Struvite Harvesting

Spring Biosolids Symposium
March 18th, 2014

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What I intend to cover today

- What is struvite?
- How is it harvested?
- Why harvest struvite?
- Benefits to harvesting struvite
- Challenges to harvesting struvite
- Questions
What is struvite?

* Struvite is equal molar ratios of Magnesium, Ammonium, and Phosphate
* Chemically expressed: \((\text{NH}_4)\text{MgPO}_4 \cdot 6(\text{H}_2\text{O})\)
* First noted in 1845 in sewers of Hamburg, named for discoverer (von Struve)
* Majority of dog kidney stones are composed of struvite, also many in cats and humans
* First fertilizer use described in 1857
Fertilizer?

* Considered a good fertilizer for agriculture:
  * Naturally slow release, very low water solubility
  * Contains nitrogen and phosphorus
  * Magnesium a desirable mineral additive
* High quality phosphorus deposits being depleted
* Wastewater a good potential source
Phosphorus Harvesting

* Anaerobic digestion results in ammonia and phosphate in abundance
* Third ingredient—magnesium—typically comes from hard water, chemical addition
* Raising pH triggers formation of precipitate called struvite
* Remove nuisance, send where needed
Basic Phosphorus in WWTF

Influent Phosphorus = PI

Effluent Phosphorus = PE

Biosolids Phosphorus = PB

PI = PE + PB

100% = 40% + 60%
Phosphorus in an EBPR WWTF

Influent Phosphorus = PI

Effluent Phosphorus = PE

Biosolids Phosphorus = PB

PI = PE + PB

100% = 10% + 90%

Wastewater Treatment Process
With EBPR + Harvesting

Influent Phosphorus = PI

Effluent Phosphorus = PE

Biosolids Phosphorus = PB

Harvested Phosphorus = PH

PI = PE + PB + PH

100% = 10% + 40% + 50%

Wastewater Treatment Process
Madison Metropolitan SD

- Nine Springs WWTF average Q ~ 40 MGD
- 43 municipalities, > 180 mi², > 300k persons
- Advanced secondary treatment (EBPR) with two pumped surface discharges
- Land-applied biosolids program ~ 40 MG/yr
- > 7,500 dry tons applied to > 4,500 acres
- Class “B” liquid; plans for >25% Class “A”
Nine Springs WWTF-Madison, WI
Historical struvite problems
Various forms of struvite
Typical Harvesting Configuration

* Usually after digestion

* Advantages:
  * Reduce phosphorus in biosolids and internal recycle streams
  * Resource recovery
  * Provide revenue (or offset costs)?

* Disadvantage:
  * Struvite formation issues before harvest remain
Reactor and recycle pump
Reactor bottom and top
Harvest and Dewatering
Dryers and classifier
Bagging and shipping
All is good 😊. Right?
Challenges

- Maintaining P concentrations in feed
- Managing use of ferric chloride
- Optimization of product sizing
- Nuisance struvite formation
- Other chemical reactions?
- Learning a new and unfamiliar process
- New type of “business relationship”
Current status at Nine Springs

- >100 tons of struvite (Crystal Green®) produced so far in 2014
- Reduction in dissolved reactive phosphorus (DRP) in anaerobic digesters
- Working to stabilize production sizing
- Working to reduce biosolids total P
Questions?

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