

**放射性炭素測定によるバイオベース製品の
バイオベース炭素含有率試験報告書**

Biobased Carbon Content Test by Radiocarbon(C14) analysis

ピーライフ・ジャパン・インク株式会社 様

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放射性炭素測定によるバイオベース製品のバイオベース炭素含有率試験**Biobased vs Petroleum-based Organic Content Derived from Radiocarbon Analysis**

放射性炭素(C14)測定結果報告書をお送りいたします。結果は“バイオベース炭素(%)”として報告いたします。これはその割合の炭素がバイオベース起源であることを意味しています。例えば、100%バイオベース炭素の場合は、その物質中の炭素が、すべて植物もしくは動物の副生物起源であることを示しています。一方、0%バイオベース炭素の場合は、その物質には植物もしくは動物の副生物起源の炭素が含まれていないことを示しています。中間値の場合は、天然起源と化石起源の混合物であることを意味します。

分析値は“パーセントモダンカーボン：percent modern carbon (pMC)”という数値で示されます。これは現代標準試料：modern reference standard (NIST 4990C) に対する測定試料のC14相対濃度比です。バイオベース炭素(%)は、現在の大気CO₂のC14濃度から求められた調整計数(2018年では100.5; = pMC/1.005)を、測定値“pMC”に適用することによって求められます。C14測定法を用いた規格では、植物原料やバイオマス原料が天然環境から得られたものであるということを前提にしています。

報告書の結果はPJLA #59423によるISO/IEC 17025:2005認定を得ております。また化学処理、AMS測定などすべての試験工程が、フロリダ州マイアミにある自社実験施設内で行われたことを保証します。

試験に用いられた国際規格の名称が報告書内に記載されます。またこの報告書には結果が、試料中の全有機炭素(TOC)を対象にしたものであるか、全炭素(TC)を対象にしたものであるかを記載しています。結果の解釈をする際には、分析方法などについて弊社と協議したすべての事柄について考慮していただくようお願い申し上げます。ご質問などございましたらいつでもご連絡ください。

どうぞよろしくお願いたします。

測定結果一覧表

ピーライフ・ジャパン・インク株式会社 様 No.28371

試料データ

C14 : (pMC)

バイオベース 炭素(%)

Beta- 502273

101.78 ± 0.24 %

100 %

試料名 (56211) P-LIFE GREEN 20 Master Batch

試料種 Biobased Material TOC

測定方法 ASTM D6866-18 Method B

Chikyu Kagagaku Kenkyusho



Summary of Results - % Biobased Carbon Content
ASTM D6866-18 Method B (AMS)

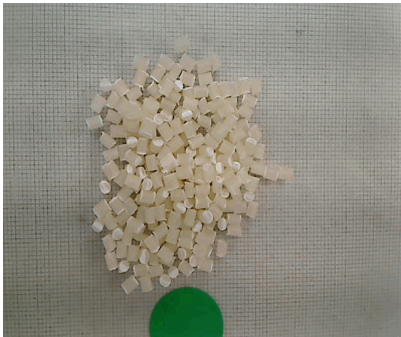
Certificate Number: 38838850227393911

Validation: *B. E. Smith Quality Manager*

Submitter	Sumihisa Matsuyama
Company	Chikyu Kagaku Kenkyusho, Incorporated
Date Received	August 22, 2018
Date Reported	August 27, 2018
Submitter Label	P-LIFE GREEN 20 Master Batch/56211

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

Laboratory Number	Beta-502273
Percent modern carbon (pMC)	101.78 +/- 0.24 pMC
Atmospheric adjustment factor (REF)	100.5; = pMC/1.005



3351.9mg 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.

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.



Summary of Results - % Biobased Carbon Content
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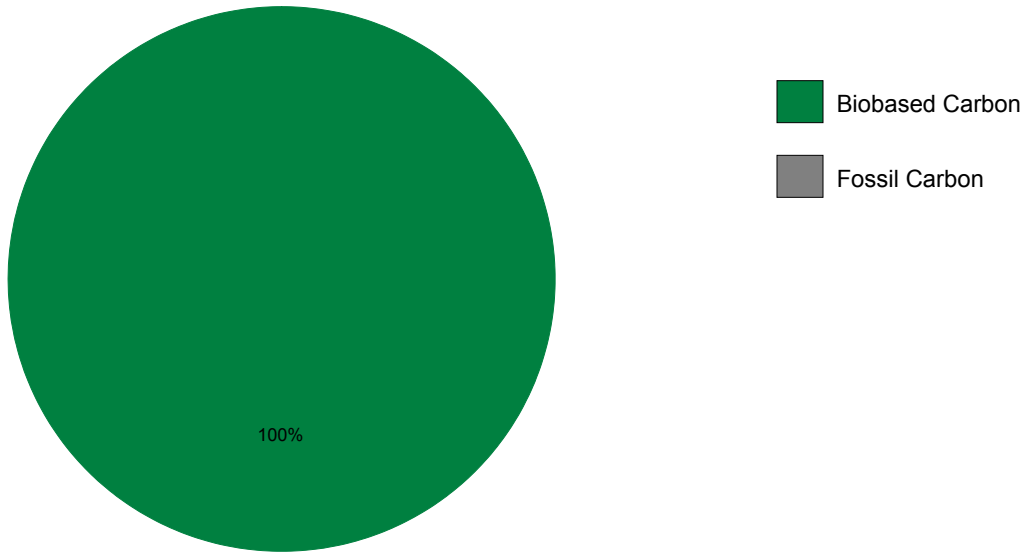
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% Biobased Carbon Content ASTM D6866-18 Method B (AMS)

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

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ISO/IEC 2005:17025-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 27, 2018
Submitter: Mr. Sumihisa Matsuyama

QA MEASUREMENTS

Reference 1

Expected Value: 0.49 +/- 0.10 pMC
Measured Value: 0.49 +/- 0.03 pMC
Agreement: Accepted

Reference 2

Expected Value: 96.69 +/- 0.50 pMC
Measured Value: 96.73 +/- 0.30 pMC
Agreement: Accepted

Reference 3

Expected Value: 129.41 +/- 0.06 pMC
Measured Value: 129.15 +/- 0.39 pMC
Agreement: Accepted

COMMENT: All measurements passed acceptance tests.

Validation:

Date: August 27, 2018