Phosphorus in Sewage Sludge

EurEau

Rue du Luxembourg 47-51,
B-1050 Brussels, Belgium
Tel : +32 (0)2 706 40 80
Fax : +32 (0) 2 706 40 81
BE 0416.415.357
secretariat@eureau.org
www.eureau.org

Summary

Sewage sludge is a valuable source of nutrients - mainly phosphorus and nitrogen - of organic matter, and of energy. Various digested, composted, thermally or chemically treated sewage sludge based fertilizers are locally available and utilized in Europe. EU legislation should not hinder but support current good practises in sewage sludge utilization and phosphorus recycling. Sewage Sludge utilization should be featured highly in a sustainability framework and should be promoted and encouraged by the Fertiliser Regulation review.

Current technologies for phosphorus recovery are not yet mature for extensive use. At the moment it is essential to concentrate on research and development work on phosphorus recovery in order to develop sustainable and more cost-effective solutions.

Strong chemical legislation and effective source control are elemental in urging phosphorus recycling and recovery.

Legislation should support recycling and recovery of phosphorus. We need markets for recovered green phosphorus for closing the cycle in an economically feasible way. Incentives for phosphorus recovery would focus actions to most promising and cost-wise solutions. EurEau suggests that new European wide mechanisms are created to support phosphorus recovery, though from recovery routes with optimal balance between financial viability and total impact on the environment. These mechanisms can be either incentives or requirements to use recovered phosphorus.

Waste water treatment, sludge treatment and recycling of sludge are an entity which should be looked upon as a whole. The entire process of phosphorus recovery must be feasible and sustainable. Local circumstances should be taken into account.

Current legislation should support future possibilities for phosphorus recovery. As long as techniques for phosphorus recovery are not feasible it should be possible to make a long-time storage of the ashes on mono-dump sites as artificial deposits for Phosphorous.

In order to work for a circular economy for Europe EurEau shall be happy to work together with the Commission to develop a policy framework on phosphorus to enhance its recycling, foster innovation, improve market conditions and mainstream its sustainable use in EU legislation on fertilisers, food, water and waste.

1. Introduction

The sustainable use of phosphorus and the recycling of phosphate-based materials as raw materials for fertilisers are subjects under discussion both among the Member States and the European Union.

Phosphorus is one of the essential nutrients for plants, animals and humans and is therefore crucial for all life on the planet. In its natural form, phosphorus only exists as phosphate rocks which are generally spoken – a range of commercially mined phosphorus-bearing minerals. Phosphate rocks are mainly used for the production of fertilisers, but also for the production of detergents and animal feedstock. Phosphate rock is finite and non-renewable. The limited availability as well as Europe's high dependency on import made the European Commission to add phosphate rock to the revised list of Critical Raw Materials May 2014. It also explains why several Member States have already taken steps towards the encouragement of a more sustainable use of phosphorus while supporting its recycling. Some forms of reuse such as manure and sewage sludge spreading are even quite common. Beside of a more sustainable use of mined phosphorus, it is feasible to recycle certain materials to make use of secondary phosphorus. Four starting materials are considered of having potential:

- manure
- waste water and the by-product from wastewater treatment sewage sludge
- animal by-products (e.g. bones)
- food and other green waste (via composting or via ashes).

Existing EU legislation neither encourages a more efficient use of phosphorus nor is it designed with recycled phosphorus as an objective. Hence, further steps have to be taken to foster phosphorus management. The EU is working on an improving market access for some sources of recycled phosphorus, notably through the future revision of the Fertiliser Regulation.

One initiative is a recently launced communication by the European Commission "Towards a circular economy: A zero waste programme " for Europe stating, that "Moving towards a more circular economy is essential to deliver the resource efficiency agenda established under the Europe 2020 Strategy for smart, sustainable and inclusive growth. Higher and sustained improvements of resource efficiency performance are within reach and can bring major economic benefits".

To address specific waste challenges the Commission is considering developing a policy framework on phosphorus to enhance its recycling, foster, innovation, improve market conditions and mainstream its sustainable use in EU legislation on fertilisers, food, water and waste

2. Sewage sludge is a valuable resource

Sewage sludge is a by-product of wastewater treatment, and its amount is rising all over the EU due to the improvement of wastewater treatment. Sewage sludge is a valuable

source of nutrients, mainly phosphorus and nitrogen, but also of organic matter and energy. In many European countries sewage sludge is utilized as a soil improver or fertilizer in agriculture and landscaping. In cases where sewage sludge is digested anaerobically, the produced methane can be utilized in the heat and electricity production or as a fuel for vehicles. Digestate, on the other hand, is a fine fertilizer. Other possibilities to utilize the energy value of sludge are incineration or the use of dried pellets to replace fuels in coal or lignite stoked power stations and in cement furnaces. In the case of incineration the by-product is ash.

EurEau wants to emphasize that sewage sludge should be managed as a resource in line with current EU thinking embodied in various policies like in the EU 2020 flagship initiative on the efficient use of resources.

Quality of sewage sludge has improved constantly. Results from long-term measurements show that concentrations of hazardous metals have drastically decreased. Similar trend can be seen also with other substances indicating that regulation for controlling hazardous substances at source has been successful. Moreover, strict national legislations together with market pressure have led to a situation where we have a wide variety of high quality soil improvers and fertilizers which use sewage sludge as a raw material.

3. Recycling of phosphorus by sewage sludge use

Various digested, composted, thermally or chemically treated sewage sludge based fertilizers are locally available and utilized in Europe. Treated sewage sludge products are widely used in agriculture, green areas and landscaping. Together with the phosphorus, also the nitrogen and valuable organic matter in the sewage sludge is exploited. Organic matter is an important and essential component of soil. Therefore sewage sludge utilization is a good way to increase organic matter in soil in agricultural use.

Furthermore sustainable use of sewage sludge and sludge-based products in agriculture is often combined with digestion and hence adds to promote an increased biogas production. This action is clearly in line with the EU Energy targets for EU 2020.

EU legislation should not hinder but support current good practises in sewage sludge utilization in agriculture, green areas and landscaping. **Sewage sludge utilization should be featured highly in a sustainability framework and should be promoted and encouraged by the Fertiliser Regulation review.**

If sewage sludge cannot be applied as a fertilizer, valuable products such as phosphorus may be recovered from sludge waters, digestates or ashes for other industrial applications.

4. Technologies for phosphorus recovery

EurEau believes that in the future waste water, as well as sewage sludge, will be seen as a resource. A lot of work has been done to develop different methods to better utilize these

raw materials and there are already positive examples on the recovery of Struvite from waste water.

Even though various technologies have been developed for Phosphorus recovery, both economic and technical limitations are preventing its extensive use. Since current technologies for phosphorus recovery are not yet mature for extensive use it is essential to concentrate on research and development work on phosphorus recovery in order to develop sustainable and more cost-effective solutions.

5. EurEau calls for sustainable phosphorus recovery

EurEau brings up the following **three points** as a prerequisite for a sustainable phosphorus recovery:

Point 1. Quality of recovered phosphorus, markets and legislative framework should interact

Various technologies are available for extracting phosphorus from waste water or sewage sludge, resulting in different qualities of recovered phosphorus, often even much better than the quality of mined phosphate. However, recovered phosphorus has not been always interesting for market. The challenge is both in the technological and in communication level to create new pathways for recovered phosphorus to enter the market. Quality of recovered phosphorus and market needs should meet.

There's is not yet a level playing field for recovered phosphorus, like struvite, as national legislations differ. Legislation on a European level is required for developing one European market for recovered phosphorus.

Point 2. Phosphorus recovery must be economically feasible – markets are a prerequisite

As the 'polluter pays' principle applies to wastewater treatment services phosphorus recovery may not result in increased water bills. We need markets and new business models for recovering phosphorus. At the moment phosphorus recovery from waste water or sewage sludge is not economically feasible. Market opportunities for recycled phosphates are essential for closing the cycle and should be broader than the fertilizers industry only. Legislative framework could better support development of cost-efficient and optimal solutions. Incentives for phosphorus recovery would focus actions to the most promising and cost-wise solutions. At the moment it is not clear what raw materials or processes are the best for phosphorus recovery.

Regulation on blending would be a strong incentive for the use of recovered phosphorus. Just as requirements for blending green gas with biogas already exist, there could also be requirements of blending recovered phosphorous with mined fertilizers.

EurEau suggests that new European wide mechanisms are developed to support phosphorus recovery by creating market for recycled phosphorus. These mechanisms can be either incentives or requirements to use recovered phosphorus. Requirements for

recovery are not advisable but effort should be targeted for creating active market environment.

Point 3. Whole process of phosphorus recovery must be sustainable

Waste water treatment, sludge treatment and recycling of sludge are an entity which should be looked upon as a whole. If phosphorus is to be recovered, impacts to all parts of this system must be considered. Local water courses, waste water quality, climate conditions, existing treatment technology or other varying factors such as regional/national legislation affect applicability and feasibility of new technologies. The situation in Europe is not homogenous in this sense, meaning that recovery of phosphorus is not equally possible everywhere. For example chemical precipitation of phosphorus is a cost-efficient and widely used method for phosphorus removal from waste waters. However, chemical precipitation makes the phosphorus less available for immediate plant uptake, and not suited for struvite formation due to the chemical bonds. On the other hand, biological phosphorus removal is a less reliable process and is not cost-effective on smaller wastewater treatment plants. Whereas recovery of phosphorus may be a highly recommendable target, protection of water courses is the main reason for the waste water treatment, and this should not be compromised.

Phosphorus recovery consumes resources as energy and chemicals. Apart from the recovered phosphorus other by-products are formed. On the other hand recovery may also lead to secondary positive effects on WWTP operation (eg. increased dewatering). All process inputs and outputs should be considered when evaluating sustainability and feasability.

6. Storing of phosphorus ashes should be possible

Current legislation should support future possibilities for phosphorus recovery. As long as techniques for phosphorus recovery are not feasible it should be possible to make a long-time storage of the ashes on mono-dump sites as artificial deposits for Phosphorous.

Ash from the sewage sludge mono-incineration has very high potential for Phosphorus recovery. Even up to 90 % of the Phosphorous from the raw wastewater can be found in this ash. It should be allowed to store ashes in a way which enables possibilities for future use in new economical and technological circumstances. At the moment in some MS it is not possible to build mono-dump sites for sewage sludge ashes due to the legal reasons. The EU should create possibilities for long time storage of ashes from sewage sludge mono incineration for a potential phosphorus recovery in the future.

7. Quality of sewage sludge and recovered phosphorus should be controlled at source

Control of pollution at source should be the absolute priority for limiting hazardous substances entering the environment. This would bring positive impacts on the sludge

quality as well as receiving waters. In the long term the sludge quality regarding heavy metals and organic contaminants will continue to improve, resulting from the strategy on controlling chemicals at source supported by the EC chemicals policies as REACH and regulations on personal care products, biocides and pesticides. Phosphorus recovery from waste water or sewage sludge does not automatically mean that impurities are removed. Thus strong chemical legislation and effective source control are elemental in urging phosphorus recycling.

About EurEau

EurEau is the voice of Europe's water sector. With a direct employment of around 500,000 people, the European water sector makes a significant contribution to the European economy.

EurEau represents drinking water and waste water service providers from 27 countries in Europe, from both the private and the public sector. Our members are the national associations of water services in Europe.

At EurEau we bring national water professionals together to agree European water industry positions regarding the management of water quality, resource efficiency and access to water for Europe's citizens and businesses.

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