

Ensure stable and effective carbon sequestration

Biosolids biochar

ABOUT THE DATA

This product sheet presents typical physical and chemical data for biochar produced from Danish sewage biosolids. **Plant-specific values may vary.**



Production process

HECLA® combines oxygen-free steam-drying at up to 200°C with 20 minutes of pyrolysis at 650°C, producing nutrient-rich, odour-free biochar.

APPEARANCE

- Resembles coal
- Black and solid
- Powder and small granules may break up when handled

BULK DENSITY (DRY)

400–500
kg/m³

SURFACE AREA

~50 m²/g
(BET method)

Chemical composition

TABLE 2

Composition varies with wastewater treatment and biomass handling.

Parameter	Typical content
Dry weight/matter	70–80%
Water content*	20–30%
Ash	60–80%
Carbon	20–40%

*Water is added after pyrolysis to eliminate the risk of dust exposure and smoldering.

Biochar phosphorus characteristics

PLANT-AVAILABLE:

Up to 70%
3.5 out of 5% is
citrate soluble¹

NON-LEACHING:

Insoluble
in water
<1% extracted by water

MINIMAL RUNOFF RISK:

75–80%
of phosphorous is extracted by HCl
and 7–10% by NaOH2

Nutrients

TABLE 1

Biosolids biochar contains valuable nutrients. Actual values depend on the wastewater treatment process and incoming biomass.

Nutrient	Typical content (% dry basis)
Nitrogen (N)	1–3
Ammonium (NH4)	<0.1
Phosphorous (P)	5
Phosphorous, citrate soluble (P)	3.5w
Potassium (K)	0.1
Magnesium (Mg)	1.0
Iron (Fe)	9–10
Aluminum (Al)	1–2
Calcium (Ca)	6–8
Sulphur (S)	1

¹AGROLAB Umwelt Kiel, Analytical report 1850658 – 280878, 2017-08-29

Heavy metals

TABLE 3

Nearly all phosphorus remains in the biochar. Heavy metals comply with the Danish “waste to soil” regulation; Cr, Cu and Zn remain at approximately 40–75% of their limit values.

The biochar results (table 3) comply with the Danish “waste to soil” regulation.



Metals	Units	Results	Limits
Arsenic (As)	mg/kg	16	–
Lead (Pb)	mg/kg	87	120
Lead (Pb)	mg/kg TP	1,700	10,000
Cadmium (Cd)	mg/kg	1.7*	0.8
Cadmium (Cd)	mg/kg TP	34	100
Chrom (Cr)	mg/kg	62	100
Copper (Cu)	mg/kg	656	1,000
Nickel (Ni)	mg/kg	64*	30
Nickel (Ni)	mg/kg TP	1,300	2,500
Mercury (Hg)	mg/kg	0.0	0.8
Mercury (Hg)	mg/kg TP	0.0	200
Zink (Zn)	mg/kg	1,780	4,000

*Cadmium and Nickel exceed the dry-matter-basis limit value, but comply via the phosphorus-basis limit value (mg/kg TP), as Danish regulation permits compliance through either measure.

Environmentally unfriendly substances

The Danish “waste to soil” regulation sets limits for six groups of organic contaminants. **In this example, the analysed compounds in HECLA® biochar were below detection limits.**

Organic pollutants are thermally degraded during pyrolysis. HECLA® operates at 650°C with a residence time of 20 minutes, followed by combustion of the pyrolysis gases at ~900°C.

Dioxin-like PCB (dl-PCB)	mg/kg
PCB (118)	<0.001
Limit	0.2
Non-dioxin-like PCB (ndl-PCB)	mg/kg
PCB (28)	<0.001
PCB (52)	<0.001
PCB (101)	<0.001
PCB (138)	<0.001
PCB (153)	<0.001
PCB (180)	<0.001
PCB sum	<LOD
Limit	0.2

Polycyclic aromatic hydrocarbons (PAH)	mg/kg
Acenaphthene	<0.05
Benzo(a)pyrene	<0.05
Benzo(b)fluoranthene	<0.05
Benzo(ghi)perylene	<0.05
Benzo(j)fluoranthene	<0.05
Benzo(k)fluoranthene	<0.05
Fluoranthene	<0.05
Indeno(1,2,3-cd)pyrene	<0.05
Phenanthrene	<0.05
Fluorene	<0.05
Pyrene	<0.05
PAH sum	<LOD
Limit	0.3

Softeners	mg/kg
Di-Ethyl-Hexyl-Phthalate (DEHP)	<0.50
Limit	50
NPE	mg/kg
Nonylphenol	<0.10
Nonylphenol monoethoxylate	<0.10
Nonylphenol diethoxylate	<0.10
NPE sum	
Limit	10
Others	mg/kg
LAS	<50
Limit	1,300

PFAS and organic micropollutants

TABLE 4

AquaGreen testing has shown PFAS below detection limits in analysed biochar and flue gas, together with **>97% reduction of organic micropollutants** under tested conditions. Published studies support effective degradation of PFAS and other organic contaminants during high-temperature pyrolysis and subsequent thermal oxidation of process gases.

Ready to create biochar at your plant?

Contact our team today for a custom business case evaluation.

Contact us

¹ Position paper in regard to biosolids as feedstock for pyrolysis to be included in the scope of the Fertilising Products Regulation, European Biochar Industry Consortium (EBI), 2020-03-04

² Moško et al. Effect of pyrolysis temperature on removal of organic pollutants present in anaerobically stabilized sewage sludge. Chemosphere 265 (2021), <https://doi.org/10.1016/j.chemosphere.2020.129082>

³ Yamada and Taylor, 2005, Thermal degradation of fluorotelomer treated articles and related materials. Taylor and Yamada, 2003, Laboratory-Scale Thermal Degradation of Perfluoro-Octanyl Sulfonate and Related Precursors. Rayne and Forest, 2009, Perfluoroalkyl sulfonic and carboxylic acids: A critical review of physicochemical properties, levels and patterns in water and wastewaters, and treatment methods.

⁴ US EPA Research brief January 2021, Potential PFAS destruction technology: Pyrolysis and gasification

⁵ EPA PFAS innovative treatment team (PITT) findings on PFAS destruction technologies, EPA Tools & Resources Webinar February 17, 2021, Gullett B.

⁶ Thoma E. D. et. al., Pyrolysis processing of PFAS-impacted biosolids, a pilot study, Journal of the Air & Waste Management Association, 2022, Vol 72, No. 4, 309–318

⁷ Thoma E. D. et. al., Pyrolysis processing of PFAS-impacted biosolids, a pilot study, Journal of the Air & Waste Management Association, 2022, Vol 72, No. 4, 309–318, Supplementary material, “SI Table 7. Summary of fluorinated compound canister analysis, acquired at LA”