Struvite Harvesting

Spring Biosolids Symposium
March 18th, 2014

Alan L. Grooms, P.E.
Process & Research Engineer

Madison Metropolitan Sewerage District

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

Madison Metropolitan Sewerage District

What is struvite?

* Struvite is equal molar ratios of Magnesium, Ammonium, and Phosphate
* Chemically expressed: $(NH_4)MgPO_4 \bullet 6(H2O)$
* 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

Madison Metropolitan Sewerage District

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

Madison Metropolitan Sewerage District

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

Madison Metropolitan Sewerage District

Basic Phosphorus in WWTF

PI = PE + PB

100% = 40% + 60%

Madison Metropolitan Sewerage District

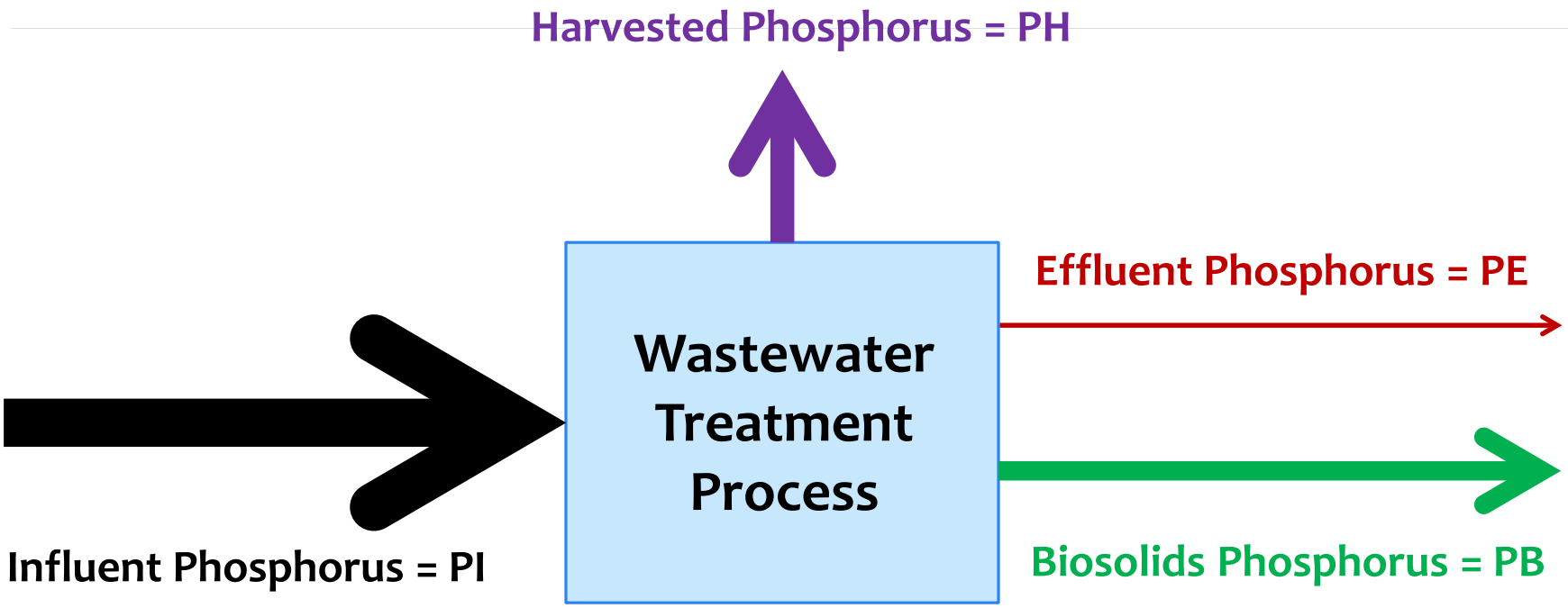
Phosphorus in an EBPR WWTF

PI = PE + PB

100% = 10% + 90%

Madison Metropolitan Sewerage District

With EBPR + Harvesting



PI = PE + PB + PH

100% = 10% + 40% + 50%

Madison Metropolitan Sewerage District

Madison Metropolitan SD

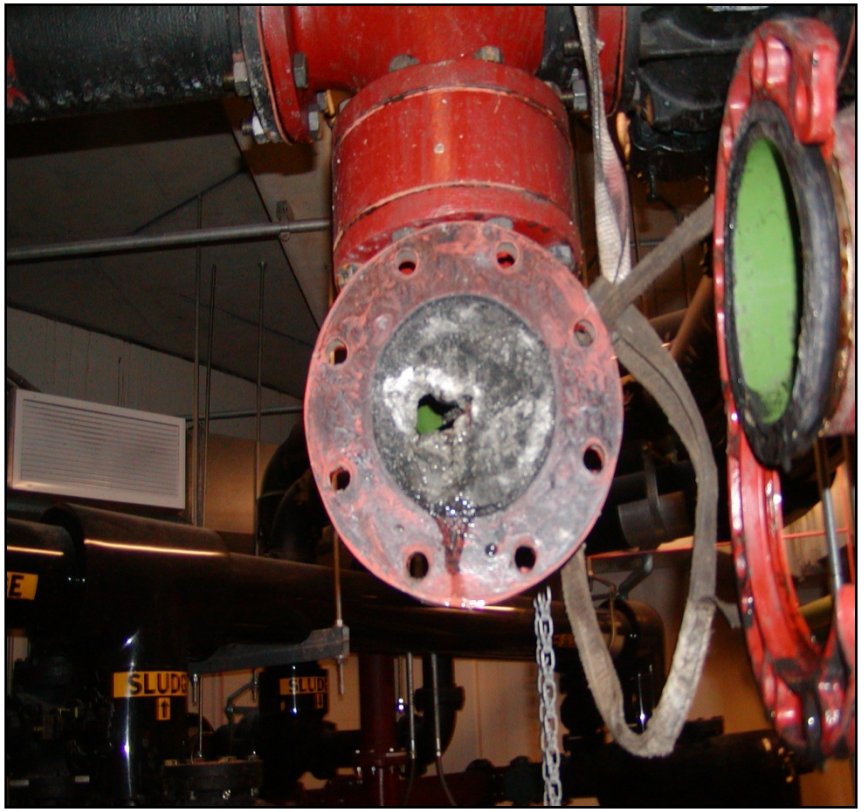
* Nine Springs WWTF average Q ~ 40 MGD
* 43 municipalities, > 180 mi^2, > 300k persons
* Advanced secondary treatment (EBPR) with two pumped surface discharges
* Land-applied biosolids program ~ 40 MG/yr
* > 7,500 dry tons applied to > 4,500 acres
* Class “B” liquid; plans for >25% Class “A”

Madison Metropolitan Sewerage District

Nine Springs WWTF-Madison, WI

Madison Metropolitan Sewerage District

Historical struvite problems



Madison Metropolitan Sewerage District

Various forms of struvite

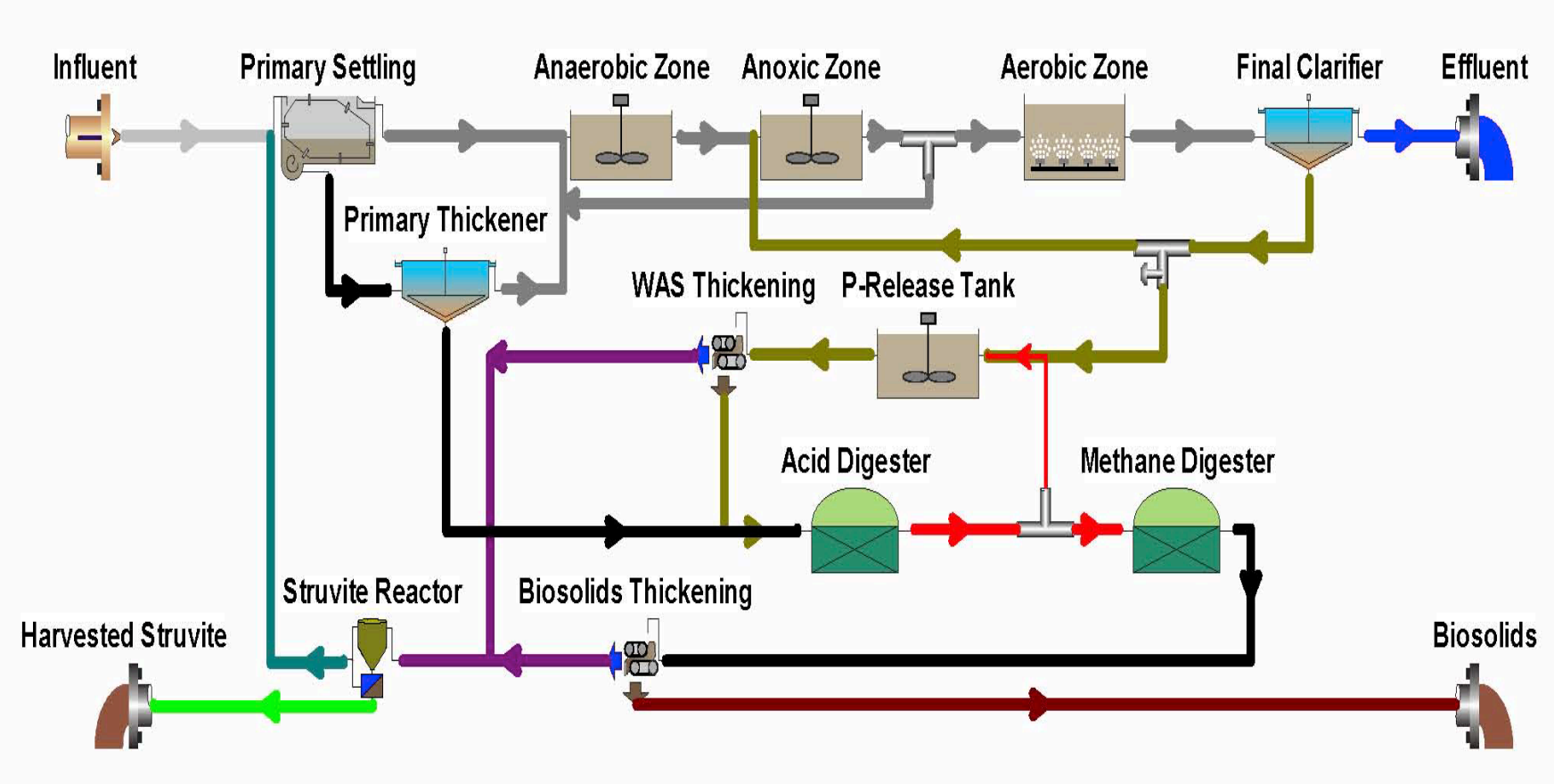
Madison Metropolitan Sewerage District

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

Madison Metropolitan Sewerage District

Nine Springs Operations

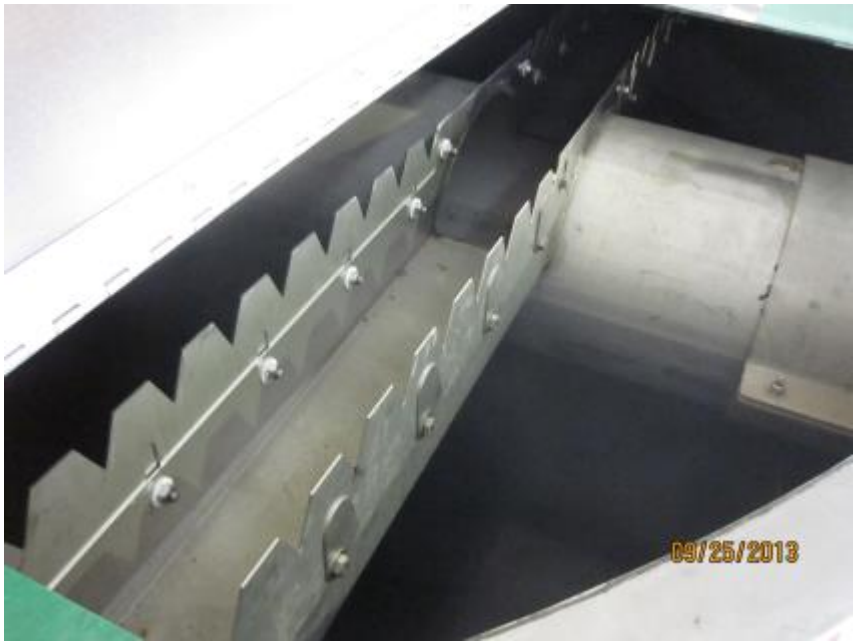


Madison Metropolitan Sewerage District

Reactor and recycle pump

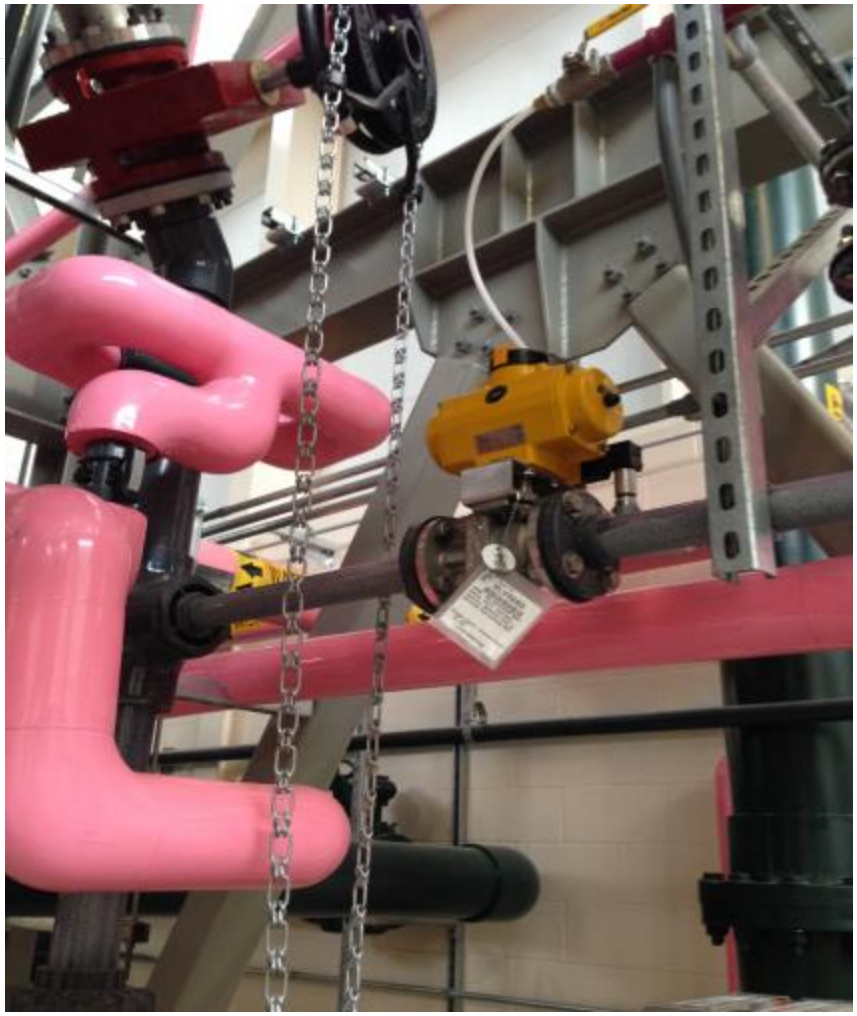
Madison Metropolitan Sewerage District

Reactor bottom and top



Madison Metropolitan Sewerage District

Harvest and Dewatering



Madison Metropolitan Sewerage District

Dryers and classifier

Madison Metropolitan Sewerage District

Bagging and shipping

Madison Metropolitan Sewerage District

All is good ☺. Right?

Madison Metropolitan Sewerage District

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”

Madison Metropolitan Sewerage District

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

Madison Metropolitan Sewerage District

Questions?

Alan L. Grooms, P.E.
Process & Research Engineer
(608) 222-1201 x253
alang@madsewer.org

Madison Metropolitan Sewerage District