RECOVERING VALUABLE MATERIALS FROM SEWAGE SLUDGE ASH
PHOSPHORUS RECYCLING FOR THE PRODUCTION OF COMPLIANT FERTILIZERS

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Introduction

Phosphorus is a macronutrient for plants. It is of essential importance as a fertilizer for use in agriculture. Due to the global shortage, the recovery of phosphorus is required by law and direct soil-related recycling is no longer permitted. It is necessary to recover phosphorus through recycling and return it to reuse. Due to the increasing trend towards thermal utilization of phosphorus-containing sewage sludge, more and more phosphorus-containing sewage sludge ash is being produced, which can be used as a raw material for the production of phosphorus-containing sewage sludge. In densely populated areas, sewage sludge ashes often contain high levels of heavy metals. To prevent excessive discharge into the environment, it is necessary to remove them.

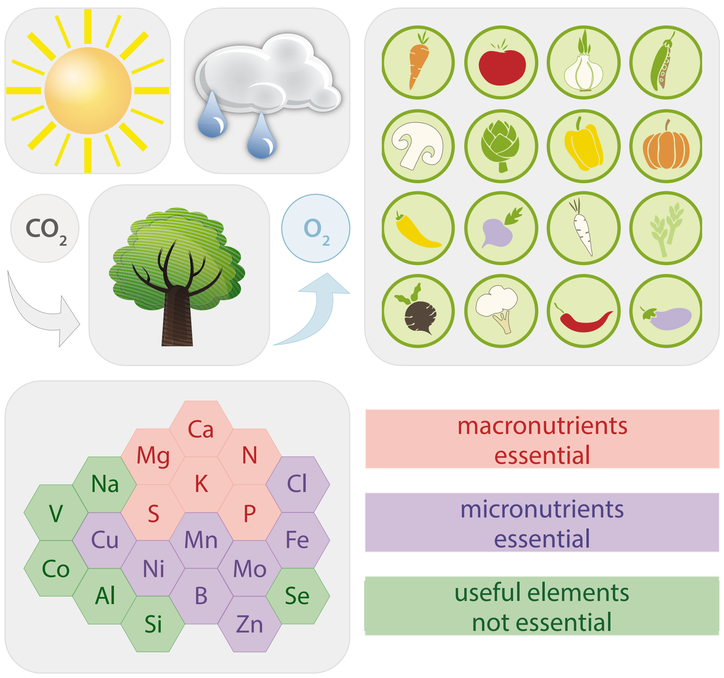

Fig. 1: The use of sewage sludge ash for the production of fertilizers has the advantage that it already contains a large number of essential macro- and micronutrients in its matrix. The PHOS4green process makes these available to plants.

Glatt PHOS4green Technology

With PHOS4green, Glatt has developed an innovative, patent-protected process with which the essential and sought-after nutrient phosphorus can be recovered from sewage sludge ash and used for new phosphate or multicomponent fertilizers.

So far, this process can be used to produce fertilizers from sewage sludge ashes that meet the quality requirements of the Fertilizer Ordinance (DüMV, Annex 2) and EU-V 2019/1009.

Heavy metal depletion

Economical heavy metal depletion increases the raw material potential of the available sewage sludge ashes. The PHOS4green process, modified with regard to heavy metal enrichment, thus provides greater planning security with regard to possible future stricter limit values or strongly fluctuating ash loads.

The extension of PHOS4green with optional heavy metal extraction is shown in Fig. 2. The processing of non-compliant ashes can be carried out with two variations, which are shown in Fig. 3 and Fig. 4.

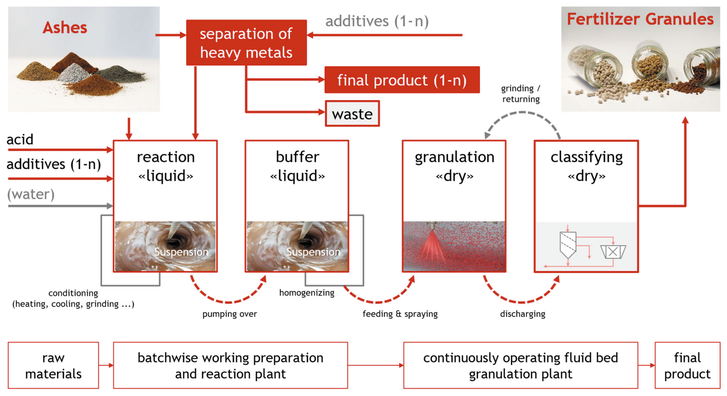

Fig 2: PHOS4green process diagram with optional heavy metal depletion.

Option 1	Extraction of phosphorus - P extraction Requirement: P-release rate > 80 %
Pros	• Application for ashes with low P content • Application for ashes with high load of heavy metals • Removal rates of 20 - 80 %
Cons	• High amounts of waste • Loss of essential elements
Products	• Depleted phosphoric acid • NPS, NPK, ...

Fig. 3: Heavy metal removal using the P-extraction process.

Option 2	Extraction of heavy metals - HM extraction Requirement: low P re-dissolution, high re-dissolution rate of heavy metals
Pros	• Low waste stream • Over 95 % of the P content of the ashes is utilized
Cons	• Lower depletion rates depending on extraction agent and ash matrix • Removal rates of 10 - 50 %
Products	• P38, P46, NPS, NPK, ...

Fig. 4: Heavy metal depletion using the HM extraction process.

Element mg/kg	Raw material Ash mixture mg/kg	Granulate mg/kg	Limit due to EU-V 2019/1009 mg/kg	Limit due to DüMV annex 2 mg/kg
arsenic	28	17.7 ± 2.27	40	40
cadmium	7.5 (GW 10 mg/kg)	2.33 ± 0.21	60 mg/kg P_2O_5	50 mg/kg P_2O_5
copper	987	476 ± 34	600	900
nickel	**86**	70 ± 5.0	100	80
lead	**142**	69 ± 4.61	120	150
zinc	2700	1389 ± 102	1500	5000
P_2O_5 (ges)/%	20	42.4 ± 2.65	-	-
P_2O_5 (H_2O)/%	< 1	29.4	-	-

Fig. 5: Heavy metal content of a P-38 fertilizer granulate. Heavy metal depletion was carried out using the HM extraction process

Acknowledgments

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Application example

The extraction of heavy metals was carried out on an Fe-rich sewage sludge ash with various extraction agents over a reaction period of 40 minutes (Fig. 6). Following solid-liquid separation, the proportion of heavy metals in the extract was reduced by adding various additives (Fig. 7 and Fig. 8).

A P38 fertilizer granulate was produced by combining the filter cake with the heavy metal-depleted extract. The missing P content was made up to 38wt% P2O5 by adding H3PO4 (Fig. 5).

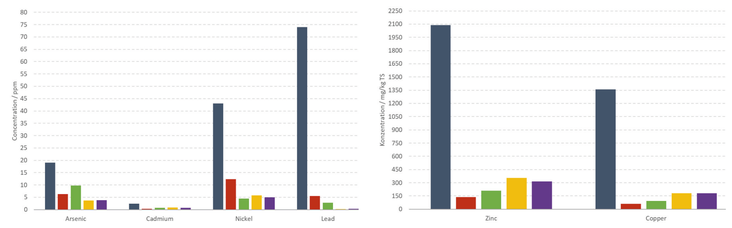


Fig. 6 Depletion of heavy metals as a function of different extraction extraction agents using the example of an Fe-rich sewage sludge ash

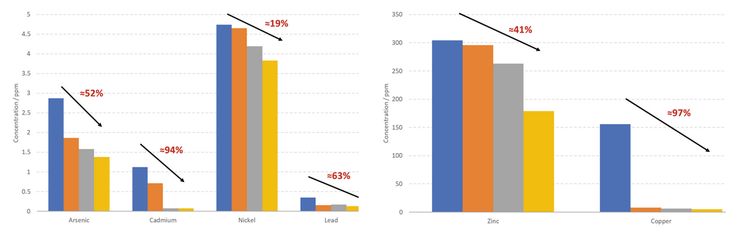


Fig. 7: Heavy metal removal using the example of extract 3 as a depending on the addition of additive 1

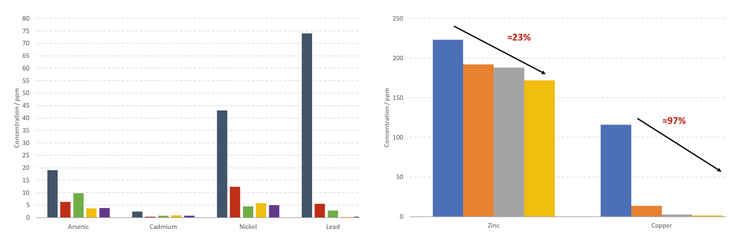
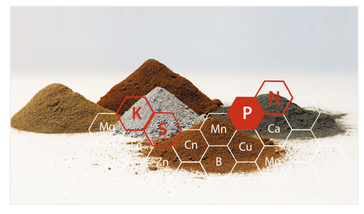


Fig. 8: Heavy metal removal using the example of extract 3 as a function of the addition of additive 2

Summary

The PHOS4green process can be used to convert ashes of various origins into fertilizer granules. The process makes the constituents available to plants. The extension of the process with heavy metal removal opens up the possibility of converting further secondary raw materials into compliant fertilizers.



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