Hazen

Sustainable Approaches to Water Treatment Residuals Management

Biosolids Workshop – December 6, 2018

OWEA

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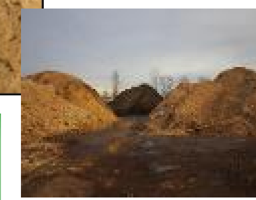
Paradigm Shift: Biosolids

Old Practices

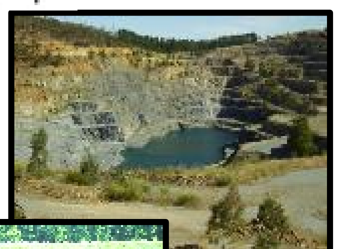
New Practices

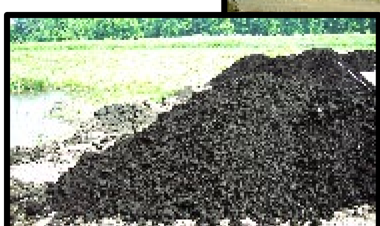
Ohio Mulch – Innovative Deep Row Hybrid Poplar (DRHP) Biomass Farming



Paradigm Shift: Water Treatment Residuals (WTRs)

Old Practices:
Disposal Focused



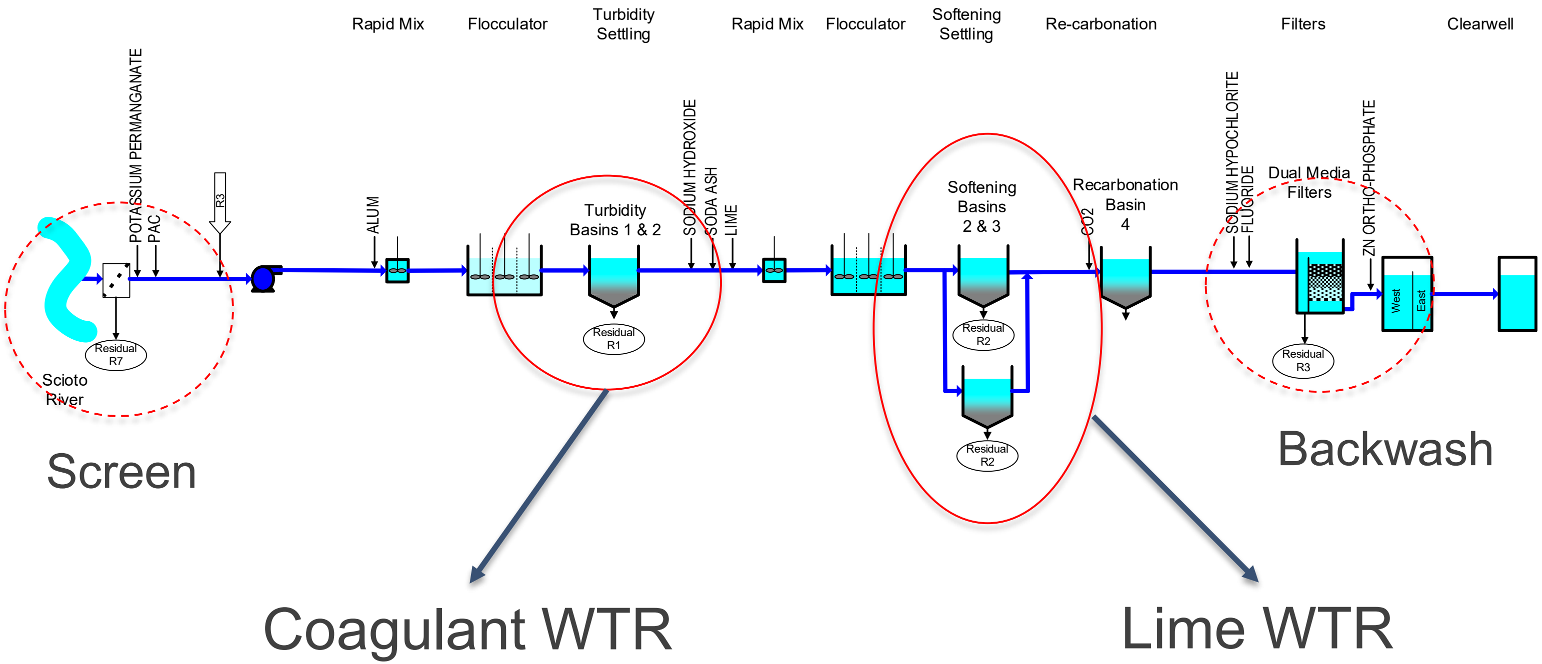


New Practices:
Market Focused

Start with the Solution in Mind

WTRs Current Approach

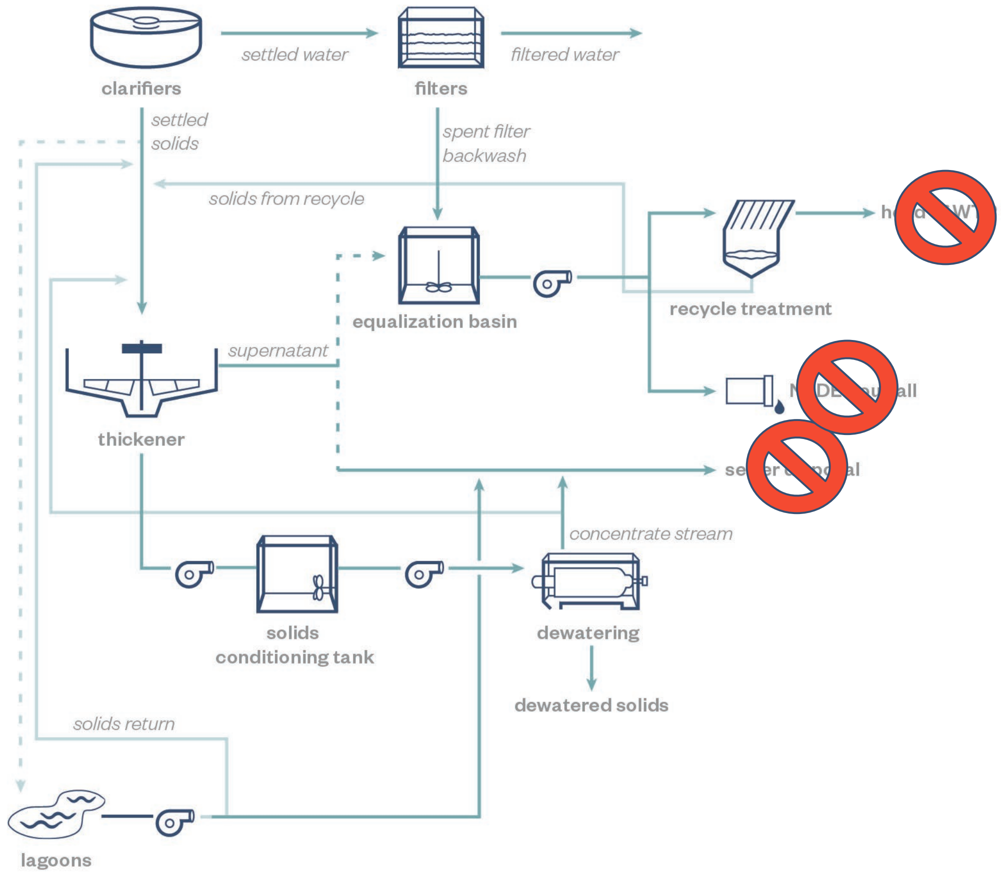
Residuals Characterization Critical to Evaluating Options



What are Water Treatment Plant Residuals?

- Coagulant solids (alum, ferric) – can include treatment additives like polymer, PAC.
- Lime softening solids – mostly $CaCO_3$, can be combined with coagulant in surface water plants.
- Spent filter backwash water – high flow, low solids. Similar for gravity filters, low pressure membranes
- Regenerant brine from ion exchange – IX softening or nitrate removal. High TDS
- High pressure membrane filtration reject – softening membranes removing dissolved compounds. High TDS

Residuals Handling is Getting More Complicated



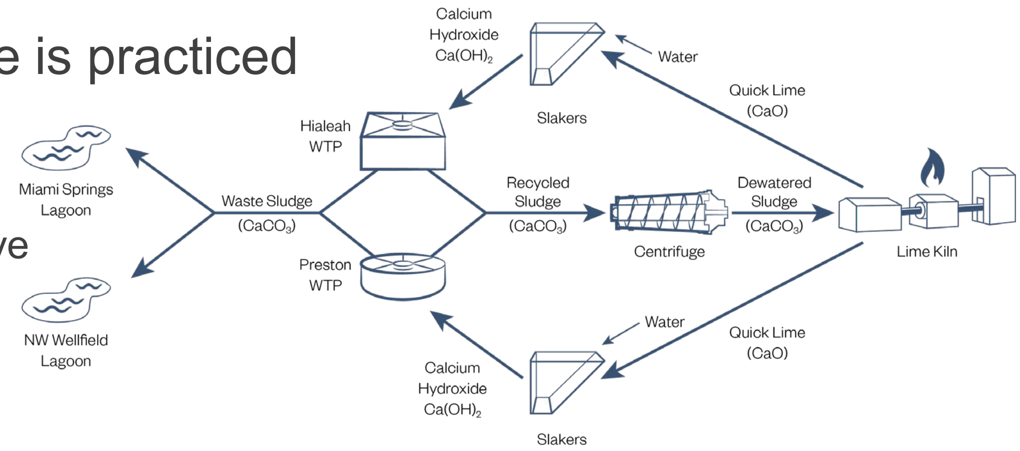
What Have Water Plants Done Historically?

Coagulant – generally not considered for beneficial use

- Discharged to sewer, dewatered/landfilled
- Costs are increasing, regulations more stringent, negative impacts to WWTPs

Lime – generally beneficial use is practiced

- Land applied – shrinking ag
- Recalcination – expensive, energy intensive



How Much Does a Typical Water Plant Produce?

- Typical coagulation solids
  - 400-800 lbs ds/mgd
- Typical softening solids for surface water
  - 1500-3000 lbs ds/mgd
- Typical softening solids for groundwater
  - 5000 lbs ds/mgd

Columbus - WTRs
~228 tons ds/day (34 tons alum, 194 tons lime)

Columbus – Biosolids
~60 tons ds/day

Affected by turbidity, hardness (lime), enhanced coagulation for additional TOC removal

What do other lime softening utilities do in Ohio?

City	Plant	Capacity MGD	Dewater	Quarry	Land App	Landfill	Recalcination
Cincinnati, OH	Bolton - GW	40	lagoon		x		
Columbus, OH	Hap Cremean - SW	125		x			
	Dublin Road - SW	80		x			
	Parsons Ave -GW	50	lagoon	x			
Dayton, OH	Ottawa -GW	96	Centrifuge		x		x
	Miami -GW	96	Centrifuge		x		x
Del-Co Water	OLE - SW	19.2 (28.8)	lagoon		x		
	TFM -SW	4	lagoon		x		
	RES - SW	6.6	lagoon		x		
	TES - GW	6	lagoon		x		
Massillon, OH	Aqua OH - GW	15	P&F		x		
Toledo, OH	Collins Park -SW	120	P&F		x		

So Can We Reduce/Eliminate Lime Softening Residuals?

- Stop softening
  - Impacts to residential/industrial customers
  - Likely cause increase in home softeners – TDS discharge to sewers will increase
- Switch to caustic softening
  - Significant reduction in solids
  - Increased cost, increased sodium in finished water
- Ion exchange softening
  - Negative impacts to water quality, high TDS waste stream
- Membrane softening
  - Problematic disposal of high TDS waste stream

Lime Softening ✓

Considerations for Discharge to WRRFs

- Disposal to sanitary sewer / removal through primary clarifiers
  - Chemically enhanced primary treatment (P removal)
  - CEPT may result in diversion of carbon from BNR
  - Increased primary solids
  - Potential toxicity / inhibition to activated sludge biology
  - Inerts can consume secondary capacity if no PC

$$$$

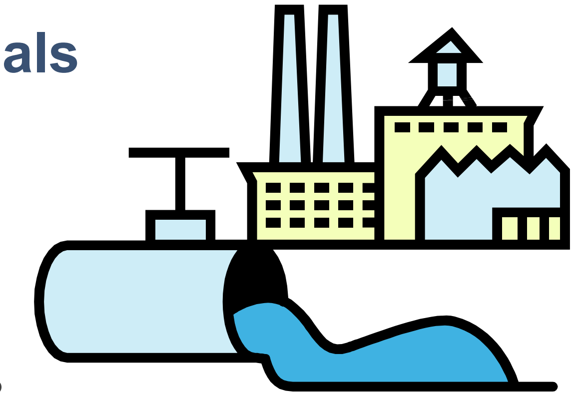
- Digestion considerations
  - Phosphorus speciation weighted toward precipitate solids
  - Reduction in VSS destruction because of inerts
  - Potential reduction in sulfide generation

Beneficial Use of WTRs

WTRs Viewed as a Resource

Alum/Ferric			Lime
			
Improves soil tilth	Binds phosphorus	Binds heavy metals	Provides liming value

Beneficial Use of Water Treatment Residuals



Water Treatment Plants

- Filter sediments from drinking water
  - Generate 2 million tons WTRs DAILY (U.S.)
- Beneficial Use of a *RESOURCE* or Disposal of a *WASTE*?

What is WTR? Silica-based, alum, ferric, lime, organic matter…soil substitute and P-binder

Manufacturing Markets	Landscaping/Restoration	Other Alternatives
Brick manufacturing	Stormwater BMPs	Agricultural land application
Cement manufacturing	Wetland/Stream/Floodplain	Phosphorus (P) removal structures (e.g. Phrog)
Topsoil blending	Dirt & Gravel Road (fill)	Blending with biosolids to reduce P availability
Composting	Landfill alternative daily cover	Recalcination, Flue gas de-S

Beneficial Use Challenges

- Markets not as fully developed compared to biosolids.
- Phosphorus control – genuine opportunity, but still emerging.
- Dewatering technologies for coagulant difficult to achieve high solids concentrations. Trucking costs for hauling dewatered residuals drive costs.
- Polymer use for dewatering can be problematic for beneficial end users.
- Some markets have uncertain futures – flue gas desulfurization.
- Algal toxin impacts to land application.

Characteristics of WTRs will Determine Markets

- Characterize your residuals prior to developing beneficial use options
- Collect data on residuals for permitting and end user information
  - Calcium (CaO, $CaCO_3$, Calcium Carbonate Equivalence) – liming value
  - Solids, sieve analysis
  - Effective Neutralizing Power (ENP)
  - Metals (permit requirements)
  - Possibly microcystin (if in source water) – method still uncertain
  - Nutrient analysis

Beneficial Use (Coagulant) Opportunities in Ohio

- Cleveland – currently discharge to NEORSD at three of their plants. Considering dewatering, beneficial use at all four plants.
- Akron – soil blending.
- Columbus – considering beneficial use alternatives for all three plants (alum and lime).
- Avon Lake – dewater combined biosolids/alum residuals. Currently landfill, considering beneficial use.

Beneficial Use Options To Consider

Market	Lime-Only WTR	Alum-Only WTR	Alum/Lime Blend
Agriculture (Phosphorus-binding / Integration into biosolids)		X	X
Agriculture (Liming Value)	X		X
Cement Manufacturing	X		
Disturbed Land Reclamation	X		X
Flue Gas Desulfurization	X		
Industrial Waste Scrubbing	X	X	
Landfill Daily Cover		X	X
Soil Blending		X	X

Considerations for Dewatering/Thickening

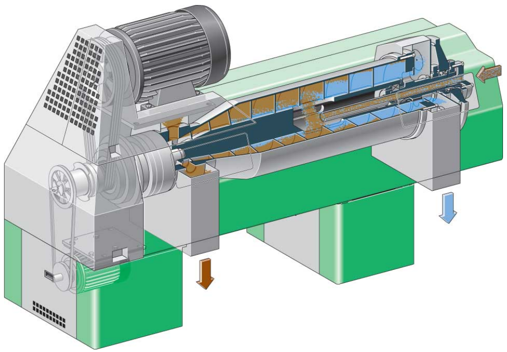
- Beneficial use options will likely require dewatering/thickening
- Dewatering significantly impacts trucking costs
- Understand how product will be applied (if land app).
- Mechanical vs nonmechanical
- Dewatering WTRs with biosolids
  - Need to understand performance when comingled prior to dewatering
  - Charge differences and polymer selection
  - Bench-scale testing and manufacturer input

Non-Mechanical Dewatering Processes

Freeze-Thaw Beds or Drying Beds

Lagoons

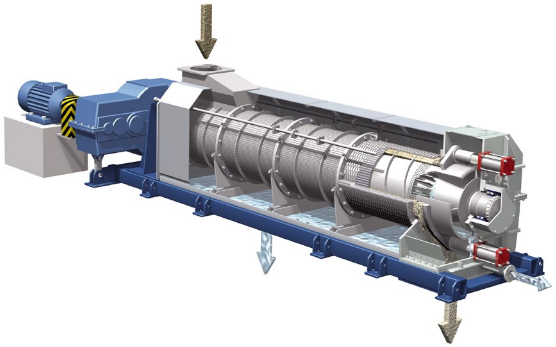
Mechanical Dewatering Processes



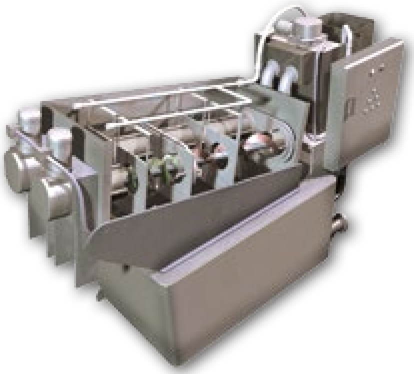
Centrifuge

Plate and Frame Press

Belt Filter Press



Screw Press



Volute Press

Lessons Learned

Beneficial Use Lessons Learned

- Diversify the beneficial use portfolio – similar to biosolids market
- Separate lime and coagulant for more beneficial use options
- Discuss coordination opportunities between biosolids and WTR beneficial use markets
- Understand all of the potential waste streams from water plants and impacts on WWTP ops.
- Compare costs, including environmental impact, using life cycle assessment. Understand the true costs of the residuals management options before making a decision.
- Fully evaluate liquid and solids processing impacts (some good / some bad) at WRRF

Questions?

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