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Troubleshooting Activated Sludge

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Troy A. Larson – Wastewater Operations Specialist

Outline of Presentation

- Background
- Triggers
- Monitoring
- Case Studies
 - Dispersed Throughout

Evolution of Cleaning Chemicals May Be Difficult for Activated Sludge Systems

- Pre WWII
 - Soap made using animal fats
 - WWII created shortage in animal fats
- Post WWII
 - Soaps give way to detergents
 - Detergents based on petrochemical or synthetic formulations
 - Detergents evolve to potentially include:
 - Enzymes
 - Bleaches
 - Hydrophobic or hydrophilic properties
 - Biocidal components
 - Other.....
 - Market pressures and regulations prompt continued change

Water Conversation Is Good! (Except If Used To The Dilution)

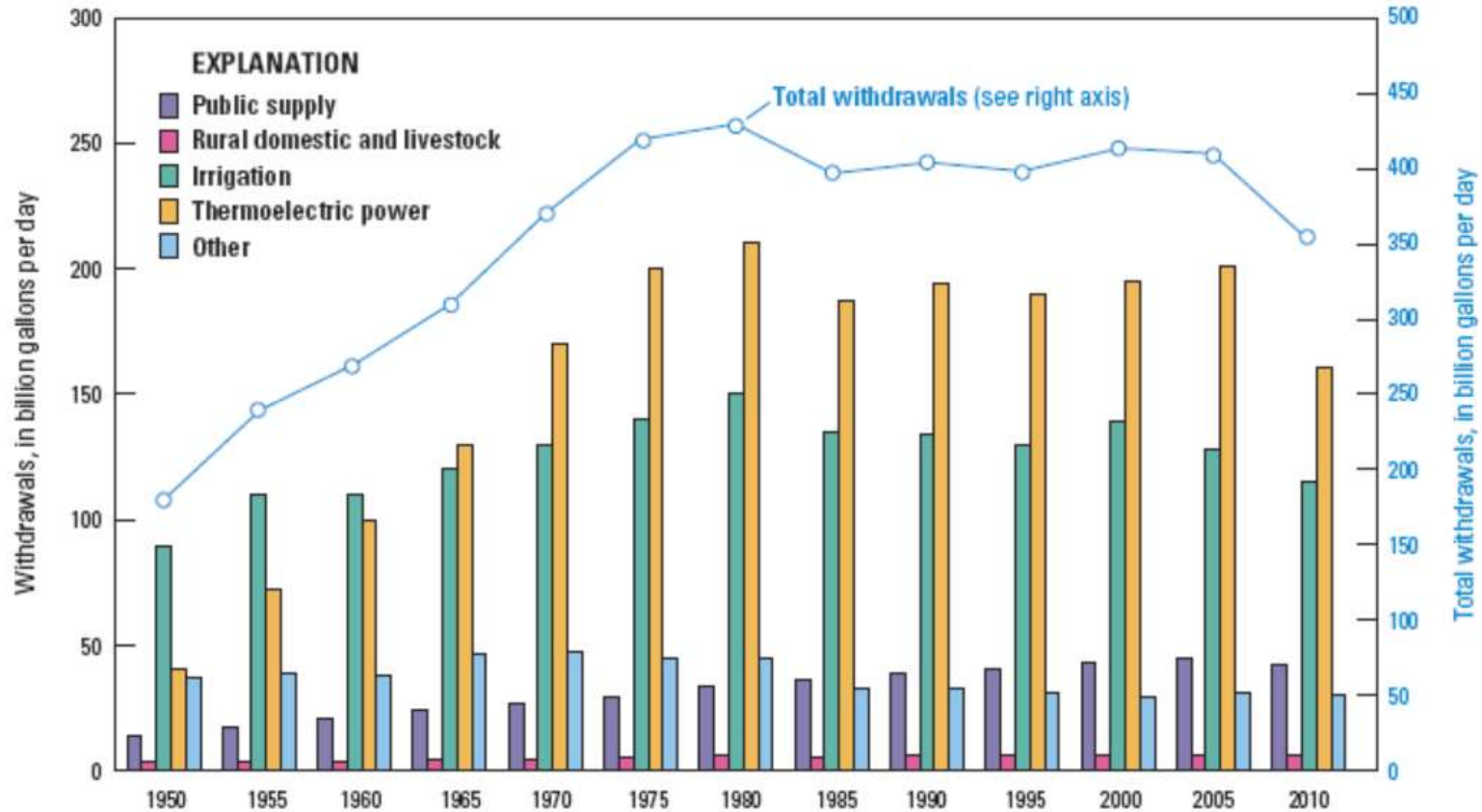


Figure 14. Trends in total water withdrawals by water-use category, 1950–2010.

Rapid Settling and Miscellaneous Stress

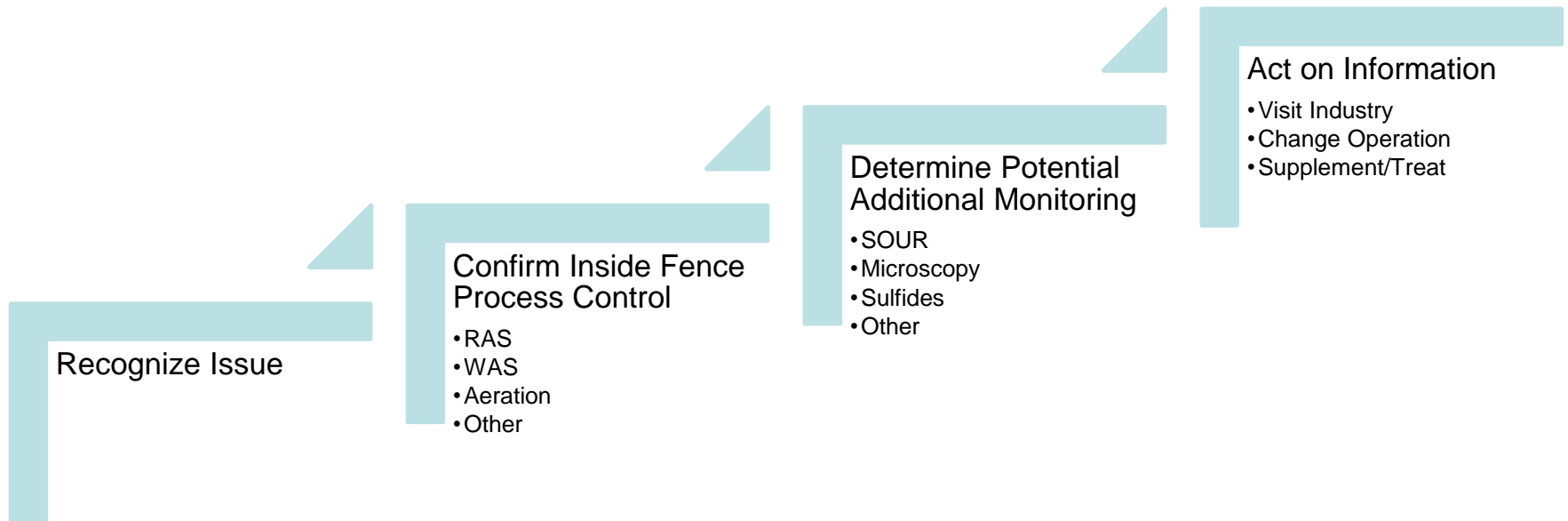
Background



Stable Conditions are Required for Proper Floc Formation

- “The following factors can adversely affect floc formation:
 - Sludge Age
 - Slug Discharges
 - Toxicity
 - Surfactants
 - Excessive Shearing”
- Toni Glymph, *Wastewater Microbiology: A Handbook for Operators*

Strategic Responses Require Well Structured Steps



Communicate, communicate, communicate!

Document, document, document!

Description of Treatment Stress

- Potential Observations
 - Influent
 - Increased Sulfides
 - Foam/Odd Colors/Odors
 - pH Changes
 - Mixed Liquor
 - Appearance/Odor
 - Settling Characteristics
 - Mixed Liquor Concentration
 - Clarifier Surface
 - Effluent
 - TSS Spike
 - BOD Spike
 - Ammonia Spike
 - Nitrite (NO₂) Spike
 - WET Test Failure



BOD – Toxic Substances

- Confirmed through serial dilutions
 - BOD bottles with greatest amount of sample that have the lowest BOD might indicate presence of toxic substances

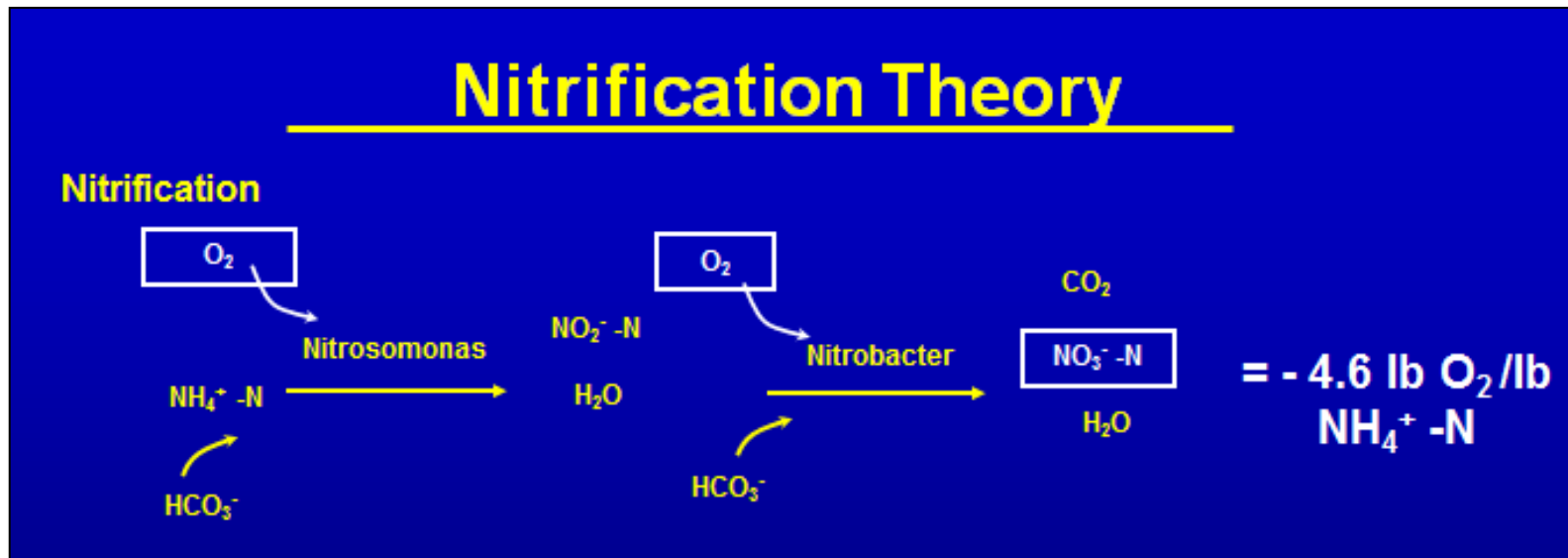
TABLE 8 - EVIDENCE OF POSSIBLE TOXICITY INTERFERENCE

Source	Bottle	Sample Vol (ml)	Initial DO	Final DO	Depletion	Dilution Factor	BODs
Final	1	5	8.9	4.6	4.3	60	222
Effluent	2	10	8.9	4.3	4.6	30	120
	3	20	8.9	3.9	5.0	15	66

- *Laboratory Testing for BOD and CBOD – Brake and Raynovic*

Description of Treatment Stress

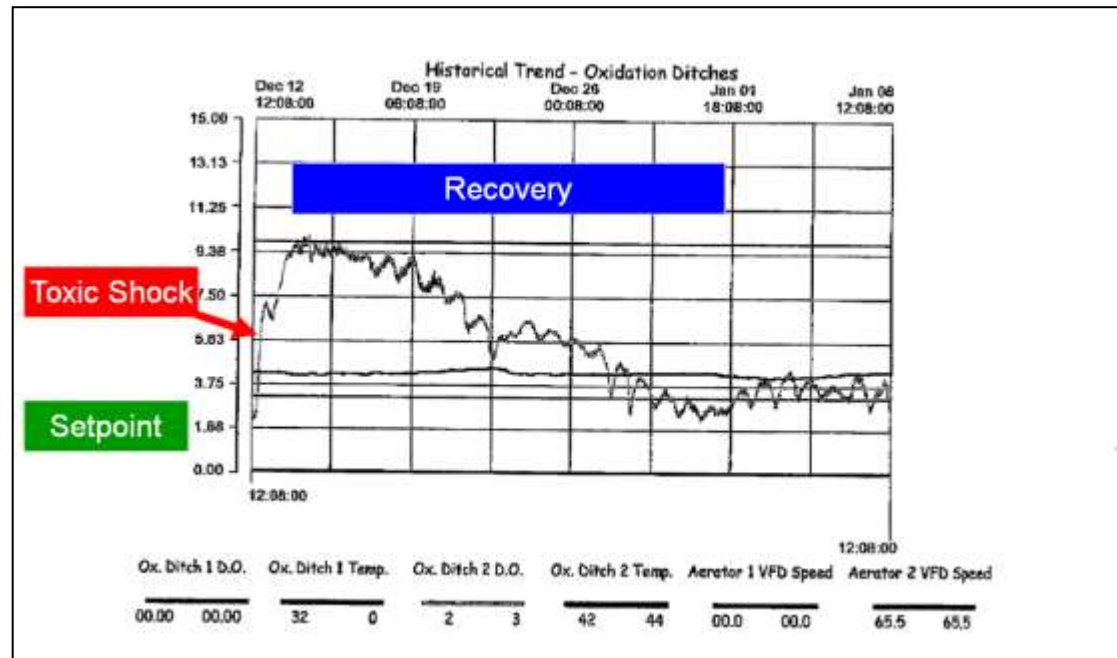
- Nitrification stress might be defined as:
 - Effluent ammonia concentrations are not as low as typical or expected
 - Nitrite is present in effluent when not typical



- 12.9 lbs of Cl_2 consumed per mg/L NO_2^- per MGD

Description of Treatment Stress

- Process Observations
 - Automation Changes
 - Less Air Required
 - More Air Required
 - Lower Residuals Detected; More Chlorine Required
 - Oddities in Optical Measurements



Underlying Triggers



Underlying Triggers

- Loss of Dilution
 - Chemicals
 - Metals
 - Organic Loads
- Change in Hydraulic Detention Times
 - Sewer
 - Process Tanks
- Change in Temperature
 - Less volume, more time, warm ambient conditions = Warm Activated Sludge

The gradual changes associated with droughts makes identification of stresses difficult.

Chemicals of Interest Include:

- Quaternary Amines
 - Used in cleaning chemicals
 - Accumulate through adsorption
 - Degrade slowly
- Anionic Surfactants
 - Used in cleaning chemicals
 - Coats bacteria surface causing deflocculation
 - Foam may be associated with these wastewaters

Note: Portable Toilets
Frequently Include
Quaternary Amines

If your industries use a chemical to kill bacteria at their facility, they should understand what it does at yours.

Wastewater Characteristic Changes of Interest Include:

- Sulfide Toxicity
 - Very pH Dependent
 - Monitor daily
 - May indicate new or greater sources of H₂S
 - Develop Baseline

“ Sulfide toxicity to activated sludge is more common than currently recognized.” Michael Richard Ph.D. *Activated Sludge Microbiology Problems and Their Controls*

@ a pH of 7.0 s.u., 1 mg/L H₂S decreased oxygen uptake by 50 %
@ a pH of 8.0, 100 mg/L H₂S was required to get the same response

Midge Fly Infestation

Where Have All the Solids Gone?

By Ron Trygar, CET | Lab Detective | June 2012





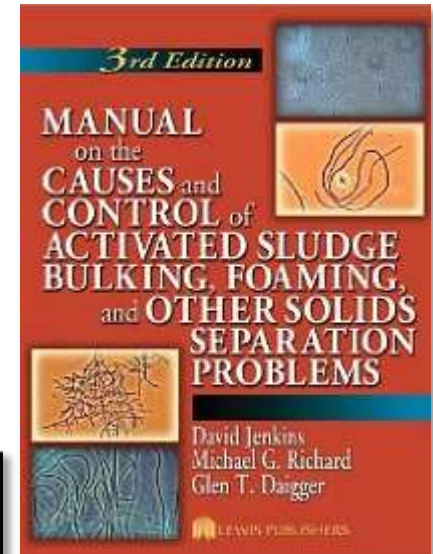
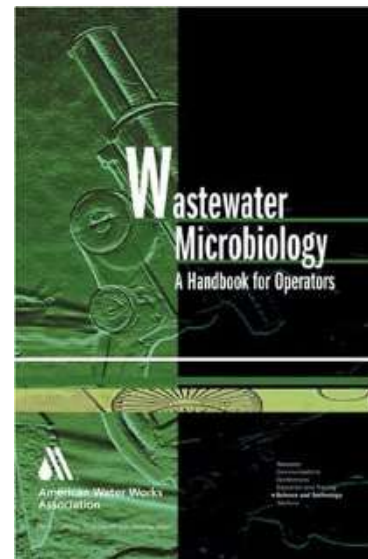
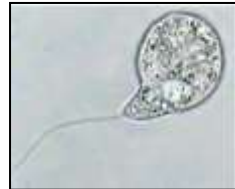
Proactive Observations

Keys To Gaining Value From Information Include

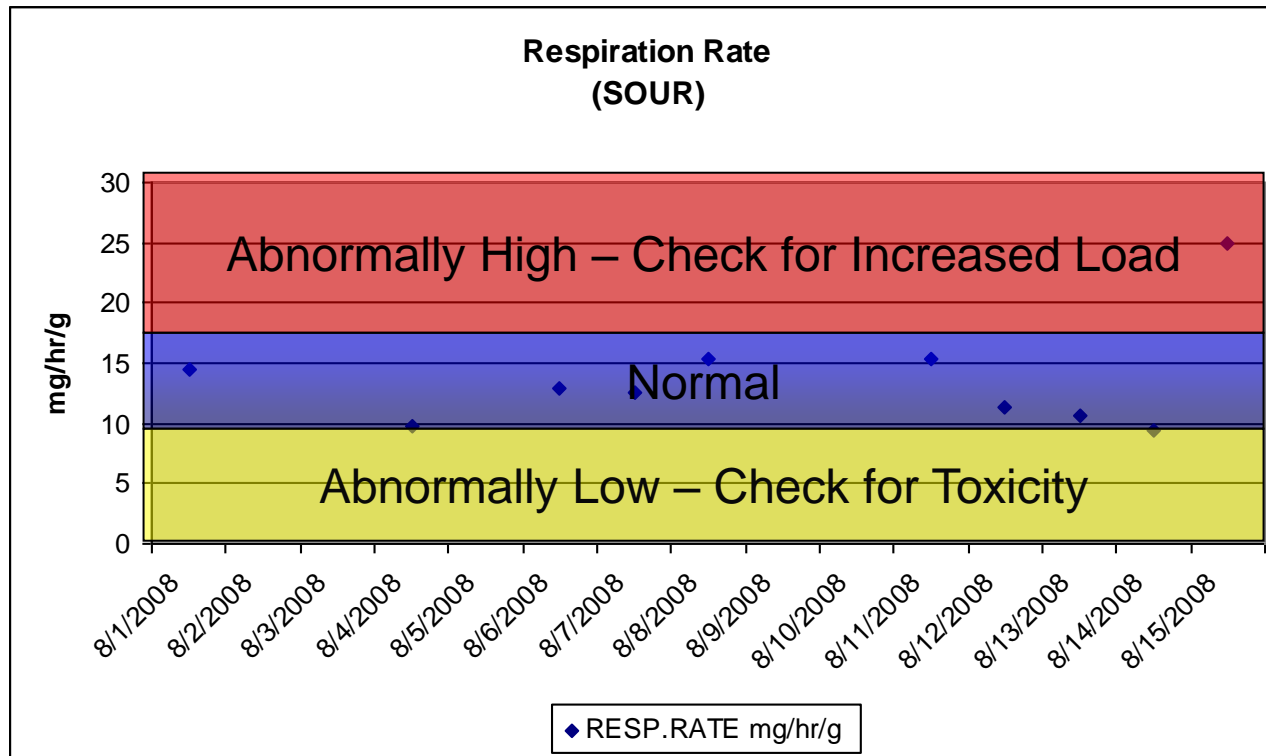
- Collect information in good times to provide a baseline
- Organize information to provide trending and other review opportunities
- Communicate findings with appropriate parties
 - Suspected contributors
 - Management
 - Operators/Team
- Isolate information when possible

Microscopy Can Indicate if Toxicity may be a Factor

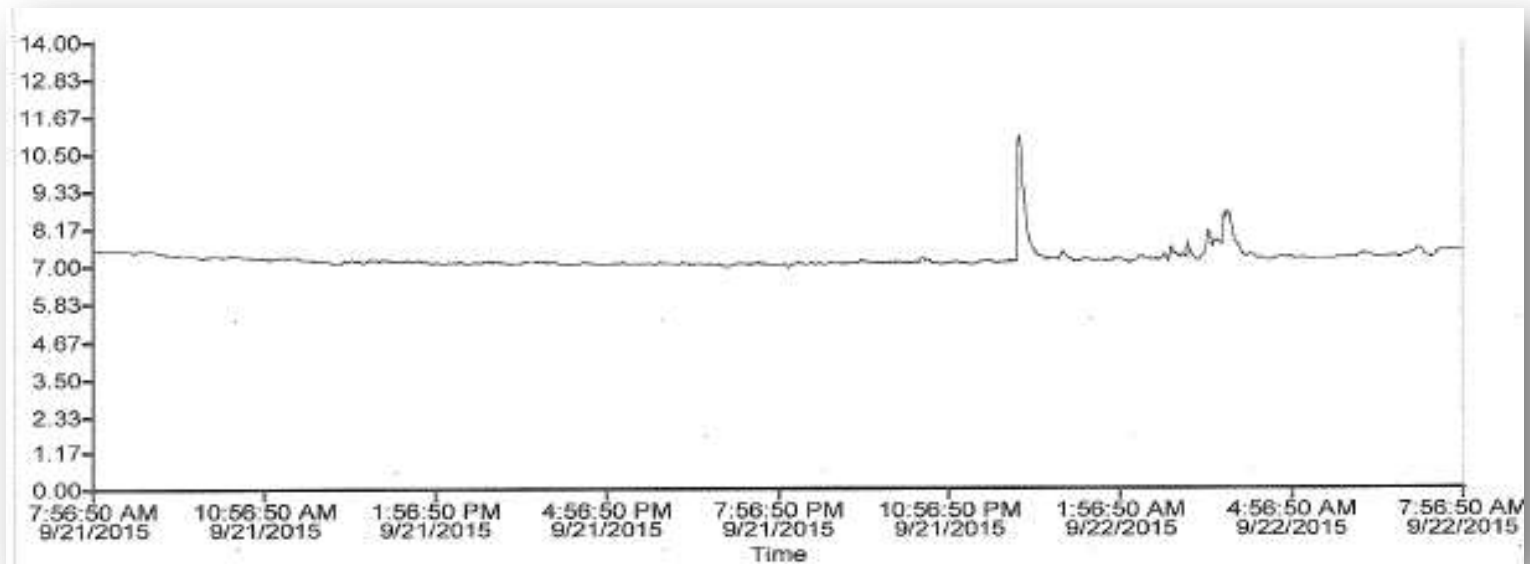
- Microscopy Evaluations
 - Changes in indicator organisms
 - More Flagellates
 - More amoeba
 - Testate or shelled indicator organisms
 - Fewer higher life forms or inactive higher life forms
 - Stress to filamentous bacteria
 - Stress to floc formation
 - Get trusted sources for reference
 - Do in-house and do so consistently



Regular SOUR or OUR Analysis May Identify Meaningful Changes in Characteristics



Influent pH Monitoring May Date/Time Stamp Trigger



Industrial Pretreatment May Avoid Issues

- Communicate with pretreatment coordinator – In House
- Gain political will if necessary
 - Respectfully proceed
- Discuss Cause and Effect Relationships with Industry
 - Raw Materials
 - Cleaning Chemicals
 - By-Products
 - Products

Identify Potential Causes

- > Cleaners
- > Disinfectants
- > Biocides
- > Concentrated Products
- > Surfactants
- > Emulsifiers
- > Acids/Bases
- > Boiler Treatments

What is xanthan gum?

Adenosine Triphosphate (ATP) Indicates Viable Organisms

- ATP analysis measures the light following the introduction of reagents creating a luminescing reaction.
- Data Provides Information
 - Total ATP
 - Dissolved ATP
 - Cellular ATP
 - Active Biomass Ratio
 - Biomass Stress Index



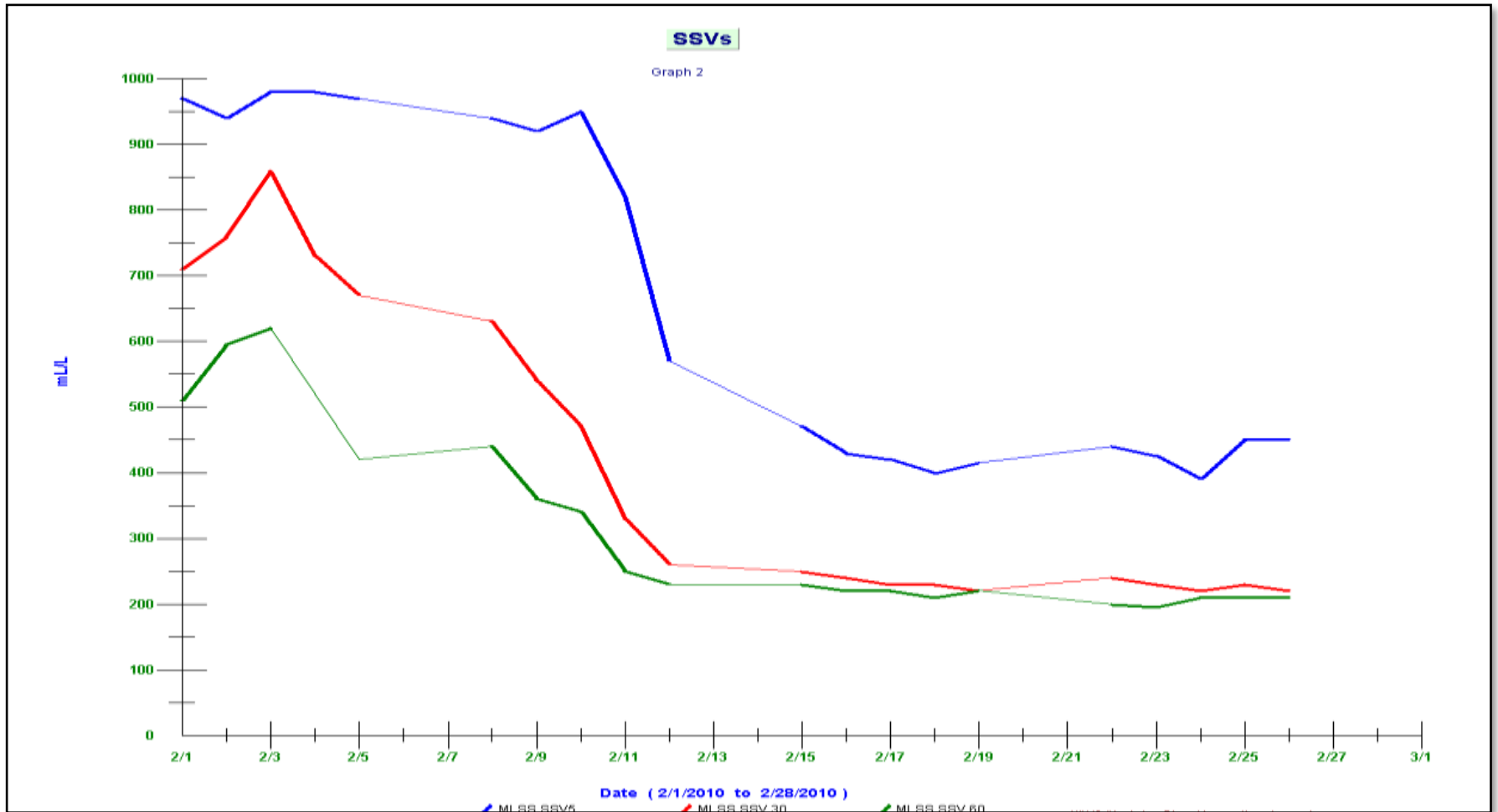
Operator Intuition!

Facility Identifies Toxicity Source by Opening Manholes



- Community of 1400
- Flow of ~ 60,000/day
- 43 gpd per person
- Treatment stress identified
- Collected samples, opened manholes
- Found paint being dumped

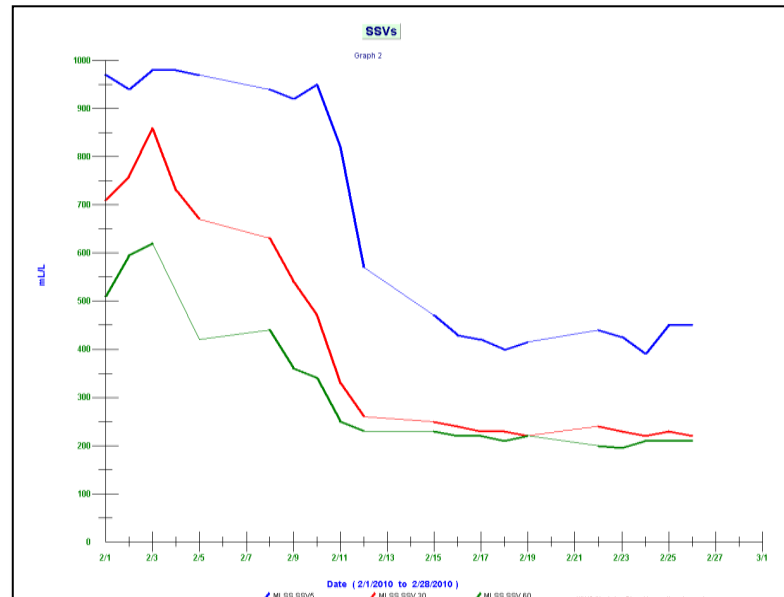
Settling Characteristics May Indicate Timing of Initial Issue



Trends of Key Information Such as Settling Characteristics Provides Timely Information

Effluent	BOD Load	COD Load	pH	WASq v Eff TSS	Res. Rate v Effl TSS	Tanks in Service	Res vs Load	SVI vs MLSS
Flow	COD Concentration	BOD Concentration	Primary Removal	RAS	Nitrogen v Effluent	SSVs	Sludge Age	WAS lbs

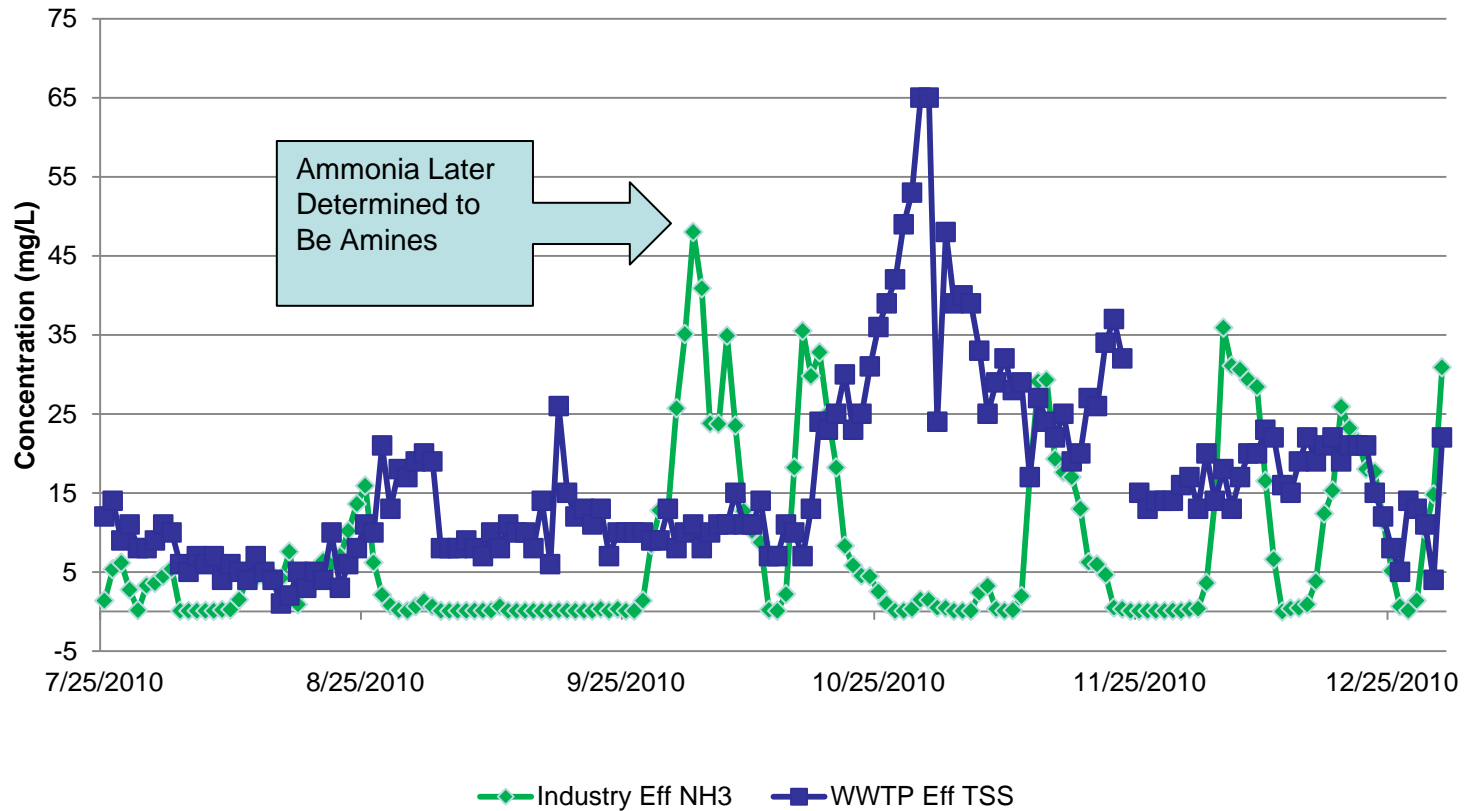
Database shortcuts to meaningful trends



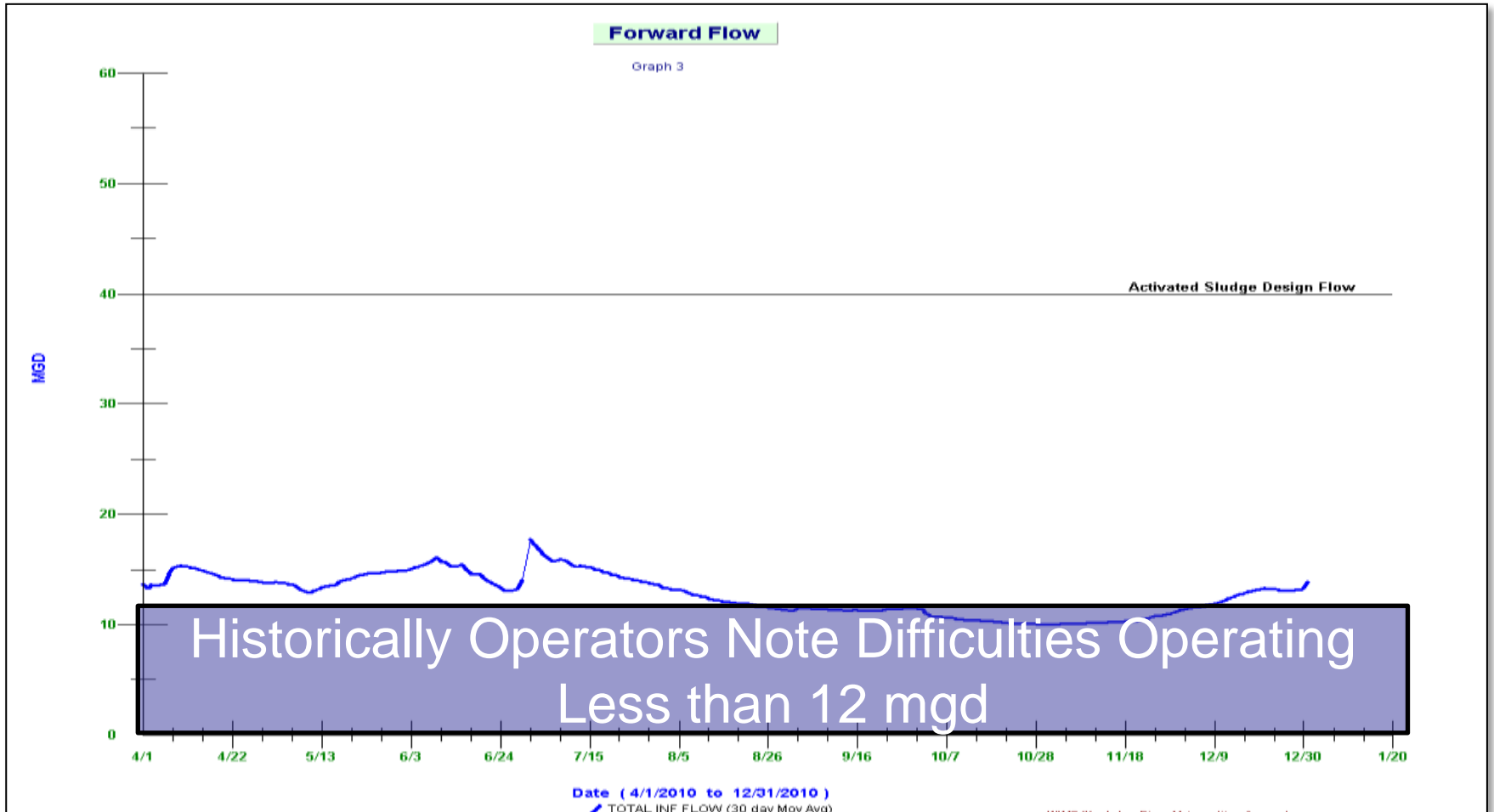
Trend of Settling Characteristics

Comparison of Information from Multiple Sources Provides Detailed Trends

2010 WWTP TSS vs Industry Ammonia (or Amines)



Track Anecdotal Information With Data to Build on “Hunches”



Closing Thoughts

Remedies May Require Multiple Adjustments

- Adjust Conventional Controls
 - Adjust RAS
 - Adjust WAS
 - More Air
- Reduce Industrial Stresses
- Reduce Hauled in Stresses
- Supplement – Bio augmentation
- Add Coagulant or Flocculent
- Add Seed

Identifying and eliminating the trigger is the best remedy.

Additional Closing Thoughts

- Developments to cleaning chemicals, biocides, and other important products may have a negative impact on wastewater treatment
- Environmental conditions may allow hidden stresses to reveal themselves
- Monitoring and proactive responses can improve performance
- Industrial pretreatment may be improved through simple communications



Questions and Answers



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