

European Sustainable Phosphorus Platform (ESPP)

ESPP proposed outline for product criteria for “Biochars and Pyrogenic Carbonaceous Materials” for the (revised) EU Fertiliser Regulation (“EUFR Biochars”)

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Options for decision

Contaminant limits

OPTION [A]: set specific limits for heavy metals for biochars

OPTION [B]: set specific limits for PAHs for biochars

That is, limits lower (more stringent) than those fixed by the (revised) EU Fertiliser Regulation for all products for each category: organic fertiliser, soil amendment, growing medium, etc

Note that under the revised EUFR, Member States may be able under certain conditions to set lower national limits.

In table of different categories of biochar production input materials:

OPTION [C]: minimum temperature obligation for biochar from animal by-products (other than manure) = 300°C or 500°C – this would represent an “exemption” from the 850° for 2 seconds required in IED and Animal By Products Directives ?

OPTION [F]: limit animal by-products inputs to
- Category 3 animal by-products only (exclude Cats. 1 & 2)
- only accept Cat. 3 if already rendered at 133°C

OPTION [D]: minimum temperature obligation for biochar from manures.
Proposal = NO minimum temperature for manures. See OPTION [G]

OPTION [E]: completely exclude from EUFR Biochars criteria biochars all food wastes

OPTION [F]: limit animal by-products inputs to
- Category 3 animal by-products only (exclude Cats. 1 & 2)
- only accept Cat. 3 if already rendered at 133°C

In the production and contaminant criteria

OPTION [G]: NOT specify minimum process temperature requirement applicable for all EUFR Biochars? Or minimum of 300°C ? 350°C ?

OPTION [H]: minimum temperatures should not apply to start up/stop and should be “average” for batches. This effectively means that any minimum temperature requirement will provide in fact only “partial” guarantee of sanitisation and contaminant treatment. Perhaps this is not relevant for “clean” biochars ?

An alternative would be to have **two types of biochar on the market: “sanitised” = minimum temperature or “not sanitised”**. I can conceive that this might be a solution for sewage or manure, both of which are widely used directly (or after AD or composting) on fields

OPTION [I] remove O/C_{org} ratio



Proposed criteria document outline

1. Context and objectives of this document

This document aims to define outline criteria for validation of biochars for use as fertilisers, soil amendments or growing media under the **(revised) EU Fertiliser Regulation (“EUFR”)**.

These proposed outline criteria will be transmitted by ESPP to the European Commission (DG GROW) with the objective of providing input to the preparation by JRC (European Commission Joint Research Centre) of an annex for “Biochars and Pyrogenic Carbonaceous Materials” to be implemented in the EUFR after completion of the currently-underway Regulation revision process.

These proposed outline criteria have been agreed by most biochar stakeholders which ESPP has been able to identify and contact. Where some stakeholders suggest different criteria for specific points, this is specified in this document. In any case, all stakeholders are free to submit their own proposals independently to the European Commission

Beyond these proposed (revised) EU Fertiliser Regulation (EUFR) criteria, certain quality specifications of biochar (e.g. additional quality criteria, use of only “organic farming” input materials, specific positive list of input materials, sustainability labelled inputs or process, biochar carbon content $C > xx\%$, clean production process ...) can be defined by industry and provided as information for marketing purposes, or be defined in EcoLabel schemes or Certification Schemes. The emissions, industrial safety and other criteria (e.g. waste management ...) of the production process are not covered by the Fertiliser Regulation but by operating licencing (under Industrial Emissions Directive or nationally).

Also, it is proposed to NOT specify limits for heavy metals or for PAH in these “Biochars and Pyrogenic Carbonaceous Materials” criteria, because limits are fixed for these contaminants all fertiliser products / soil amendments / growing media in the EU Fertiliser Regulation (proposed revision). Companies producing biochars with heavy metal or PAH levels lower than the EUFR limits will be able to use this information as a marketing argument. However, we consider that there is no reason to impose additional specific regulatory constraints for these contaminants for biochars, because this would make regulation implementation and understanding by users additionally complex.

OPTION [A]: set specific limits for heavy metals for biochars

OPTION [B]: set specific limits for PAHs for biochars

That is, limits lower (more stringent) than those fixed by the (revised) EU Fertiliser Regulation for all products for each category: organic fertiliser, soil amendment, growing medium, etc

2. General definition of biochar and examples

Biochar is produced from various types of biomass, under controlled pyrolysis: a thermal process whereby organic substances are transformed (partly decomposed) [A] in a low-oxygen (reductive) conditions. The pyrolysis also results in gas and/or oil products (pyrolytic



oils or bio-oils), useable for energy production or chemical industry feed, in addition to biochar.

Torrefaction, hydrothermal carbonisation and coke production are other carbonisation processes whose end products are not covered by this definition of biochar.

Examples of biochar production processes include

- Traditional charcoal stacks
- Rotary kilns
- PYREG patented process
- Wood gasifier (e.g. Spanner RE²)
- REFERTIL
- EPRIDA
-

NOTE: inclusion of a process in this list does NOT imply that these processes necessarily produce EUFR Biochar – for this, the specified criteria must be met

3. Market potential

This section should be completed after agreeing already the main categories proposed in this document. The following should be estimated:

- *EU potential for biochar production (different types ? from different input materials ?), at horizon 2025, 2040*
- *EU market potential (value) for different applications*

4. Different categories of input materials

The objective is not to have a closed and limitative “positive list”, because this prevents or delays innovation (new biochar products, based on currently not-identified biomass materials, wastes or byproducts).

A list of “categories” of input materials does however seem necessary, because specific process parameter and product testing/monitoring requirements should be specified for certain categories of input material, and in order to base criteria for ensuring traceability and quality consistency (production series, see below).

Once agreed in principle, this list (table below) should be referenced to the standardised list of waste 2000/532/EC

In table of different categories of biochar production input materials:

OPTION [C]: minimum temperature obligation for biochar from animal by-products (other than manure) = 500°C – this would represent an “exemption” from the 850° for 2 seconds required in IED and Animal By Products Directives ?

OPTION [F]: limit animal by-products inputs to
- Category 3 animal by-products only (exclude Cats. 1 & 2)
- only accept Cat. 3 if already rendered at 133°C



**OPTION [D]: minimum temperature obligation for biochar from manures.
Proposal = NO minimum requirement for manures**

OPTION [E]: completely exclude from EU FR Biochar criteria biochars all food wastes

For all the categories in the table of input materials below, a treated biomass is considered to continue to be in the same category as the “raw” biomass: e.g. anaerobic digestion, composting, liming, biological treatment (but not combustion/incineration).

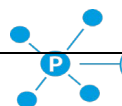
(1) NOTE concerning “Limits”: (1) for mixtures containing proportions or traces of a type of input material, this is the % dry mass limit above which the biochar must conform to specifications relevant for this input material

(2) the word “Clean” is not ideal but is used here for simplicity to mean biochar made from non-sewage, non-animal-origin, non-contaminated input materials



5. Different categories of biochar products based on input materials

<u>Input material</u>		<u>Limit(1)</u>	<u>Specific requirements</u>
A	Animal by-product biochar Meat and Bone Meal and/or slaughterhouse wastes or by-products OPTION [F]	0%	- requirements on PROCESS to ensure sanitisation → 300°C x 30 mins ? 500°C x 20 mins ? OPTION [C] - regular testing of pharmaceuticals, hormones in product
B	Manure by-product biochar Animal manures	10%	- requirements on PROCESS to ensure sanitisation (temperature / time) → NO ? OPTION [D] - occasional testing of pharmaceuticals, hormones in product
C	Municipal sewage biosolids biochar Municipal sewage sludges	0%	- requirements on PROCESS to ensure pharmaceutical removal (temperature / time) → 500°C x 20 mins - regular testing of pharmaceuticals, hormones in product - occasional testing of other organic contaminants such as flame retardants
D	“Clean” biomass biochar (2)		
D1	General “clean” biomass biochar <ul style="list-style-type: none"> • agricultural crop byproducts (straw, maize foliage ...), forestry products (topplings, stumps, bark ...) • collectivity (e.g. parks and gardens, not household) green wastes • biomass from freshwater maintenance • biomass from industries such as paper, textile ... ONLY IF this is collected before any chemical processing. • by-product streams from biorefineries or biofuel production where input is clean biomass 	N.A.	- no specific testing or process requirements - possibly for some food industry inputs, requirement to test and label chlorine or salinity in final product
D2	Saltwater “clean” biomass biochar Biomass from saltwater maintenance (e.g. algae cleaned from beaches), including after processing	30%	- testing and labelling of chlorine or salinity in final product
D3	“Clean food” waste biochar OPTION [E] <ul style="list-style-type: none"> • food and beverage industry waste (NOT containing non-hygienised animal by-products), e.g. sugar factory molasses, beer or whisky industry liquors or sludges ... • collectivity kitchen and canteen food wastes 	10%	
E	Industry/household waste biochar		
E1	Household food and organic waste OPTION [E] Food, green and organic wastes originating from households and municipal collections, separately collected or separated by sorting from mixed solid municipal wastes - subject to showing that impurities (plastics, non-organics, etc) are < 1% dry matter ?	10% total E1 + E2	- possibly for some food or specific industry inputs, requirement to test and label chlorine or salinity in final product
E2	Industry wastes Divers industry biomass wastes or byproducts susceptible to contain synthetic chemicals, e.g. paper industry sludges, separately collected used textile fibres, wood from demolition susceptible to contain paints or treatments ...		
F	Mixed input biochars		- if biochar is produced using a mixture of the more than one of the above input material categories, then the requirements for all included input categories are cumulatively applicable



6. Input materials exclusions applicable for all biochars

Are EXCLUDED all biochars containing the following wastes

- Hazardous chemical wastes, hospital wastes, radioactive materials (not deliberately added to the waste stream)
- MSW Municipal Solid Waste = any waste stream with >5% by weight mixed, unsorted or residual (after separation of organics) municipal solid refuse

For all biochars, feedstock materials must not contain non-organic waste such as plastic, rubber, or electronic scrap (not contain, or must be verified and removed if potentially present e.g. in separately collected municipal organic wastes)

7. Non-biomass and non-organic input materials

In addition to biomass materials, inorganic materials or organic additives may be added either to facilitate the process or improve the final product agronomic characteristics, for example:

- Process catalysts or additives
- Minerals such as calcium, sulphur, lime
- Mineral and organic fertilisers or soil amendments
- Biomass ashes

If such input materials respect EU Fertiliser Regulation (revised) criteria (e.g. for biomass ashes or fertiliser products), then addition is not limited (but the final biochar product must respect the carbon and other product criteria below). If they do not respect or are not subject to EUFR (e.g. stabilised manures), then the final product is a “mixture” of EUFR biochar and other non-EUFR materials, and must be used / sold / regulated as such.

Input materials not respecting EU Fertiliser Criteria (revised), such as catalysts or additives:

- Dose < 1%
- Must respect the biochar product contaminant criteria

8. Traceability of input materials and production process

Each biochar series must be clearly labelled and be given a unique identification number for reconstructing the circumstances of production and guaranteeing the quality of the biomasses used. For each biochar series, complete production records must be kept, including descriptions and dates of any production problems or halts.

These records include the waste/residue documentation for all “waste” or similar materials used (waste / residue producer company and production series identification)

A uniform biochar series is deemed to exist when the following criteria are met:

1. The pyrolysis temperature in °C does not fluctuate more than 20% (continuous monitoring). For small-scale production with a yearly production below 20 t of biochar continuous recording of production temperatures is not required.



2. Interruption of the production is allowed as far as the production parameters are the same after the resumption of production and production during the start-up/close-down phases (production where parameters are not the same) is excluded from the series.
3. The %'s of different types of input materials (based on the categories indicated in §4, where e.g. E1 and E2 are treated here as different categories) do not fluctuate more than 15%: that is, fluctuation of % of EACH feedstock category is < 15%, for example % of category A could fluctuate from 0% to 15%, type B2 from 45% to 60%
4. The production period of the series does not exceed one year including any interruption of the production.

Once any one of these four criteria is not met, the biochar subsequently produced belongs to a new series.

OPTION [H] some stakeholders suggest that the exclusion of non-conform start-up/close-down production is not feasible and that (similarly) in batch processes only the average temperature should be considered. However, this would mean that the minimum temperature requirements (for sanitisation, contaminant elimination) are de facto ineffective.

9. Biochar production process criteria

The production process must respect

- **Temperature: > 300°C for 30 mins or 500°C for 20 mins ?**
- Maintained at all times and throughout the reactor: that is, all input material must reach at least this temperature at some time during processing
- Duration of processing : not necessary to specify

For feedstock types A, B, C (animal by-products, manure, municipal sewage sludge), specific requirements to ensure sanitisation, elimination of pharmaceuticals and hormones ?

OPTION [G]: NOT specify minimum process temperature requirement applicable for all EUFR Biochars?

10. Biochar product criteria

10.1. Carbon

% carbon (C/dry matter) > 10%

- Biochars with %C < 50% must be labelled "Pyrogenic Carbonaceous Material (PCM)"

Test: DIN51732 – **specify Specify EU or ISO standard ???**

10.2. Respirable dust:

Product must not contain > 10% of particles diameter < 100µm (note this is the REACH hazard definition)

Or product should be wetted to 30% - 40% moisture content to avoid dusting



10.3. Hydrogen : organic carbon ratio

The molar H/C_{org} ratio is an indicator of the degree of carbonisation and therefore of the biochar's stability.

$$\text{H/C}_{\text{org}} < 0.7$$

Test: DIN51732 – Specify EU or ISO standard ???

10.4. Oxygen : organic carbon ratio

$$\text{O/C}_{\text{org}} < 0.4$$

Test: DIN51733 or ISO 17247, calculation of O from C, H, N, S and ash is accepted.

OPTION: remove O/C_{org} ratio from criteria

10.5. Heavy metals

Proposal is to not specifically limited for biochars – the (proposed) limits of the Fertiliser Regulation (revised) would apply as for other products (Cd, CrVI, Hg, Ni, Pb, As plus limits above which labelling is required for Cu, Zn)

10.6. Salmonella spp, E. coli, viable weed seeds, macroscopic impurities, stones

Apply the limits proposed EU Fertiliser Regulation limits for organic fertilisers and soil improvers

*Note that salmonella, E. coli and weed seeds will be eliminated at the proposed minimum temperature (see **OPTION [G]**), so biochars should be exempted from this testing if a minimum temperature is defined.*

10.7. Dioxins and furans

Dioxins and furans < 20 ng/kg (I-TEQ OMS). Test: AIR DF 100, HRMS

10.8. PAH

It is proposed to apply the same limits as in the draft Fertiliser Regulation revision for composts, organic fertilisers and organic soil improvers = would apply as for other products : PAH₁₆ < 6 mg/kgDM

Test should be as specified in EUFRs, or DIN EN 15527: 2008-09 (with toluene extraction); DIN ISO 13877:1995-06 – Principle B with GC-MS.

10.9. PCB

PCB < 0.2 mg/kg DM

11. Biochar labelling criteria

Labelling or accompanying transport and delivery documentation shall specify:



- Producer data, identity and location of production site
- Production site operating permit number or reference
- EPR Extended Producer Responsibility certificate number or reference
- Production series number (see above)
- If applicable: REACH registration reference number.
NOTE: at present, it is not clear whether biochar is exempted from REACH (by analogy to composts) or whether it is subject to REACH (as are biomass ashes). Also, the (revised) Fertiliser Regulation may or may not render REACH registration NOT necessary for fertiliser and soil amendment applications.
- Input materials types and % ranges for each one (see above)
- Bulk density
- Particle size distribution
- pH (test: DIN 10 390)
- Water content: (test:)DIN 51718; TGA 701 D4C)
- Specific surface area (test: BET measurement ISO 9277)
- Total P, N, K, Mg, Ca, Fe, Mn (% dry matter)
- Salinity (Na, Cl) – only required in case of certain specific inputs, see \$4
- % of P which is water soluble, NAC soluble
- User information concerning transport, storage and application recommendations

12. Control and monitoring

To be defined ... after agreeing the criteria

