Global Artisan C-Sink - Dry Matter Assessment

Update on biochar dry matter assessment– April 8th, 2026

The method for determining dry matter in the Global Artisan C-Sink Standard has been revised and is hereby made available for public consultation for 30 days (04/10/2026–05/10/2026).

The update provides a clear and standardized procedure for assessing the dry matter content of biochar via (1) bulk density method or via (2) maximum moisture method. The consultation does not cover the entire Global Artisan C-Sink Standard but specifically addresses the determination of the dry matter content and, consequently, the determination of the carbon content in a packaging unit.

Following the public consultation, the update will be incorporated into the Global Artisan C-Sink Standard as it leads to the replacement of chapter 10.2 and Annex 1 "Bulk Density Analysis for Biochar Produced in a Kon-Tiki under the Global Artisan Standard". The new method will become mandatory for dry matter determination following the publication of the updated Artisan C-Sink Standard with a transition period of three months.

Feedback can be provided during the publication period using the "**Standards Amendment Form**" on the website. The Chief Standard Officer, with the assistance of the Technical and Scientific Committee, evaluates the feedback. Carbon Standards International will publish the feedback with structured responses (accepted/not accepted, justification).

The Dry Matter Assessment Method for the Artisan C-Sink Standard Version 3.0

Assessing the dry weight of biochar before its application to a C-sink is a prerequisite for reliable C-sink certification and trade. The Global Artisan C-Sink standard uses two dry weight assessment methodologies, which are 1) The Bulk Density Method, and 2) Maximum Moisture Method.

1. The Bulk Density Method

The bulk density of the biochar must be determined to convert the measured biochar volume into its corresponding dry weight.

Bulk density is a feedstock and technology-specific parameter and must therefore be assessed separately for every registered feedstock and pyrolysis type (e.g., cotton stalk pyrolyzed in a Kon-Tiki type kiln). Sending raw biochar samples to laboratories, particularly those located abroad, is not only time-consuming, but also risky in regard to alterations of the physical biochar structure and moisture content during handling and transport. Such alterations would lead to inaccurate dry matter content values.

Dry matter content must be determined and registered by the C-Sink Manager for each registered feedstock and pyrolysis type. The frequency of the analyses depends on the produced volume of biochar and if the biochar is produced by an Artisan Pro, C-Sink Network, or C-Sink Village (See Frequency of Sampling and Measurements). Artisan C-Sink Managers may commission a qualified local laboratory to measure bulk density using the method described here but remain responsible for correct results and registration.

Biochar volume must be recorded immediately after production, directly at the production site, by filling it into a standardized box (see Figure 1). Do not crush or compact the biochar when filling it into the measuring container. The entire content of the box may then be transferred into bags (e.g., 50 l PP bags) for easier handling during transport. The initial, production-fresh volume is assessed using the standardized box and is therefore not altered by subsequent transport and handling (see Bulk Density Assessment Protocol, Step 1). The fresh weight, in contrast, must be recorded immediately before the moisture content assessment, either at the C-Sink Manager's office or at the commissioned laboratory (see Bulk Density Assessment Protocol, Step 2). Two photographs with a resolution of at least 300 dpi from the bulk biochar sample must be taken and recorded with the analytical results.

1.1. Required Tools and Equipment

- Mortar and pestle.
- CSI-endorsed thermogravimetric moisture analyzer (e.g., PCE MA 110TS).
- 250 ml measuring cup.

- Shovel and tarp.
- Ziplock bags.
- Standardized measuring box (See Figure 1).

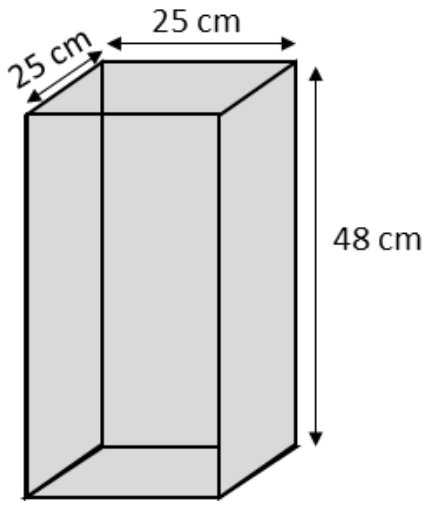

Figure 1. Drawing of a standardized measuring box used to take an exact 30 L sample. The inner (not outer) dimensions are 25 cm × 25 cm × 48 cm (= 30,000 cm³ = 30 l). Boxes with other dimensions, such as 31.1 cm × 31.1 cm × 31.1 cm (inner dimensions), are also admissible. The measuring box should ideally be made of steel or aluminum, but it can also be made of wood or any other material, provided that the product of the three inner side lengths equals 30,000 cm³.

1.2. Bulk Density Assessment Protocol

Step	Description
1	**Filling of the standard box** The 30 l standard box is filled with biochar stored in the 100 L bulk density retention sample container. For this, the container is emptied on a clean floor or tarp. The 30 l box is then filled from at least 12 different spots of the 100 l pile.
2	**Transferring the content of the box to a bag** The content of the 30 l box is transferred into an empty bag, which is then closed. The bag thus contains a known biochar volume of 30 l and can be used for subsequent dry matter analysis. Do not crush or compact the biochar when filling it into the measuring container.
3	**Fresh weight measurement** The fresh weight of the bag (used to store the biochar measured with the box) must be recorded immediately before the dry matter analysis. This means it is assessed either after storage and transport to the C-Sink Manager's office or to the laboratory where the moisture content analysis is carried out, or directly on site if the moisture content analysis is carried out on site.
4	**Homogenization of biochar** After weighing, the bag is opened and the biochar is emptied onto a tarp. The material is then thoroughly homogenized by shoveling it from one pile to another three times.

5	**Sampling** From the homogenized pile, one subsample of 250 ml is taken from random locations across the pile. Use at least 10 spots of the pile to collect the subsample. Store and label the subsample in zip-lock bag.
6	**Sample preparation** The 250 ml sample is milled using a mortar and pestle. From the milled sample, an approximately 10 g sub-sample is transferred to the moisture analyzer.
7	**Drying and measurement** The sub-sample is dried using the slow auto-drying mode of the PCE MA 110TS moisture analyzer. The resulting moisture and dry matter values are recorded.
8	**Data submission** All measurement results for each feedstock must be registered on the same day in the CSI Dry Matter Tool.

The dry weight of the sample is calculated as follows:

$$\text{Dry weight [kg]} = \text{Wet weight [kg]} \times (1 - \text{Moisture content}) \qquad \text{(i)}$$

where the moisture content of the respective sample is expressed as a fraction (e.g., 0.6 for 60% moisture content).

1.3. Frequency of Sampling and Measurements

The frequency of sampling and dry matter measurements differs between C-Sink Networks, Artisan Pro, and C-Sink Villages.

- **C-Sink Network**
  Every farmer network must register for every feedstock (e.g., corn spindles) and pyrolysis type (e.g., Kon-Tiki) three bulk density measurements following the protocol above. For each measurement, a 100 l biochar sample must be collected from a different production unit (e.g., Kon-Tiki).
  The sampling and bulk density measurement must be repeated once per year or for every 500 m^3 of biochar produced, whichever comes first. This repetition is compulsory for every feedstock and production technology in each C-Sink Network.

- **Artisan Pro**
  At the beginning of a batch, biochar samples are collected over 3 consecutive production days. Every day at least 30 liters of biochar must be sampled from a different kiln given that more than one kiln is used at the registered site. The samples are collected and stored in a sealable container of at least 100 l to form a specific bulk density retention sample. The 3-day sampling and bulk density measurement must be repeated once per month or every 100 m^3 whichever comes first.

- **C-Sink Village**
  Once every month, a 100 l sample is taken from all biochar that was delivered during the month and piled for packaging or further use. The sample must be taken from at least 12 distinct spots.
  Given the highly variable logistics of collecting the biochar from C-Sink Villages, different sampling procedures may be outlined and approved during the technical audit.

1.4. The Mean Bulk Density

The mean bulk density of all measurements over the last 400 days is applicable to all biochar produced from the same feedstock in the same pyrolysis type for the next 30 days of production. All measurements must be registered in the CSI Dry Matter Tool that calculates the applicable mean bulk density.

The mean bulk density is calculated in the CSI Bulk Density Tool. The Tool delivers a digital certificate. The certified mean bulk density must be used to convert the biochar volume of any packaging unit into biochar dry weight (in t dry matter) during the 30 days where the mean bulk density is valid, given the feedstock and the pyrolysis type did not change.

The 100 l bulk density retention container can be emptied after the bulk density analysis and used or traded with the biochar produced during the batch.

2. Maximum Moisture Method

Biochar generally exhibits a high water-holding capacity (WHC), a property that varies with feedstock type and pyrolysis conditions. When exposed to water, biochar absorbs moisture progressively until saturation is reached — the point referred to as maximum water-holding capacity (WHCmax). At WHCmax, all accessible pore spaces are filled, and no additional water can be retained; any excess water drains freely from the material. The moisture content of biochar at this saturation point, referred to here as maximum moisture content (MCmax), is a directly measurable quantity and serves as the practical parameter for field-based dry weight calculations in the present guideline.

To convert the fresh weight of quenched biochar into its corresponding dry weight, the maximum moisture content (MCmax) of the biochar must be determined for each feedstock and pyrolysis type (e.g., cotton stalk pyrolyzed in a Kon-Tiki type kiln). MCmax is a feedstock- and technology-specific parameter and must therefore be assessed separately for every registered feedstock and pyrolysis type. Sending raw biochar samples to laboratories, particularly those located abroad, is not only time-consuming, but is likely to alter the physical structure of the biochar during transport and handling. Such alterations would eventually lead to inaccurate MCmax measurements.

MCmax must be determined and registered by the C-Sink Manager for each registered feedstock and pyrolysis type. Artisan C-Sink Managers are responsible for conducting MCmax analyses in accordance with the present guidelines. They may commission a qualified local laboratory to measure MCmax using the method described here but remain responsible for correct results and registration.

The MCmax approach is currently only available for the assessment of biochar production quantities under Artisan Pro production. The measurement must be repeated once per month or every 100 m^3 whichever comes first.

To determine the maximum moisture content, the biochar is quenched in the kiln by filling the kiln with water until the biochar begins to float. The biochar is left to saturate for one hour, before the water is released and the kiln emptied. Three samples of approximately 15 kg are then taken immediately, and their exact fresh weight is recorded. The samples are homogenized and one subsample of 250 mL is taken per sample. Three subsamples for moisture content analysis are thus obtained and immediately sealed in Ziplock bags to prevent moisture loss.

The subsamples are subsequently analyzed for moisture content using a thermogravimetric moisture analyzer. The resulting average moisture content (e.g., 70%) reflects the MCmax value and is registered for the corresponding feedstock and pyrolysis type. It is then applied to calculate the dry weight of any subsequent biochar batch from its recorded fresh weight in the field.

2.1. Required Tools and Equipment

- Mortar and pestle.
- CSI-endorsed thermogravimetric moisture analyzer (e.g., PCE MA 110TS).
- 250 ml measuring cup.
- Shovel and tarp.
- Weighing scale (accuracy at least 0.01 kg).
- Ziplock bags.

2.2. Maximum Moisture Content Assessment Protocol

Step	Description
1	**Quenching the biochar and filling the kiln with water** To saturate the biochar and reach the maximum moisture content/maximum water holding capacity the kiln is filled with water until the biochar starts to float and the biochar is left to saturate for one hour. Subsequently the water is released, and the biochar is transferred on a tarp.
2	**Fresh weight measurement** The produced biochar is homogenized, and three samples of around 15 kg are placed in bags. The exact fresh weight of each of the three bags is recorded.

3	**Homogenization of biochar** Immediately after weighing, the first of the three samples is opened, and the biochar is emptied onto a tarp. The material is then thoroughly homogenized by shoveling it from one pile to another three times.
4	**Sampling** From the homogenized pile, one samples of 250 mL is taken from random locations across the pile. Use at least 10 spots of the pile to collect the sample. Store and label the sample in a zip-lock bag.
5	**Sample preparation** Each 250 mL sample is milled using a mortar and pestle. From each milled sample, an approximately 10 g sub-sample is transferred to the moisture analyzer.
7	**Drying and measurement** The three sub-samples (one per sample) are dried using the slow auto-drying mode of the PCE MA 110TS moisture analyzer. The resulting moisture and dry matter values are recorded.
8	**Data submission** All measurement results must be registered on the same day in the CSI Dry Matter Tool.

The maximum moisture content analysis calculation is carried out as follows:

$$\text{Mean maximum moisture content}_{\text{n}}\,[\%] = \frac{1}{3}\sum_{\text{i}=1}^{3}\text{MC}_{\text{n,i}} \qquad \text{(ii)}$$

where *n* is the number of the biochar bag (1–3) and *MC* is the moisture content of the respective sub-samples *i*, expressed as a fraction (e.g., 0.2 for 20% moisture content).
The standard deviation of the moisture content is added to the average moisture content to provide the default maximum moisture content (MCmax) of the biochar.

$$\text{Default MCmax} = \text{Mean MCmax} + \text{standard deviation MCmax} \qquad \text{(iii)}$$

If the highest individual MCmax value of the three assessed values exceeds the lowest by more than 25%, the sampling procedure must be repeated from the start.

The default maximum moisture content receiving a digital certificate in the CSI Bulk Density tool can be used as a constant to convert the biochar fresh weight of any packaging unit produced from the same feedstock and with the same pyrolysis type into biochar dry weight (in kg dry matter).

The dry biochar mass is then obtained by applying the previously determined maximum moisture content (MCmax) as follows:

$$\text{Dry weight [kg]} = \text{Wet weight} \times (1\text{-Default MCmax}) \qquad \text{(iv)}$$

For example, if the default MCmax was determined to be 75% and the wet weight of a bag of recently produced biochar is 80 kg, the dry weight is calculated as: $80 \times (1 - 0.75) = 20$ kg dry matter. During operation, all biochar must be brought to saturation moisture, after which each bag is weighed individually and the weight is recorded. The previously determined maximum moisture content (MCmax) is subtracted to directly obtain the dry biochar mass produced.

The calculated dry weight is applicable until the obtention of the result from the next regular measurements either one month later or after the production of 100 m^3 whichever comes first.
