biosweet
Biomass for Swiss Energy Future
Swiss Competence Center for Energy Research

Outotec

In cooperation with the CTI
Energy funding programme
Swiss Competence Centers for Energy Research
Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra
Swiss Confederation
Commission for Technology and Innovation CTI

Phosphorus Recovery from Wastes and Biomass for High Value Products [PhoVaPro]

B.Patel[1], M. Tarik[1], R. Struis[1], A. Schuler[1], T. Schaaf[2], L. Hermann[2], C. Ludwig[1,3]

[1]Paul Scherrer Institute, General Energy Research Department, CH-5232 Villingen PSI, Switzerland.
[2]Outotec GmbH & Co. KG Ludwig-Erhard-Strasse 21, D-61440 Oberursel, Germany.
[3]Ecole Polytechnique Fédérale de Lausanne (EPFL), ENAC IIE GR-LUD, Station 6, CH-1015 Lausanne, Switzerland

Background

- Applied as a fertilizer, Phosphorus (P) is a key nutrient utilized by crops to help it promote the conversion of nutrient building block during growth.
- An increase in meat demand has resulted in a subsequent increase in the use of P for agricultural purposes accounting for over 90% of the total 20 million ton annual global use[1].
- Although ample reserves exist in North Africa, increasing rate of consumption is anticipated to put a constraint on global supply in the foreseeable future[2]. As P cannot be produced synthetically, the efficient recovery of this resource is of utmost importance to maintain global food security.

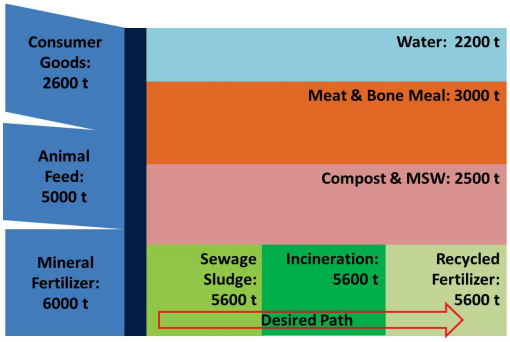

Fig. 1 – The flow of Phosphorus in Switzerland and potential recovery route [MSW = Municipal Solid Waste][3,4]

Problem – The Swiss Case

- In 2000, the disposal of organic waste directly into landfills was outlawed and subsequently a directive was introduced in 2006 to prevent the use of sewage sludge as fertilizer.
- An update on the most recent directive encourages the recovery of energy and P from sewage sludge prior to disposal. It is approximated that 210,000 tons (dry wt.-%) of sewage sludge is produced per year[3].

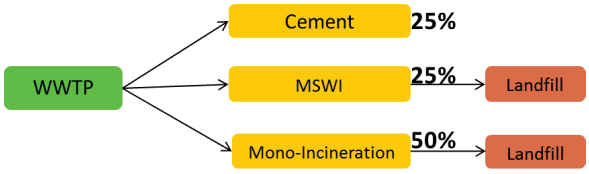

Fig. 2 – Present material flow of sewage sludge from WWTP [WWTP = Wastewater Treatment Plant, MSWI = Municipal Solid Waste Incineration][3]

Solution

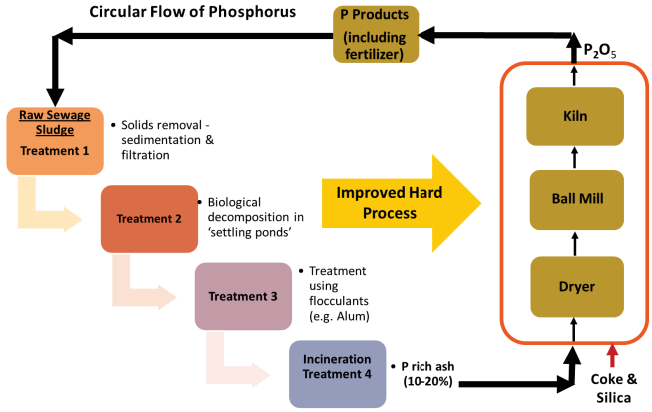

Fig. 3 – Proposed Closed Loop Model for recovery and utility of P from Sewage Sludge

Process

- The Improved Hard Process enables the recovery of P at ca. 1250°C. Volatile P compounds are formed using a mixture of P ores, coke and silica in a rotating kiln.
- The presence of a successive reduction and oxidation reaction offers the opportunity for increased efficiency via heat integration to produce a higher quality P compared to wet processing technique.
- Opportunity to use alternative P containing feedstocks (organic and/or inorganic).

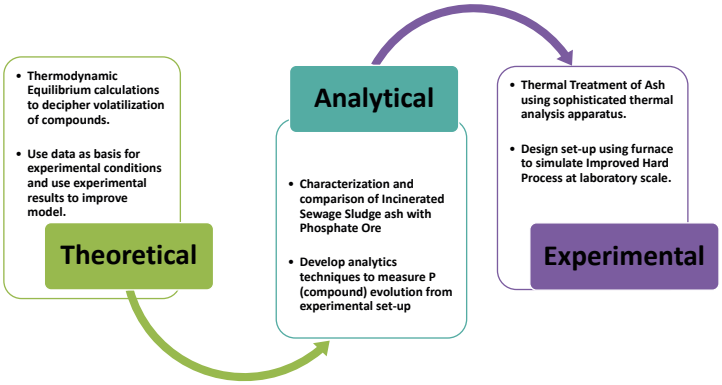

Fig. 4 – Breakdown of tasks and plan to investigate recovery of P from

References

1. CRU International, Phosphate Rock Cost Report (2016).
2. Cordell, Dana, and Stuart White. "Life's bottleneck: sustaining the world's phosphorus for a food secure future." *Annual Review of Environment and Resources* 39 (2014): 161-188.
3. Nättorp, Anders. "Regions implementing sustainable phosphorus management ." Institute for Ecopreneurship, School of Life Sciences, FHNW (2015).
4. http://ec.europa.eu/environment/waste/sludge/index.htm [Accessed 18.08.2017]