ESPP response to JRC STRUBIAS Interim Report

Draft v3 28/8/17

This document presents the comments of ESPP (European Sustainable Phosphorus Platform www.phosphorusplatform.eu) on the EU Commission JRC Interim Draft Report "STRUBIAS". This report is an impact assessment and "nutrient recovery rules" for struvite (widened to recovered phosphate salts), ash-based materials and biochars, as proposed Component Material Categories (CMCs) for the revised EU Fertilisers Regulations. This report is available online at www.phosphorusplatform.eu/regulatory

See also on this website the ESPP proposal for draft criteria for ash used as a chemical process ingredient for fertiliser production, which is not addressed in the STRUBIAS document.

The comments below present ESPP's overall comments and questions, and a compilation of input received from ESPP members and stakeholder network.

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A. ESPP main comments and questions

A1. Choice by JRC of criteria as the basis of the STRUBIAS report

It is indicated lines 51-59 that:

> *"The JRC assesses STRUBIAS materials against following criteria …"*
> *- I. The material shall provide plants with nutrients or improve their nutrition efficiency, either on its own or mixed with another material [following the definition of fertilising products in the proposal for the Revised EC Fertiliser Regulation];*
> *- II. The use of the materials will not lead to overall adverse environmental or human health impacts;*
> *III. A demand exists for such a recovered fertiliser material, based on the current market and the projected future market conditions*"

ESPP has not found this wording in:
- the draft EU Fertilisers Regulation
- the mandate from DG GROW
- the STRUBIAS "Background Document" of 21/6/16
- the minutes of the STRUBIAS meeting 6-7 July 2016.

We note that the mandate from DG GROW specified: "*assess the suitability and feasibility of developing nutrient recovery rules for struvite, biochar and ash-based products from waste, biological materials or industrial by-products, and where deemed appropriate, will make technical proposals for such nutrient recovery rules*."

We also note that Art. 42.1 of the proposed Fertiliser Regulation text reads:
"The Commission shall be empowered to adopt delegated acts in accordance with Article 43 to amend Annexes I to IV for the purposes of adapting them to technical progress and facilitating internal market access and free movement for CE marked fertilising products
(a) which are likely to be subject of significant trade on the internal market, and
(b) for which there is scientific evidence that the they do not present an unacceptable risk to human, animal or plant health, to safety or to the environment, and that they are sufficiently effective."

In particular, we have the following comments:

- The Fertiliser Regulations (Art. 42.1(a)) refers to **likely significant "trade"** whereas the JRC wording refers to "demand". These are not the same. For example, it is unlikely that there will be "demand" for sewage sludge incineration ash, whereas it is certain that there will be significant trade (consequence of e.g. German legislation requiring phosphorus recovery from sewage). We note that the Waste Directive (2008/98), cited in the STRUBIAS meeting 6-7 July 2016 minutes ($4) refers to "a market or demand". There will indeed be a market for sewage sludge incineration ash, albeit likely at a negative price.

- The criteria used by JRC (I) refers to the **definition of a "fertilising product"** in the draft Fertilisers Regulations (Art. 2(1)). This is used in the Regulations to refer to "CE marked fertiliser products", that is to the finished product, not to the input materials (CMCs), as stated in Recital (6) "*CE marked fertilising products should therefore be divided into different product function categories, which should each be subject to specific safety and quality requirements*". However, **STRUBIAS is not addressing product function categories (PFCs), but CMCs**. Many chemicals authorised as CMCs under CMC1 will not fit JRC's first criterion (line 52-55).

From these two comments, it appears that the definition of new and different assessment criteria by JRC, as expressed in lines 51-59, have resulted in exclusion of sewage sludge incineration ash (and other ashes) where these are chemically processed rather than used directly on land (see discussion below). This is very regrettable and needs to be remedied, as explained below.

We request an explanation of why the assessment criteria in lines 51-59 were chosen and defined as worded and indications as to what other consequences (in addition to the exclusion of processed ash) result from this choice of wording.

A2. Need for new, distinct criteria for ash-as-a-process-ingredient

ESPP considers **the JRC May 2017 STRUBIAS proposed ash criteria are inappropriate for the CMC category of ash used as a fertiliser process ingredient**[i]:

- **nutrient solubility and nutrient content criteria are not relevant**, because the chemical process can solubilise or concentrate nutrients
- **contaminant limits are not appropriate**, because the process can reduce these by extraction processes, in order to achieve the PFC requirements (product for field application). If specific contaminant criteria are considered necessary for ash-based products in additional to those in PFCs[ii] then these should be applied at the 'final fertiliser product' stage, not at the ash-as-an-ingredient stage
  For comparison, the Fertiliser Regulation proposes to limit cadmium in fertilisers, but not to limit cadmium in the phosphate rock being used to produce fertilisers (because the process could include decadmiation)
  Specific contamination limits in the ash may be appropriate for specific incineration-generated contaminants (dioxins, PAH).
- similarly, **limits to respirable particles or particulate contaminants** (lumps of metal or other) or respirable silica are not appropriate, or should be applied at the final product not the ash-ingredient stage, because these can be removed/modified in processing

If a new and different set of criteria are not proposed for ash-as-an-ingredient, then the use of major ash sources for recycling to CE fertilisers will be excluded[iii], in particular sewage sludge incineration ash. For such ashes, nutrient content, nutrient plant availability and/or contaminant limits do not respect the proposed criteria in the JRC STRUBIAS Interim Report – but this is irrelevant if processing ensures concentration of nutrients, modification of their plant availability and/or removal of contaminants.

This is particularly problematic as the new **German (and Swiss) legislation will render obligatory recovery of phosphorus from important volumes of sewage sludge incineration ash[iv]**, which should not be excluded from use in CE Fertilisers. This immediately concerns phosphorus recovery from sewage sludge ash in these countries, but is likely also (by leading to large-scale implementation of technology, demonstration, new technologies, improved economics) to facilitate phosphorus recycling from sewage sludge ash and other ashes elsewhere.

Therefore:

- **ESPP asks that DG GROW specifically request to JRC to start development of an additional STRUBIAS criteria proposal for ash-as-an-ingredient**, including clarifying the distinction from ash-used-directly (after blending, granulation, etc) = existing May 2017 STRUBIAS criteria proposals (subject to consultation)
  This JRC additional criteria development can be to a large extent based on information JRC has already received concerning different ashes and processes. ESPP is fully willing to facilitate collection of any further information needed by JRC from concerned companies and stakeholders.
- **ESPP proposes at www.phosphorusplatform.eu/regulatory, for discussion, an initial proposal for structure / outline of such criteria for ash-as-an-ingredient**
- **ESPP asks that DG GROW support JRC in addressing rapidly this issue**, in particular the questions of : how these new criteria function at the different stages of CMC / PFC in the proposed Fertilisers Regulation ; interactions with End-of-Waste and REACH status ; compatibility with Art. 42(1)[v]

A3. Contaminant removal or dilution in ash-as-a-process-ingredient

It needs to be resolved whether contaminants present in ash used as a process ingredient (e.g. heavy metals such as mercury or lead) must be *removed* in the processing (to a waste stream for disposal) or can acceptably be *diluted*.

This raises questions of political acceptability and of interpretation of the Waste Framework Directive:

- On one hand:
  the EU Waste Framework Directive 2008/98, art. 4(7) states "The reclassification of hazardous waste as non-hazardous waste ***may not be achieved by diluting or mixing*** the waste with the aim of lowering the initial concentrations of hazardous substances to a level below the thresholds for defining waste as hazardous.". Art. 13 of this Directive states "Member States shall take the necessary measures to ensure that waste management is carried out without endangering human health, without harming the environment …" and Commission Guidance (June 2012) states that this should be interpreted as follows: "For example, diluting hazardous substances in recycled products (for example diluting pesticides in recycled plastics products) would increase adverse environmental impacts."
  This appears to only be applicable if the ash is a "hazardous" waste.
- On the other hand:
  it can be argued that the obligation to 'remove not dilute' is not necessary or justified, because if dilution ensures that the final fertiliser product is below the PFC contaminant levels, then (by definition of the Fertilisers Regulation) the final product **does not endanger human health nor harm the environment**, so therefore Art. 13 of the Waste Framework Directive is respected.

In terms of level playing field, it should be noted that it is not required to remove cadmium or other contaminants from phosphate rock to achieve (not yet decided) Fertiliser Regulation limits, a company could achieve limits by mixing high and low contaminant-level rock inputs. If such 'dilution' of contaminants is not authorised for processing of ash to fertilisers, then the principle of a level playing field for recycling is not respected.

A4. Avoid CMC limits and criteria where these duplicate PFC criteria

As a general principle, and to ensure a level playing field between fertilisers produced from recycled materials and those from virgin materials (CMC1), we suggest that the CMCs should not include limits and criteria additional to those in the PFCs, unless there is specific reason to do this.

For example, we suggest:

- Remove 'additional' heavy metal limits proposed in the draft nutrient recovery rules, unless there is data to show that a specific heavy metal is likely to be found in the recovered material concerned and is not found in virgin materials and industrial byproducts (cf. IMCO amendment 281), and there is scientific evidence that the possible levels in the recovered material are susceptible to pose health or environmental risks.
- An exception is dioxins/furans and PAH which are a specific possible pollutant in ashes or biochars (note comment on line 3263 on use of PCB levels as surrogate measure for PCDD/F)
- Remove phosphorus solubility criteria for phosphate salts and ashes as this is ensured in PFC criteria, or simply refer to the PFC criteria

A5. More flexible criteria for nutrients for ash-used-directly

The proposed K_2O + P_2O_5 + SO_3 ratio of ">0.3" (30%) is too high. Bonemeal ashes widely marketed today are between 0.25 and 0.3. We propose to fix this limit a ">0.2" (20%).

We also suggest to widen this to include other nutrients (potassium and magnesium), as is already proposed for biochars:
→ (P_2O_5+K_2O+CaO+MgO+SO_3)/(all oxides) >0,2

The citric acid solubility should preferably be deleted and replaced by reference to NAC (neutral ammonium citrate, which is the most representative test of plant phosphorus availability) OR water solubility OR formic acid. This is conform to specifications and limit values in the draft Fertilisers Regulations (PFC1(C) with the IMCO voted "OR" amendment: IMCO n°133). If the inappropriate 2% citric acid solubility specification is retained, then the limit value should be reduced to 20%.

We suggest that **the phosphorus solubility criteria should be deleted for phosphate salts and ash-used-directly, because these materials will be placed on the market as PFC "mineral" or "low carbon" fertilisers** (IMCO amendment 132), for which phosphorus solubility is already specified in PFC criteria (not the case for biochars which will be sold under other PFCs). Including CMC phosphorus solubility for these two categories is therefore unnecessary and susceptible to cause confusion with the PFC phosphorus solubility criteria (but see our footnote question)[vi].

A6. Widen input materials list for ashes and for biochars

In**put materials list should be widened** to allow industrial wastes, e.g. aqueous, used to adjust processing, where these do not pose risks or compromise ash quality and properties.

Cat. 1 ABP should be authorised as input materials for ashes, as is the case at present.

Sewage sludges should be accepted as input materials for biochars. There is no justification for excluding such an important nutrient recycling input resource, if sewage source control and biosolids selection combined with pyrolysis processes can achieve the STRUBIAS contaminant and safety criteria.

This widening of input materials respects the overall objective that safety should be ensured (for both fertilisers from virgin materials and fertilisers from recycled materials = level playing field) by PFC contaminant limits and safety requirements.

A7. Remove or adjust unjustified contaminant limits

In general, unless there is a very specific reason to expect to find a given contaminant in a given STRUBIAS product (e.g. dioxins in ash-based or pharmaceuticals in non-incinerated products recovered from municipal wastewater or manure), we consider that **"additional" contaminant limits should not be specified, that is the PFC contaminant limits should suffice** (as is the case for e.g. composts, digestates, food industry by-products CMCs).

For example, a **PAH limit for struvite** / recovered phosphate salts is not justified.

In any case the **Sb (antimony) and Mo (molybdenum) limits for ash** (used directly) are unjustified and too low. We would suggest to increase both of these to the same level as As (arsenic) in PFCs.

Overall, **a cost estimate should be provided for the contaminant and quality testing requirements** for all three STRUBIAS materials, as this is a logical part of the feasibility assessment.

A8. Call biochars … biochars

The term “pyrolysis materials” as title of this CMC is technically correct, but not comprehensible to farmers and the market. We propose to modify “*and biochars*” or “*including biochars*”

A9. Avoid fixing rigid time/temperature process criteria for biochars

ESPP suggests that the requirements for ensuring sanitation (animal by products) and degradation of organic contaminants such as pharmaceuticals, **should be ensured by appropriate testing of indicative substances in the final product, not by fixing temperature/time profiles for the pyrolysis process**.

Experience with composting and anaerobic digestion shows that results can be achieved with different processes (depending not only on temperature and time, but also particle size, pH, oxygen conditions …) and that fixing one “profile” in regulation blocks innovation without improving security (some Member States then accept alternative profiles, leading to market confusion).

We also underline that the proposal for >500°C >20 minutes is based in effect on only one study which shows only that 300°C was inadequate and 500°C adequate, but says nothing about whether 400°C or 450°C are adequate. See on the other hand the extensive full-scale operating data from Hiachi Zosen (HITZ) which we understand have been transmitted to JRC.

A10. Widening from struvite to “phosphate salts”

ESPP supports the widening to “Recovered P-salts” (not only “struvite”) as this corresponds to potential processes (e.g. K-struvite, brushite) and to the fact that in some situations the precipitated phosphate will be a mixture of calcium and magnesium phosphates. This is not a problem provided that the farmer is informed of the different nutrient content and that the phosphorus plant availability respects the criteria.

We are opposed however to the <3% organic carbon limit for phosphorus salts. An amendment is currently under discussion in European Parliament (supported by both the mineral and the organic fertiliser industries, and adopted by IMCO n°132) to define within PFC1: mineral fertiliser for C-org < 1% and “low carbon” fertiliser for 1% < C-org < 15% (the level for organo-mineral fertiliser). Adding a new, different cut-off limit for P-salts will cause unnecessary confusion, whereas the organic carbon can be of interest to the farmer (given that its quality is ensured by the list of accepted input materials, contaminant limits are respected, and the level is clearly labelled). Quality and safety are ensured by the PFC specifications for the relevant categories (mineral and “low carbon” fertilisers).

A11. P_2O_5 requirement, drying, coherence with Fertiliser Regulations

The P_2O_5 minimum of 35% for phosphate salts is too high. This level is only applicable to struvite, if struvite is dried at 105°C so destroying it by driving off both the water of crystallisation and part of the ammonium (the material remaining is no longer struvite). Thus, fixing this limit requires use of a drying technique which is not applicable to struvite, and should not be used, and so will cause market misunderstanding (the actual % P_2O_5 even in pure struvite is << 35%, so farmers are not in fact getting 35% …). As specified line 1192, the 105°C proposal will effectively result in having two different drying temperatures, one for testing P_2O_5 and a different one for testing contaminants – this will cause confusion and complication and additional costs. Also, it the 105°C will generally incite industry or other stakeholders to use a drying method which should be avoided.

All references to drying phosphate salts should be deleted and replaced with drying at temperatures which do not destroy struvite molecules.

Furthermore, some calcium phosphates placed on the market as fertilisers today do not respect the 35% limit. A limit of maybe 20% would have to be fixed to cover both struvite (dried without chemical modification, see possible appropriate method standards in our comments on line 4019).

However, we do not understand the logic of fixing a minimum phosphate requirement for recovered phosphate salts, other than that already defined in the draft Fertiliser Regulation for straight solid inorganic macronutrient fertilisers PFC1(C)(I)(a)(i) or for compound solid inorganic macronutrient fertilisers PFC1(C)(I)(a)(ii), page 8-9 of Annex II. If struvite or other phosphate salts are placed on the market as inorganic fertilisers, whether they be manufactured from virgin chemicals (CMC1) or recovered, they will have to respect these minimum P_2O_5 levels (12% P_2O_5 for a phosphate fertiliser): why should recovered phosphate salts have to also respect a different and higher P_2O_5 minimum. This is not a level playing field and will cause market confusion.

We recommend to remove the minimum % P_2O_5 and to refer only to the PFC requirements.

Also, the proposed 40% solubility in citric acid is too high for phosphate salts, and is not appropriate as the only P-availability test (for all three STRUBIAS materials). We suggest in any case to simply refer to PFC1 phosphorus availability requirements (with the proposed European Parliament amendments of citric acid, water "OR" NAC). Neutral Ammonium Citrate (NAC) is also a good indicator of plant phosphorus availability. The criteria (if this is not added into PFC1) should specify water solubility OR citric acid OR NAC

Also for coherence with the Fertilisers Regulations and to ensure a level playing field, the PAH limit for biochars the same limits as in the draft Fertiliser Regulation revision for composts, organic fertilisers and organic soil improvers: $PAH_{16} < 6$ mg/kgDM.

B. Specific comments on the Interim Report text, line by line

Line no	Comments

15	'STRUBIAS materials can be used as component materials for the different Product Function Categories (PFCs)'. It is unclear if the intention is that struvite would require further processing in order to be considered a PFC. Recovered struvite is often applied as a straight fertiliser and as a blend; it is unclear if this is acceptable based on the draft document.
44	This is an important clause to allow conditioning screening, rejection of tramp material etc.
44	Suggests that STRUBIAS materials should "meet quality requirements so that they can be used directly without any further processing, other than normal industrial practice". It is unclear what is meant by "normal industrial practice".
51	Why are the assessment criteria I-II specified in lines 51-59 different from the mandate t JRC from DG GROW and from the criteria in Art. 42.1 of the draft Fertilisers Regulation ? What other consequences (in addition to the exclusion of processed ash) result from this choice of wording ?
169	It is vitally important that some recognition of "End of Waste " status remains, otherwise the financial and logistical obstacle to using a STRUBIAS material as fertiliser will be overwhelming. This should be ensured by the Fertilisers Regulations
246	If this is satisfied, then there is no need to exclude waste materials as input materials
311	Sustainable Arable LINK Project LK09136 undertaken in the UK by the Agriculture and Horticulture Development Board concluded that struvite outperformed triple super phosphate (TSP) and other P sources: 'The best way of enhancing recovery of fertiliser P was to use struvite (a slightly soluble P compound recovered from wastewater) instead of TSP and place it close to the seed, but best recoveries were still <10%. Placement of struvite proved significantly better than placement of TSP at just one of the ten sites (with potatoes).' The report is attached for information. See document: UK LINK Project LK09136 final report
311	Ostara has invested significantly into Crystal Green (recovered struvite) market development, including extensive research into the mode of action and plant response rates. To date over 175 trials across 13 crops have been undertaken, which has resulted in an initial application focus on crops that show a particularly strong response to phosphorus, such as potatoes and sugar beets. This development effort has allowed Ostara to position Crystal Green as a premium priced alternative to chemical phosphorus fertilisers due to the superior performance, including proven increase in crop yields. The Ostara Pearl technology is currently installed in 14 locations throughout North America and Europe with a combined production capacity of 20,000 tonnes per annum of Crystal Green. Due to the production development effort, some product inventory has been built up since production commenced in 2009, however, Ostara forecasts that their global annual fertiliser sales will exceed their annual production (which is forecast to more than double in the same period) by 2019/2020. In Europe, Ostara are already constrained by supply and have imported Crystal Green from their North American inventory to fulfil sales orders. Ostara's North American market analysis has identified demand for around 45,000 tonnes of Crystal Green fertiliser per annum in potatoes and sugar beets alone and potential for over one million tonnes per annum based upon the crop trials conducted thus far. Equivalent market analysis is currently underway for the European market.
326	Agreed - important
352	We agree chemical extract tests are more practical. If the proposed ratio of 40% (citric acid extraction) cannot be reduced to 20%, as we recommend, then a bioassay test should be permitted as an alternative means of demonstrating plant availability
357	Also other solubility methods should be considered: 1 0.5 M $NaHCO_3$ extraction for alkaline or neutral soils (Olsen-P method); 2. Bray P for acid soils
394	Also K-struvite (potassium ammonium phosphate) can be recovered. REACH registration may have not yet been done because to date the expense is not accessible to R&D or start-

	up pilots.
454	It is stated that “there may be a potential for P-recovery from sludges containing Al-P and Fe-P complexes as input materials for the production of recovered phosphate salt fertilisers”. That is, the ash would be used not as a fertiliser product itself, but as an input material to fertiliser production by chemical processing. Why is this possibility then ignored by proposing criteria only for ash used directly on the field, and not for ash as a chemical process ingredient?
489	The (Ca + Mg)/P > 0.8 requirement makes no sense. This should be removed. This ratio seems to contradict examples in the paragraph 492-504
513	Ostara Crystal Green is applied directly as a fertiliser without further processing as an NP fertiliser type B.2.1 under the current regulation (EC) No 2003/2003.
753	The future completion of CMC11 (ABPs) does not prevent that it is logical to deal specifically with ABPs in each of these three STRUBIAS materials
775	Also line 4021. Ostara successfully demonstrated the techno-economic feasibility of phosphorus recovery from fertiliser production (phosphogypsum) process water. Analysis of nutrient and heavy metals concentrations in Crystal Green produced from this source is consistent with analysis from municipal wastewater sources. We consider that this input material should be added. More data available on request.
908	As explained in 962, and in our comments on 4018, the <3% organic carbon limit for P-salts is not justified and should be removed and replaced by the minimum for “organo-mineral” fertilisers (PFC1B)
916	“metals and metalloids” are independent of organic C – so should be removed here, or the paragraph rewritten
919	PCDD/F, PCB, PAH are independent on organic C content. Rather, they depend on contamination of parent material and / or production technology (e.g. Schimmelpfennig and Glaser 2012 for biochars)
1284	This states that name ”ash based materials” is proposed to cover both raw ashes obtained from the incineration process as well as ashes that have been processed in the aim to partly remove metals etc. which is contradictory to the statement in 44-49 (“without any further processing, other than normal industrial practice”).
1087	The proposal to fix a limit for PAH the same as for digestates and composts (line 1087) is not justified: a possible limit for struvite should logically be considerably higher than for e.g. composts or digestates or biochar, given the higher nutrient content of struvite and consequently lower expected application rates. In any case, the evidence suggests that significantly higher levels are not expected. Overall, there is no reason to expect struvite (as specified in line 587), which does not come from a thermal process, to contain significant levels of PAH. The levels noted in some samples by STOWA (line 898) at 9 mg/kg or others (line 1021) even lower can be considered not significant.
1192	The proposal to have two drying temperatures, one for testing P_2O_5 content, one for testing contaminant content, will result in confusion for industry and for farmers.
1285	Line 1285 states: “whenever the fertilising materials are partly manufactured from ashes, all criteria of CMC "ash-based materials" should be met”. We do think that this is realistic nor acceptable? - If a company uses 5% ash and 95% phosphate rock to produce phosphoric acid which is then used to produce a range of fertilisers (solid, liquid, MAP, TSP …), then it makes no sense to apply the “ash criteria” for PAH, PCB, PCDD/F to each of these products. This would mean a meaningless duplication of testing. - also, this would enable ash with high levels of these pollutants to be used, with the pollutants simply being diluted by phosphate rock which does not contain these pollutants. This may be contrary to the Waste Framework Directive principles.
1292	Ashes from poultry manure and meat and bone meal are also widely used already today as fertiliser
1304	These ashes are not used as a “component” of fertiliser, but directly as such after e.g. pelletisation
1413	This is incorrect as written and should be modified: ABP rules currently allow the use of ash from Category 1 ABP incineration to be used as fertiliser. Ref: ABP Implementing Regs 25

	Feb 2011 - Section 9 in intro – allows use of residues in P fertiliser and the 181 regs are repealed
1424	Phosphorus recycling is focussing on fluidised bed incineration we would suggest the following: Row 1424 “content of slags, bottom ashes and fly ashes shall be less than 3%” – however this is only applicable for ash-used-directly, not for ash-as-a-process-ingredient
1432	And throughout the document. Replace the term waste by residues throughout the document to avoid discussion concerning end of waste criteria
1454	The organic carbon limit is not necessary if installations are operating to the Industrial Emissions Directive requirements (850°C, 2s)
1457	ESPP supports the reference to IED and ABP combustion conditions and also the proposed more lenient conditions for the listed biomass and biowaste input materials
1496	Various industrial wastes/by-products can also be used as additives to improve ash production (combustion process), e.g. aqueous wastes. These should be authorised, beyond the limitative list here, on condition that the final product meets the quality requirements (STRUBIAS, PFC). The list of accepted wastes could either be limitative (using EWC codes for waste materials) or be open subject to the final product respecting quality criteria.
1509	25% max additive is OK
1529	Here should be added, that the limits for “ash based materials” do not apply to the input-ashes in the processes in which components (like metals) are removed, but only to the end product of such processes. The ashes are not directly used as a fertiliser. There should be a clear differentiation between ashes directly used in a fertilisers and using ashes as a feedstock in a fertilising producing process in which several components (for example metals) are removed.
1539	The statement “Based on the information from the STRUBIAS sub-group, thermal post-processing steps are only economically viable if they take place as an integral part of the combustion process for which reason any added materials during the thermochemical approach can be considered as input materials and additives to the combustion process (see requirements stipulated above)” is not true, and will become irrelevant with the regulatory obligations to recover phosphorus from sewage / sewage sludge incineration ash in Germany and Switzerland. The economic viability of the P-recovery processes from sewage sludge incineration ash depend on various parameters (regulatory obligations and context, capacity, P-concentration in the ash, available energy sources for pre-heating, etc.). This phrase should be removed.
1539	Alkaline additives are used in P-recovery from ash for some processes (ash-as-a-process-ingredient) to evoke the required reactions and cannot be considered as belonging to the additives facilitating the incineration and gas cleaning process. Limits in feeding Na_2SO_4 or K_2SO_4 to such processes are not justified nor appropriate: they could be compared to limits in feeding H_2SO_4 to phosphate rock for producing phosphoric acid.
1596	Line 1596 and table summary page 114 line 4022: “post processing” defined as simply “mixing” with virgin chemicals or on-site by-products is inadequate - in the cases cited 1529-1570 there is a chemical reaction, plus in some cases thermal treatment, not simply “mixing” - in many cases, non-virgin chemicals may be used, for example sulphuric acid for the acid process is a by-product e.g. of oil refineries (not an on-site by product as specified) - biobased polymers or similar should be authorised for granulation, if these are conform to the Fertilisers Regulation polymers criteria
1632	Must include Category 1 ABP material – these are already authorised for ashes
1682	The $K_2O+P_2O_5+SO_3$ minimum fraction should be reduced to 0.2 to ensure that a fertiliser material has valuable nutrients but does not exclude materials which are proven to be effective fertilisers.
1682	The $K_2O+P_2O_5+SO_3$ minimum fraction will exclude sewage sludge incineration ash
1705	The statement that “plant availability of P in ash-based materials should be regulated for raw ashes that are directly applied on land as well as for ash-based materials that have been produced from the post-processing of raw ashes (see also section 2.3)” is confusing and should be removed, because the criteria proposed at present do not deal with new materials

	resulting from processing of ash.
1720	Practical on-farm experience with Kalfos ash-based fertilisers in the UK over the last 5 years has shown that a material with a ratio below the ratio proposed is proven to be effective.
1724	Plant availability of phosphorus (for all three STRUBIAS materials): citric acid solubility is not representative, best correlation for various recovered products has shown to be neutral ammonium citrate (NAC) or alkaline ammonium citrate (AAC). See P-REX project results. aWe suggest in any case to simply refer to PFC1 phosphorus availability requirements (proposed European Parliament amendments). Neutral Ammonium Citrate (NAC) is also a good indicator of plant phosphorus availability. The criteria (if this is not added into PFC1) should specify water solubility OR citric acid OR NAC
2038	Ash fertilisers are currently applied up to 1 tonne/ha based on its phosphorus content. The proposed AR of 5 t/ha is therefore exaggerating the accumulation risk by nearly an order of magnitude
2132	In row 2189 No specific limits are proposed for the leachable ash fraction. In table 7/row2132 limits are proposed! We would propose that the limits mentioned in table 7 are only for ashes directly used in a fertiliser without removing any components. If the JRC annexes page 25/38 are studied, these limits will make the reuse of ashes from waste water treatment sludge impossible: in table 7 maximum metal concentration for Mo=20 and Sb=6 is mentioned. Page 25 of Annexes show Sb concentrations varying from 6.9-160mg/kg. Similarly for Mo in our experience the concentration in the ashes are even higher than the maximum concentration of 45mg/kg as mentioned on page 25. Therefore the mentioned limit of Mo=20, would also make recycling of ashes from waste water sludge impossible.
2133	Table7: antimony level of 6 mg/kg seems unrealistically low. This is much lower than for arsenic and is not justified.
2264	These limits should only apply to ashes directly used as fertiliser without removing any components. The limits should not apply to ashes used in a chemical process in which these components are removed. These limits should apply to the end products of such chemical processes.
2371	For ashes which are used directly as a product on fields, the respirable silica criterion should be included as an obligation or labelling (if the product contains respirable silicon it should be further processed to resolve this)
2383	It is not coherent to fix a respirable particle limit (labelling) for phosphate salts but not for ashes. This effectively ignores the fact that some ash products are used directly as fertilisers (not re-processed). We propose to include this limitation in labelling not as a material obligation.
2399	pH limit range is currently proposed is OK, but must not be reduced
2419	The title "Pyrolysis materials" should be questioned. If hydrochars are included in this chapter it must be made clear that hydrothermal carbonisation is a process completely different from pyrolysis. Suggested titles: "Char materials" or "Hydrochars and biochars"
2429	EBC requires a minimum organic carbon content of 50%
2436	It can also be interesting to use nutrient-rich materials for co-composting with nutrient-poor but carbon-rich biochar (cf. Birk and Glaser 2012 or Glaser 2015)
2458	Nitrogen loss is mainly determined by N content of feedstock
2461	Most nitrogen is volatilized as N2O or N2 during thermochemical conversion
2481	There are many studies showing different and results, sometimes positive and sometimes negative and sometimes "no effect" from biochar application. The different results in many cases probably relate to very different types of biochar material: nutrient content or not, physico-chemical properties as well as context of application / use … The following recent study should be referenced. This shows that low-rate application of biochars can enhance yield through nutrient – root interaction, see Schmidt et al., Land Degradation & Development, attached Schmidt Land Degradation & Develc
2491	Use the term "physico-chemical" instead of "physical"

2494	Include a new review article "Kern et al. 2017": Kern J, Tammeorg P, Shanskiy M, Sakrabani R, Knicker H, Kammann C, Tuhkanen EM, Smidt G, Prasad M, Tiilikkala K, Sohi S, Gascó G, Steiner C, Glaser B (2017). Synergistic use of peat and charred material in growing media – an option to reduce the pressure on peatlands? Journal of Environmental Engineering and Landscape Management 25 (2): 160-174. doi.org/10.3846/16486897.2017.1284665.
2535	We would prefer for a number of parameters that the IBI standards are used – see comments below
2551	If chars are only used for energetic purposes, product quality plays a minor role
2578	Avoid the term wet pyrolysis and speak only about hydrothermal carbonisation
2607	this makes the point of no limitations on the pre-treatment of pyrolysis feedstock. Given that in the case of animal slurry - extensive de-watering is need - this is a very useful point. The EUFR needs to reflect this: i.e. no wording which covers pre-treatment.
2609	If "any thermal pretreatment is authorised", this would include pyrolysis, which seems to make little sense ?
2615	"Slow pyrolysis" is defined by reaction time rather than by temperature
2621	Not clear enough, what the product quality criteria are (EBC?)
2621	This directly contradicts what is in the EUFR: Recital 55 "Promising technical progress is being made in the field of recycling of waste, such as phosphorus recycling from sewage sludge, and fertilising product production from animal by-products, such as biochar. It should be possible for products containing or consisting of such materials to access the internal market without unnecessary delay when the manufacturing processes have been scientifically analysed and process requirements have been established at Union level. For that purpose, the power to adopt acts in accordance with Article 290 of the Treaty on the Functioning of the European Union should be delegated to the Commission in respect of defining larger or additional categories of CE marked fertilising products or component materials eligible for use in the production of such products. For animal by-products, component material categories should be expanded or added only to the extent an end point in the manufacturing chain has been determined in accordance with the procedures laid down in Regulation (EC) No 1069/2009, since animal by-products for which no such end point has been determined are in any event excluded from the scope of this Regulation."
2625	"… it is not possible to predict …" – this is not accurate as written, see Schimmelpfennig and Glaser (2012).
2625	Change "Therefore, it does not appear suitable to set strict criteria for production conditions with the aim of making a pyrolysis material with a demonstrated agronomic value." → "Therefore, it does not appear suitable to set strict criteria for production conditions provided the pyrolysis material has a demonstrable agronomic value". Explanation: the responsibility for demonstrating agronomic value lies with biochar producers and their customers i.e. commercial aspects - does the product work, or not. An alternative approach is to leave out all wording after "conditions" since it is self-evident that end users of "pyrolysis materials" will neither buy nor use them if they have no agronomic value. As an alternative, the report could observe that pyrolysis materials will have no market unless they can show agronomic value.
2632	It is stated that organic pollutants and pathogens are "concentrated" in pyrolysis materials. This should be modified. These substances will be mostly degraded, not concentrated. Even PAH and dioxins/furans which might possibly be "generated" are not "concentrated".
2632	This section opens with observations about organic micropollutants in two types of feedstock (manures & animal carcasses). It further (2636 – 2639) notes that the removal of organic micropollutants is a function of the temperature profile and states Lines 2640 – 2648 indicate that "based on research (Weiner et al., 2013; Ross et al., 2016; vom Eyser et al., 2016)" it is claimed that process temperatures of <500C are unable to remove micropollutants that were originally present in contaminated feedstocks. Line 2656 proposes a process temp of >500C & residence time of +20 minutes. Hitz Response & Proposal The Hitz proposal is for a minimum temperature when treating livestock manure (or

wastewater sludge) using pyrolysis of 400 degree Celsius in an oxygen-free atmosphere and no minimum residence time.

Pyrolysis & Biochar Test Parameters
The above proposal is based on an investigation of biochar production using an indirectly heated kiln with a feedstock of pig manure (having 40% water content) and a process temperature of 450 degree Celsius under oxygen-free condition. Multiple samples of biochar were collected during one-week of continuous operation using this feedstock and process temperature.

Outline of Pyrolysis System
The indirect heating kiln consists of double cylinders. The diameter of the internal cylinder is 560 mm and the length is 4.5 m. Raw material is fed into the internal cylinder and hot gas flows through the area between internal and external cylinder. The gas flows against the raw material, i.e. the gas flows from the downstream side of the material to the upstream side. The internal cylinder is heated by the hot gas which comes from the combustion of the gas produced by the pig manure. Temperatures of over 850 degree Celsius are reached in the combustion chamber. The gas from the combustion chamber has a temperature of 700 degree Celsius when it reaches the downstream side of the pyrolysis system. By the time the gas reaches the upstream end of the process it has a temperature of 300 degree Celsius.

Organic Micropollutants
Six common antibiotics, such as tetracycline(TC), chlortetracycline(CTC), oxytetracycline (OTC), doxycycline(DOX), tylosin(TYL) and tilmicosin (CHM) were investigated as target micro organic pollutants because of their abundances in pig manure. Pig manure and biochar of pig manure were analyzed by liquid-liquid extraction or accelerated solvent extraction (ASE), followed by solid phase extraction and quantification by high-performance liquid chromatography mass spectrometry (HPLC-MS/MS). In this study, five organic solvents, citric acid solution, methanol, acetonitrile, toluene and dichloromethane were used for extraction.

Results of tests for Organic Micropollutants.
Concentrations of each pollutant in pig manure were 27 ng/g-TC, 430 ng/g-CTC, 840 ng/g-DOX and 36 ng/g-TYL. By contrast, the concentration of all pollutants were below quantifiable levels for biochar derived from pig manure and processed as above. Specifically: 5 ng/g for TC, CTC and DOX and 10 ng/g for TYL). Oxytetracycline(OTC) and tilmicosin(CHM) was also below quantification levels in all materials analyzed (5 ng/g for OTC and 10 ng/g for CHM).

Hitz Comments & Observations concerning the sources mentioned in the draft Strubias report.

1. Toluene is a more powerful extraction solvent than methanol (used by Ross et al (2016).

2. The paper by von Eyser 2016 considers the presence of micropollutants with process temperatures in the range 90-210 C (& not surprisingly finds them)
The paper by Weiner et al 2013 considers the presence of micropollutants with process temperatures in the range 200/255 C (& not surprisingly finds them)
The paper by Ross et al 2016, considers temperatures of 22, 100, 200, 300, 400, 500, 600 C. The paper finds that micro-pollutants remains at 400 C, but not 500 C. Ross et al do not show any data for micro-pollutants in biochar pyrolyzed in the range 400-500 C

Conclusion
The results obtained in the Hitz study strongly suggest that biochar derived from livestock manure can have organic micropollutants removed through oxygen-free pyrolysis at a maximum temperature of 450 degree Celsius.

	A pyrolysis pilot plant was used to produce samples for the Hitz tests. The pilot plant has a multi-tonne weekly output of biochar and can be considered representative of a full-scale pyrolysis production system both in terms of its operation and the product that it produces.
2664	Use the term “residue” not “waste”
2666	Limit to bio-origin fibres (e.g. cotton, wool) not synthetic fibres
2698	2.6.3.4 Post-processing - this is a good section & needs to be reflected in the EUFR - i.e. what happens post-pyrolysis is largely a matter for those using the material.
2703	The reference “Schulze et al. 2016” regarding the stability of chars after washing can be included to point b) Schulze M, Mumme J, Funke A, Kern J (2016) Effects of selected process conditions on the stability of hydrochar in low-carbon sandy soil. Geoderma 257: 137-145. http://dx.doi.org/10.1016/j.geoderma.2015.12.018
2711	Replace “decomposition” by “conversion”
2742	“Based on the precautionary principle, a positive input material list is therefore appropriate to control adverse environmental or human health impacts.” - who will generate this list (of input materials)?
2753	“In this respect, it is interesting that the upper limit for the scale of individual pyrolysis reactors will likely remain smaller than that of biomass combustion technologies (Boateng et al. This means that pyrolysis may provide an alternative compared to current business-as usual treatment scenarios from animal by-products (e.g. manure) that show a high degree of geographical dispersion.” This is not scientifically justified and adds nothing to the overall aim of the report: to provide a science-based basis and criteria for including biochar in the EUFR. It also misses an important point: pyrolysis systems are scalable in the sense that one or more rotary kilns can be placed in a location depending on feedstock availability. Also if there is a high degree of dispersion (of manure generating farms) - there is usually not a disposal problem. This should be removed.
2769	Limit to bio-origin fibres (e.g. cotton, wool) not synthetic fibres
2775	Animal by-product ABP end-point: line 2775 indicates “Please note that the pyrolysis process can only start once the end product of Regulation (EC) No 1069/2009 has been reached”. However, in some cases the pyrolysis process can itself achieve the ABP end-point. Therefore this phrase should be deleted.
2866	Effects of char materials on GHG emissions are complex and results are somewhat inconsistent. Depends on the type of char, the scale, the nutrient supply etc. Hydrochar for example may reduce N_2O emissions as often shown in lab experiments. Just now the message is that GHG emissions increase after biochar with low C stability are applied. Remove the bold style (2867-2868) and to note considerable uncertainties, which are reviewed in the article of Kammann et al. (2017): Kammann C, Borchard N, Cayuela M, Hagemann N, Ippolito J, Jeffery S, Kern J, Rasse D, Sanna S, Schmidt H-P, Spokas K, Wrage-Mönnig N (2017). Biochar as a novel tool to reduce the agricultural greenhouse-gas burden – knowns, unknowns and future perspectives. Journal of Environmental Engineering and Landscape Management 25(2): 114-139.
2889	Remove the criterion: O/C-org as this depends on process conditions. Most HTC chars have higher O/C ratios (cf. Schimmelpfennig and Glaser 2012)
2889	The O/C-org ratio (paragraph 2.6.5.1) should not be fixed as a standard or limit. This is based on the following rationale: - line 2428 - 2429 of the report notes that "The carbon content of pyrolysed chars significantly varies from 5 % to 95 % of the dry mass" - the report goes on to note (Line 2436 - 2438) that there are two broad types of pyrolyisis material, C-rich and Nutrient-rich. - nutrient-rich pyrolysis material contains carbon with lower concentration than C-rich one. Thus O/C-org ratio of Nutrient-rich one gets much higher than those of C-rich one. The content depends on the feedstock (=raw material) and process temperature, paragraph 2.6.1 (line 2428) of the report. Given the above, setting a O/C-org ratio of 0.7 could lead to the exclusion of biochars derived from animal manures such as pig-slurry which are rich in phosphorous (and have

	O/C-org ratios higher than 0.7). One of the points of the revision of the Fertiliser Regulation is to recycle phosphorous from sources such as animal slurry. It would thus be unfortunate if the use of a low O/C-org ratio excluded animal slurries as a feedstock for biochar.
2902	Refer also to Schimmelpfennig and Glaser 2012
2909	Requirement to declare particle density, specific surface area and volatile matter. This is just an additional cost as farmers/growers would not need this detail of information for soil applied biochars. It is not a requirement of IBI for example
2939	Also most N s volatilized as N2O or N2 causing high C:N ratios of chars
3201	Regarding metal limits for Ba, Co, Sb and V. In order to avoid unnecessary monitoring costs, monitoring of these elements should be waived if it can be justified that the input materials do not contain significant levels (e.g. non chemically treated biomass)
3050	One assertion (cause) and an impact (effect) is claimed in line 3050 and 3051 - extract: “high production costs (as communicated by the STRUBIAS subgroup) for pyrolysis materials have severely restricted pyrolysis applications in real-world agroecosystems.” - dealing first with "cause" - high production costs - the Hitz process has one main cost - that of capital. Whilst you can argue that this is a production cost, once the Hitz pyrolysis process is running - there are very few "production costs". One of the reasons that biochars have seen limited use in the EU is because they are not in the EUFR/ This argument is thus circular and non justified Discussions with fertiliser companies indicate an interest in testing biochars to address the knowledge gap (see Line 3052). Furthermore, fertiliser companies (at least the ones spoken to by Hitz) already tacitly acknowledge the need for fertilisers blended to suit a given location. One company offered 300 different formulae. There is no doubt that biochar would thus be tested in the field by fertiliser companies to see where it works well & makes a difference (& thus the end user will pay to have it) and where it does not.
3070	When biochar / pyrolytic materials fulfil all given requirements, they will all pass an earthworm avoidance test (contrary to most chemical fertilizers). However, such bio-asset tests are expensive and take a lot of time prolongating the obtainment of certification results. The earthworm avoidance tests are not available in most professional laboratories, they are mainly used in universities. We therefore suggest to remove this criterion for biochars.
3152	Just make 1 category of pyrolysis materials, not 2, what about overlaps ?
3215	“contaminants such as hormones, veterinary products and their metabolites” – specify that these are more likely to be degraded than concentrated
3244	PAH maximum level. This is proposed as < 4 mg/kg dry matter. We note that, e.g. IBI standards have < 6 mg/kg and for recovered P salts and ash materials STRUBIAS proposes < 6 mg/kg. Analysis of PAH’s is at the absolute limit for many laboratories, analysis of many of Carbon Gold’s biochars indicate that total PAH’s < 4 mg/kg may not always be achievable. For consistency, we propose a figure of < 6 mg/kg. In addition biochars are sites for microbes that break down PAH’s to non-toxic compounds. Biochars are not applied on an annual basis so accumulation of PAH’s is not an issue here.
3263	ESPP proposes to for biochars to specify that PCDD/F need only be measured if PCB > 0.07 mg/kg, because measurement is expensive and because the PCB limit is expected (for these materials) to provide a reliable surrogate indication of PCDD/F
3388	‘The framework of the proposal for the Revised Fertiliser Regulation indicates that STRUBIAS materials are CMCs, and are not yet products, since product status only applies to PFC materials. Therefore, STRUBIAS materials maintain the legal status of the materials they have been derived from.’ Lack of clarity regarding struvite categorisation as a PFC; contradicts 3495-3497.
3467	Must also include ashes derived from Category 1. These are already today classed as exempt from ABP legislation ie they have ceased to become ABP materials
3495	‘STRUBIAS materials will likely become products when used as substances on their own or in mixtures with other CMCs when compliant with all requirements laid down for the corresponding PFC…’ Implied that struvite can be a PFC; contradicts 3388-3391.
3847	Please correct text as follows: “Saria (UK) processes around 45 kt of MBM to produce ~ 2kt P yr-1 as the P–fertiliser product “Kalfos” (mainly calcium phosphate mineral fertiliser ~21% P2O5 plus potassium, sulphur)”

3937	PYREG mainly sell plants, not operate, therefore the production volume quoted is not relevant and should be removed or replaced by the annual production volume from the plants that they have sold and which (others are now) operating
4018	T recovery rules" proposed are not in the format appropriate for introduction into Annex II of the Fertilisers Regulation as CMC specifications. When and by whom will draft CMC criteria text be prepared?
4018	Nutrient Recovery Rules – A: Product and Labelling – for ash-based materials. It will not be possible for many ash based fertilisers to meet the draft nutrient specification. The K_2O+P_2O_5+SO_3 minimum fraction should be reduced to 0.2 to ensure that a fertiliser material has valuable nutrients but does not exclude materials which are proven to be effective fertilisers. The ratio for bonemeal ashes today sold and used as effective fertilisers is between 0.25 and 0.3. The required ratio for citric solubility should be reduced to 0.2. A product at this level can still provide valuable nutrients to plants; customers wanting higher phosphate solubility will merely choose another product based on commercial and technical realities. The ratio for bonemeal ashes today sold and used as effective fertilisers is between 0.2 and 0.27 for the citric acid solubility test and between 0.23 and 0.32 for the neutral ammonium citrate solubility test.
4018	For ash based materials, the (K_2O+P_2O_5+SO_3)/(all oxides) ratio should be replaced by (P_2O_5+K_2O+CaO+MgO+SO_3)/(all oxides), to cover all nutrients, as is already proposed for pyrolysis materials, and the limit reduced from 0.3 to 0.2
4018	For pyrolysis materials, the (P_2O_5+K_2O+CaO+MgO+SO_3)/(all oxides) ratio should be set at < 0.1 rather than <0.15 as currently proposed, in order to not exclude biochars with higher organic carbon value and lower mineral nutrient content.
4018	If citric acid solubility is not deleted, then for all three STRUBIAS categories, the required ratio for citric acid solubility should be reduced to 20% of total P.
4018	For all three STRUBIAS categories, replace the 2% citric acid (phosphorus) / total P by NAC (neutral ammonium citrate) phosphorus solubility test
4018	Ash based products – the organic carbon (3%) limit is not necessary for class B ashes, as these are coming – BY DEFINITION 4022 "Core Process" - from IED installations which require <3% C-org (as explained at1405). Therefore, delete this requirement for Class B ashes (add under "Core Process" that this is an IED requirement).
4018	The <3% organic carbon limit is not necessary for P-salts and should be replaced by the lower limit for organo-mineral fertilisers (PFC1B) in the Fertilisers Regulations. If the "mineral"/"low organic carbon" fertilisers amendments are adopted (mineral < 1% C-org) then having an additional, different cut-off for P-salts will cause confusion in the market for no justified reason (as explained in 962).
4018	Nutrient Recovery Rules - A Product and Labelling – The K2O+P2O5+SO3 minimum fraction will exclude sewage sludge incineration ash.
4019	Drying of struvite at 105°C is not possible: loss of water of crystallisation and loss of ammium (destruction of the struvite molecules). Suggest to refer to the following two standards - Association of Fertilizer and Phosphate Chemists AFPC, Methods of analysis for phosphoric acid, superphosphate, triple superphosphate and ammonium phosphates, No 2 Free Water, B. Vacuum desiccator method - under development: ISO/AWI 19745, Determination of Crude (Free) water content of Ammoniated Phosphate products -- DAP, MAP -- by gravimetric vacuum oven at 50 °C http://www.iso.org/iso/home/store/catalogue_tc/catalogue_detail.htm?csnumber=66222&commid=52376
4019	Nutrient recovery rules- ash-based materials and biochars: increase Sb and Mo limits to same levels as for arsenic in PFC1C (60 mg/kg), or at least to the level for Mo in UK Poultry Litter Ash end-of-waste protocol (45 mg/kg)
4019	Ashes: Mn limit – avoid reference to bioassay test – ambiguous (which test, what results?) and expensive
4019	Regarding metal limits for Ba, Co, Sb and V. In order to avoid unnecessary monitoring costs, monitoring of these elements should be waived if it can be justified that the input materials do not contain significant levels (e.g. non chemically treated biomass)
4019	Total carbon content – biochars: should be modified to "organic carbon". Content of

	inorganic carbon (e.g. in carbonate) is not relevant to biochar properties.
4020	PCB, PAH, micropollutants, … : why not the same thresholds for all those materials covered by STRUBIAS for which these are pertinent (ash, biochars). Neither are relevant for struvite/phosphate salts.
4020	For biochars, apply the same limits as in the draft Fertiliser Regulation revision for composts, organic fertilisers and organic soil improvers: $PAH_{16} < 6$ mg/kgDM
4020	For PAHs, for biochars: extraction with toluene should be specified because PAHs can be strongly adsorbed to the biochar matrix, so that PAH analysis methods adapted for soils may not accurately detect PAH present in biochars. Proposed text method: DIN EN 15527: 2008-09 (with toluene extraction); DIN ISO 13877:1995-06 – Principle B with GC-MS
4020	The particle size (respirable dust) criterion should be a labelling requirement (not an obligation), at the same level for all STRUBIAS materials, because this criterion is irrelevant if the material is used as an input to a fertiliser manufacture or granulation.
4020	For ashes which are used directly as a product on fields, the respirable silica criterion should be included as an obligation or labelling (if the product contains respirable silicon it should be further processed to resolve this)
4020	Why are “Macroscopic impurities (organics, glass, metal and plastics > 2mm)” left blank for ash and for pyrolysis materials? These are relevant quality criteria.
4020	E. coli are eliminated by the temperature/time profile of biochar production, therefore the reference to PFC should be removed.
4020	For biochars – specify that PCDD/F need only be measured if PCB > 0.07 mg/kg. The REFERTIL project www.refertil.info and the WESSLING Group laboratory have investigated seven different biochar series from five EU countries. Even in low end technology performance cases PCDD/F limits were significantly below the targeted < 20 ng/kg (I-TEQ OMS) limit. Therefore, REFERTIL recommends: a) PCBs: <0.2 mg/kg DM (PCB7 sum of PCBs 28, 52, 101, 118, 138, 153 and 180. Indicator for PCDD/F). TEST: EN 16167:2013 b) PCDD/F: <20 ng/kg (I-TEQ OMS) (mandatory measurement only if PCB >0.07 mg/kg). TEST: CEN/TS 16190:2012 The application of PCBs as PCDD/F indicator is efficient, reliable and cost-effective, because PCDD/F measurements are rather expensive.
4020	For $H/C_{\text{-org}}$ for biochars, specify Test: DIN 51732:2014-07 Testing of solid mineral fuels - Determination of total carbon, hydrogen and nitrogen - Instrumental methods
4020	When biochar / pyrolytic materials fulfil all given requirements, they will all pass an earthworm avoidance test (contrary to most chemical fertilizers). However, such bio-asset tests are expensive and take a lot of time prolongating the obtainment of certification results. The earthworm avoidance tests are not available in most professional laboratories, they are mainly used in universities. We therefore suggest to remove this criterion for biochars.
4020	It is suggested that the authors make an estimation of the analytical cost for their suggested certification program. The EBC analysis already cost currently 710 Euro. With the proposed program these costs will rise to more than 2000 Euro (per sample). Especially the PCDD/F and PCB analyses are very expensive (> 1000 Euro) and not yet standardized for biochar materials. We think there are sufficient publications to show the very limited risks. Moreover, most of the suggested analyses can currently only done by one professional laboratory it should therefore really be investigated how realistic some of the analytical exigencies are.
4021	Ash-based materials, class B: remove the exclusion of ABP Cat.1, these are currently authorised as inputs and are no longer classified as ABP after incineration under IED conditions (as specified here for class B ashes)
4021	Phosphate salts: Input materials: under “specific” food processing industries, we suggest to not limit to only potato treatment with sodium acid pyrophosphates and to food processing with “no chemical substances and additives”, but rather to indicate any food industry using only “food additive” authorised chemicals. Why exclude food processing where vinegar or alcohol or salt have been used ? More generally, a number of vegetable processing and other materials are specified in other CMCs: we propose to authorise struvite recovery from other CMCs (e.g. any CE-labelled digestate). This ensures coherence.
4021	Pyrolysis materials: sewage sludges should not be excluded. There is no justification for

	excluding such an important nutrient recycling input resource, if sewage source control and biosolids selection combined with pyrolysis processes can achieve the STRUBIAS contaminant and safety criteria.
4022	Phosphate salts: Additives - polymers and other flocculants may be used in either recovery of precipitated salts from solution or granulation. These are accepted in the current proposal if from "virgin materials". Propose to add also polymers as authorised by the EU Fertilisers Regulation CMC 10.
4022	Ash-based materials - "post processing" defined as simply "mixing" with virgin chemicals or on-site by-products is inadequate - in the cases cited 1529-1570 there is a chemical reaction, plus in some cases thermal treatment, not simply "mixing" - in many cases, non-virgin chemicals may be used, for example sulphuric acid for the acid process is a by-product e.g. of oil refineries (not an on-site by product as specified) - biobased polymers or similar should be authorised for granulation, if these are conform to the Fertilisers Regulation polymers criteria
4022	Pyrolysis temperature and time conditions are proposed: this contradicts - line 2621 which states "With product quality of primordial importance, it is proposed not to impose any constraints on the pyrolysis process, as long as the output material meets the product quality criteria" - line 2614 - Line 2623 which list various pyrolysis processes (& typical temperatures) & ends with the comments: "no process constraints provided output material meets product quality criteria" - Line 2625 - Line 2630 which note that molecular structures and agronomic properties are NOT predictable based on temperature profiles - & ends with the statement "Therefore, it does not appear suitable to set strict criteria for production conditions with the aim of making a pyrolysis material with a demonstrated agronomic value."
4022	Nutrient Recovery Rules ash based materials – B Input Materials. This list needs expanding and defining in terms of EWC codes for waste materials. The principle should be to allow wastes such as compost and AD plant liquors (19 .. .. codes), aqueous wastes from for example detergent and pharmaceutical manufacturers (07 .. ..) provided the product meets the specification agreed in the Nutrient Recovery Rules Part A. Aqueous wastes are very important for some production processes as a means of controlling combustion and emissions. The effect of an aqueous waste on the product is minimal or insignificant and is easily and effectively controlled by input material sampling and analysis. For example, the full list of input materials for the Kalfos UK production plant under the Environment Agency End of Waste requirements is available on request.
4022	Ash-based products – Core process – the ABP regulation allows (in addition to the IED incineration requirements) possibility to respect 0.2 seconds at 1100°C. This should be added for Class B ashes.
4022	Nutrient Recovery Rules – ash-based materials – additives (max 25%). Specify that this is "as wet weight" and as % of input into combustion process.
4100	See comments concerning market potential of recovered struvite under line 311

[ii] The STRUBIAS report proposes for phosphate salts to apply the same criteria where these are reprocessed chemically (to produce another fertiliser product) as when they are used directly on the field. ESPP supports this for these products, because reprocessing will probably be a minor route (in terms of quantities and economic value) and for simplicity it is easier to apply the same criteria. Also, these salts are very similar to fertiliser products, so two sets of criteria would lead to ambiguity. This is not the case for ashes, where different ashes are completely different in agronomic properties (sewage sludge incineration ash, meat and bone meal ash) and where chemical reprocessing will probably be the only route for some types of ash (sewage sludge incineration ash).

[ii] the JRC May 2017 STRUBIAS proposals suggest limits for B, Ba, Co, Mn, Mo, Sb and V. ESPP is currently consulting stakeholders and may propose justification that some of these limits be removed, adjusted or only applicable in case of certain input materials – however we do accept the principle that some such specific heavy metal limits may be appropriate for elements not limited in the PFC annexes and susceptible to be found at significant and potentially concern-raising levels in ashes

[iii] a fertiliser product manufactured using ash as a main ingredient, or even ash as a small part of ingredients (e.g. alongside phosphate rock), cannot be CE labelled under CMC1 (because ashes are a waste), even if the final product produced is a standard mineral fertiliser (such as DAP or TSP …) which would be covered by CMC1 if produced entirely from virgin materials (phosphate rock). The currently proposed "industrial by-products" amendment to CMC1 – if adopted - will not and is not intended to resolve this because ash is a waste, not a by-product.

[iv] The German regulation is expected to require at least 80% recovery of phosphorus from some 300 000 tonnes/year of sewage sludge incineration ash

[v] Art. 42.1 (if not amended) effectively defines the conditions for adding new CMCs: (a) which are likely to be subject of significant trade on the internal market, and (b) for which there is scientific evidence that the they do not present an unacceptable risk to human, animal or plant health, to safety or to the environment, and that they are sufficiently effective. It needs to be clarified how the criteria in (b) are applicable for "ash as an ingredient" in that the ash itself does not need to be safe or effective, if the chemical processing it undergoes renders it so in the final product placed on the market.

[vi] The following question should however be verified: it should not be possible to place on the market as "mineral" phosphate fertiliser (PFC1(C)(a)(i)) a blend of a recovered phosphate salt with low phosphate solubility mixed with a virgin fertiliser with high phosphorus solubility, to "just" achieve the PFC solubility limit. If this is an issue, then the CMC phosphate salts should simply require conformity to the PFC phosphorus solubility criterion, and avoid specifying other specific/different phosphorus solubility limits.