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Certificate

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Carbon sink certificate – for CO_2eq potential

ID of C-sink certificate: cs-j3gz-kxjg-6g2a-g9xm

Abfallwirtschaft und Stadtreinigung Freiburg GmbH
Hermann-Mitsch-Strasse 26
79117 Freiburg
Deutschland

EBC Producer ID: co-de-52
GPS of production: 48.04885183995528,7.834066501598406

The Carbon sink potential of the mentioned batch is certified according to the following standard:

EBC carbon sink

BIOCHAR BASED CARBON SINKS

Data of batch:

EBC Batch ID	ba-de-52-1-4
Amount of produced biochar (dry matter)	84 t
C-sink potential of biochar (dry matter)	73.0%
C-sink potential per ton of biochar (dry matter)	2.68 t CO2eq
C-sink potential of total amount of produced biochar (dry matter)	224.97 t CO2eq

Frick, 11.09.2023

Peter Jossen
President of board of directors

Ueli Steiner
Director

EBC producer ID: co-de-52 **ID of C-sink certificate:** cs-j3gz-kxjg-6g2a-g9xm

Certification details of Carbon sink potential

Biomass	Type of biomass (EBC feedstock ID)		Ag-04,R-01	
	Total amount of biomass (DM) used for the certified batch		278 t	
	Emissions due to fertilization		0.00 t	CO_2eq
	Transportation of biomass to pyrolysis site		0.47 t	CO_2eq
	Preparation of feedstock		3.56 t	CO_2eq
	Emissions for drying of feedstock		0.00 t	CO_2eq
	Feedstock storage emissions		0 t	CH_4
	Total biomass related GHG emissions without CH_4 per batch		**4.03 t**	**CO_2eq**
Pyrolysis	Source of electric energy used on site	Renewable		
	Emissions due to electricity consumption for entire pyrolysis plant incl. post pyrolysis treatment		0.00 t	CO_2eq
	Emissions due to LPG and other external fuel for reactor heating		16.98 t	CO_2eq
	Emissions due to carrier gas		0.00 t	CO_2eq
	CH_4-emissions of pyrolysis unit		0.03 t	CH_4
	Total pyrolysis related GHG emissions without CH_4 per batch		**16.98t**	**CO_2eq**
Methane	Total methane emissions		0.03 t	CH_4
	Amount of compensated methane emissions		0.00 t	CH_4
	Type of methane compensation		none	
	Total non-compensated CH_4 emissions per batch		0.03 t	CH_4
	Total non-compensated CH_4 emissions in CO_2eq per batch (@GWP20 of 86)		**2.39 t**	**CO_2eq**
Margin of security	**10 % of total GHG emissions (incl. GWP 20 of CH_4) per batch**		**2.34 t**	**CO_2eq**
Total emissions	**Total GHG emissions in CO_2eq per batch**		**25.74 t**	**CO_2eq**
	Total GHG emissions in C per ton of biochar (DM)		0.084 t	C
Energy	Carbon neutral thermal energy per batch		892.00	MWh
	Carbon neutral electricity per batch		0.00	MWh
Biochar	Amount of biochar (DM) produced per certified batch		84 t	
	H/Corg ratio		0.2	
	C-content		81.40 %	
	C-sink potential		**73.0 %**	**of DM**
Data per ton of biochar	Total GHG emissions per t biochar (DM)		0.31 t	CO_2eq
	CO_2eq content per t of biochar (DM) [gross C-sink]		2.98 t	CO_2eq
	C-sink potential in t CO_2eq per t of biochar (DM) [net C-sink]		2.68t	CO_2eq
Data of batch	C-sink potential in t CO2eq of total amount of produced biochar (DM)		**224.97 t**	CO_2eq

EBC producer ID: co-de-52 **ID of C-sink certificate:** cs-j3gz-kxjg-6g2a-g9xm

The biochar batch ba-de-52-1-4 produced by Abfallwirtschaft und Stadtreinigung Freiburg GmbH has carbon sink potential of 73.0%. Each ton of biochar from the certified batch has a carbon sink potential of 2.68 t CO_2eq.

The carbon sink potential of 73% 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 * 73% CS) = 95.63 kg C which is the equivalent of 351.08 kg CO_2eq per big bag.

The 95.63 kg carbon of a 1 m^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. Depending on the intended use of the biochar, the amount of persistent carbon varies after 100 years. If the biochar applied to soil the persistent Carbon of the sink after 100 years is 74 % (@P100=74%).

The production of 1 t of biochar (dry matter) caused emissions of 306 kg CO_2eq (84 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 tree, vine and shrub pruning and urban green cutting 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 regarding 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. The stored feedstock has a water content below 20%, and no CH4 emissions due to self-heating are accounted for. 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 (Csink100) or any other EBC-defined sequestration period should be traded as C-sink certificate.

During the biochar production, 892.00 MWh thermal and 000.00 MWh electric energy were 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 certificate for CO_2eq potential at factory gate is valid for the biochar batch ba-de-52-1-4 and can be used for carbon sink certification and trade procedures.