CIRAM
Laboratoire Biosourcé

ANALYTICAL REPORT

Report
N° 1022-BS-1050-4a

DETERMINATION OF THE PERCENTAGE OF BIO-BASED CARBON CONTENT USING THE RADIOCARBON METHOD

EN 16640:2017 (Method B)

Customer :

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Martillac, November 7, 2022

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SAMPLE

Sampling was done by the customer. * *Information supplied by the customer*

The sample has not been submitted to any treatment.

CIRAM code	**CBIO-776**
Name of the sample*	Peinture acrylique
Customer sample number*	Sample 4
Batch number*	nc
Date of reception item	October 24, 2022
Non-conformity at arrival	none

ANALYSIS

CIRAM code	**CBIO-776**
Customer sample number	**Sample 4**
Method of analysis	EA, IRMS, AMS (norm EN 16640:2017)
Date of EA – IRMS – GRAPHITIZATION	October 25, 2022
Date of AMS	November 2, 2022
Done by	SC / MG / ZE
Special conditions	SO
$\delta^{15}N$ (‰)	not detected
$\delta^{13}C$ (‰)	- 23.74
Percentage of Modern Carbon (pMC)	51.98 ± 0.26
x_B^{TC} is the biobased carbon as a fraction of total organic carbon (% of mass)[1]	**52%**
x^{TC} is the total organic carbon content as a fraction of the sample mass (dry)	21.75
x_B is the biobased carbon content as a fraction of the sample mass (dry)	11.31

[1] Norm EN 16640 :2017 indicates that the radiocarbon measure can suffer a deviation of ± 2 %. This indicates that the percentage of bio-based carbon can suffer a deviation of ± 2 %.

SUMMARY

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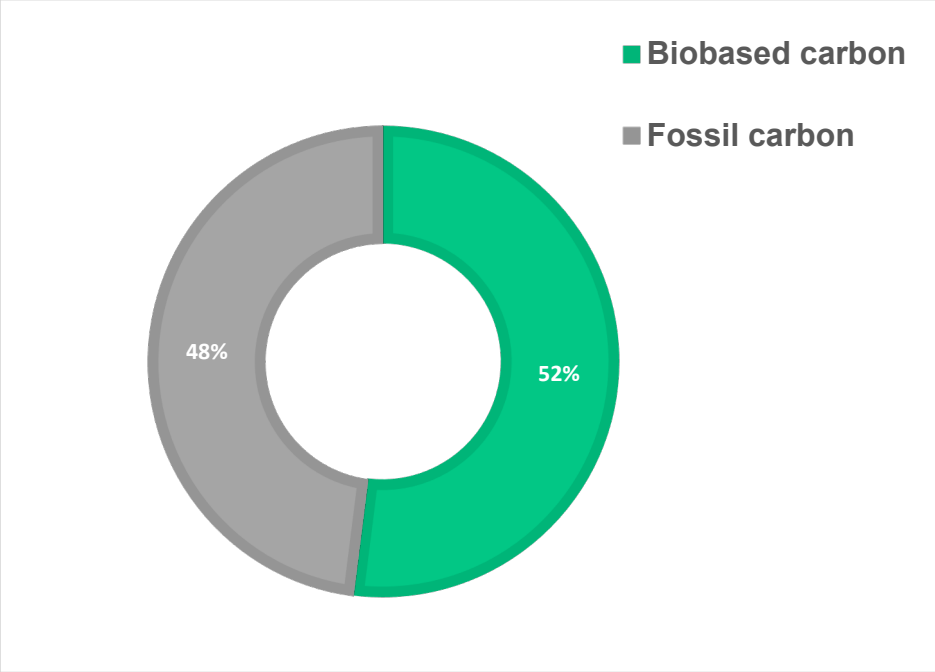

EXPERIMENTAL METHOD

The study presented here takes place in the context of quantification of the bio-based carbon and the fossil carbon into industrial production. The purpose of the methodology described below is to quantify the percentage of biobased (derived from biomass) versus petrochemical (fossil carbon) carbon, based on the measure of the carbon and nitrogen.
The Modern Carbon is the contemporary carbon present today in the atmosphere and in the biomass. The radiocarbon measurement is expressed as part of Modern Carbon (pMC). This corresponds to the percentage of radiocarbon (^{14}C) measured in the sample. The percentage of bio-based carbon is calculated on pMC basis, the total carbon content and an atmospheric adjustment factor (REF).
The reference value used for the carbon year adjustment was 100 in 2021 (ASTM D6866-21). This means that a 100 % natural product manufactured in 2021 has a pMC of 100.
The percentage of bio-based carbon corresponds to the percentage of “natural” carbon (derived from biomass) versus “fossil” carbon (derived from petrochemistry). A 100 % bio-based carbon compound is made from 100 % plants and/or animal by-products. A 0 % bio-based carbon compound corresponds to a product entirely of fossil origin, which does not contain any carbon from plant and/or animal by-products. Therefore, a value between 0 and 100 % confirms a mixture of bio-based and fossil carbon, indicating the percentage of bio-based carbon in the total carbon.
The sample is combusted at a temperature of 920°C and is transformed into gas. During this first step, a measure of % C and N is performed using an elementar analyser (Elementar Vario ISOTOPE Select). Residual carbon dioxide (CO_2) was separated from other combustion residues using a zeolite trap. Then, the carbon dioxide is transformed into graphite using an automated system (AGE 3, Ion Plus) by catalysis. Meanwhile $^{13}C/^{12}C$ ratio (expressed as $\delta^{13}C$) and $^{15}N/^{14}N$ (expressed as $\delta^{15}N$) were measured using a mass spectrometer dedicated to stable isotopic reports with an error below 0,1‰ (IRMS, Elementar Isoprime precisION). The different carbon isotopes were separated using a 250 kV accelerator mass spectrometer in joint venture with JSC Barnas (ISO 9001 and ISO 14001). ^{14}C content is determined by comparing the simultaneously collected ^{14}C, ^{13}C and ^{12}C beams with those of control products: Oxalic Acid, CO_2 standard, charcoal).
Conventional radiocarbon age is calculated according to the method described by Stuiver and Polach. It takes into account the $\delta^{13}C$ correction for isotopic fractionation, based on the comparison between the concentration measurements of $^{13}C/^{12}C$ and $^{14}C/^{12}C$. This factor enables the control of potential pollution and further evaluate the reliability of the measure, it is a good indicator of the quality of the sample. The precision on the analytical measure of pMC is 1σ (1 sigma relative standard deviation). International standards NIST 4990C, IAEA-C-7 et IAEA-C-9 were used. $\delta^{13}C$ is expressed per mile (‰) in conformity with international standard V-PDB (Vienna Pee Dee Belemnite). $\delta^{15}N$ is expressed per mile (‰) in relation to Air. International standards IAEA-600, IAEA-N-2 and BCR-657 were used.

NOTE

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All traceability elements including measure uncertainty are available on request. For any subcontracted results supplied by accredited laboratories, measures are also available.

Dr Olivier Bobin
Directeur scientifique

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