Towards widespread phosphorus recovery: achieving the highest value return for recovered phosphorus

Presented by:
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Thomas Room: P recovery & reuse III

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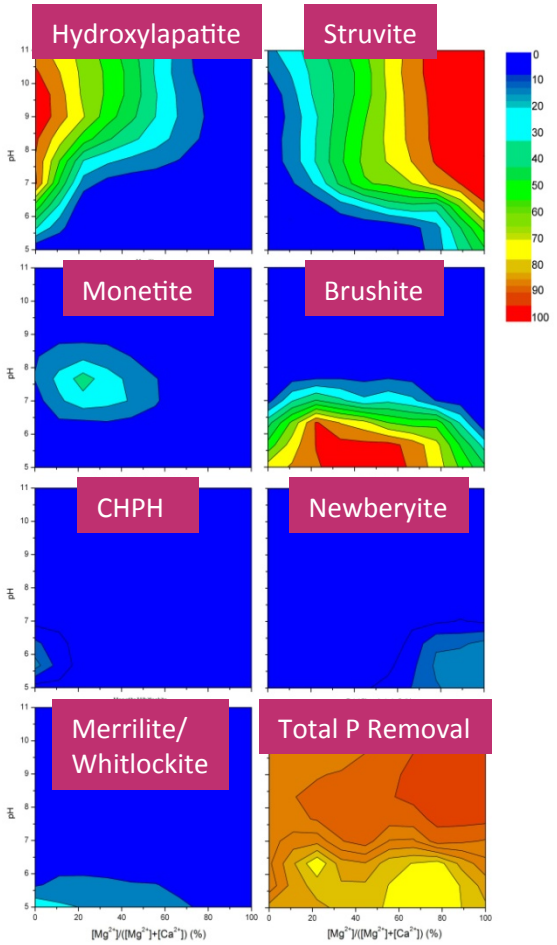
- To recover P for agronomic use, need produce Mg or Ca precipitates
- Widespread technology uptake → need to produce highest value & accepted form
- Choice between Mg and Ca addition: which to choose or a combination?
- There are many phases that may form

Crystalline phases identified in Mg-Ca-NH_4^+-$H_x(PO4)_{3-x}$ mixtures

Compound	Formula	pK_{sp}
Struvite	$Mg(NH_4)PO_4.6H_2O$	13.36
Hydroxylapatite	$Ca_5(PO_4)_3OH$	57.8
Brushite	$CaHPO_4.2H_2O$	6.55
Newberyite	$MgHPO_4.3H_2O$	5.8
Merrilite	$Ca_9MgNa(PO_4)_7$*	45
Whitlockite	$Ca_9Mg(HPO_4)(PO_4)_6$	29.53
Calcium hydrogen phosphate hydrate	$Ca_8H_2(PO_4)_6.5H_2O$	96.6 47
Monetite	$CaHPO_4$	6.60 6.76
Bobierrite	$Mg_3(PO_4)_2.8H_2O$	25.2
Cattiite	$Mg_3(PO_4)_2.22H_2O$	23.1



- Outcomes of matrix study
  - Definition of operating ranges for high-quality products
  - Methods for improved purification
  - Kinetics of crystallisation dominant

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Purity data for phosphorus products

Element	Co	Cu	Cd	Ni	As	Cr	Hg	Mo	Pb	Zn	Se
Estimated level in sewage sludge (mg/kg P)		64000	3600	8500	650	26200	380	1300	24000	134 000	600
Reported levels for struvite (mg/kg P)	0.8-3	13-473	0.8-5.5	1-15	4-20	1-6	<1.6	8	<51	106	< 43
Purity of commercial fertilizers (mg/kg P)			47	184	669	802					
Regulations for fertilizers (mg/kg)	150		35-343 mg/kg P	120-180	75	270	5	20	100-2000	1100-1850	14

- **Struvite** is clearly the best option for phosphorus recovery
  - Highest quantity
  - Easy to purify
  - Rapid kinetics
- Exception: **Waste CaP** in thermal phosphoric acid production (China, Netherlands, USA, Kazakhstan)
- We are continuing the research
  - Technologies to increase and enhance P recovery into high value products
  - Economics of implementation
  - Synergies for management of water, C, N and P in wastewater