European Sustainable Phosphorus Platform
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To **Sabine Jülicher,** Director, Food and feed safety, innovation (SANTE.DDG2.E)
European Commission, 1049 Bruxelles, Belgium Sabine.Juelicher@ec.europa.eu

7th May 2021

Dear Dr. Jülicher,

Following our letter of 20th October 2020, we discussed with you at our telcon of 21st January 2021 the questions posed by Art. 6(1) and Annex III $1 and $5 of the Animal Feed Regulation 767/2009 which exclude materials derived from manure "*irrespective of any form of treatment*" and from municipal or industrial wastewater "*irrespective of any further processing*" and the obstacles this poses for the nutrient Circular Economy.

Our discussion at this telcon was very positive, and on this point we understood that you could request an opinion from COM legal services. You requested that we provide you with further information.

We have therefore contacted companies concerned (operating or developing relevant nutrient recycling processes), both ESPP members and other operators in Europe whom we have identified either within our network or via contacts. **We attach for your information the table of information collected**. This does not claim to be exhaustive, but probably covers most operators in Europe with full-scale or pilot plants (not R&D).

To summarise, we suggest that there are probably three main routes relevant today:

- **"A" (for acid) in the table:** production of phosphoric acid or phosphate chemicals (e.g. calcium phosphate) from sewage sludge incineration ash. The phosphoric acid is are then placed on the market as a commodity chemical, which could be used in animal feed production. The phosphate chemicals can be appropriate for direct use in animal feed, or can be placed on the market as commodity chemicals;
- **"G" (for gas) in the table:** production of nitrogen chemicals from ammonium gas "stripping" from sewage, manures or digestates. Again, these would be placed on the market as commodity chemicals, and so could be used in production of animal feed;
- **"B" (for biomass) in the table:** use of wastewater or manure (or digestates of these) to feed production of algae or other biomass, processed directly, or as chemical extracts, to animal feed.
- Note also **"X" in the table:** not concerned, or not industrial scale today.

The levels of possible pathogen risk are different for A, G and B:

- **for A,** we would suggest that the pathogen risk can be considered as zero, in that the starting point is incineration ash (subject to incineration under IED conditions of 850°C etc), and additionally the ash is then acid attacked;
- **for G**, evidence may need to be gathered to prove that pathogens are not transferred through the gas scrubbing and chemical processing;
- **for B**, case specific risk assessment may be necessary.

Would it be possible to organise a further telcon with yourself and your services, after you have had time to consider the information attached, to discuss how to take this further, and what additional information is now appropriate?

We thank you for your attention and look forward to hearing from you.

Yours sincerely

Ludwig Hermann, President

Summary of some processes currently operational for recycling nutrients from wastewater to animal feed use :

	Company and process, website and contacts, state of implementation	Process route technical summary	Product safety	Product use in feed and regulatory challenges
A	**Precipitated calcium phosphate (PCP) from sewage sludge incineration ash (SSIA)** EasyMining: Ash2Phos process http://easymining.se/ Contact: Jan.svard@ragnsells.com and Christian.kabbe@easymining.se Full scale plants in planning/permitting: - 30 000 t/y ash, Sweden - 30 000 t/y ash, close to Bitterfeld, near Berlin - further projects underway ***NOTE: this process could in the future also take as input other ashes rich in phosphorus (e.g. meat and bone meal ash, manure ash).***	Sewage sludge ash is incinerated to produce sewage sludge incineration ash (SSIA). Incineration (generally) respects IED criteria: 850°C, 2 seconds. SSIA is leached with hydrochloric acid at pH < 2. Phosphorus (as PCP) and iron and aluminium compounds are separated from the acid leachate and from each other by specific dissolution and precipitation reactions. The other streams from the process are valorised or recycled: - Acid – purified and reused - Iron, aluminium compounds – recycled to wastewater treatment - Sand remaining from the ash: construction industries	All pathogens and organic contaminants (e.g. pharmaceuticals, microplastics) are eliminated in the sludge incineration. The PCP has low heavy metal levels due to removal in process purification steps (concentration < 5% that in ash). Dioxins and organic contaminants are not detectable.	Because of its high purity levels, the PCP can be used directly in animal feed. It is >85% digestible in citric acid. The legality of this is unclear because the Animal Feed Regulation 767/2009 art. 6(1) and Annex III $5 excludes "*All waste obtained from the various phases of the treatment of the urban, domestic and industrial waste water … irrespective of any further processing*".
A	**Phosphoric acid from sewage sludge incineration ash (SSIA)** Remondis: TetraPhos process. Full scale plant: Hamburg, Germany, start-up underway, 20,000 t/a ash www.phosphorrecycling-hh.de and www.phosphorusplatform.eu/Scope129 Técnicas Reunidas : Phos4Life www.phosphorusplatform.eu/Scope119 Contact: agalindoc@trsa.es Full scale plant (30,000 tons t/y ash) planned in Solothurn, Switzerland Parforce www.parforce-technologie.de Batch pilot (1 t/day ash) has been tested. Prayon - 4 000 t/y ash demonstration plant operational in Varna, Bulgaria (previously Ecophos) Contact: Hubert Halleux hhalleux@prayon.com ***NOTE: these processes could in the future also take as input other ashes rich in phosphorus (e.g. meat and bone meal ash, manure ash).***	Sewage sludge ash is incinerated to produce sewage sludge incineration ash (SSIA). Incineration (generally) respects IED criteria: 850°C, 2 seconds. SSIA is leached with phosphoric, sulphuric, nitric or hydrochloric acid. Resulting phosphoric acid is then separated and purified: calcium sulphates precipitate as gypsum, solid/liquid separation, solvent extraction, nono-filtration and/or membrane dialysis. The phosphoric acid is generally then concentrated using secondary heat. Gypsum can be recycled to construction industry and separated iron/aluminium salts to wastewater treatment.	All pathogens, organic contaminants (e.g. pharmaceuticals, microplastics) are eliminated in the sludge incineration.	The produced phosphoric acid is a commodity chemical, placed on the market with a value depending on the purity level achieved (contaminant metals, e.g. iron) and concentration. Customers will mix with other sources of acid and use in trading and use in factories which generally process phosphoric acid to a range of applications such as fertilisers, cleaning products, animal feed, human food, chemicals, metal treatment, pharmaceuticals. Factories using phosphoric acid will often sell to several markets, in that the processing results in products with different quality characteristics adapted to different markets. The exclusion of materials processed from wastewaters under 767/2009 (see above) makes the legality of this unclear. It is not economically feasible to market the resulting commodity phosphoric acid with traceability / labelling "must not be used in animal feed"

Summary of some processes currently operational for recycling nutrients from wastewater to animal feed use :

	Company and process, website and contacts, state of implementation	***Process route technical summary***	***Product safety***	***Product use in feed and regulatory challenges***
A	**Animal feed grade phosphates from sewage sludge incineration ash (SSIA).** Prayon - Get-More-P: currently at the R&D/pilot stage - hydrochloric acid leaching – DCP production: 4 000 t/y ash demonstration plant operational in Varna, Bulgaria (previously Ecophos) Contact: Alexandre Wavreille AWavreille@prayon.com ***NOTE: these processes could in the future also take as input other ashes rich in phosphorus (e.g. meat and bone meal ash, manure ash).***	"Get-More-P" process: ash is leached with dilute sulphuric acid, then neutralised with calcium, precipitating gypsum. After filtration and a second neutralisation, animal feed grade DCP (di calcium phosphate) is produced. Ecophos process: ash is leached using hydrochloric acid, then purified by ion exchange, producing animal feed grade DCP (di calcium phosphate).	All pathogens, organic contaminants (e.g. pharmaceuticals, microplastics) are eliminated in the sludge incineration.	Animal feed grade DCP (di calcium phosphate) is produced. As above, the exclusion of materials processed from wastewaters under 767/2009 (see above) makes the legality of this unclear.
X	**Other processes: from sewage sludge or from SSIA (ash) to phosphoric acid or to commodity chemicals (e.g. calcium phosphates).** ***NOTE: these processes could in the future also take as input other ashes rich in phosphorus (e.g. meat and bone meal ash, manure ash).***	**Extraphos (ex. Budenheim, now Remondis)**: CO2 extraction process was tested at pilot scale, but development is currently on hold. Contact info@remondis-aqua.de **Italmatch / Recophos**: thermal P4 process, current at pilot development stage. Not relevant, in that the resulting P4 has higher-value markets (industrial chemicals) and is unlikely to be used in animal feed phosphates. Contact: carlos.galeano@phos4ever.com	Not discussed here. The thermal P4 process operates at c. 1500°C so all pathogens and organic contaminants are completely eliminated.	Not proposed for current discussion.
X	**Potassium salts from municipal solid waste incineration.** EasyMining – Ash2Salt process			Not concerned by current discussion: there is no regulatory problem for use in animal feed, because 767/2009 excludes "Solid urban waste" from animal feed but does NOT extend this exclusion to materials processed from this waste
G	**Nitrogen recovery by stripping of ammonia gas from digestate after anaerobic digestion of manure or sewage sludge, or from manure upstream of anaerobic digestion, or from other manure treatment processes** From sewage sludge digestate: Turku WWTP + Gasum Biogas plant processing 70,000 t/y sewage sludge and recovering N from digester to ammonium salt. https://www.turunseudunpuhdistamo.fi/in-english - Jarkko Laanti jarkko.laanti@turku.fi	Manure/slurry or sewage sludge is treated in an anaerobic digester (AD) to produce biogas (methane) and digestate. In particular, biogas plants taking other inputs such as biomass or food waste will often also intake some manure to improve biogas production, logistics and economics. In the AD process, nitrogen in input materials is partly transformed to ammonium in soluble form in the digestate.	The ammonia products may contain volatile impurities present in the digestate, e.g. sulphur compounds, carbonate. R&D and analysis are needed to assess to what extent: - pathogens may are transferred from digestate/liquid to the stripping air/gas,	The nitrogen salts or ammonia solution can be sold to the chemical industry as a commodity chemical. As for phosphoric acid above, the producer cannot feasibly guarantee that it will not then be used for production of animal feeds. The AD process may be operated such as to achieve an ABP End-Point (70°C, 1 hour, 12 mm). This is the case in Turku. In this case, there is no legal problem to use ammonia

Summary of some processes currently operational for recycling nutrients from wastewater to animal feed use :

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	From digesting sewage sludge: Acqua&Sole Cassinazza, between Pavia and Milano, a thermophilic HSAD (High Solids Anaerobic Digestion) process coupled with side-stream ammonia stripping, recovering N as ammonium sulphate. Anaerobic digestion process capacity is 120,000 ton/y sewage sludge (wet weight). https://neorisorse.net/ From manure digestate: Nijhuis Industries AECO-NAR please add examples of operational sites (place, tonnes/year …) https://www.nijhuisindustries.com/solutions/resource-recovery/aeco-nar - contact thijs.wolbrink@nijhuisindustries.com From sewage sludge: VEAS (Oslo) municipal wastewater treatment plant (650 000 p.e.) sewage sludge digester. 12-15% of input nitrogen recovered as ammonium nitrate - that is 300 – 500 tN/y http://www.circulary.eu/project/yara-recovery/ From manure digestate, and from manure upstream of a anaerobic digester (to reduce nitrogen levels in the anaerobic digester), without need of separation and chemicals before or during stripping: FiberPlus process, BENAS Gruppe, DE https://benas-gruppe.com/ - u.bauermeister@gns-halle.de From pre-fermentation of manure, upstream of an anaerobic digester (to reduce nitrogen levels in the digester in order to optimise biogas production): Ductor (Haren, near Meppen, Germany) Ductor (Haren, near Meppen, Germany) 15477 tonnes manure per year = 313,5 tN/y recovered. From poultry manure digestate, three Colsen AMFER/POUL-AR plants, one in Kent UK (170 000 t/y digestate) and two in The Netherlands (each 30 000 t/y digestate) Others: VP HOBE, DETRICON	Some ammonia may also come off the AD process along with the biogas, but this is not relevant for the ammonia stripping (recovery) process. Ammonia (and carbon dioxide) are removed from the digestate (or from the liquid fraction of the digestate after solid-liquid separation) by “stripping”. This is generally achieved by a combination of one or more of the following: - changes of temperature - changes in pressure - bubbling of air through the digestate/liquid - bubbling of steam - raising the pH. The ammonia (and carbon dioxide) come off as a humid gas and/or dissolved in water droplets. The ammonia is then recovered, e.g.: - by condensation to produce ammonia solution (e.g. up to 20% ammonia = 16.4 % N with steam stripping). - by reaction with acid (sulphuric, nitric, phosphoric, carbonic …), to generate ammonium salt solution or ammonia solution, - (in the BENAS process) by reaction of the ammonia and carbon dioxide with solid gypsum (a calcium sulphate secondary material) generating aqueous ammonium sulphate solution with ~25% dry matter content and calcium carbonate (precipitate, which is separated from the solution).	- pathogens present in the stripping air/gas may be inactivated by conditions in the stripping gas (e.g. pH, osmotic concentrations, toxicity of ammonia …) - pathogens may be inactivated by the ammonia recovery process and the conditions in the recovered product (acid reaction, chemical solution, …). This R&D/analysis may need to address different gas stripping and ammonia conditions and configurations: temperature, time, pressure, pH, physical, chemical and osmotic conditions, ammonia concentration … It should be noted that were stripping is downstream of an anaerobic digester, the digestion process may ensure an ABP End-Point (sterilisation). A temperature sanitisation process could also be added to treat the recovered ammonia solution, but with energy and process costs.	products produced from the digestate in animal feed production. If the AD process does not provide an ABP End Point , then in the case of manure input, the Animal Feed Regulation 767/2009 art. 6(1) and Annex III $5 excludes “*Faeces, urine… irrespective of any form of treatment or admixture*”. For the case of sewage sludge, the Animal Feed Regulation 767/2009 art. 6(1) and Annex III $5 excludes “*All waste obtained from the various phases of the treatment of the urban, domestic and industrial waste water … irrespective of any further processing*”
X	**Struvite or other ammonia salts from separately collected human or animal urine** Contact: Kai Udert kai.udert@vuna.ch			Not relevant – use in fertilisers – no commodity chemicals market - not intended for use in animal feeds

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B	**Materials extracted from, or biomass of, algae or from aquatic plants (e.g. duckweed *lemnae*) grown using as inputs** **- sewage** **- manure** **- or digestate** from digesters using sewage sludge or manure as input (often along with other inputs such as plant material, green waste, food waste, food processing waste …) **E.g. where algae or plants are used for wastewater or digestate treatment or nutrient removal** Swansea University UK / EU ALG-AD project, Louise Hall l.t.hall@swansea.ac.uk and Claudio Fuentes Grunewald c.fuentesgrunewald@swansea.ac.uk Reindert Devlamynck, Inagro, Belgium: duckweed grown in pig manure reindert.devlamynck@inagro.be Thomas More, Belgium: algae grown in poultry farm wastewater: Floris Schoeters floris.schoeters@thomasmore.be	Algae, micro-algae or aquatic plants (e.g. duckweed *lemnae*) are grown in sewage or manure (or in digestate from sewage or manure), so using secondary nutrients to feed the biomass growth and contributing to wastewater treatment (nutrient removal in particular). The resulting biomass can be used directly as animal feed (e.g. after drying), or chemicals can be extracted from the biomass for use in animal feeds (oils, proteins), or the biomass can be used for production of other chemicals (e.g. extraction of lipids for biofuels) and the resulting left-over biomass may then be used as animal feed.	Pathogens or contaminants may be taken in from the wastewater substrate and may be found in the produced biomass. The EU ALG-AD project used the liquid fraction of digestate as feed for algae production, after membrane filtration (Ultrafiltration 100 Kda or Microfiltration 0.2 microns) and/or UV sterilisation. This has shown to avoid pathogens in the algae biomass.	If the substrate is sewage or manure (or digestate from these), then the 767/2009 exclusions of faeces/urine and of wastewaters, even after treatment/processing might be considered to apply to the biomass grown in the substrate. If the substrate used is digestate, then the AD process may be operated such as to achieve an ABP End-Point (70°C, 1 hour, 12 mm).
B	**Similarly to above, proteins or other molecules produced using bacteria (e.g. single cell protein culture) cultured using as inputs sewage or manure (or digestates thereof).**			