20.8	19.32	0.0498	52.08	6.71	0.61	0.06	3.75	36.79	**100.0**
21-Oct-21	AF387	PEF	20.5	18.94	0.1059	52.93	7.04	0.46	0.15	11.54	27.88	**100.0**
03-Nov-21	AF390	PEF	20.6	19.22	0.1762	47.05	6.31	0.57	0.11	11.08	34.87	**100.0**

RDF

Parameters:	**unit**	**Sample July 7 2022) (Min-Tech Campbellford)**
Biogenic/Biobased Carbon	%	44
Fossil Carbon	%	56
Flash Point	°C	257
Heating Value (ARB)	BTU/lb	12220
Heating Value (DB)	BTU/lb	12573
Heating Value (Moisture-Ash Free)	BTU/lb	13106
Proximate Analysis		
Moisture	%	2.81
Ash (ARB)	%	3.96
Ash (DB)	%	4.07
Sulfur(ARB)	%	0.04
Sulfur(DB)	%	0.04
Vol Matter (ARB)	%	86.34
Vol Matter (DB)	%	88.84
Fixed Carbon (non-volatile carbon) (ARB)	%	6.89
Fixed Carbon (non-volatile carbon) (DB)	%	7.09
Lbs. Sulfur/mil. BTU		0.03
Lbs. Ash/mil. BTU		3.24
Ultimate Analysis		
Carbon (ARB)	%	60.75
Carbon (DB)	%	62.51
Hydrogen (ARB)	%	8.85
Hydrogen (DB)	%	9.11
Nitrogen (ARB)	%	0.42
Nitrogen (DB)	%	0.43
Oxygen (ARB)	%	23.17
Oxygen (DB)	%	23.84
Forms of Sulfur		
Sulfate	%	0.02
Organic	%	0.02
Pyritic	%	0.00
Carbonates		
(analysis performed by)		
CaCO3	%	
MgCO3	%	
Oxides - Mineral Chemistry of Ash Residue		
(analysis performed by)		***SGS Denver***
Method		Borate Fusion/XR

RDF

Parameters:	**unit**	**Sample July 7 2022) (Min-Tech Campbellford)**
CaO	%	13.28
SiO2	%	13.16
Al2O3	%	3.64
Fe2O3	%	1.12
K2O	%	0.76
Na2O	%	27.44
MgO	%	3.99
TiO2	%	33.09
P2O5	%	0.76
ZnO	%	
Mn2O3	%	
SO3	%	1.17
V2O5	%	
NiO	%	
SrO	%	0.02
BaO	%	0.34
MnO2	%	0.09
LOI	%	
Total	%	98.86
Other/Chemical		
T-Alk	%	
Sulfide S-	%	
Cl	%	
Cl (AD)	%	0.000335
F	%	
Mercury	ppm	0.017
pH		
Total Water	%	
Free Water	%	
Total Organic Carbon	%	
Total Inorganic Carbon	%	

May 09, 2022

LEHIGH CEMENT, A DIVISION OF LEHIGH HANSON MATERIALS LTD
SSC CEMENT A/P
PO BOX 44044
PRO GARSIDE
EDMONTON AB T5V 1N6
CANADA

Report Reference: 0000039954

REPORT OF ANALYSIS

Sample ID:	EDM-RDF 12 Sept ,2019
Sample Type:	RDF
Date Received:	April 29, 2022
P. O. #:	3000081083 Dated 01/26/2022

SGS Minerals Sample ID: 203-2200583.001

The sample(s) to which the findings recorded here (the "Findings") relate were drawn and/or provided by the Client or by a third party acting at the Client's direction. The Findings constitute no warranty of the sample's representation of any goods and strictly relate to the sample(s) are said to be extracted. The Company accepts no liability with regard to the origin or source from which the samples are said to be extracted.

THIS IS TO REPORT that in accordance with instructions received from our Principal to perform analysis of the above mentioned sample(s), we hereby report the following:

PROXIMATE ANALYSIS

	Method	As Determined	As Received	Dry
Moisture, Total %	ASTM E871		26.18	
Moisture, 60 Mesh %	ASTM E790	2.70		
Ash %	ASTM E830	11.23	8.52	11.54
Volatile Matter %	ASTM E897	73.52	55.78	75.56
Fixed Carbon (by diff) %	(by difference)	12.55	9.52	12.90
Proximate Sum %		100.00	100.00	100.00
Sulfur %	ASTM D4239 A	0.19	0.14	0.19

CALORIFIC VALUES

	Method	As Determined	As Received	Dry
Gross Calorific Value Btu/lb	ASTM D5865	12310	9339	12651
Gross Calorific Value kcal/kg	ASTM D5865	6839	5188	7028
Gross Calorific Value GJ/MT	ASTM D5865	28.63	21.72	29.43
Net CV @ Constant Pressure Btu/lb	ASTM D5865	11544	8505	11894
Net CV @ C. Pressure kcal/kg	ASTM D5865	6414	4725	6608
Net CV @ C. Pressure GJ/MT	ASTM D5865	26.85	19.78	27.66

Carmina Jinga
Laboratory Supervisor

SGS Canada Inc.
Minerals Services
7500 76th Street Delta BC **t** (604) 946-2249 **f** (604) 946-2257 www.sgs.com/minerals

May 09, 2022

LEHIGH CEMENT, A DIVISION OF LEHIGH HANSON MATERIALS LTD
SSC CEMENT A/P
PO BOX 44044
PRO GARSIDE
EDMONTON AB T5V 1N6
CANADA

Report Reference: 0000039954

REPORT OF ANALYSIS

Sample ID:	EDM-RDF 12 Sept ,2019
Sample Type:	RDF
Date Received:	April 29, 2022
P. O. #:	3000081083 Dated 01/26/2022

SGS Minerals Sample ID: 203-2200583.001

ULTIMATE ANALYSIS

	Method	As Determined	As Received	Dry
Moisture, Total %	ASTM E871		26.18	
Moisture, 60 Mesh %	ASTM E790	2.70		
Ash %	ASTM E830	11.23	8.52	11.54
Sulfur %	ASTM D4239 A	0.19	0.14	0.19
Carbon %	ASTM D5373		45.80	62.04
Hydrogen %	ASTM D5373		6.08	8.24
Nitrogen %	ASTM D5373		0.70	0.95
Oxygen (by diff) %	ASTM D5373 (by diff)		12.58	17.04
Ultimate Sum %			100.00	100.00

MISCELLANEOUS ANALYSIS

	Method	Dry
Chlorine, Cl ppm	ASTM D6721	3761

Carmina Jinga
Laboratory Supervisor

SGS Canada Inc.
Minerals Services
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May 09, 2022

LEHIGH CEMENT, A DIVISION OF LEHIGH HANSON MATERIALS LTD
SSC CEMENT A/P
PO BOX 44044
PRO GARSIDE
EDMONTON AB T5V 1N6
CANADA

Report Reference: 0000039954

REPORT OF ANALYSIS

Sample ID:	EDM-RDF 12 Sept ,2019
Sample Type:	RDF
Date Received:	April 29, 2022
P. O. #:	3000081083 Dated 01/26/2022

SGS Minerals Sample ID: 203-2200583.001

Tests	Method	Result	Unit
TRACE ELEMENTS*			
Aluminum, Al	ISO 16968:2015	1108	ppm
Antimony, Sb	ISO 16968:2015	10.82	ppm
Arsenic, As	ISO 16968:2015	0.69	ppm
Beryllium, Be	ISO 16968:2015	<1	ppm
Boron, B	ISO 16968:2015	11	ppm
Cadmium, Cd	ISO 16968:2015	0.86	ppm
Calcium, Ca	ISO 16968:2015	20542	ppm
Chromium, Cr	ISO 16968:2015	6.9	ppm
Copper, Cu	ISO 16968:2015	48.1	ppm
Iron, Fe	ISO 16968:2015	922	ppm
Lead, Pb	ISO 16968:2015	10.07	ppm
Magnesium, Mg	ISO 16968:2015	1063.3	ppm
Manganese, Mn	ISO 16968:2015	46.7	ppm
Mercury, Hg	ISO 16968:2015	0.14	ppm
Molybdenum, Mo	ISO 16968:2015	1.16	ppm
Nickel, Ni	ISO 16968:2015	6.1	ppm
Selenium, Se	ISO 16968:2015	0.8	ppm
Tin, Sn	ISO 16968:2015	2.87	ppm
Titanium, Ti	ISO 16968:2015	14.3	ppm
Zinc, Zn	ISO 16968:2015	110	ppm

**Denotes analysis done by SGS Canada Inc., Burnaby BC*

Carmina Jinga
Laboratory Supervisor

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Minerals Services
7500 76th Street Delta BC **t** (604) 946-2249 **f** (604) 946-2257 www.sgs.com/minerals

CERTIFICATE OF ANALYSIS

-
LEHIGH CEMENT (HEIDLEBERG CEMENT GROUP)
8909 PURDUE ROAD
SUITE 100
INDIANAPOLIS
IN 46268
UNITED STATES OF AMERICA

Test Date(s): **21-Mar-2022 to 22-Apr-2022**
Date of Report: **27-Apr-2022**

Date Received: 21-Mar-2022

AHK Ref: DW/386409
Material Described As: PLASTIC CORN KERNELS
Client Ref: PLASTIC CORN KERNAL SAMPLE REC 21/03/22

Samples were received by Alfred H Knight Energy Services Ltd and analysis results relate only to the items tested.

Client Ref.	Test	Unit	As Received	Dry Basis	Dry Ash-Free
Plastic Corn Sample					
	Total Moisture	%	21.5		
	Ash Content	%	4.8	6.1	
	Volatile Matter	%	64.3	81.9	87.2
	Fixed Carbon	%	9.4	12.0	12.8
	Total Sulphur	%	0.14	0.18	0.19
	Chlorine	%	0.29	0.37	0.39
	Carbon	%	35.2	44.8	47.7
	Hydrogen	%	4.48	5.71	6.08
	Nitrogen	%	1.37	1.75	1.86
	Oxygen By Difference	%	32.3	41.1	43.8
	Gross Calorific Value	MJ/Kg	14.547	18.531	19.735
	Net Calorific Value	MJ/Kg	13.044		
	Biomass Content by Carbon	%		98.9	

Scott Foster
Biomass Operations Manager
For and on behalf of Alfred H Knight Energy Services Ltd

Alfred H Knight Energy Services Ltd
Unit 1 Palmermount Industrial Estate, Bypass Road, Dundonald Kilmarnock, KA2 9BL
Tel: +44 1563 850 375 Email: solidfuels@ahkgroup.com

APPENDIX C

Carbon Dioxide Emission Intensity Calculations

Carbon Dioxide Emission Intensity Calculation for Conventional Fuels

Description Lehigh proposes to replace conventional fuels (coal, petroleum coke) with up to 200 tonnes per day of alternative low carbon fuels (ALCFs).

Methodology As per O.Reg. 79/15 section 9.(1) (amended by O. Reg. 824/21) the CO_2 emission intensity of coal or petroleum coke (petcoke) is calculated using the following formula:

CO_2 emission intensity = CC_{total} x 3.67/HHV

where,

CC_{total} = total carbon content of coal or petcoke [kg C / tonne fuel]
HHV = high heat value of coal or petcoke [MJ / tonne fuel]

Sample Calculation CO_2 emission intensity = CC_{total} x 3.67/HHV

For sample FUEL220125-04

$$CO_2 \text{ emission intensity} = \frac{61.40 \text{ kg C}}{100 \text{ kg fuel}} \times \frac{1000 \text{ kg fuel}}{1 \text{ tonne fuel}} \times \frac{3.67 \text{ kg } CO_2}{\text{kg C}} \times \frac{1 \text{ kg}}{25.06 \text{ MJ}} \times \frac{1 \text{ tonne fuel}}{1000 \text{ kg fuel}}$$

$$CO_2 \text{ emission intensity} = \frac{0.0899 \text{ kg } CO_2}{\text{MJ}}$$

Summary of Carbon Dioxide Emission Intensity

			Coal								Petcoke					
		Client Sample ID	FUEL220125-04	FUEL220131-06	FUEL220228-02	FUEL220527-04	FUEL220430-04	FUEL220527-03	FUEL220531-05	FUEL220630-03	FUEL220131-05	FUEL220228-01	FUEL220331-03	FUEL220430-03	FUEL220531-04	FUEL220630-02
		Date of Sample Collection	January 25, 2022	January 31, 2022	February 28, 2022	March 31, 2022	April 30, 2022	April 30, 2022	May 31, 2022	June 30, 2022	January 31, 2022	February 28, 2022	March 31, 2022	April 30, 2022	May 31, 2022	June 30, 2022
Test	ASTM Method	Unit	Results													
HHV, Calorific Value, As Received	ASTM D5865	BTU/lb	10773	12051	12312	12394	13092	12278	11902	11919	14627	13359	14370	14493	14245	14446
		MJ/kg	25.06	28.03	28.64	28.83	30.45	28.56	27.68	27.72	34.02	31.07	33.42	33.71	33.13	33.60
Carbon, As Received	ASTM D5373	% wt.	61.40	68.20	70.40	71.03	75.20	70.97	67.96	68.03	83.76	77.71	82.71	83.70	81.24	82.75
CO_2 Emission Intensity	—	kg CO_2/MJ	0.0899	0.0893	0.0902	0.0904	0.0906	0.0912	0.0901	0.0901	0.0904	0.0918	0.0908	0.0911	0.0900	0.0904

Carbon Dioxide Emission Intensity Calculation for C&D

Description

Lehigh proposes to use up to 200 tonnes per day of alternative low carbon fuels in place of conventional fuels (coal and petroleum coke).

Material baskets: Construction & Demolition By-Products (C&D)
Biomass

Methodology

As per O.Reg. 79/15 section 10. (1) (amended by O. Reg. 824/21), the carbon dioxide emission intensity of a fuel, in this case shredded wood from post construction waste (biomass) with minor amounts of non-recyclable paper and plastic, proposed to be combusted as an alternative low-carbon fuel is calculated using the following formula:

Carbon dioxide emission intensity = $CC_{non\text{-}bio}$ x 3.67/HHV

where,

$CC_{non\text{-}bio}$ = non-biological carbon content of fuel [kg C / tonne fuel]
HHV = high heat value of fuel [MJ / tonne fuel]

A non-biological carbon value was calculated for each of the samples of fuel material by subtracting the biological carbon portion from total carbon. The non-biological carbon content value was used to calculate a carbon dioxide emission intensity for each sample.

Sample Calculation

$CC_{non\text{-}bio}$ = total carbon [%wt] x (1 - biological carbon [% wt])
$CC_{non\text{-}bio}$ = 41.19% x (100% - 79%)
$CC_{non\text{-}bio}$ = 8.65%

Carbon dioxide emission intensity =	8.65	kg C	1000	kg fuel	3.67	kg CO_2	1	kg	1	tonne fuel
of sample AF294	100	kg fuel	1	tonne fuel		kg C	17.40	MJ	1000	kg fuel

Carbon dioxide emission intensity =	0.0182	kg CO_2
of sample AF294		MJ

Summary of Fuel Sampling Data

		Sample ID	AF294
		Source of Material	Eagle Disposal
		Date of Sample Collection	September 18, 2020
Test	Unit	Test Method	Results
HHV, Calorific Value	BTU/lb	ASTM D5865	7480
As Received	MJ/kg		17.40
Carbon, As Received	% wt.	ASTM D5373	41.19

		Sample ID	AF222	AF239	AF247	AF271	AF331	AF374	AF387	AF390	C&D - GFL Toronto
		Source of Material	Eagle Disposal	Eagle Disposal	Eagle Disposal	Eagle Disposal	Eagle Disposal	Revolution	Revolution	Revolution	GFL Toronto
		Date of Sample Collection	February 13, 2020	April 10, 2020	May 15, 2020	July 10, 2020	April 15, 2021	September 2, 2021	October 21, 2021	November 3, 2021	April 8, 2022
Test	Unit	Test Method	Results								
HHV, Calorific Value	BTU/lb	ASTM E711	6323	5354	6461	5646	7387	7738	6532	6365	7988
As Received	MJ/kg		14.71	12.45	15.03	13.13	17.18	18.00	15.19	14.80	18.58
Carbon, As Received	% wt.	ASTM D5373-21	37.36	30.70	32.03	33.30	40.73	45.12	39.31	33.84	46.07

Summary of Carbon Dioxide Emission Intensity

		Sample ID	AF294	AF222	AF239	AF247	AF271	AF331	AF374	AF387	AF390	C&D - GFL Toronto
		Source of Material	Eagle Disposal	Eagle Disposal	Eagle Disposal	Eagle Disposal	Eagle Disposal	Eagle Disposal	Revolution	Revolution	Revolution	GFL Toronto
		Date of Sample Collection	October 26, 2020	June 2, 2020	June 2, 2020	August 7, 2020	August 7, 2020	August 16, 2021	September 2, 2021	October 21, 2021	November 3, 2021	April 8, 2022
Test	Unit	Test Method	Results									
Biological Carbon	% wt.	ASTM D6866	79	100	80	79	90	44	68	77	85	100
Non-biological Carbon	% wt.	—	8.65	0	6.14	6.73	3.33	22.81	14.44	9.04	5.08	0.00
CO_2 Emission Intensity	kg CO_2/MJ	—	0.0182	0.0000	0.0181	0.0164	0.0093	0.0487	0.0294	0.0218	0.0126	0.0000

Carbon Dioxide Emission Intensity Calculation for IC&I

Description

Lehigh proposes to use up to 200 tonnes per day of alternative low carbon fuels in place of conventional fuels (coal and petroleum coke).

Material baskets: Industrial, Commercial and Institutional (IC&I) materials
Non-Recyclable Paper and Plastics
Non-Recyclable Textiles/Tire Fiber/Wood/Plastic Composites

Methodology

As per O.Reg. 79/15 section 10.(1) (amended by O. Reg. 824/21), the carbon dioxide emission intensity of a fuel, in this case non-recyclable paper, plastic, wood, and fiber materials, proposed to be combusted as an alternative low-carbon fuel is calculated using the following formula:

Carbon dioxide emission intensity = $Cc_{non\text{-}bio}$ x 3.67/HHV

where,

$CC_{non\text{-}bio}$ = non-biological carbon content of fuel [kg C / tonne fuel]
HHV = high heat value of fuel [MJ / tonne fuel]

A non-biological carbon value was calculated for the sample of fuel material by subtracting the biological carbon portion from total carbon. The non-biological carbon content value was used to calculate a carbon dioxide emission intensity for the sample.

Sample Calculation

$CC_{non\text{-}bio}$ = total carbon [%wt] x (1 - biological carbon [% wt])
$CC_{non\text{-}bio}$ = 53.13% x (100% - 30%)
$CC_{non\text{-}bio}$ = 37%

Carbon dioxide emission intensity =	37.19	kg C	1000	kg fuel	3.67	kg CO_2	1	kg	1 tonne fuel
of sample Buffalo Fuels Sample #2	100	kg fuel	1	tonne fuel		kg C	23.36	MJ	1000 kg fuel

Carbon dioxide emission intensity =	0.0584	kg CO_2
of sample Buffalo Fuels Sample #2		MJ

Summary of Fuel Sampling Data

		Sample ID	Buffalo Fuels Sample #2	July 7, 2022 - Min-Tech Campbellford
		Date of Sample Collection	March 15, 2022	July 7, 2022
Test	Test Method	Unit	Results	Results
HHV, Calorific Value As Received	ASTM procedures	BTU/lb	10045	12220
		MJ/kg	23.36	28.42
Carbon, As Received	D5373	% wt.	53.13	60.75

Summary of Carbon Dioxide Emission Intensity

		Sample ID	Buffalo Fuels Sample #2	July 7, 2022 - Min-Tech Campbellford
		Date of Sample Collection	March 15, 2022	July 7, 2022
Test	Test Method	Unit	Results	Results
Biological Carbon	ASTM D6866	% wt.	30	44
Non-biological Carbon	—	% wt.	37.19	34.02
CO_2 Emission Intensity	—	kg CO_2/MJ	0.0584	0.0439

Carbon Dioxide Emission Intensity Calculation for RDF

Description

Lehigh proposes to use up to 200 tons per day of alternative low carbon fuels in place of conventional fuels (coal and petroleum coke).

Material baskets: Refuse Derived Fuel (non-recyclable household waste)

Methodology

As per O.Reg. 79/15 (amended by O. Reg. 824/21) section 10.(1), the carbon dioxide emission intensity of a fuel, in this case non-recyclable household waste (with plastic, metal and glass removed), proposed to be combusted as an alternative low- carbon fuel is calculated using the following formula:

Carbon dioxide emission intensity = $Cc_{non\text{-}bio}$ x 3.67/HHV

where,

$CC_{non\text{-}bio}$ = non-biological carbon content of fuel [kg C / tonne fuel]
HHV = high heat value of fuel [MJ / tonne fuel]

A non-biological carbon value was calculated for the sample of fuel material by subtracting the biological carbon portion from total carbon. The non-biological carbon content value was used to calculate a carbon dioxide emission intensity for the sample.

Sample Calculation

$CC_{non\text{-}bio}$ = total carbon [%wt] x (1 - biological carbon [% wt])
$CC_{non\text{-}bio}$ = 45.80% x (100% - 21.00%)
$CC_{non\text{-}bio}$ = 36.18%

Carbon dioxide emission intensity = $\frac{36.18}{100}\frac{\text{kg C}}{\text{kg fuel}} \times \frac{1000}{1}\frac{\text{kg fuel}}{\text{tonne fuel}} \times 3.67\frac{\text{kg } CO_2}{\text{kg C}} \times \frac{1}{21.72}\frac{\text{kg}}{\text{MJ}} \times \frac{1}{1000}\frac{\text{tonne fuel}}{\text{kg fuel}}$

Carbon dioxide emission intensity = $0.0611\ \frac{\text{kg } CO_2}{\text{MJ}}$

Summary of Fuel Sampling Data

		Sample ID	EDM-RDF
		Date of Sample Collection	April 29, 2022
Test	**Test Method**	**Unit**	**Results**
HHV, Calorific Value, As Received	ASTM D5865	BTU/lb	9339
		MJ/kg	21.72
Carbon, As Received	ASTM D5373	% wt.	45.80

Summary of Carbon Dioxide Emission Intensity

		Sample ID	EDM-RDF
		Date of Sample Collection	April 29, 2022
Test	**Test Method**	**Unit**	**Results**
Biological Carbon	ASTM D6866	% wt.	21
Non-biological Carbon	—	% wt.	36.18
CO_2 Intensity	—	kg CO_2/MJ	**0.0611**

Carbon Dioxide Emission Intensity Calculation for Discarded Treated Seed

Description

Lehigh proposes to use up to 200 tons per day of alternative low carbon fuels in place of conventional fuels (coal and petroleum coke).

Material baskets: Discarded Treated Seed

Methodology

Lehigh proposes to use discarded plastic-coated corn kernels as alternative fuels.
As per O.Reg. 79/15 section 10.(1) (amended by O. Reg. 824/21) the carbon dioxide emission intensity of a fuel proposed to be combusted as an alternative low carbon fuel is calculated using the following formula:

Carbon dioxide emission intensity = $Cc_{non\text{-}bio}$ x 3.67/HHV

where,

$CC_{non\text{-}bio}$ = non-biological carbon content of fuel [kg C / tonne fuel]
HHV = high heat value of fuel [MJ / tonne fuel]

A non-biological carbon value was calculated for the fuel sample by subtracting the biological carbon portion from total carbon. The non-biological carbon content value was used to calculate a carbon dioxide emission intensity for the material.

Sample Calculation

$CC_{non\text{-}bio}$ = total carbon [%wt] x (1 - biological carbon [% wt])
$CC_{non\text{-}bio}$ = 35.20% x (100% - 100%)
$CC_{non\text{-}bio}$ = 0%

Carbon dioxide emission intensity = of sample Plastic Corn Kernal Sample	0.0%	C	3.67	$kg\ CO_2$ / kg C	1 / 14.55	kg / MJ

Carbon dioxide emission intensity = of sample Plastic Corn Kernal Sample	0.0000	$kg\ CO_2$ / MJ

Summary of Fuel Sampling Data

		Sample ID	Plastic Corn Kernal Sample
		Date of Sample Collection	July 6, 2022
Test	Test Method	Unit	Results
HHV, Calorific Value, As Received	ISO BS EN 18125	MJ/kg	14.55
Carbon, As Received	ISO BS EN 16948	% wt.	35.20

Summary of Carbon Dioxide Intensity

		Sample ID	Plastic Corn Kernal Sample
		Date of Lab Report	July 6, 2022
Test	Test Method	Unit	Results
Biological Carbon	ASTM D6866	% wt.	100
Non-biological Carbon	—	% wt.	0
CO_2 Intensity	—	$kg\ CO_2/MJ$	0.0000

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