To the media

Stuttgart, August 6, 2019

Zentrum für Sonnenenergie- und Wasserstoff-Forschung Baden-Württemberg (ZSW)

Site: Meitnerstr. 1,
70563 Stuttgart, Germany

Recovering Phosphorus during Sewage Sludge Incineration

Testing facility successfully put in operation at ZSW

Phosphorus, currently obtained from phosphate rock, is a key component of fertilizers, detergents and food additives, while its resources are limited. Alternatively phosphorus can be recovered from sewage sludge. The problem is that today's recycling processes are cumbersome and expensive. The Centre for Solar Energy and Hydrogen Research Baden-Württemberg (Zentrum für Sonnenenergie- und Wasserstoff-Forschung Baden-Württemberg, ZSW) is pursuing a three-year research project to change that. Its scientists are developing a process to extract phosphorus as an incinerator burns sewage sludge. A testing plant has been up and running successfully since spring of 2019. The business prospects for phosphorus recycling certainly look very promising in Germany, where all large waste water treatment plants will be required to recover it as of 2029.

All living organisms need phosphorus in the form of phosphate. Plants, animals and humans obtain it from soil. Depleted farmland is usually replenished with fertilizers. The problem with these fertilizers is they are produced using mineral phosphorus resources that are finite, non-renewable and increasingly contaminated with cadmium and uranium The largest deposits are found in just five countries, most being in Africa. Mining pollutes the environment and consumes a great deal of energy. Dependent on offshore sources, the EU has to import this critical resource, which is so vital to the economy. This indispensable element also figures prominently in other products such as detergents.

Local sourcing from sewage treatment plants

There is an alternative source of phosphorus – the sludge produced by sewage treatment plants. This is where the substance ends up in the form of phosphate, carried there with the waste water of households and industry. Experts believe that up to 50 percent of Germany's demand could be recovered by recycling it from sewage sludge. As it stands, though, sewage sludge containing phosphorus is still incinerated. The ash is disposed of in landfills and mines, or mixed with cement during the production process, wasting a valuable resource that could be put to productive use.

Recycling processes have been in development for 15 to 20 years. There are two competing methods – wet chemical processes that extract phosphorus from the sewage treatment plant and sewage sludge

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incineration. The advantage of the latter option is that it is well-established. Fluidized-bed reactors have been burning sludge at large sewage treatment plants for decades. They produce ash free of pollutants, so processes are being developed to extract phosphorus from this ash. ZSW is aiming to start a step earlier to extract the ash during the incineration process. If this concept pans out, it will be possible to retrofit legacy sewage incineration plants with the new technology.

ZSW is testing and further improving the process on a test plant in the Stuttgart lab. A material containing calcium binds the phosphorus as calcium phosphate during incineration. The reactive limestone has proven to be sufficiently resistant to abrasion both in the lab and on a technical scale, making it an economical, non-toxic and locally available resource. The mechanical shocks of particles colliding with one another and with the wall of the reactor produce finely abraded particles containing phosphate. A hot gas cleaning process separates them from the flue gas stream via a candle filter, for example. Pollutants are gaseous at these temperatures, so scientists can obtain a stream of phosphate-enriched recyclable material that is practically pollutant-free. This phosphorus is then returned to the material cycle.

The results of the tests conducted so far on the ZSW lab's fluidized bed system have been promising. A trial run to test the system in continuous operation was successful. Researchers are now optimizing the system by varying individual parameters of the fluidized bed process and the amount of additives. The ZSW scientists aim to produce an ash that is rich in phosphorus and ideally suited for subsequent use.

Mandatory recycling in 2029

The pressure is on the research community and industry to advance the state of the art in phosphorus recycling with policymakers tightening up the regulations in October 2017. The amended German sewage sludge ordinance will require sewage plant operators in cities with more than 100,000 inhabitants to return part of the phosphorus in sewage sludge to the material cycle starting in 2029. This is why scientists and key industrial players are stepping up efforts to develop and commercialize processes and products within a few years.

This ZSW project goes by the name of *Phosphorus Extraction as Part of Thermal High-Temperature Treatment of Sewage Sludge*, or RECaPHOS for short. It goes to develop, optimize and assess the thermal sewage sludge process. The European Union is funding the project as part of the research and innovation framework program known as *Horizon 2020 – Marie Sklodowska-Curie Individual Fellowships*.

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About ZSW

The Zentrum für Sonnenenergie- und Wasserstoff-Forschung Baden-Württemberg (Centre for Solar Energy and Hydrogen Research Baden-Württemberg, ZSW) is one of the leading institutes for applied research in the areas of photovoltaics, renewable fuels, battery technology, fuel cells and energy system analysis. There are currently around 260 scientists, engineers and technicians employed at ZSW's three locations in Stuttgart, Ulm and Widderstall. In addition, there are 90 research and student assistants. The ZSW is a member of the Innovationsallianz Baden-Württemberg (innBW), a group of 13 non-university, applied research institutes.

Media Contacts

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ZSW researcher analyzing the ash produced by incinerating sewage sludge. Photo: ZSW

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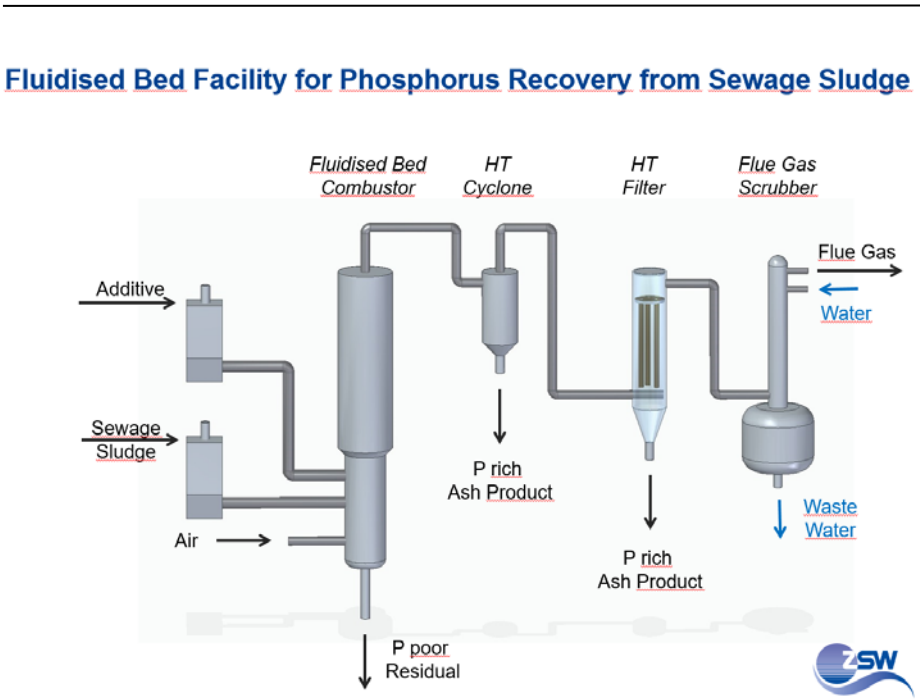

The steps of the proposed process. Diagram: ZSW

The images are available from Solar Consulting or from https://energie.themendesk.net/zsw/.