Arbaz, 29th August 2022

EBC carbon sink certificate

General Data	ID of C-sink certificate = C-sink register ID	11pe-guk2-n4ld-dapb (replaces: cs-z7hy-mmw-tto2-wrds)
	EBC ID	co-at-34
	EBC Batch ID	ba-at-34-1-3
	Production periode (from -til)	2021-09-16 - 2022-09-15
	QR-Code of Biochar Batch Analysis	

Producer	Sonnenerde GmbH Oberwarter Strasse 100 7422 Riedlingsdorf Österreich
GPS of production	48.20849 16.37208
	www.sonnenerde.at e.moisl@sonnenerde.at

Biomass	Type of biomass (EBC-class)	Ag-05, N-02
	Total amount of biomass (dry matter) used for the certified batch	390 t
	Emissions due to fertilization per batch	0 t CO_2eq
	Transportation of biomass to pyrolysis site per batch	2.3 t CO_2eq
	Preparation of feedstock per batch	7.5 t CO_2eq
	Emissions for drying of feedstock per batch	- t CO_2eq
	Feedstock storage emissions per batch	0 t CH_4
	Total biomass related GHG emissions without CH_4 per batch	**9.8 t CO_2eq**

Pyrolysis	Source of electric energy used on site	Renewable
	Emissions due to electricity consumtion for entire pyrolysis plant incl. post pyrolysis treatment per batch	0 t CO_2eq
	batch	6 t CO_2eq
	Emissions due to carrier gas per batch	0 t CO_2eq
	CH_4-emissions of entire batch	0.04 t CH_4
	Total pyrolysis related GHG emissions without CH_4 per batch	**6.0 t CO_2eq**

Methane	Total methane emissions per batch	0.04 t CH_4
	Amount of compensated methane emissions	0 t CH_4
	Type of methane compensation	-
	Total non compensated CH_4 emissions per batch	0.04 t CH_4
	Total non compensated CH_4 emissions in per batch (@ GWP20 of 86)	**3.35 t CO_2eq**

Margin of security	**10% of total GHG emissions (incl. GWP20 of CH_4) per batch**	**1.9 t CO_2eq**

Total emissions	**Total GHG emissions in CO_2eq per batch**	**21.1 t CO_2eq**
	Total GHG emissions in C per ton of biochar (dry matter)	0.053 t C

Energy	Carbon neutral thermal energy per batch	542 MWh
	Carbon neutral electricity per batch	- MWh

Biochar	Amount of biochar (DM) produced per certified batch	108.00 t
	H/Corg ratio	0.38
	C-content	73.8 %
	C-sink potential	**68.5% of DM**

Data per ton of biochar	Total GHG emissions per t biochar (dry matter)	0.20 t CO_2eq
	CO_2eq-content per t of biochar (dry matter) [gross C-sink]	2.71 t CO_2eq
	C-sink potential in tCO_2eq per t of biochar (dry matter) [net C-sink]	2.51 t CO_2eq
	Csink100 in tCO2eq per t of biochar (dry matter) [persistent C of the sink after 100 years when applied to soil @ P100=74%]	1.86 t CO2eq

EBC Carbon Sink Certificate

Issued for Sonnenerde GmbH

The biochar batch ba-at-34-1-3 produced by Sonnenerde GmbH has carbon sink potential of 68.4 %. Each ton of biochar from the certified batch has a carbon sink potential of 2.51 t CO_2eq. When applied to soil, the accountable fraction of carbon persistent after 100 years ($Csink_{100}$) is 1.86 t CO_2eq.

The carbon sink potential of 68.5 % provides the percentage of a mass unit of biochar that, on a dry matter base, can be considered as a temporal carbon sink. For example, a big bag containing 131 kg biochar (dry matter) has a carbon sink potential of (131 kg * 68.5 % C_S) = 89.7 kg C which is the equivalent of 329 kg CO_2eq per bigbag.

The 89.7 kg carbon of a $1m^3$ big bag of biochar is the amount of carbon that can be considered a carbon sink once the biochar is applied to soil, to compost, to digestate, to animal feed or to any other durable product or protective matrix.

The production of 1 t of biochar (dry matter) caused emissions of 195 kg CO_2eq (53 kg C) due to feedstock production, transportation, storage, preparation and operation of the pyrolysis plant and methane emissions during both biomass storage and the combustion of the pyrolysis gases. These emissions were deduced from the carbon sink value of the biochar.

The CO_2 emissions of the combustions of the pyrolysis gases used for energy production are considered as carbon neutral as the feedstock for the pyrolysis originated from agricultural farms and food processing residues.

The CH_4 emissions were measured repeatedly during regular operation on at least three pyrolysis plants of the same type. The methane values are thus subject to some uncertainty in regard to start-up and shut down of the process or possible problems during regular operation. For this reason, a margin of 50% was added to the measured CH_4 emissions. It was guaranteed that the feedstock is never stored longer than 30 days before drying to below 20% water content, therefore no CH_4-emissions due to self-heating were considered. All electricity used for the production was provided as renewable, carbon neutral energy.

Neither the carbon expenditures necessary to transport the biochar from the production site to the location of the final C-sink (via a merchant and/or processor) nor the carbon expenditures when manufacturing or blending the biochar into a carbon sink product are considered so far. These emissions must be deducted as soon as a C-sink certificate or an offset service is generated for an end customer based on this C-sink potential certificate. Equally, when applied to soil, only the carbon fraction that is persistent after 100 years ($Csink_{100}$) or any other EBC-defined sequestration period should be traded as C-sink certificate.

During the biochar production, 542 MWh thermal energy was produced. As all GHG emissions of the entire process were deduced from the biochar carbon sink potential, this thermal energy is completely carbon neutral. The total certified amount of carbon neutral heat will be provided at the end of the batch.

The present ***EBC carbon sink potential certification*** is valid for the entire biochar batch produced between 16/09/2021 and 15/09/2022 and can be used for carbon sink certification and trade procedures.

The present EBC carbon sink potential certification was issued by the Ithaka Institute (Switzerland) on 29th August 2022 and replaces the EBC carbon sink potential certification cs-z7hy-mmw-tto2-wrds from 12th May 2022.

Hans-Peter Schmidt
Head of Ithaka Institute