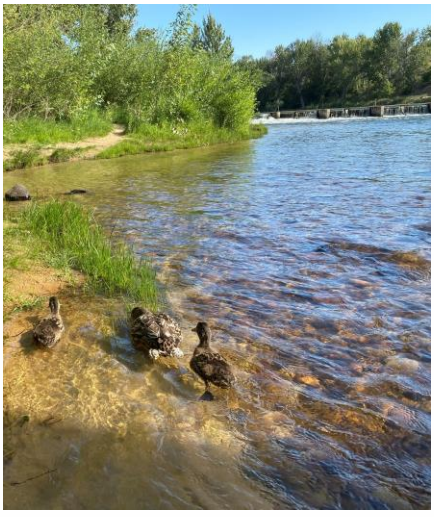
SESSION 3: CHAT QUESTION OF THE DAY:

WHAT IS YOUR FAVORITE THING ABOUT SUMMER?



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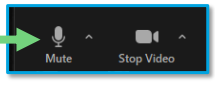
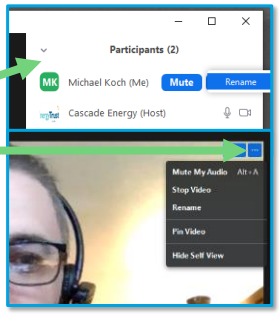
Using Zoom!

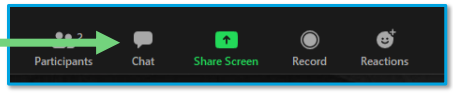
Mute yourself!
Have a question?
Use the chat feature.
Controls accessed at the bottom



Rename yourself
"Name (Company)"
Right click on your picture or 3 dots
OR
Controls accessed at the right after clicking 'Participants' at bottom.



Access Chat at the bottom



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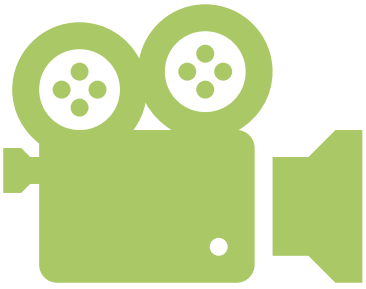
This meeting is being recorded (both audio and video)

If you do not consent to being recorded, please let the meeting moderator know ASAP and we will facilitate your participation in another way or adjust our procedure.



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VIRTUAL WASTEWATER INPLT
SESSION 3

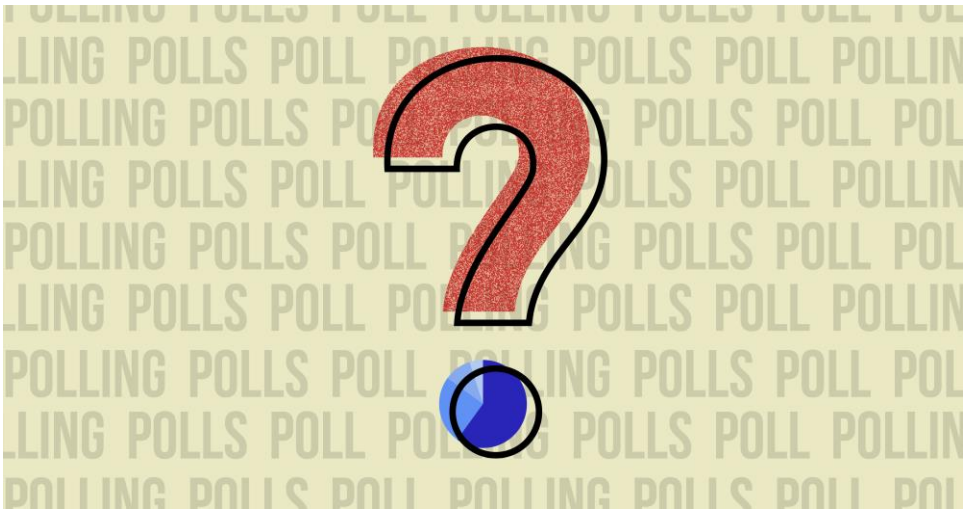
UNDERSTANDING PRIMARY CLARIFICATION

4

Thank You to Our Sponsor!

Today's Agenda

Welcome/Opening	Primary Solids & Clarification
Old Homework Review	New Homework Review
Headworks & Disinfection	Energy & PD Blowers
Break	Wrap-up



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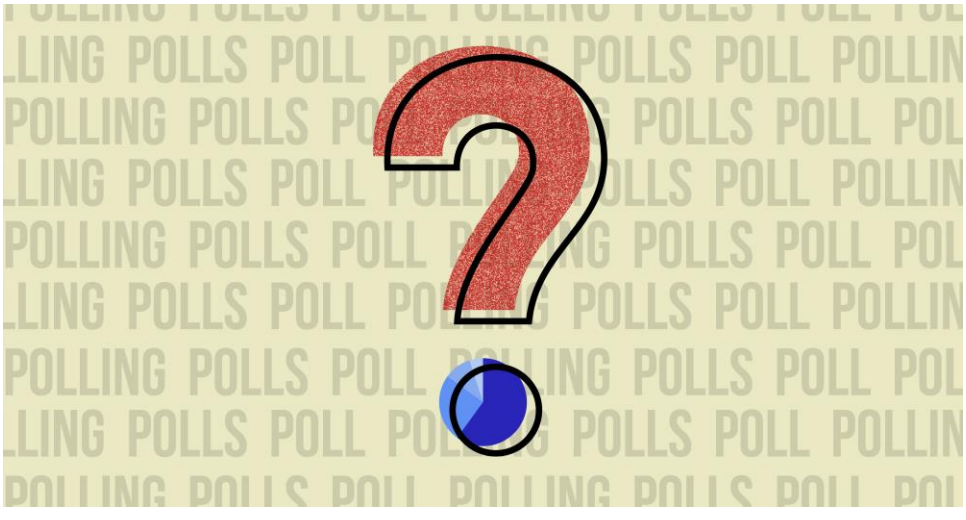

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Opportunity Register – Value Mapping

Expand or collapse steps using the +/- signs above Expand or collapse steps using the +/- signs above ↑ Expand or collapse steps using the +/- signs above ↑

Energy Projects

Energy Project		Step 1	Identify				Step 2	Prioritize					Step 3	
#	Opportunity Name		Description	Location	System*	Submitted By		Energy Impact	Energy Savings	Type of Energy Saved*	Cost/Effort Required	Decision		Next Step
1	Reduce Non-Potable Water Pressure		Average pressure is 100 psi. Pressure needed is 80 psi. Average flow is 300	Plant water pump skid	Non-potable water	Wendy		Gems	24,954	Electric	Low	Do it now		
2														
3														
4														
5														
6														
7														
8														
9														
10														
11														

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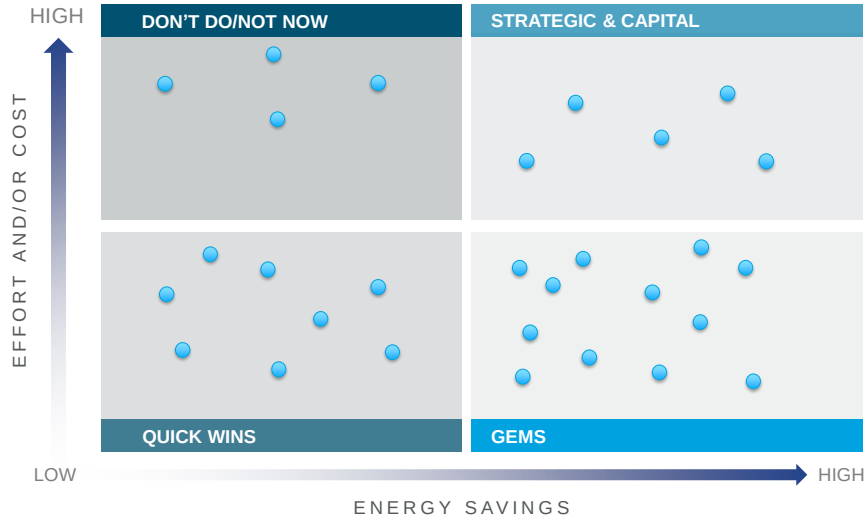
Value Matrix



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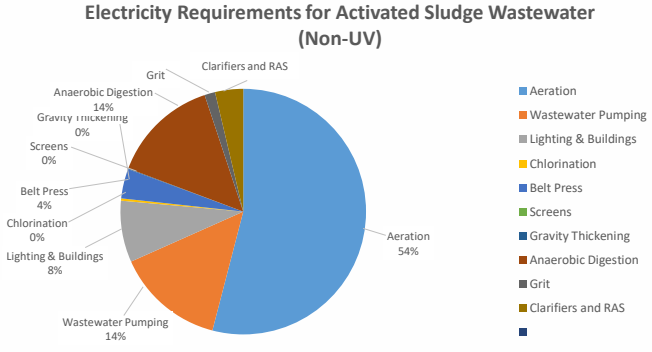
Relating Plant Process to Energy

11

ENERGY MAPS



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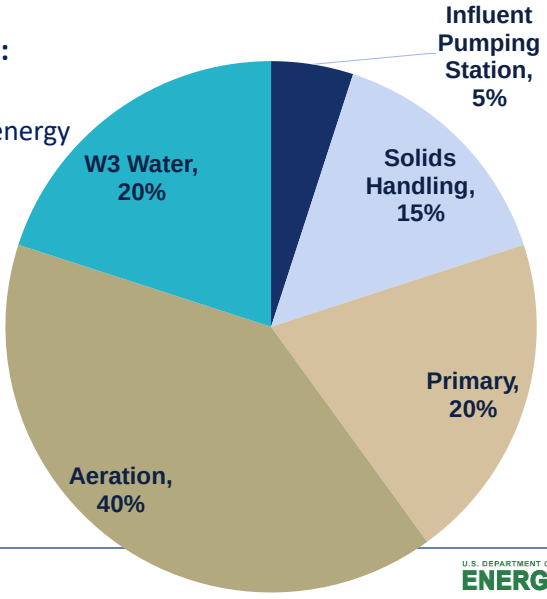
Energy Map

The energy map helps us:

- Focus on where to save energy
- Prioritize efforts for the treasure hunt
- Break energy use into manageable areas
- Assign accountability
- Raise awareness



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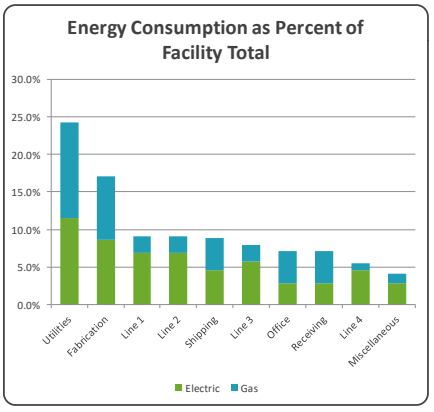
Basic Energy

Approximate Energy Consumption By EAC			
#	Energy Account Center	Electric (% of Total)	Gas (% of Total
1	Office	2.9%	4.2%
2	Receiving	2.9%	4.2%
3	Shipping	4.6%	4.2%
4	Fabrication	8.7%	8.5%
5	Utilities	11.5%	12.7%
6	Line 1	6.9%	2.1%
7	Line 2	6.9%	2.1%
8	Line 3	5.8%	2.1%
9	Line 4	4.6%	0.8%
	Miscellaneous	2.9%	1.3%
	Total	**57.7%**	**42.3%**



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HEADWORKS

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Headworks

17

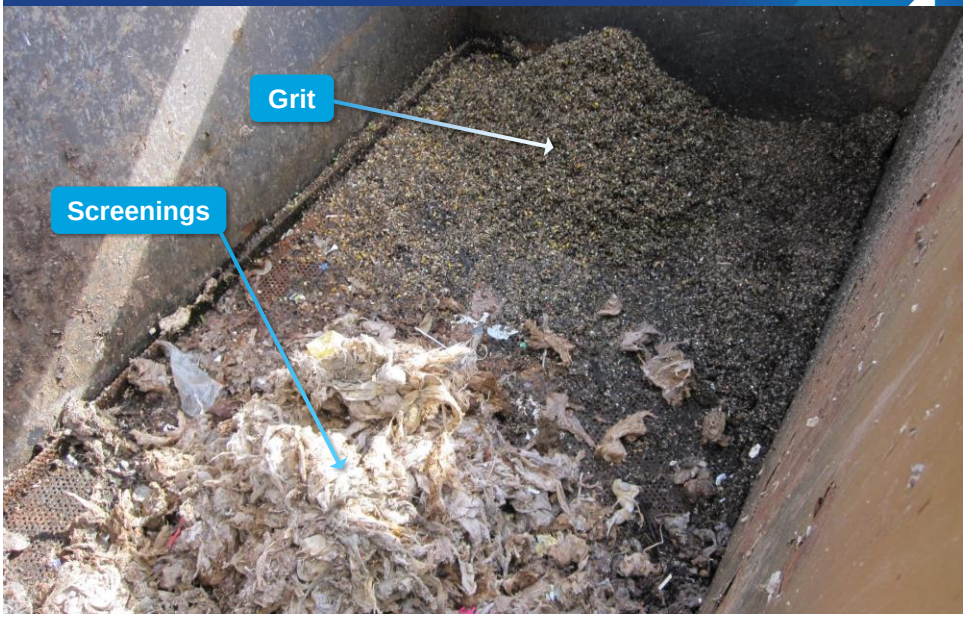
Screening

18

Grit Removal

19

Grit Removal



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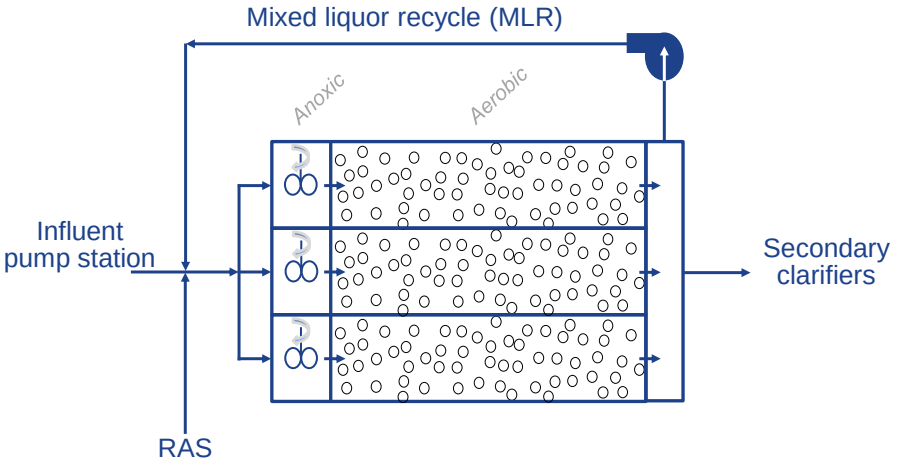
Grit Removal – It Matters A Lot



Headworks –
What You Can Control to Save Energy

Process

→ Good capture saves $ and energy in downstream process

Mechanical

- Aeration (for aerated grit)
- Minimize plant water use (e.g. sluice water)
- Timing cycle
- Interlocks on ancillary equipment

Other Headworks Considerations

How much channel agitation air do you need (really)?

Can you run fewer trains? Perhaps seasonally?

Better screens, the less worry about downstream equipment. Consider semi-open impellers rather than full open for sludge pumps, ML recirc., etc.

Are you taking advantage of NFPA allowance for reduced airflow in cold weather?

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Pump Station Considerations

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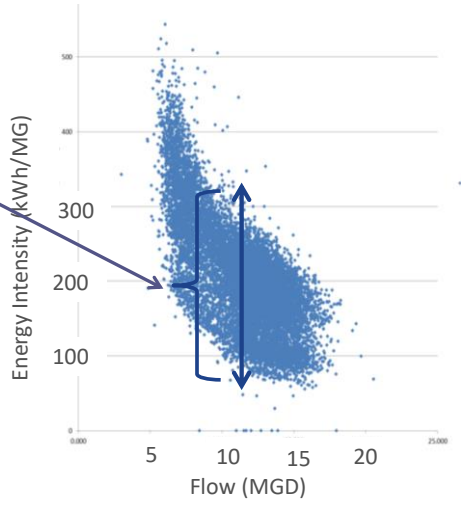
At 11.5 MGD, efficiency ranged from under 100 to over 300 kWh/MG pumped.



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Pump Operating Regime	Total operating time (HOURS)	Percent of Total Runtime	Average flow (MGD)	Average kWh/MG Pumped
Pump Station Overall	1156.3		11.5	204.3
BIG ALONE				
Pump 1 Alone	63.8	5.5%	10.9	140.2
Pump 5 Alone	143.8	12.4%	12.2	126.8
Subtotal / average		**17.9%**	**11.5**	**133.5**
SMALL ALONE				
Pump 3 Alone (only 4 points)				
SMALL COMBO				
Pump 3 + 4	38.2	3.3%	12.9	100.3
Subtotal / average		**3.3%**	**12.9**	**100.3**
BIG COMBO				
Pump 1 + 2	19.8	1.7%	11.6	222.3
Pump 1 + 5	234.8	20.3%	11.5	246.1
Pump 2 + 5	24.0	2.1%	11.4	243.3
Subtotal / average		**24.1%**	**11.5**	**237.2**

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Pump Operating Regime	Total operating time (HOURS)	Percent of Total Runtime	Average flow (MGD)	Average kWh/MG Pumped
Pump Station Overall	1156.3		11.5	204.3
ONE BIG, ONE SMALL				
Pump 4 +1	90.3	7.8%	11.7	202.4
Pump 4 + 5	182.6	15.8%	11.3	209.3
Pump 3 + 1	73.6	6.4%	11.6	200.6
Pump 3 + 5	117.8	10.2%	11.1	208.7
Subtotal / average		**40.1%**	**11.4**	**205.3**
TWO BIG, ONE SMALL				
Pump 3 + 2 + 5 (3 points)				
Pump 3 + 2 + 1 (5 points)				
TWO SMALL, ONE BIG				
Pump 4 + 3 + 1	34.6	3.0%	13.3	206.1
Pump 4 + 3 + 5	128.7	11.1%	10.9	260.0
Subtotal / average		**14.1%**	**12.1**	**233.1**
TWO SMALL, TWO BIG				
Pump 4 + 3 + 1 + 5 (only 5 points)				

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Pump Operating Regime	% of Total Runtime	Average Flow (MGD)	Average kWh/MG Pumped
BIG ALONE	17.9%	11.5	134
SMALL ALONE	0		
SMALL COMBO	3.3%	12.9	100
BIG COMBO	24.1%	11.5	237
ONE BIG, ONE SMALL	40.1%	11.4	205
TWO BIG, ONE SMALL	0		
TWO SMALL, ONE BIG	14.1%	12.1	233
TWO SMALL, TWO BIG	0		

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DISINFECTION – UV SYSTEMS

30

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UV (Energy Perspective)

UV

- UV is a known "energy hog"
- Overkill is rampant
- Regulators promote overkill

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UV Disinfection

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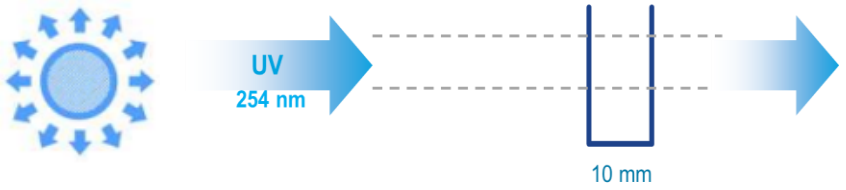
3 things to know about UV Disinfection



UV transmittance or ***UVT***, is a measurement of the amount of ultraviolet light, commonly at 254 nm, that passes through a water sample compared to the amount of light that passes through a pure water sample. The measurement is expressed as a percentage, % UVT.

Wastewater	UV Transmittance, %
Primary	28 to 50
Secondary	45 to 70
Nitrified secondary	56 to 79
Filtered secondary	56 to 86
Microfiltration	79 to 91
Reverse osmosis	89 to 98
Lower % UVT requires higher UV energy input for an equal UV dose	

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3 things to know about UV Disinfection

UV DOSE = X

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UV Transmittance

- Engineers base UV system designs on UVT.
  - Almost always over-conservatively

UVT = 0.8

UVT = 0.7

UVT = 0.6

Finding Opportunity in Conservative Designs

Start now Collect UVT data

Get involved during planning *through* design. . .
Ask hard questions!

Understand how your UV system was designed?
What UVT was it based on? What is your UVT?

Designate one UV ops expert

Opportunity Register Thoughts?

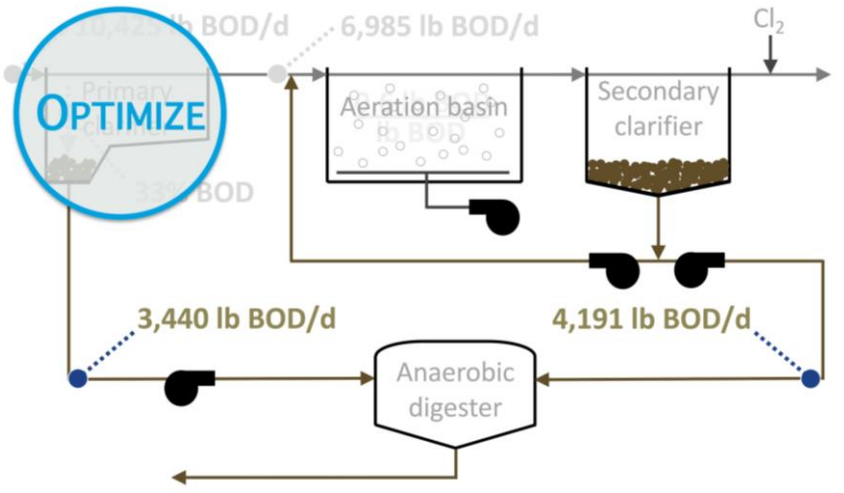
Break

Understanding Primary Clarification

Primary Clarifiers: Why We Care

Primary clarifiers remove more BOD for less operating expense than any other treatment process

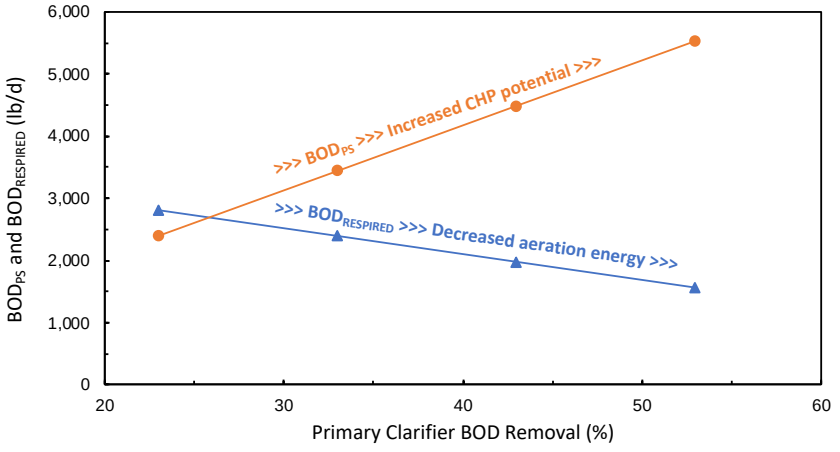
An Optimized Primary Clarifier is an Optimized Plant = Least Cost Operation



An Optimized Primary Clarifier is an Optimized Plant

Primary clarifier BOD removal (%)	BOD_{PS} (lb BOD/d)	BOD_{PE} (lb BOD/d)	BOD_{WAS} (lb BOD/d)	$BOD_{RESPIRED}$ (lb BOD/d)	BOD_{PS}/BOD_{WAS}
23	2,398	8,027	4,816	2,811	0.50
33	3,440	6,985	4,191	2,394	0.82
43	4,483	5,942	3,565	1,977	1.26
53	5,525	4,900	2,940	1,560	1.88

Increasing BOD Removal Efficiency in Primary Clarifiers Gives Double Whammy



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Primary Clarifier Removal Efficiencies All Operators Have Committed to Memory

>95% settleable solids

40−60% TSS

20−40% BOD

Where do these numbers come from?

Are they in our control?

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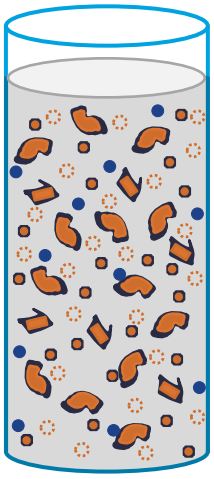
Plant-wide Energy Impacts Require Understanding Solids

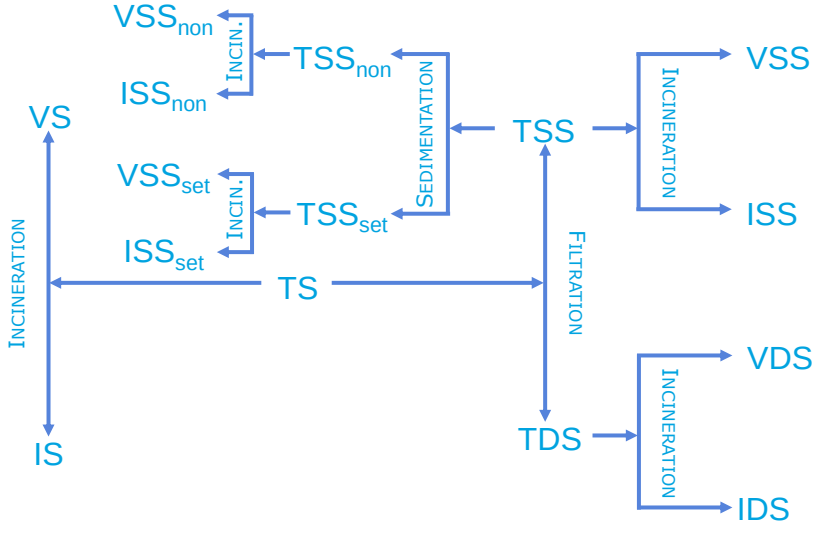


Primary clarifier performance defined by two kinds of solids

Those that settle

Those that don't

Wastewater Treatment Universe Explained!



Total Solids (TS) Measures All Solids: Visible, Too-Small-To-See, Dissolved

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Wastewater Treatment Universe Explained!

TS

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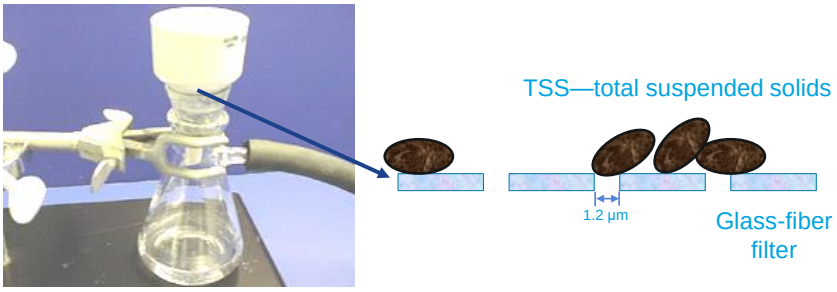
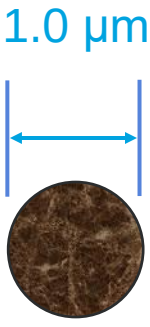
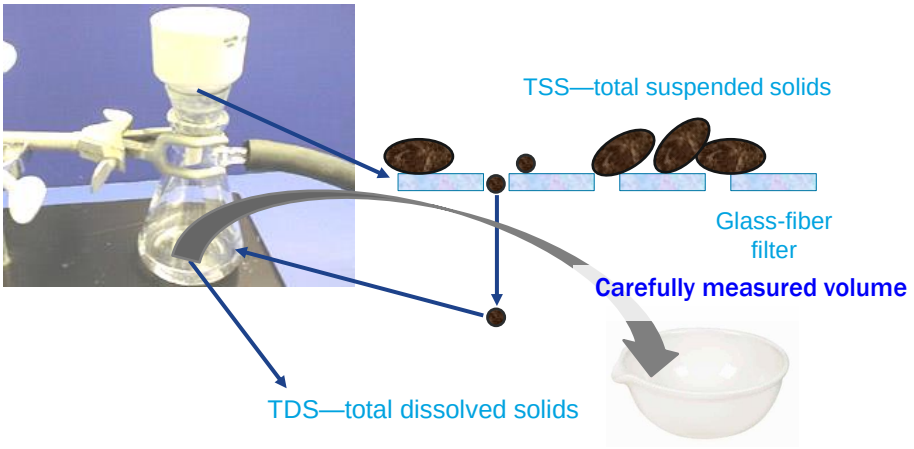
Filtration Separates TS into TSS and TDS



Colloids Are Particles with a Maximum Dimension Between 0.001 and 1.0 µm



Filtration Separates TS into TSS and TDS



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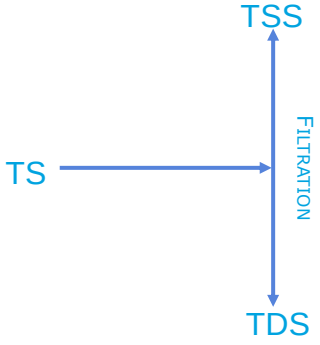
TS = TSS + TDS



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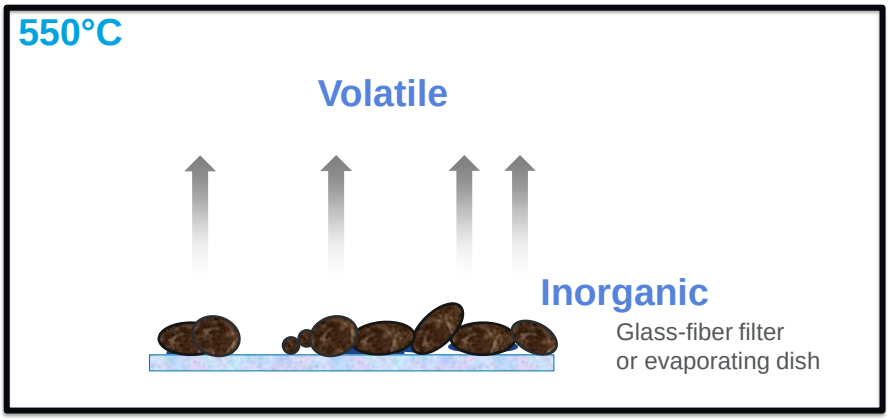
Incineration = 550°C



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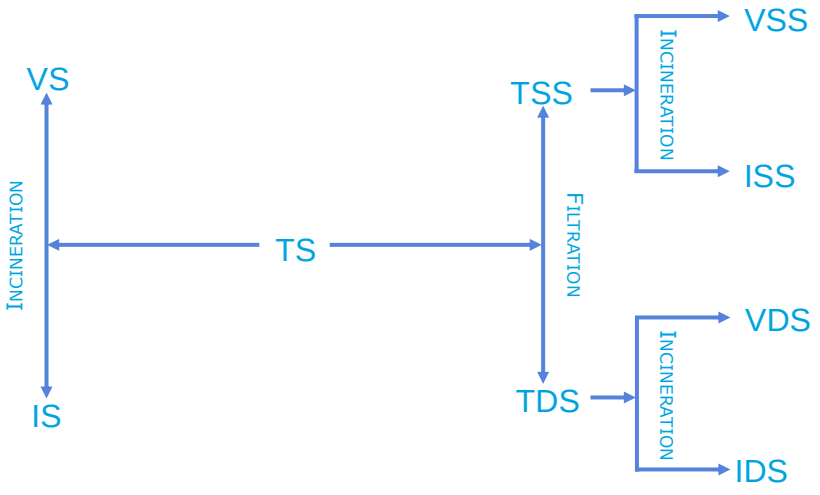
Incineration Separates TS into VS and IS; TSS into VSS and ISS; TDS into VDS and IDS



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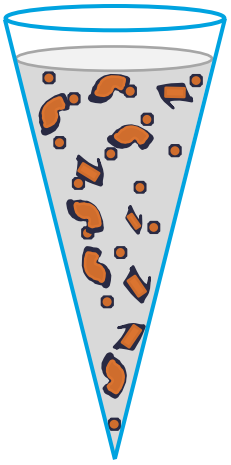
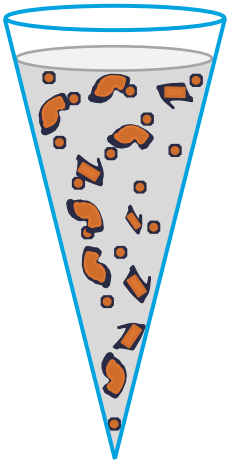
“Settleable Solids” Measured in an Imhoff Cone



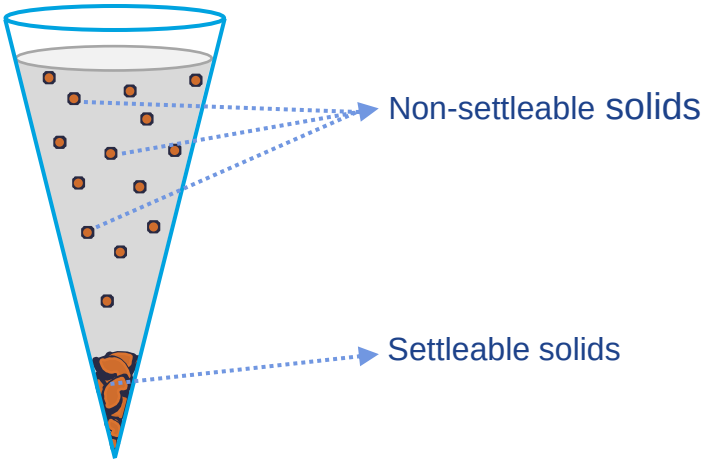
If We Can See It, It Will Be Measured as TSS



The human eye can see down to the diameter of a human hair, about **100 µm**

(way bigger than 1.2-µm pore size)

Both Settleable and Non-settleable Solids Must be TSS Because They're Visible



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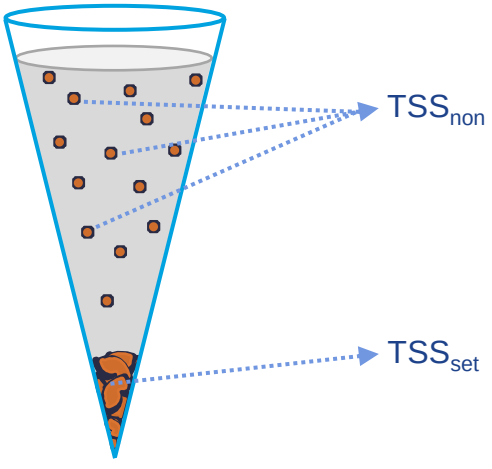
All Settleable Solids are TSS but Not All TSS are Settleable



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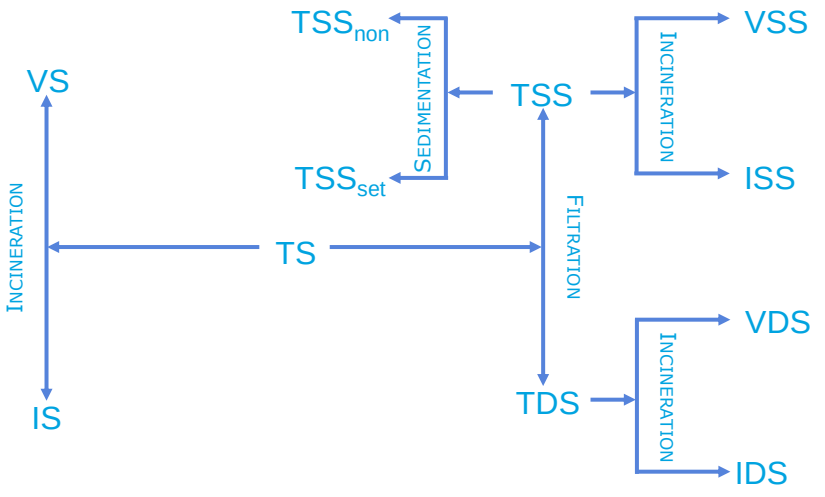
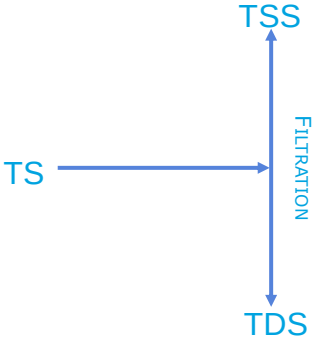
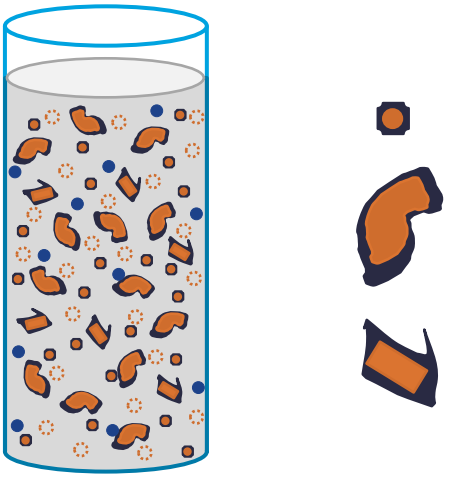
Either TSS Settle or Not



Strictly Speaking, TDS Also are Non-settleable



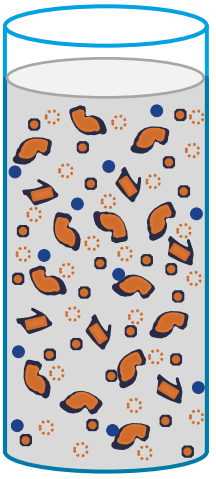
Each TSS Particle has Organic and Inorganic Components



Contemplate a Campfire on a Winter's Eve…

The organic part of the log burns, warming us in the process, until only ash remains

Each TSS Particle has Organic and Inorganic Components



Inorganic (ash)

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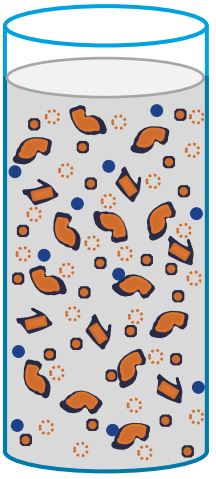
Each TSS Particle has Organic and Inorganic Components



Organic (volatile)

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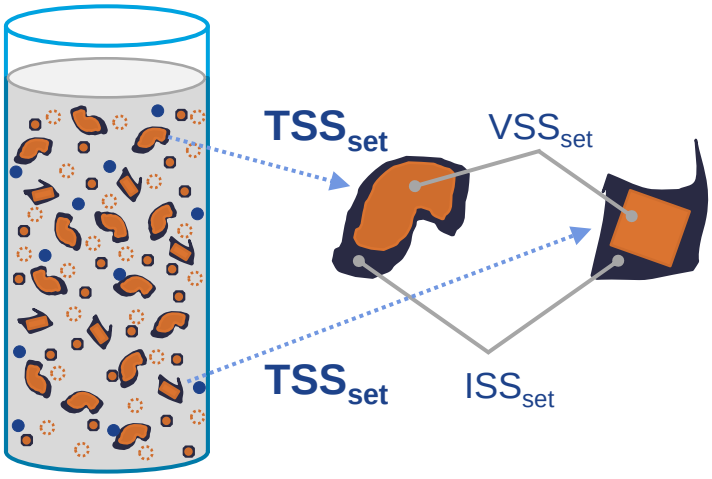
Each TSS_{set} Particle is Made Up of Volatile and Inorganic Fractions



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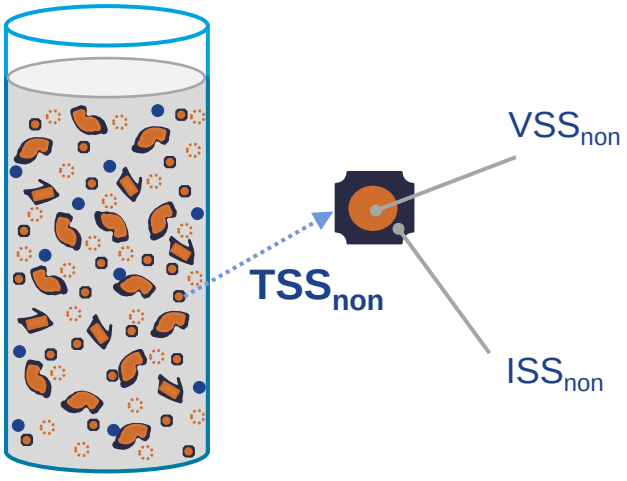
68

Each TSS_{non} Particle is Made Up of Volatile and Inorganic Fractions



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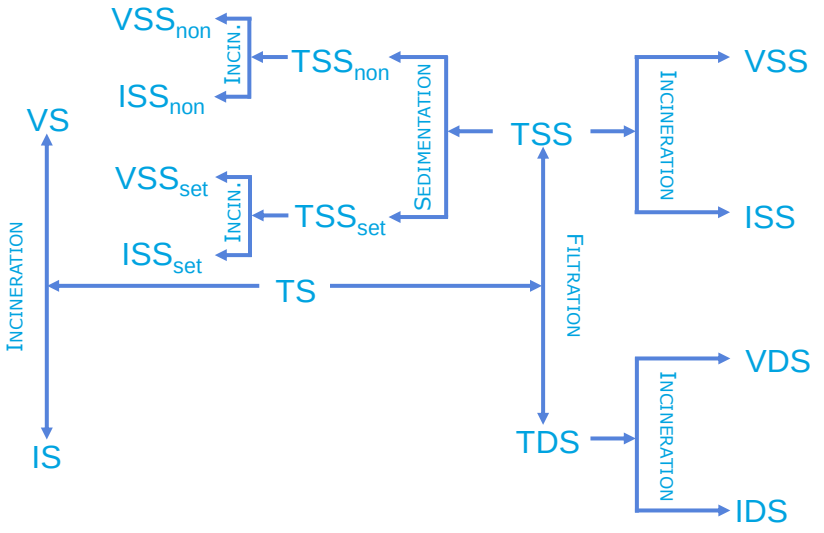
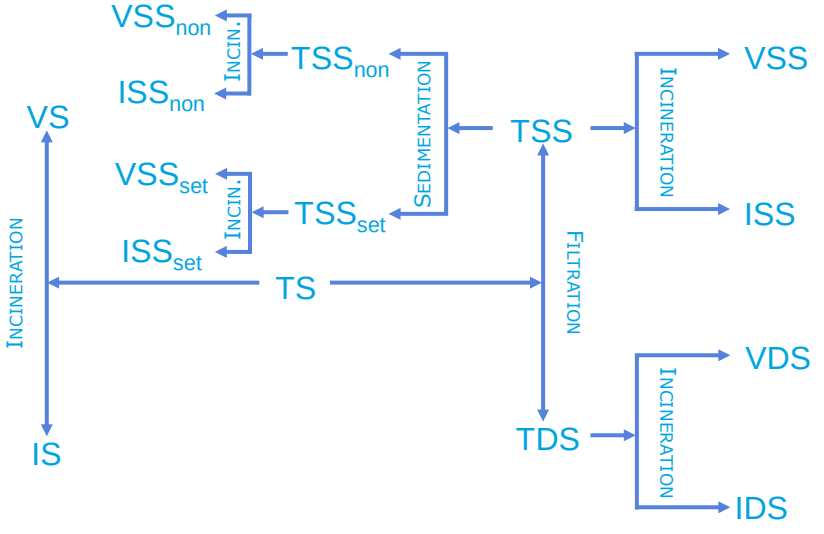
69

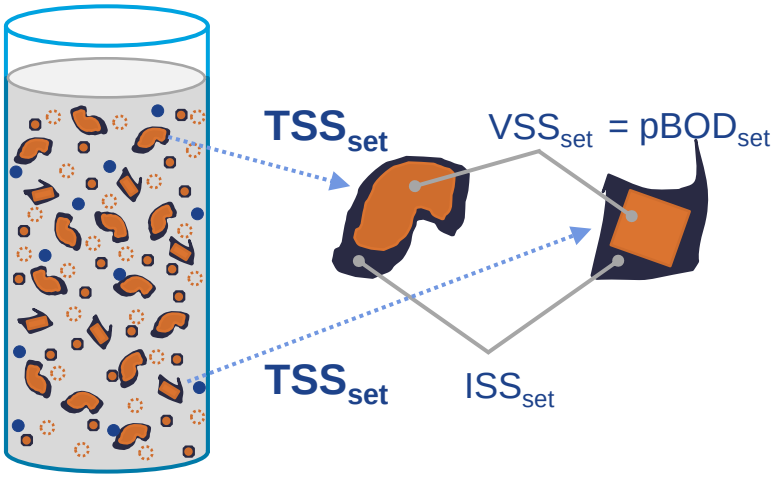
Wastewater Treatment Universe Explained!



Where's the BOD?



VSS Equivalent to Particulate BOD (pBOD)
Thus, $pBOD_{set}$



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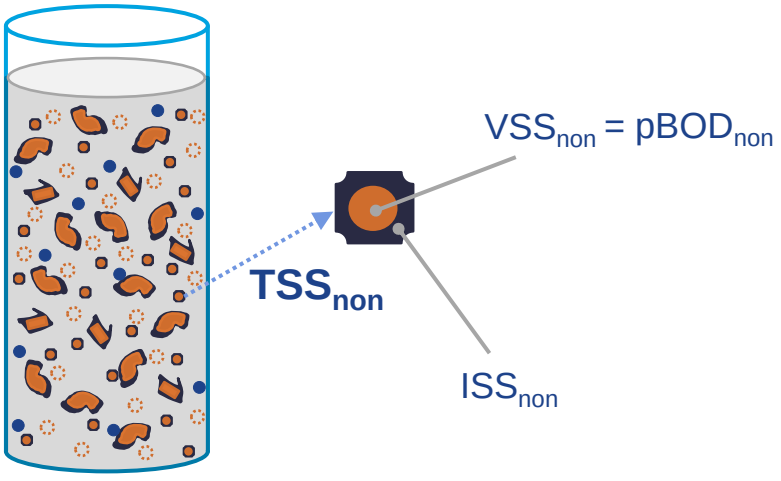
VSS Equivalent to Particulate BOD (pBOD)
Thus, $pBOD_{non}$



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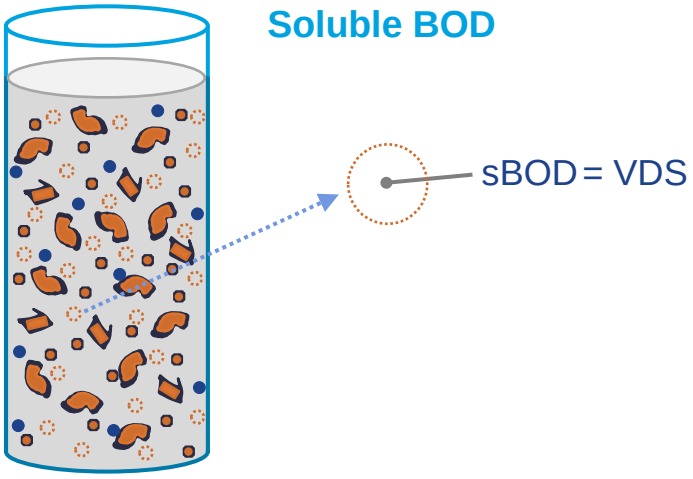
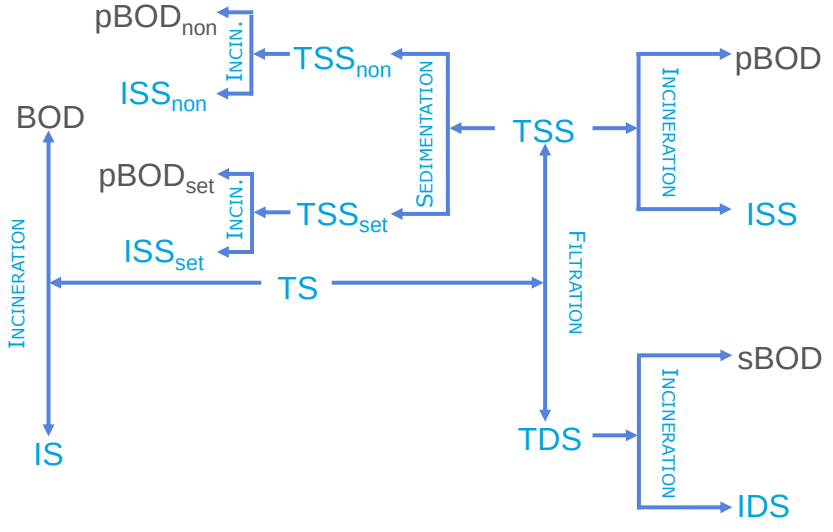
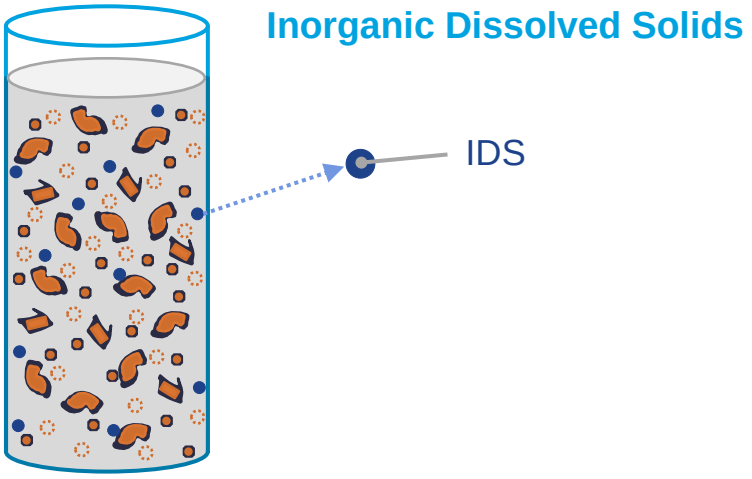
Some BOD is Soluble, Measured as VDS



BOD Measures Organics
V is for Volatile, Same as Organic



Last of the Solids, IDS
Essentially Untouched Through Treatment



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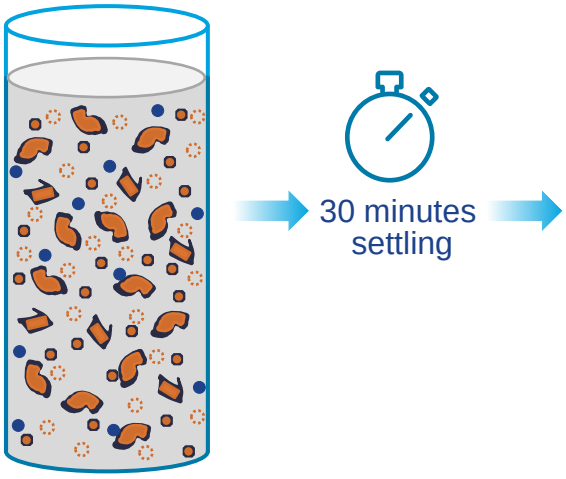
What's removed? What's remaining?



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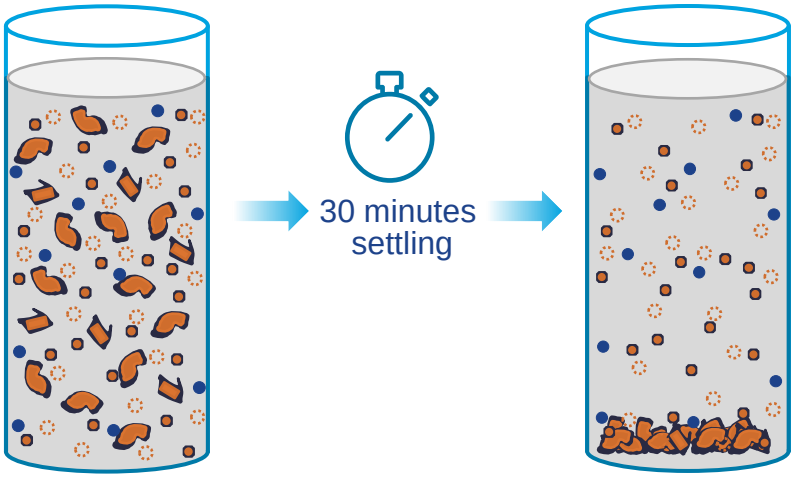
Removed: TSS_{set} (ISS_{set}, VSS_{set} = $pBOD_{set}$)



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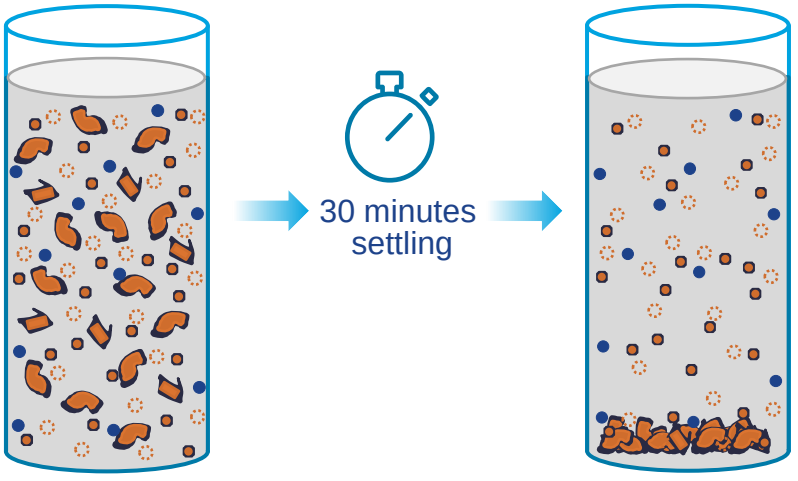
78

Not Removed: sBOD, IDS, TSS_{non} (ISS_{non}, VSS_{non} = $pBOD_{non}$)



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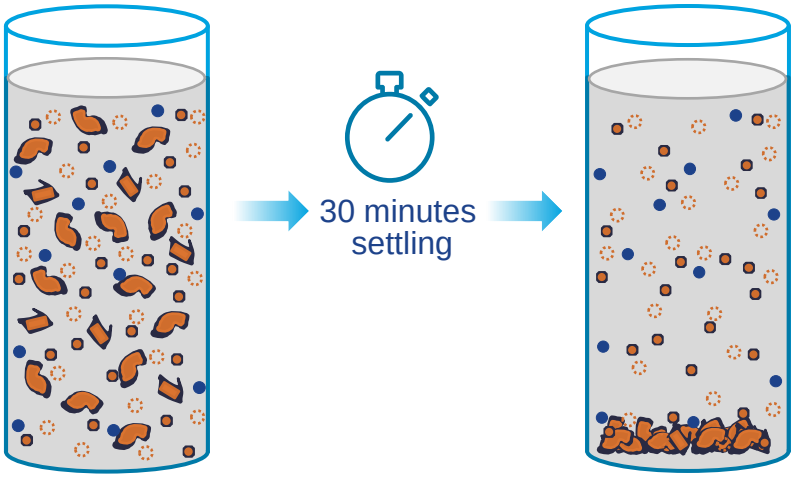
79

As Operations Professionals, We Have Little Control Over What's Settleable, What's Not



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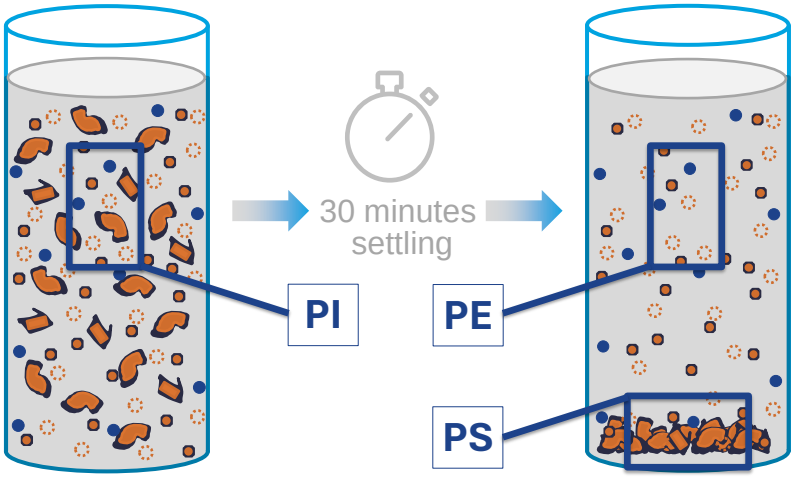
80

Primary Influent (PI), Primary Effluent (PE) Primary Sludge (PS)



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Primary Clarifiers Can Only Remove What's Settleable

Settleable

- TSS_{set} (ISS_{set}, VSS_{set} = $pBOD_{set}$)

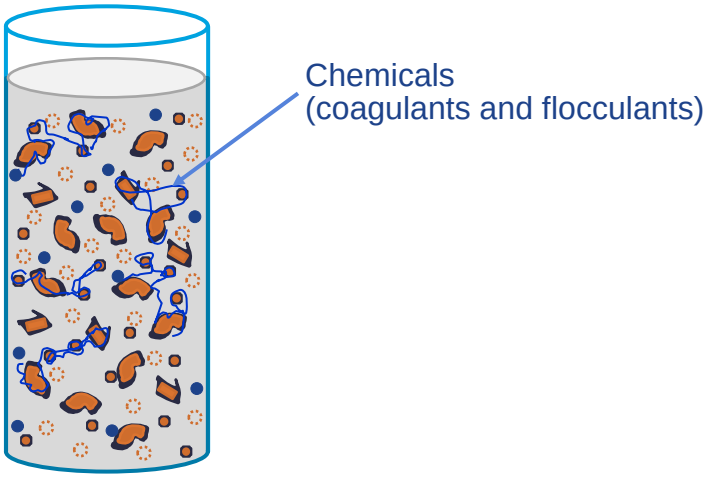
Not Settleable

- TSS_{non} (ISS_{non}, VSS_{non} = $pBOD_{non}$)
- sBOD
- IDS

Primary Clarifier Removal Efficiencies All Operators Have Committed to Memory **Explained**

1. >95% settleable solids
   [All TSS_{set} are settleable]
2. 40−60% TSS
   [40−60% of TSS_{INF} are TSS_{set}]
3. 20−40% BOD
   [20−40% BOD_{INF} is $pBOD_{set}$]

Chemically Enhanced Primary Treatment (CEPT) —Two Different Objectives



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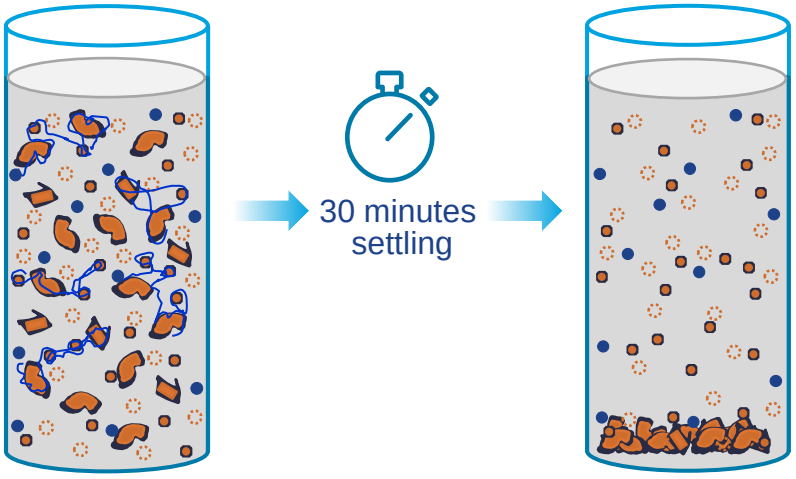
84

1. CEPT "Converts" Some TSS_{non} to TSS_{set} Increasing Removal Efficiencies



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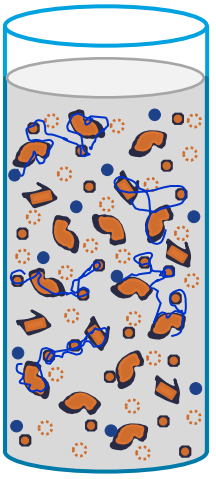
2. Larger TSS_{set} Settle Faster Maintaining Performance at High Flows



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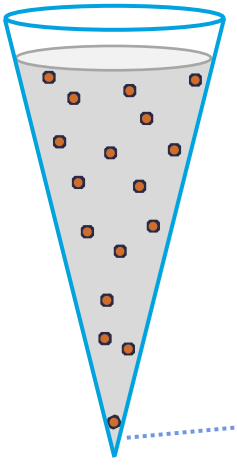
Optimum Primary Clarifier Performance Indicated by Two Test Results



1. No TSS_{set} in Primary Effluent

$TSS_{set} = 0$

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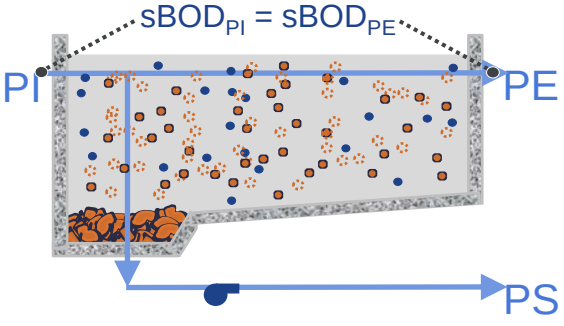
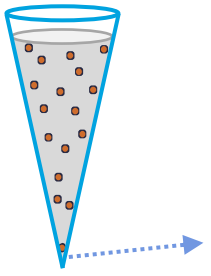
Optimum Primary Clarifier Performance Indicated by Two Test Results

2. No Increase in sBOD Influent to Effluent



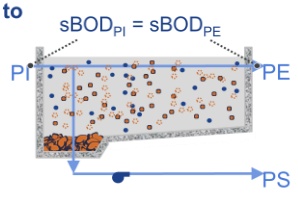
Homework Assignment 1

- Perform these 2 tests when you get back to your plant.



1. No TSS_{set} in Primary Effluent

2. No Increase in sBOD Influent to Effluent



PD Blowers

90

91

92

@ 2500 RPM & 6 PSI

4.8 BHP & 112 CFM

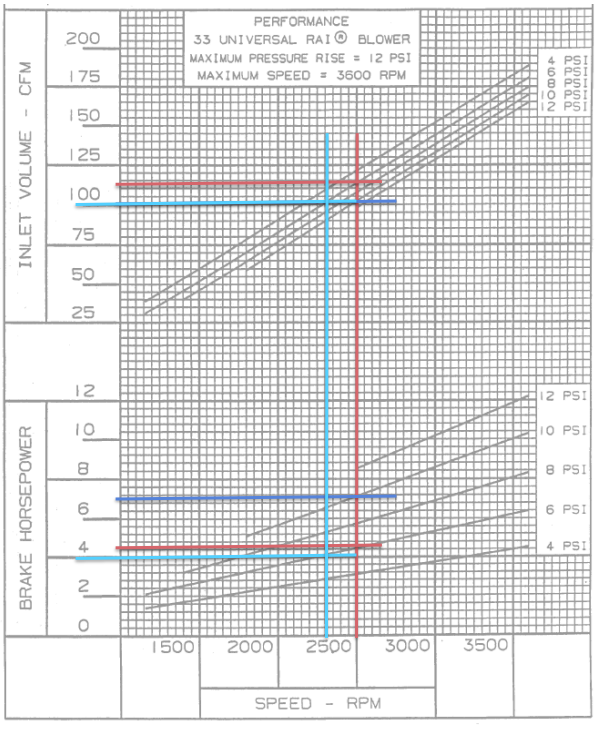
@ 2500 RPM & 10 PSI

7.1 BHP (UP 48%)
& 102 CFM (DOWN 9%)

Change the sheave
or use a VFD

@ 2300 RPM & 6 PSI

4.0 BHP (DOWN 16%)
& 102 CFM



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93

Homework

Think of three motors that are currently operating in your plant that you think you can reduce the runtime on, either through a timer or other automatic control.

List the motor equipment involved & fill in the table in your Workbook:

Equipment	HP	Current runtime	New runtime

Now, estimate the energy savings that will occur should you implement this opportunity

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Closing

See you next week

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