

## **Proposed EU Fertiliser Regulation criteria for recovered struvite**

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### **Introduction**

#### **This document: preparation and objectives**

This ESPP Platform **joint proposal** is based on specific proposals gathered (under confidentiality) from 10 different companies/organisations, representing all identified operators and/or processes producing struvite today in Europe, either in full-scale plants, or in pilot scale test installations and/or struvite technology suppliers.

The objective is to provide outline proposals for “struvite criteria” for consideration for integration into the EU Fertiliser Regulation revision process currently underway. It is expected that this revised regulation will include progressively as annexes a “**positive list**” of materials accepted as EU fertilisers (subject to respecting the regulation specifications). This document proposes an outline definition for “what is struvite” in such a positive list.

It is underlined that ESPP does not claim to in any way substitute the **EU Commission (DG GROW, JRC) competence to define criteria** with adequate content and legal form, and to ensure appropriate stakeholder and administrative consultation. The objective of this joint proposal is to facilitate and accelerate this criteria development. ESPP is open to provide, as far as is possible in consultation with our members and contact network, further information if required.

## Scope

This **proposal covers only struvite** (magnesium ammonium phosphate, EINECS 232-075-2) and, at present, not other potential recovered phosphate products (e.g. recovered DCP, K-struvite, other ...). We suggest that if criteria can be first finalised for the specific substance struvite, then it should be relatively simple to adapt these to other recovered phosphates produced by comparable processes (crystallisation / precipitation) and from the same waste streams.

This proposal covers both struvite placed on the market

- either **as a fertiliser = directly** “as is” or after for example mixing with other nutrient products or after conditioning (e.g. granulation, drying)
- but also struvite as a **raw material (ingredient) for fertiliser production** (non-disseminated intermediate, further processing in a fertiliser factory). Certain criteria (where specified in the proposal) should not be applied (on a case by case basis) if this processing is such that they are no longer relevant (e.g. pathogens, if the struvite is being re-dissolved in strong acid).

*The logic behind applying the same criteria to struvite used as fertiliser and to struvite used as a fertiliser ingredient is*

*a) after discussion, there seems to be no technical reason to require different criteria*

*b) fertiliser factories will generally not want as inputs (in struvite as a fertiliser ingredient) contaminants which are not wanted in struvite as a fertiliser*

*c) in some cases, the “processing” of struvite (struvite as a fertiliser ingredient) may be mainly mixing and bagging. In this case, clearly the same criteria applicable to struvite as a fertiliser should be applied to the struvite as a fertiliser ingredient: simple “dilution” is not an acceptable way of treating contaminants. Because of processing confidentiality, it is not always available information as to whether the processing is such simple mixing or whether it is a more complex process susceptible to modify/eliminate certain contaminants.*

## Reference to EU Fertiliser Regulation revision process

This proposal has been prepared taking into account **current status of the EU Fertiliser Regulation revision** discussions in the EU Fertiliser Working Group (to which ESPP is an Observer): it does not pre-suppose any specific conclusions of these discussions. Nonetheless, the European Sustainable Phosphorus Platform does underline the **importance attached to the finalisation and implementation of the EU Fertiliser Revision** by the different stakeholders (which the Platform brings together), in order to enable a harmonised market and criteria for recovered nutrient products.

## 1. Substrate

*The criteria should allow wide flexibility as to the substrate, subject to the conditions of respecting the purity and contaminant criteria.*

Include struvite recovered from any waste stream, for example but not exclusively

1. municipal wastewater, including municipal sewage sludges
2. manure and livestock stable slurries
3. separately collected food waste
4. organic industrial waste streams: e.g. abattoirs, food industry, food preparation, biofuel/biomaterials production
5. chemical / industry waste streams: e.g. phosphoric acid or fertiliser production, pharmaceuticals production
6. other

In all cases above, this also includes the residues from processing the cited waste streams (e.g. outflow liquor from anaerobic digestion, dewatering, biological or physico-chemical treatment of a given cited waste stream ...)

Exclusions: nuclear and radioactive processing.

Safety of struvite recovered from waste **streams susceptible to contain Animal By-Products** should be ensured by application of this regulation (as modified in coherence with the Fertiliser Regulation revision to facilitate safe nutrient recycling).

For struvite recovered from waste streams other than 1-3 above, any **specific contaminant in the waste stream** which is not covered by the criteria below (e.g. a pharmaceutical product X in a stream from a factory manufacturing X) should be assessed to show that levels are safe (fate in process, analysis of concentration in struvite, risk if detected).

## 2. Recovery process characteristics

*The proposed criteria cover struvite deliberately precipitated, separated and recovered in a specific struvite precipitation/recovery installation, which offers the capacity to adjust and control the struvite recovery process.*

*This struvite recovery installation may also ensure other functions (e.g. sanitisation, solid/liquid separation) or the struvite recovery installation may be an integral part of a larger installation (e.g. precipitation of struvite within an anaerobic digester or composter), but it must include systems specifically to facilitate and control struvite precipitation.*

*There should be an appropriate operating quality procedure defined to ensure that the recovered struvite conforms to these Fertiliser Regulation criteria. The struvite producer should justify that this procedure is adequate for this purpose.*

*Are not covered, e.g.*

- collection of struvite which spontaneously deposits in pipes or digesters,
- precipitation of struvite into digestate or compost, or into other organic products / wastes, from which it is not separated
- struvite which is recovered in a slurry in the waste stream liquor

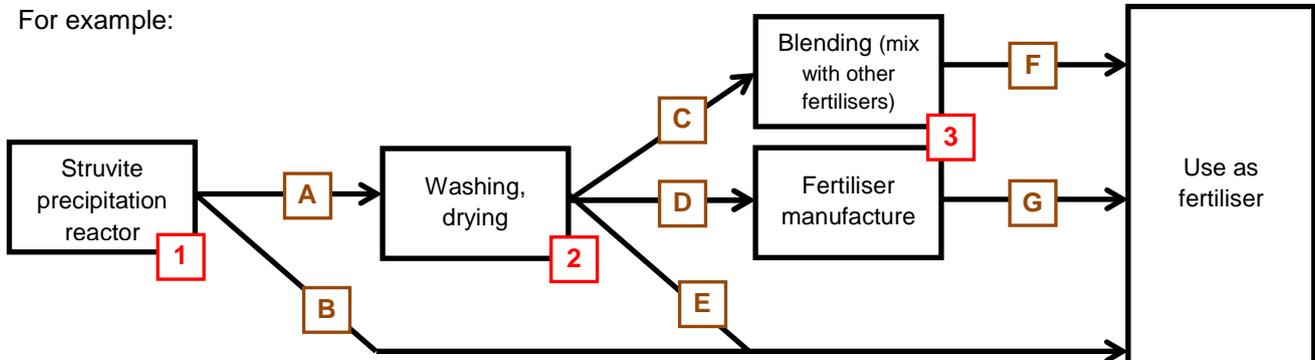
Recovery of struvite is in an installation or system specifically designed to generate struvite (by precipitation or crystallisation) from a solution containing the soluble ions phosphorus, magnesium and ammonium (either present in the substrate waste stream and/or deliberately dosed), and then to extract the struvite in a form in which it can be used as a fertiliser or as a fertiliser production ingredient (see below):

- the struvite recovery installation(s) may also carry out other functions / be integrated into other installations (e.g. filtration or solid/liquid separation, neutralisation, digestion ...) so long as struvite is precipitated, separated and recovered
- depending on the wastewater characteristics, the recovery of struvite may involve the addition of some or all of the following reagents: magnesium, ammonium, phosphate, pH adjustment (alkali dosing or aeration/degassing), coagulants, either within or upstream of the struvite recovery installation
- the struvite recovery process includes the separation of the struvite, e.g. by settling, filtration, centrifugation, bubble flotation, concentration, scraping off precipitation supports, or other technologies, to recover struvite in a form adapted for use as a fertiliser or as a fertiliser production ingredient and conform to these FR criteria
- this recovered struvite may be (optionally and depending on its characteristics and user requirements) washed, dried (e.g. by heat, centrifuge, standing – draining ...), purified, concentrated, sieved/sorted for granulometry, milled or pelletised, packaged, etc

## 2a. Point of application in the process chain

This proposed criteria document covers both struvite recovered for use as a fertiliser (B, E, F below) and struvite recovered for use as a raw material in a fertiliser production process (D below).

For example:



In the above, process steps 1, 2, 3 can be situated in the waste water treatment plant, or elsewhere.

These criteria can be applied to all the arrows (A – F) above, if the producer wishes the struvite at that point to be considered as a product placed on the market at that point in the chain.

Thus, for example, if struvite is recovered in a wastewater treatment plant (1) and transported to a separate installation for washing and drying (e.g. a centralised struvite processing plant), then either

- the recovered struvite conforms on leaving the wastewater treatment plant (arrow A) to these criteria, and can be transported as a EC-mark “fertiliser ingredient” (not a waste)
- it does not conform, in which case it must be transported as a waste or by-product or under local end-of-waste criteria

### 3. Purity requirements

#### 3a. Water content:

These FR criteria cover struvite recovered as a solid or as a “clean” slurry: particles of struvite suspended in water – but NOT, as indicated above, struvite suspended in waste effluent or treatment liquor. Therefore, there is no limit on water content. Water content should however be specified on label (see Labelling).

#### 3b. Struvite content

Although recovered substances are exempt from REACH registration (under Art. 2(7)d, provided the substance has been already registered once), we nonetheless note that REACH guidelines from ECHA suggest that purity should be generally at least 80% (of dry matter) and propose to take this as a general basis for purity definition. However, distinguishing different phosphate / magnesium / ammonium minerals is relatively complicated (e.g. requiring spectroscopy) whereas the key information for the fertiliser user is the content of nutrient ions. The following criteria limits are therefore proposed

NOTE: these proposed criteria are constraints which the product must respect to be considered as “struvite”. They are distinct from labelling specifications.

As % dry matter	Comment	Theoretical % pure struvite (in $MgPO_4NH_4 \cdot 6H_2O$ )	Acceptable purity range	
			80% x theoretical	110% x theoretical
Phosphorus (%P)	Measured as total P	12.6% P	<b>10.0%</b>	<b>13.9%</b>
Magnesium (%Mg)	Measured as MgO	16.4% MgO	<b>13.1%</b>	<b>18.1%</b>
Nitrogen (%N)	Measured as total N	5.7% N	<b>4.6%</b>	<b>6.3%</b>

#### 3c. Total organic content (TOC)

**Total organic carbon in struvite should not exceed the limit fixed for “inorganic” fertilisers in the revised EU Fertiliser Regulation.** This limit is currently expected to be 2 % TOC (of dry matter).

Struvite with higher levels of organic matter can possibly be placed on the market, not as “struvite”, but as an organic or organo-mineral soil amendment, subject to respecting Fertiliser Regulation criteria for that category, without using the term “struvite”. Products consisting of struvite mixed with organic matter, so resulting in a level of carbon (TOC) higher than the above limit, could also be marketed as a mixture of struvite plus an organic or organo-mineral fertiliser, subject to being able to separate out the struvite and the organic/organo-mineral components for analysis, and to each respecting criteria for struvite and for relevant Fertiliser Regulation product categories.

NOTE: Struvite with levels of organic matter below the proposed limit may, if compatible with the revised Fertiliser Regulation Criteria, be sold as either an inorganic fertiliser or as an organic or organo-mineral soil fertiliser if the producer wishes to market them in this segment (rather than marketing as “inorganic” fertiliser).

## 4. Contaminants

**The principle is to oblige, for struvite, to respect all contaminant criteria for all categories of Fertiliser Regulation product (inorganic, organic ...), that is to apply the most demanding criteria in the revised Fertiliser Regulations. This seems feasible with Fertiliser Regulation criteria currently discussed, but will need to be verified as these are finalised.**

*In some cases, struvite has significantly lower levels of contaminants than levels proposed in the EU Fertiliser Regulation revision. It is NOT however proposed to fix specific lower limits for struvite because (a) there is no safety justification for this (the limits in the EU Fertiliser Regulation are intended to ensure safety), (b) this would add unnecessary additional constraints and complication and (c) struvite producers are free to advertise such positive quality characteristics in labelling, as a marketing added-value.*

### 4a. Hazardous contaminants

All Classified or hazardous impurities are < 0.1% (cf. REACH, Classification & Labelling)

### 4b. Inorganic contaminants

For inorganic contaminants, in struvite apply only the limits fixed in the EU Fertiliser Regulation revision (for category "Inorganic fertilisers" unless specified below).

No limits for struvite for inorganic substances which are not limited in the revised EU Fertiliser Regulations: in particular, no specific limits for e.g. Fe, Al, ...

NOTE for information: 2/6/2014 Fertiliser Regulation revision proposal:

#### Limits:

Cadmium	60	mgCd/kgP <sub>2</sub> O <sub>5</sub> – with possibility for lower limits in certain Member States
Cr VI	2	mg/kg dry matter
Hg	2	mg/kg dry matter
Ni	120	mg/kg dry matter
Pb	150	mg/kg dry matter
As	60	mg/kg dry matter

#### Limits requiring labelling

Cu	200	mg/kg dry matter [EU FR proposal: limit requiring labelling in organo-minerals]
Zn	600	mg/kg dry matter [EU FR proposal: limit requiring labelling in organo-minerals]

### 4c. Organic contaminants, pathogens, seeds

For only those organic contaminants for which a limit is defined by the EU Fertiliser Regulation (as revised) for "Organic Fertilisers", or in Fertiliser Regulation criteria for e.g. composts or digestates, then this should be applicable to struvite, taking the strictest limit (as mg/kg dm).

Note: given that organic fertilisers (e.g. composts) are likely to be applied at a much higher rate (in kg dry matter/ha) than is struvite, this is effectively the application of a considerably more protective limit.

NOTE for information: 2/6/2014 Fertiliser Regulation revision proposal:

PAHs (16 congeners)	6	mg/kg dry matter
Salmonella spp	Zero	in 25g
E. coli	1000	CFU/g
Viable weed seeds	2/kg	[adapted: no limit in FRs for organic fertilisers, limit of 2/litre for growing media]

No limits for other organic contaminants (i.e. not covered in EU Fertiliser Regulation).

Where the struvite production substrate, process or final form justify this (e.g. sanitised substrate, use of high pH in process, low organic levels in recovered struvite produced ...), a reduced testing / monitoring regime should be possible.

## 5. Physical quality criteria and general safety criteria

No specific requirements for recovered struvite other than those for “Inorganic Fertilisers” in the revised EU Fertiliser Regulation.

See Labelling regarding respirable dust.

Granulometry / handling, stability, pH, odour ...: no criteria, this is left to market to decide.

## 6. Labelling

Labelling requirements = in addition to EU Fertiliser Regulations requirements.

### **Water content**

For solid recovered struvites, labelling the water content, evaluated by drying at maximum 40-50°C – to be defined (note: higher temperatures should not be used because they lead to loss of crystallisation water. In theory, this occurs at 56°C, in practice there is a risk at lower temperatures if there are hotspots in the drying apparatus).

A recognised method should be used, for example, but with specified lower temperature:

- 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  
[http://afpc.net/?page\\_id=73](http://afpc.net/?page_id=73)

- 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](http://www.iso.org/iso/home/store/catalogue_tc/catalogue_detail.htm?csnumber=66222&commid=52376)

### **Nutrient content, respirable dust, organic carbon, other**

Labelling should specify % **soluble phosphorus**, with a defined tolerance:

- as water soluble P
- and as NAC soluble

If the **organic carbon** content is above a given level (proposal: 0.1% TOC), then labelling should specify the range of possible % organic carbon in the product (as % TOC dry matter), e.g. 0.2 – 0.5% TOC dry matter or 0 – 2 % TOC.

If organic carbon content is below this given level, then this does not have to be specified on the label, but the producer can optionally specify this if wished.

**Respirable dust:** it should be specified in labelling (and handling precautions should be communicated) if the product contains > 10% of particles diameter < 100µm

It should **not be obliged to specify from which waste streams** the struvite is recovered, but this can be included in company marketing.

## 7. Testing and verification

As per EU Fertiliser Regulations requirements for “mineral fertilisers” for all criteria except as for “organic fertilisers” for organic contaminants (note comment above regarding reduced testing regime)