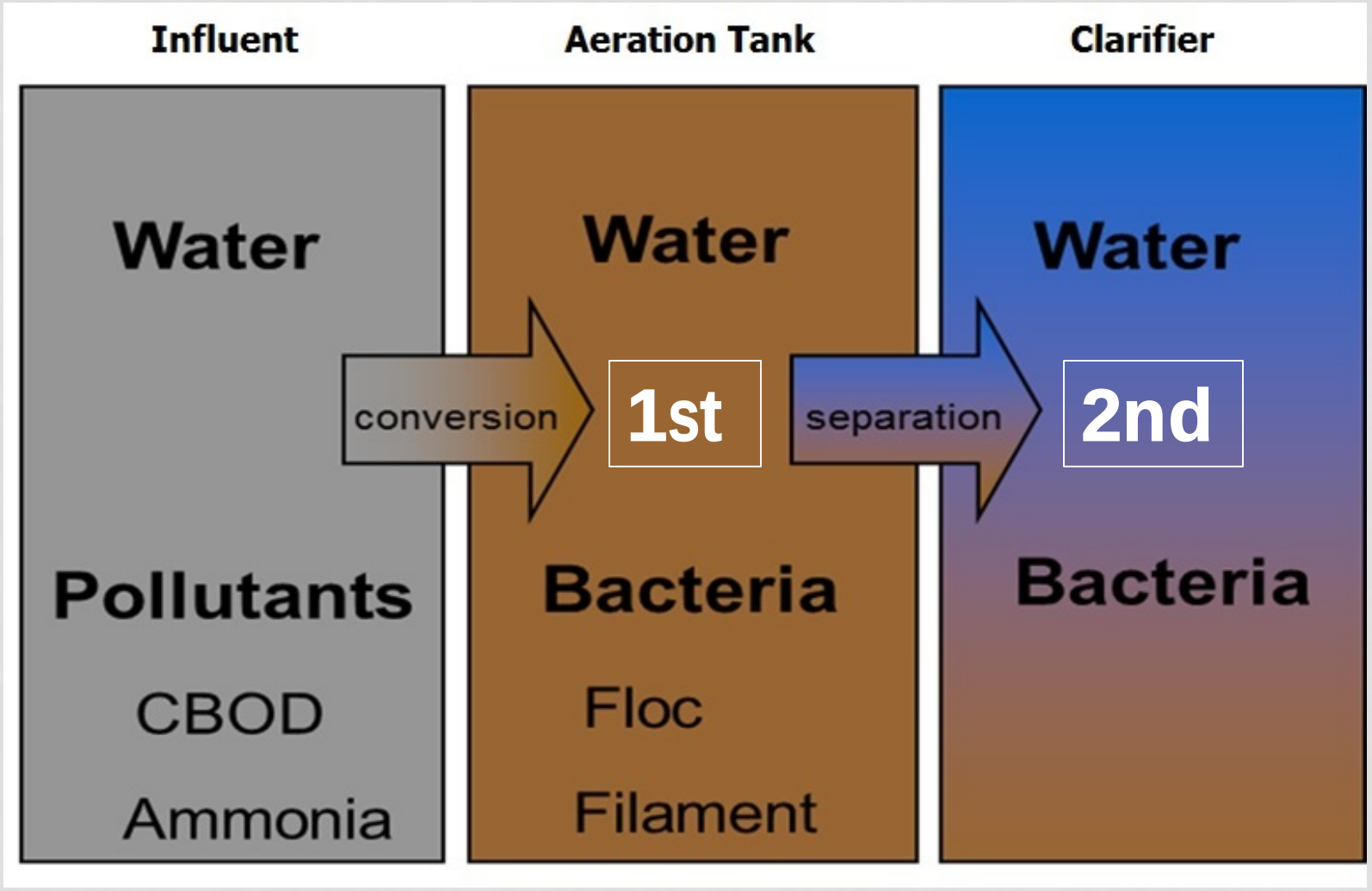
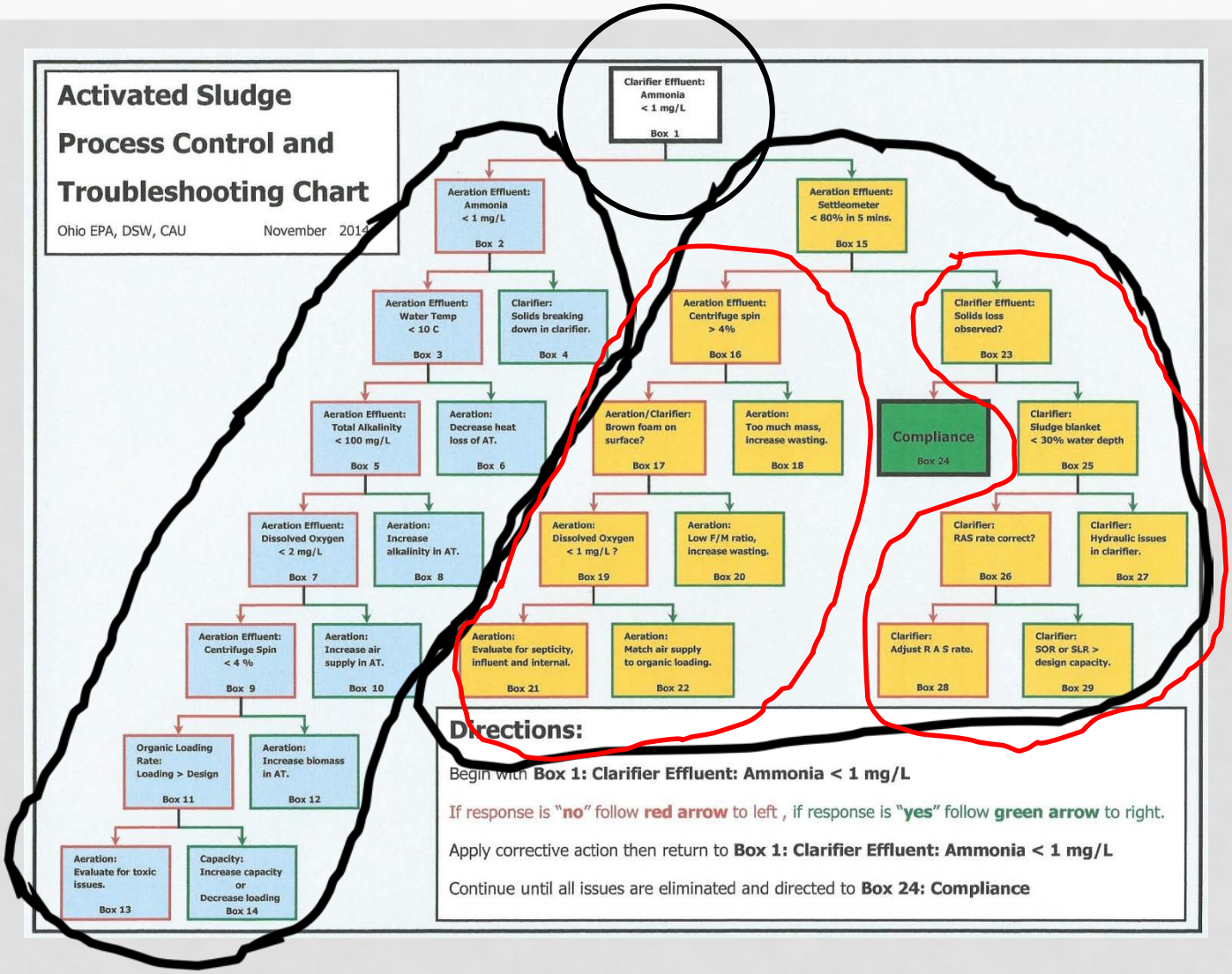
ACTIVATED SLUDGE PROCESS CONTROL

TROUBLESHOOTING CHART

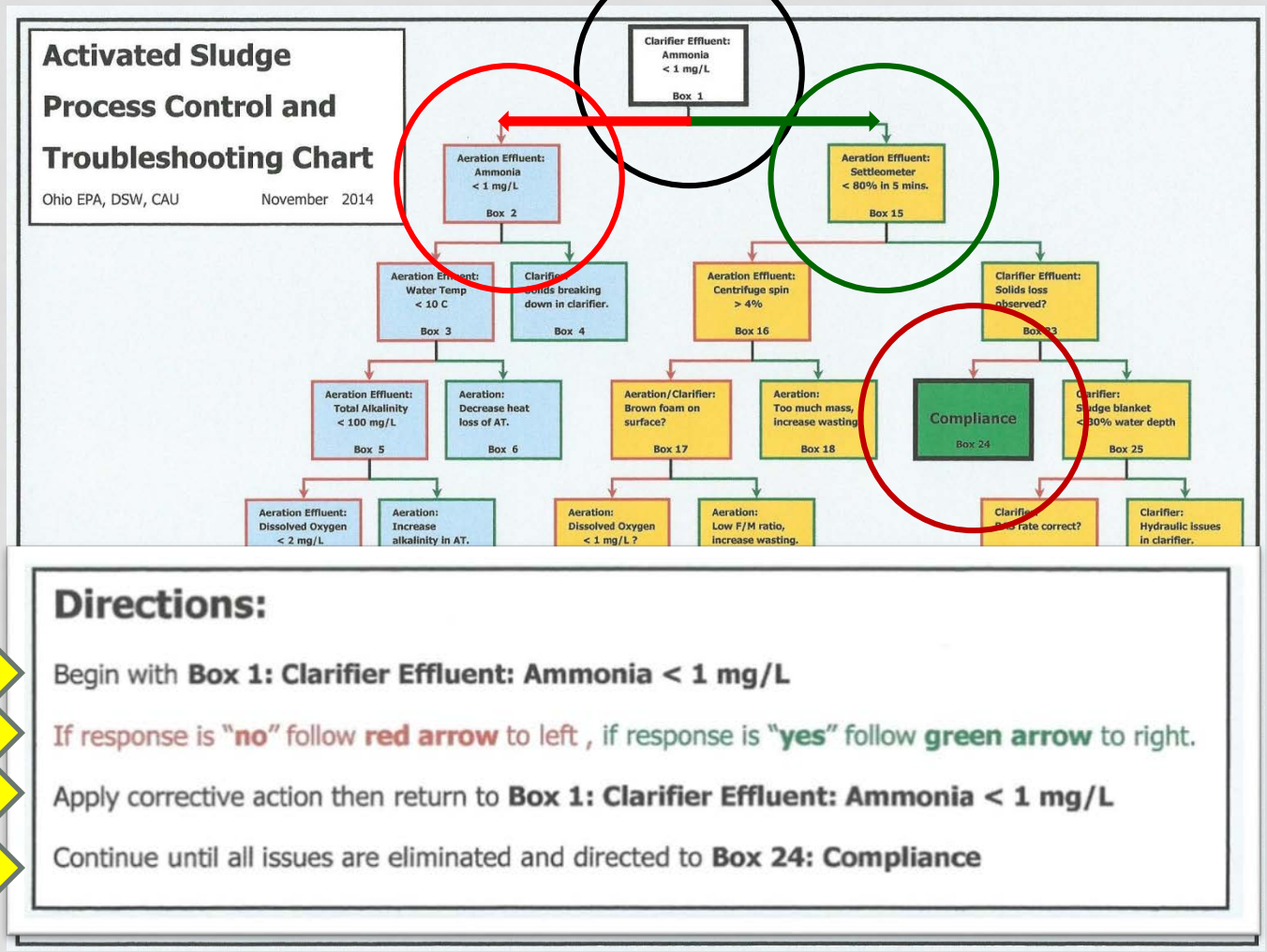
BASIC CONCEPTS



ACTIVATED SLUDGE PROCESS CONTROL



Each box will either request more data or identify the issue.



Directions:

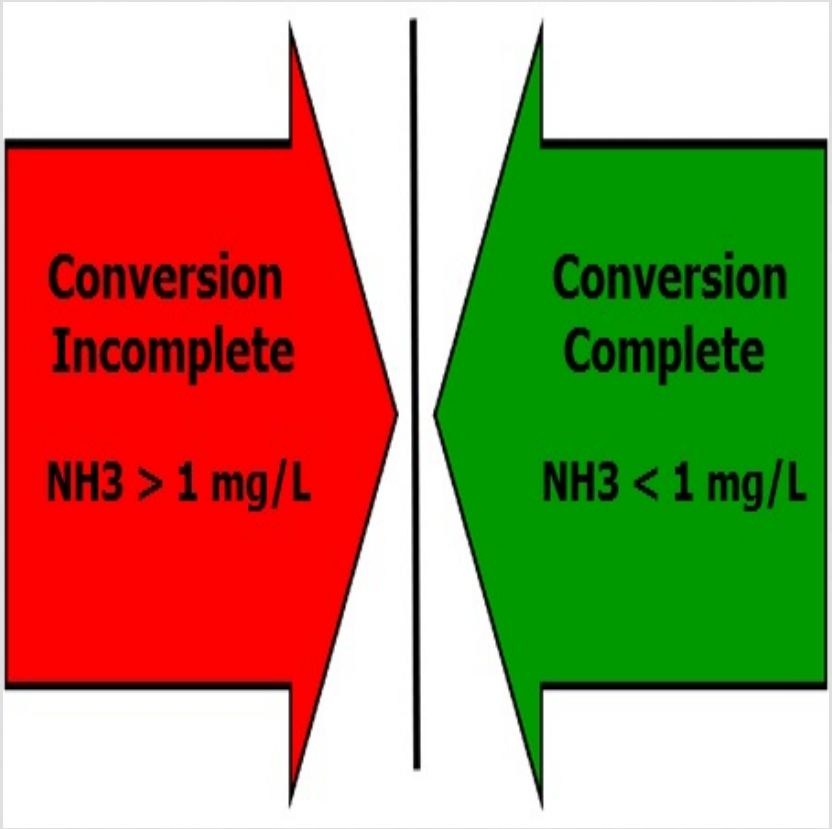
Begin with **Box 1: Clarifier Effluent: Ammonia < 1 mg/L**

If response is "**no**" follow **red arrow** to left , if response is "**yes**" follow **green arrow** to right.

Apply corrective action then return to **Box 1: Clarifier Effluent: Ammonia < 1 mg/L**

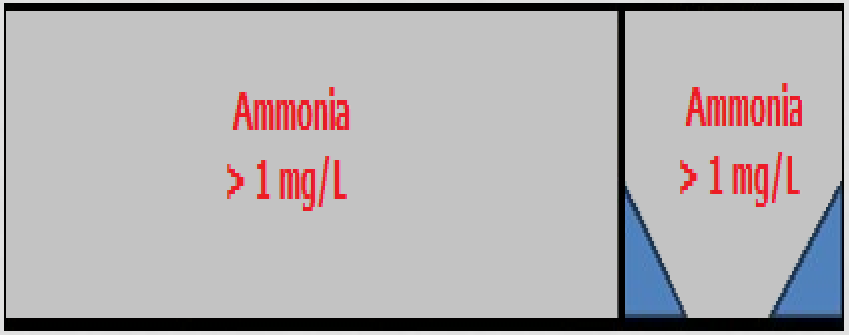
Continue until all issues are eliminated and directed to **Box 24: Compliance**

BOX # 1 CLARIFIER EFFLUENT: AMMONIA < 1 MG/L

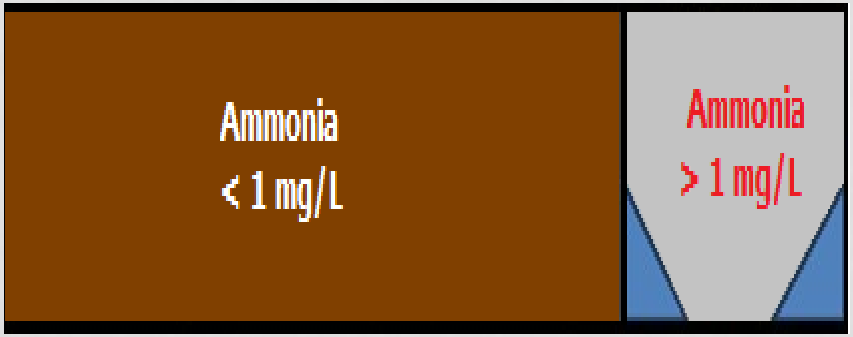


- Conversion Process
  - CBOD & NH3
- Ammonia Indicator
  - "sensitive"
    - Early warning
  - < 1 mg/L NH3
    - Conversion Complete
  - > 1 mg/L
    - Conversion problem

BOX # 2 **AERATION EFFLUENT: AMMONIA < 1 MG/L**



- Aeration Effluent
  - Problem: Conversion
  - Location: Aeration



- Clarifier Effluent
  - Problem: Re-release
  - Location: Clarifier

BOX # 4

CLARIFIER:
SOLIDS BREAKING DOWN IN CLARIFIER

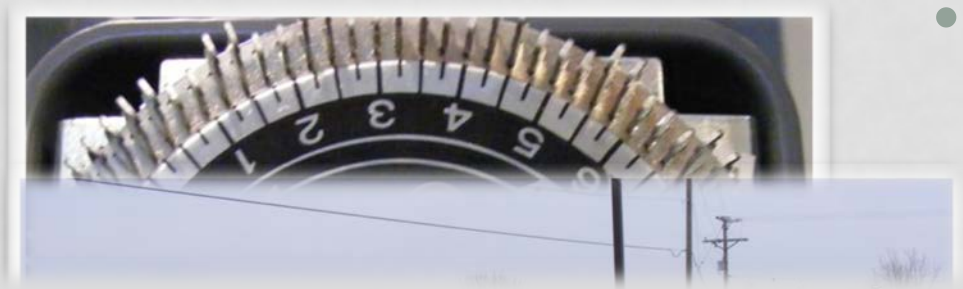
- Sources:
  - Scum Baffle
  - Clarifier Surface
  - Clarifier Sludge Blanket

BOX # 3 **AERATION EFFLUENT:**
WATER TEMPERATURE < 10 C

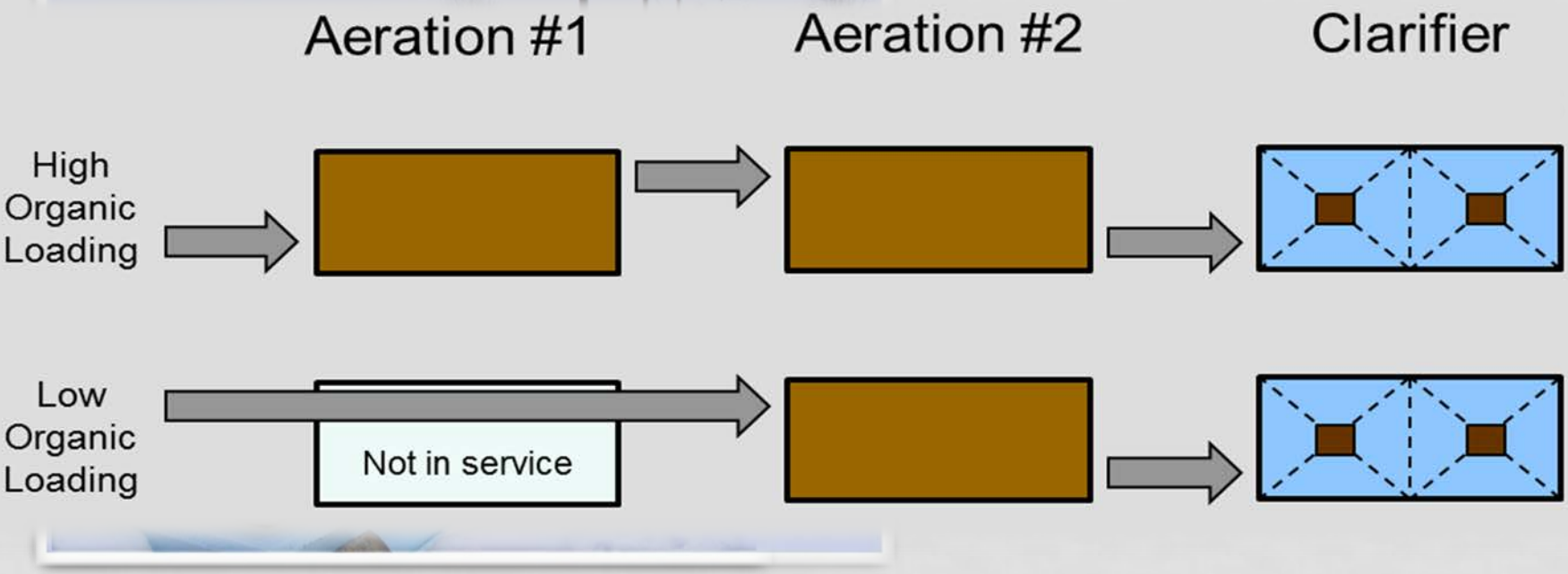
- WATER temperature impacts growth rate
  - slower growth = slower removal rates
- Measure AT effluent water temperature

BOX # 6

AERATION:
DECREASE HEAT LOSS OF AERATION TANK



- Reduce Heat Loss
  - Aeration Capacity



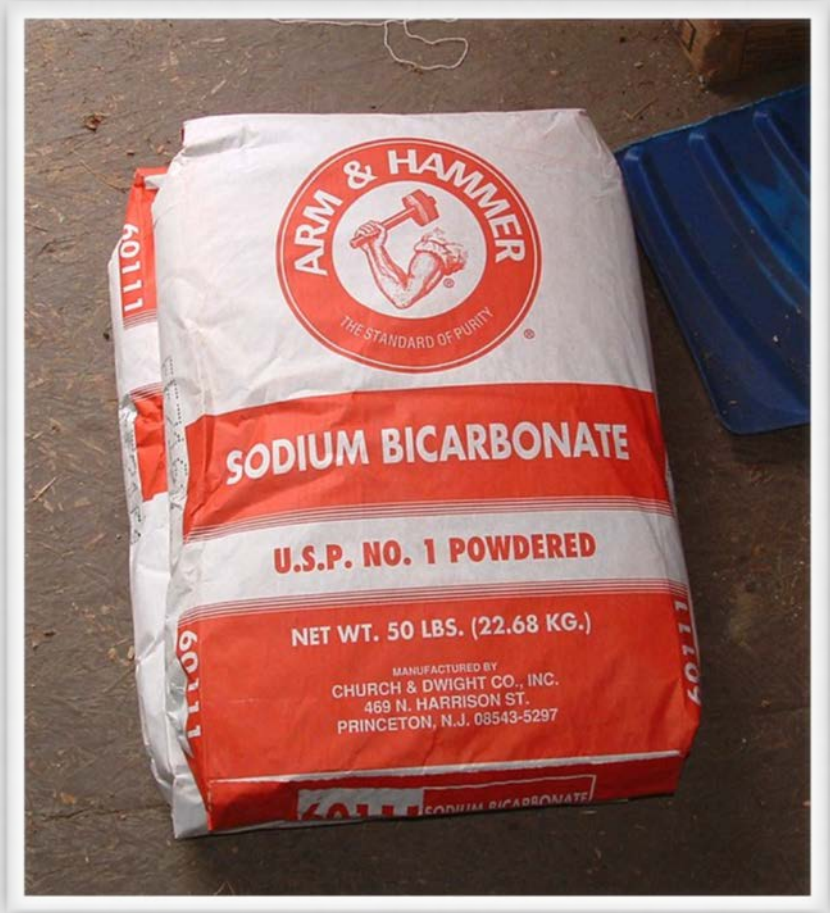
BOX # 5

AERATION EFFLUENT:
TOTAL ALKALINITY < 100 MG/L

- Nitrification
  - Consumes alkalinity
    - 7.14 mg/L alkalinity
  - No Alkalinity, No Buffer
  - pH “post mortem”
    - Drops like a rock

BOX # 8

AERATION:
INCREASE ALKALINITY IN AERATION TANK



- Bicarb is best for an upset reactor
  - Safer to use in AT
  - Safer to use by operator
- Measure and know
  - Need 100 mg/L residual AND NH3 < 1 mg/L in AT

BOX # 7

AERATION EFFLUENT:
DISSOLVED OXYGEN < 2 MG/L

- DO Concentration
  - Aeration Tank Effluent
  - Photo vs Video
  - Multiple tanks
    - Parallel = equal value
    - Series = increasing value

BOX # 10 **AERATION: INCREASE AIR SUPPLY IN AERATION TANK**

- Operational Issue
  - Blower run time
  - System Loading
- Mechanical Issue
  - Blower
  - Motor
  - Air Distribution

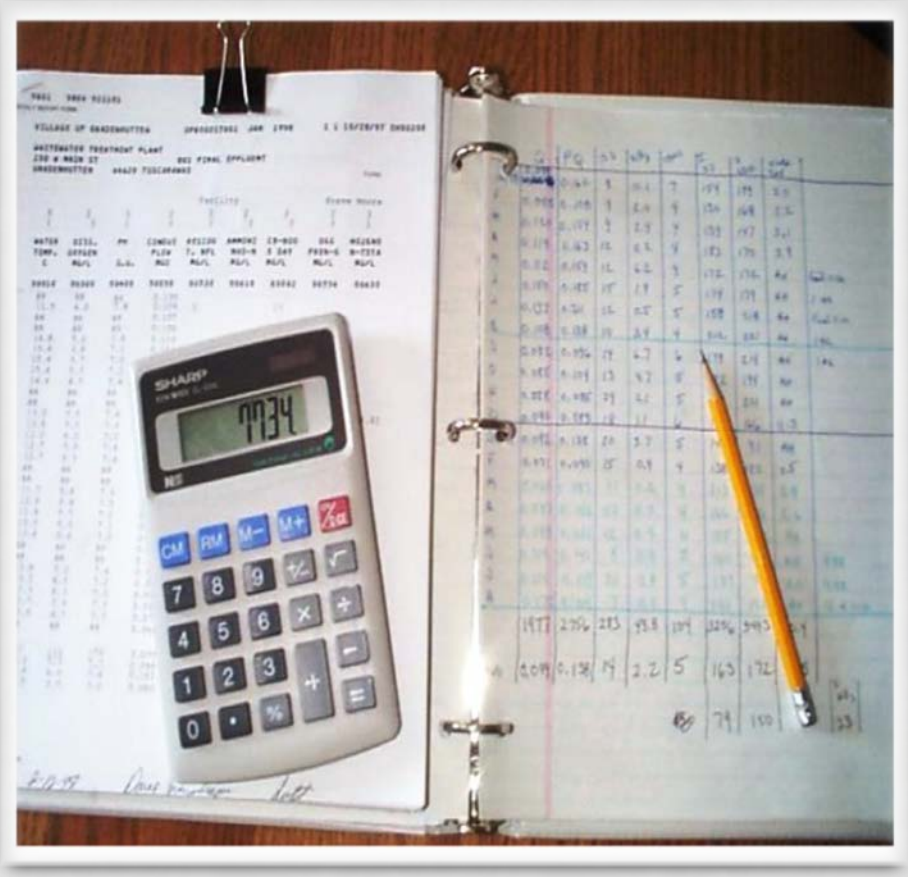
BOX # 9 **AERATION EFFLUENT: CENTRIFUGE SPIN < 4%**

- Need bacteria in AT to convert NH3
  - Hiding in clarifier?
- Estimate amount in 15 minutes
- Typical range 2-4% by volume

BOX # 12 **AERATION: INCREASE BIOMASS IN AERATION TANK**

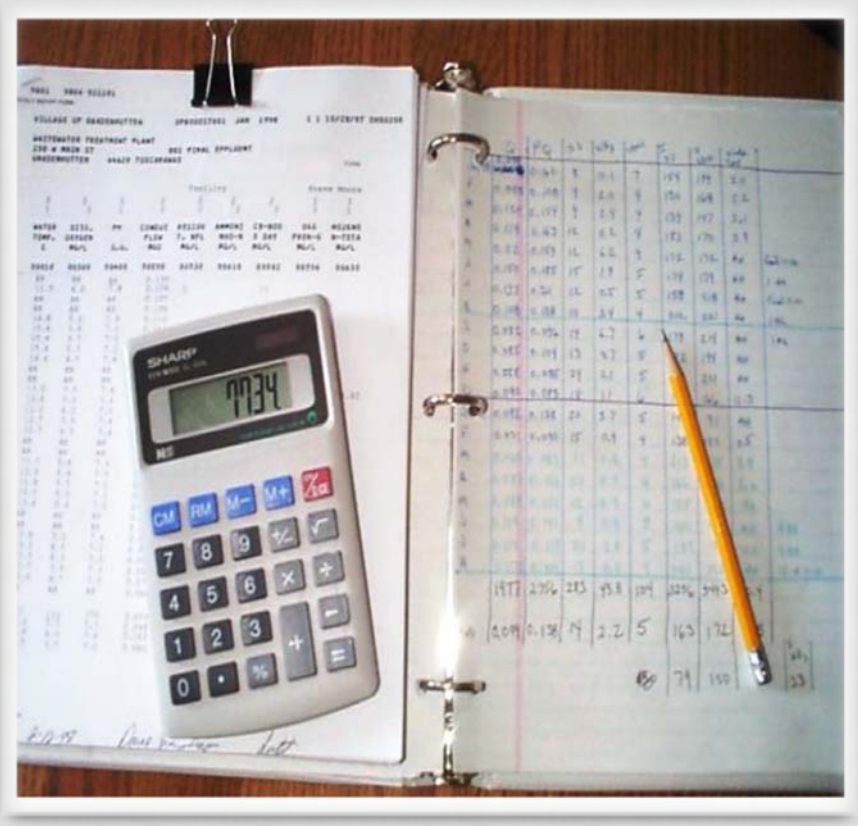
- Aeration Tank
  - 2% to 4% concentration
  - Decrease wasting to increase biomass
  - Colder temps require more biomass
  - Increased loadings require more mass

BOX # 11 **ORGANIC LOADING RATE: LOADING > DESIGN**



- **lbs./day/1,000 ft^3**
- (BOD)(MGD)(8.34)
- $\frac{\text{(length x width x wd)}}{1{,}000\ ft^3}$
- > 25 lbs./d/1,000 ft^3

BOX # 11 **ORGANIC LOADING RATE: LOADING > DESIGN**



Typical Design
15 to 25 lbs./d/1,000 ft^3

- **lbs./day/1,000 ft^3**

AT Dimensions
= 12'x 6'x 9' w.d.

AT Environment
= 15,000 gpd
= 170 mg/l BOD

lbs./day/BOD
= 8.34 x 0.015 MGD x 170 mg/L
= 21.3 lbs./d/BOD

1,000ft3
= (12'x 6'x 9')/1,000
= 0.648 AT capacity in 1,000 ft^3

lbs./d/1,000 ft^3
= 21.3/.648
=32 lbs./d/1,000 ft^3

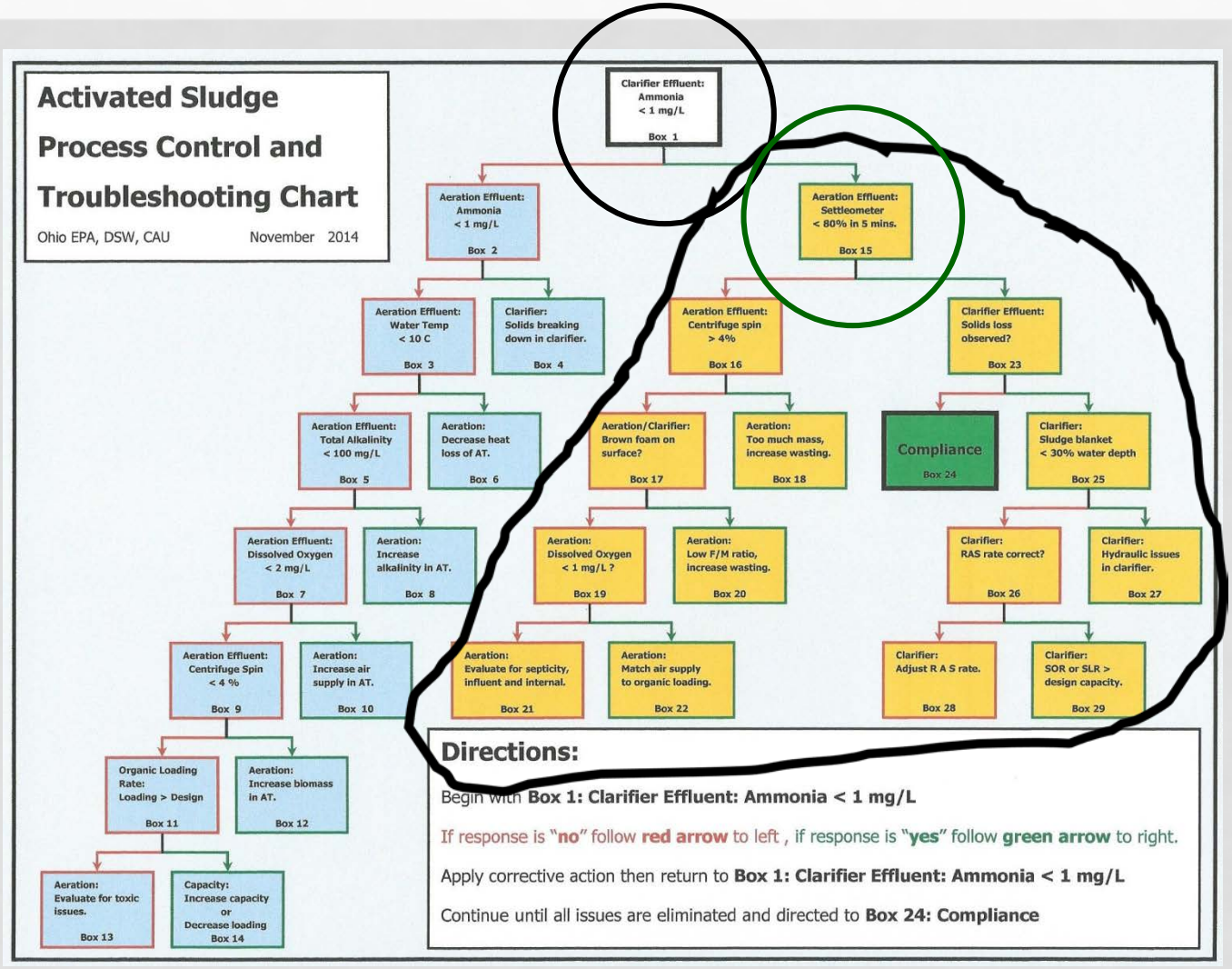
BOX # 14 **CAPACITY: INCREASE CAPACITY OR DECREASE LOADING**

- Equalize Flows
  - Avg. Daily Flow vs. Pumping Rate
  - Flow EQ Design
  - Evidence of Problem
    - "the block"
- Add more capacity

BOX # 13 **AERATION: EVALUATE FOR TOXIC ISSUES.**

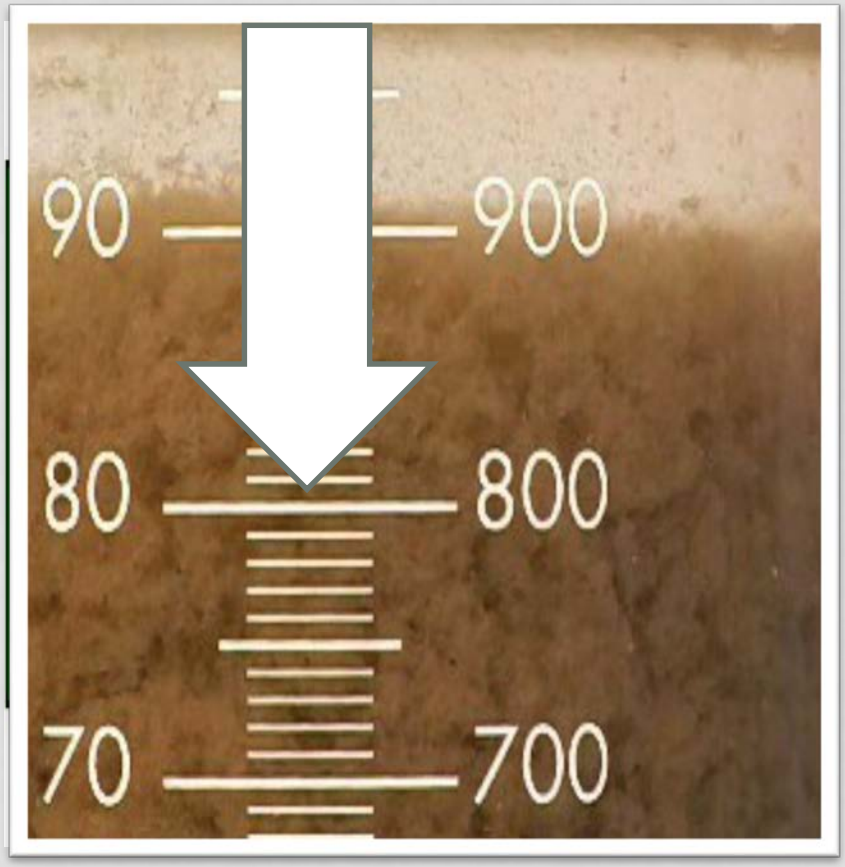
- Common sources
  - Internal
  - Digester Supernatant
  - Other side streams
- Other sources
  - External
  - Force Mains
  - Septage Receiving
  - Color, corrosion, odor

A. S. PROCESS CONTROL



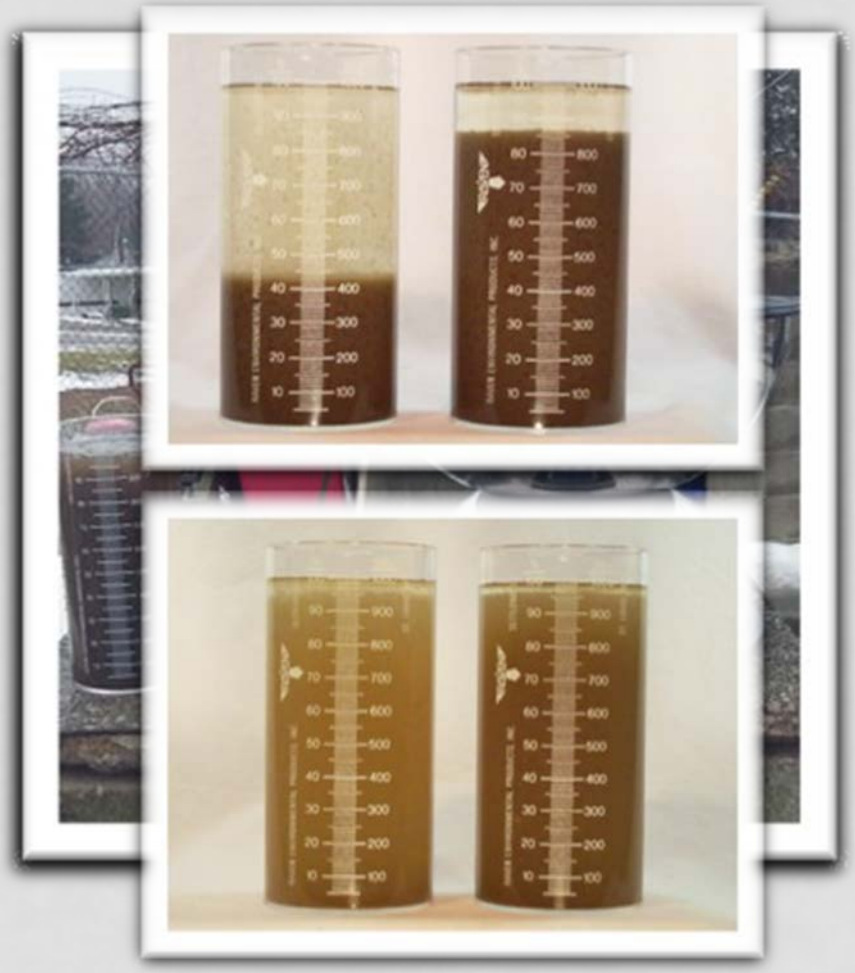
BOX # 15

AERATION EFFLUENT: SETTLEOMETER < 80% IN 5 MINUTES



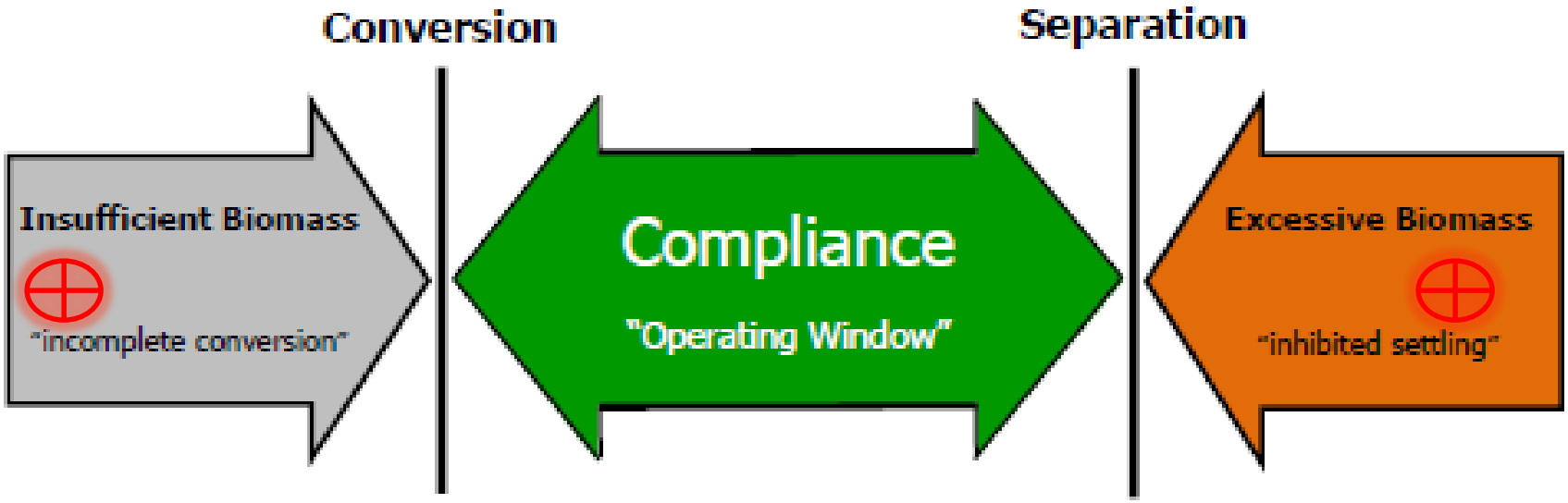
- Conversion Complete
- Separation Analysis
  - "Perfect Clarifier"
  - < 80 % in 5 minutes
- Inhibited Settling
  - High concentration mass (too crowded)
  - Low density mass (too buoyant)

BOX # 16 **AERATION EFFLUENT: CENTRIFUGE SPIN > 4%**



- Centrifuge Spin
  - Aeration Effluent
  - > 4% inhibits settling
  - Measure and know
- 2 Minute Diluted Settleometer
  - 100% vs 50%

BOX # 18 **AERATION:**
TOO MUCH BIOMASS, INCREASE WASTING

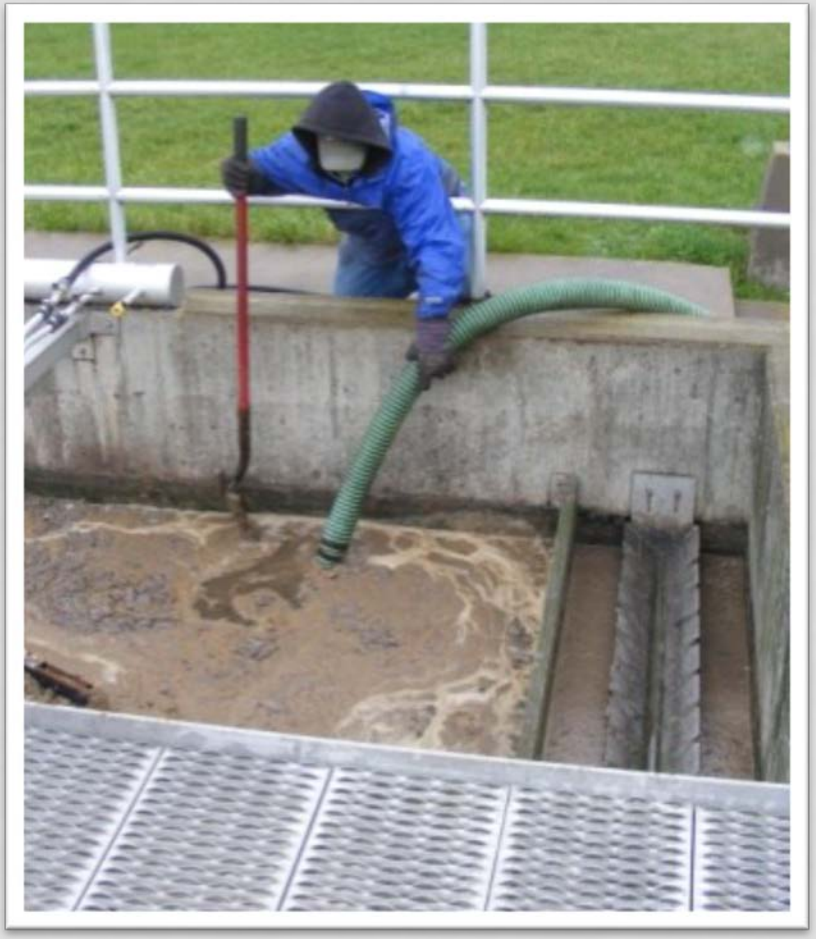


Establishing a wasting rate is simply a process of maintaining sufficient biomass to achieve complete conversion in the aeration tank (ammonia < 1 mg/L), while not maintaining an excessive amount of biomass to inhibit the settling rate in the clarifier (< 80% in 5 minutes).

BOX # 17 **AERATION / CLARIFIER: BROWN FOAM ON SURFACE**

- Filaments
  - >80% in 5 mins.
  - AT spin < 4%
  - 2 min. diluted Settleometer analysis
  - Coning/Jagged
  - Supernatant Clarity
  - Low AT effluent NH3
  - **Brown Foam**
- Low F/M Environment

BOX # 20 **AERATION: LOW F/M RATIO, INCREASE WASTING**

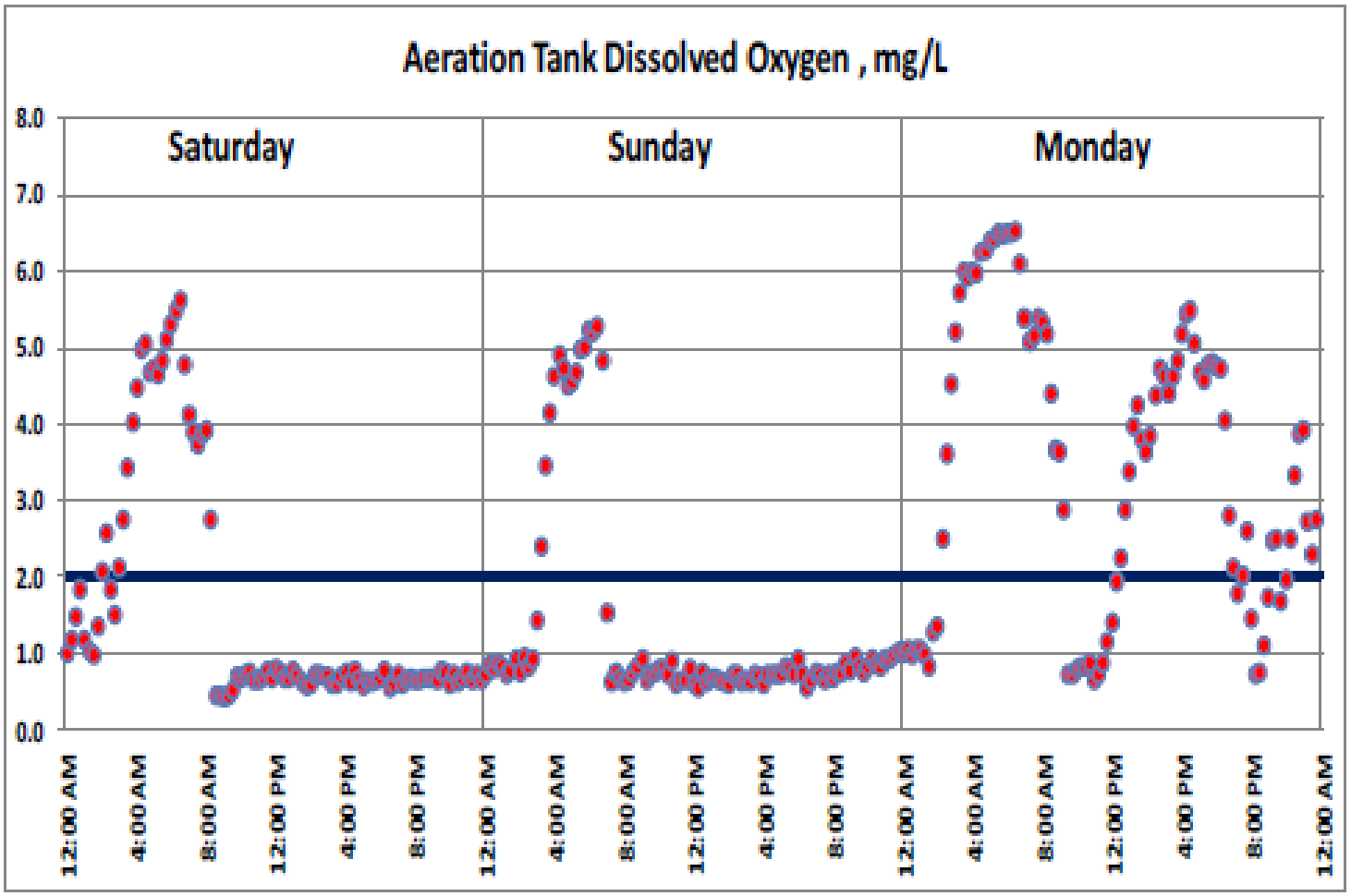


- Low F/M Filaments
- Waste
  - Stop the madness
  - Clean up the mess

BOX # 19 **AERATION: DISSOLVED OXYGEN < 1 MG/L**

- Filaments
  - >80% in 5 mins.
  - AT spin < 4%
  - 2 min. diluted Settleometer analysis
- Low DO
  - Long, low levels
    - 1 mg/L DO
  - Short, deep levels
    - < 1 mg/L DO
  - Measure and know

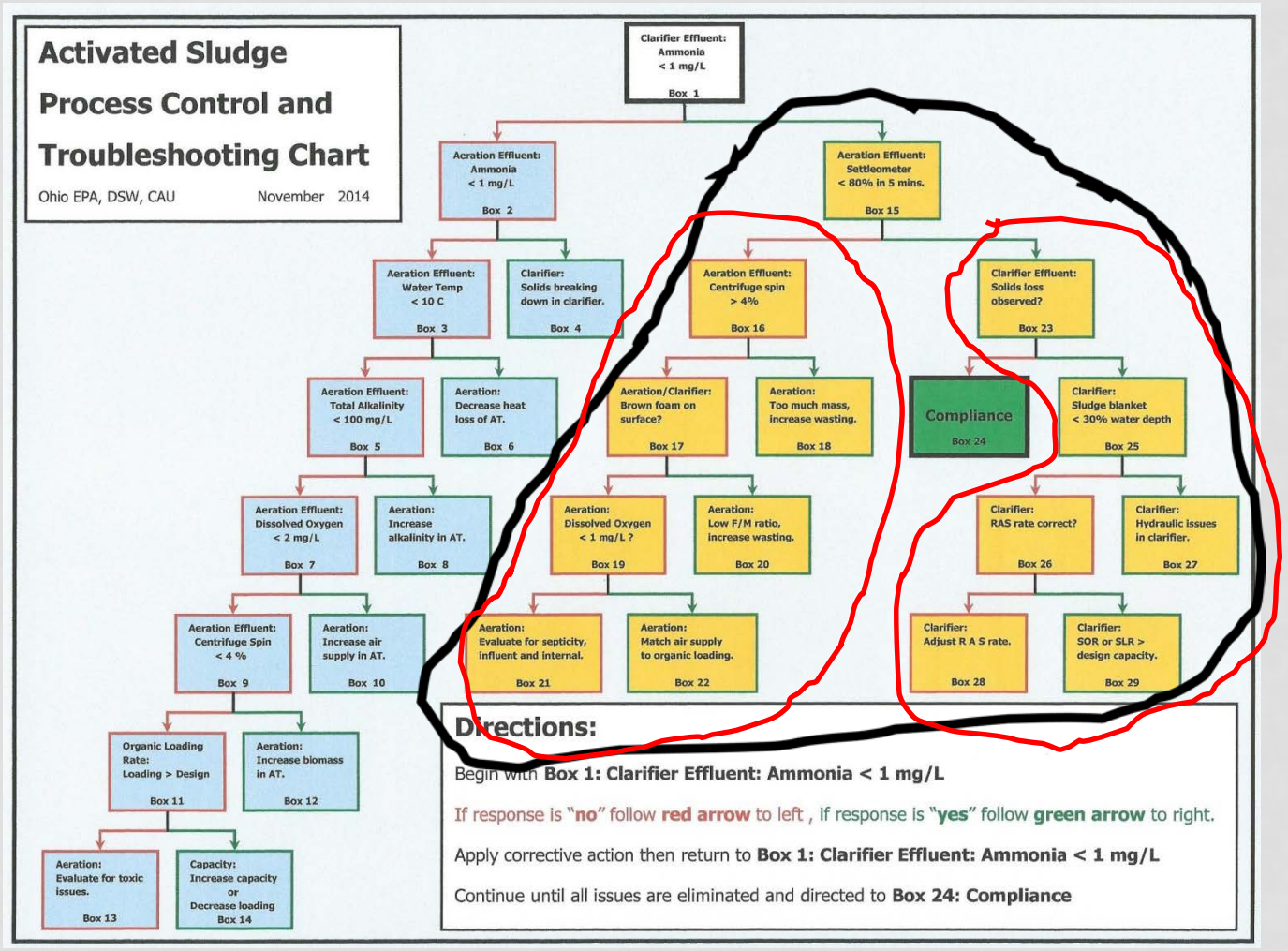
BOX # 22 **AERATION: MATCH AIR SUPPLY TO ORGANIC LOADING**



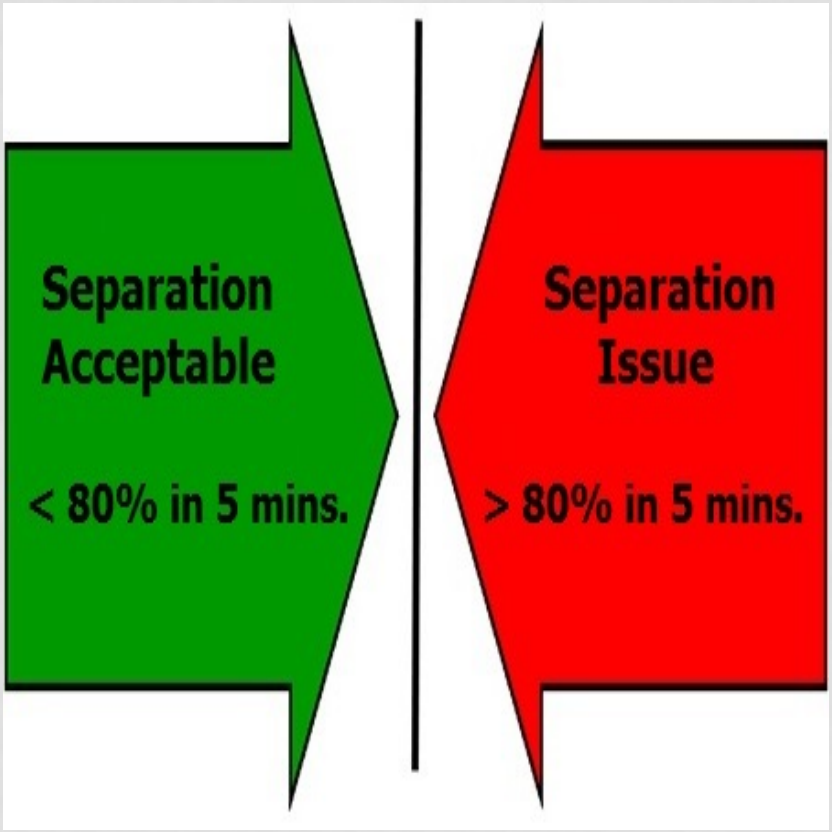
BOX # 21 **AERATION: EVALUATE FOR SEPTICITY, INFLUENT AND INTERNAL**

- Filaments
  - >80% in 5 mins.
  - AT spin < 4%
- Septic Sources
  - Influent
    - Odor
    - Corrosion
    - Color
  - Internal
    - “aerobic” digester
    - Solids breaking down in clarifier

A. S. PROCESS CONTROL



BOX # 15 **AERATION EFFLUENT:**
SETTLEOMETER < 80% IN 5 MINUTES



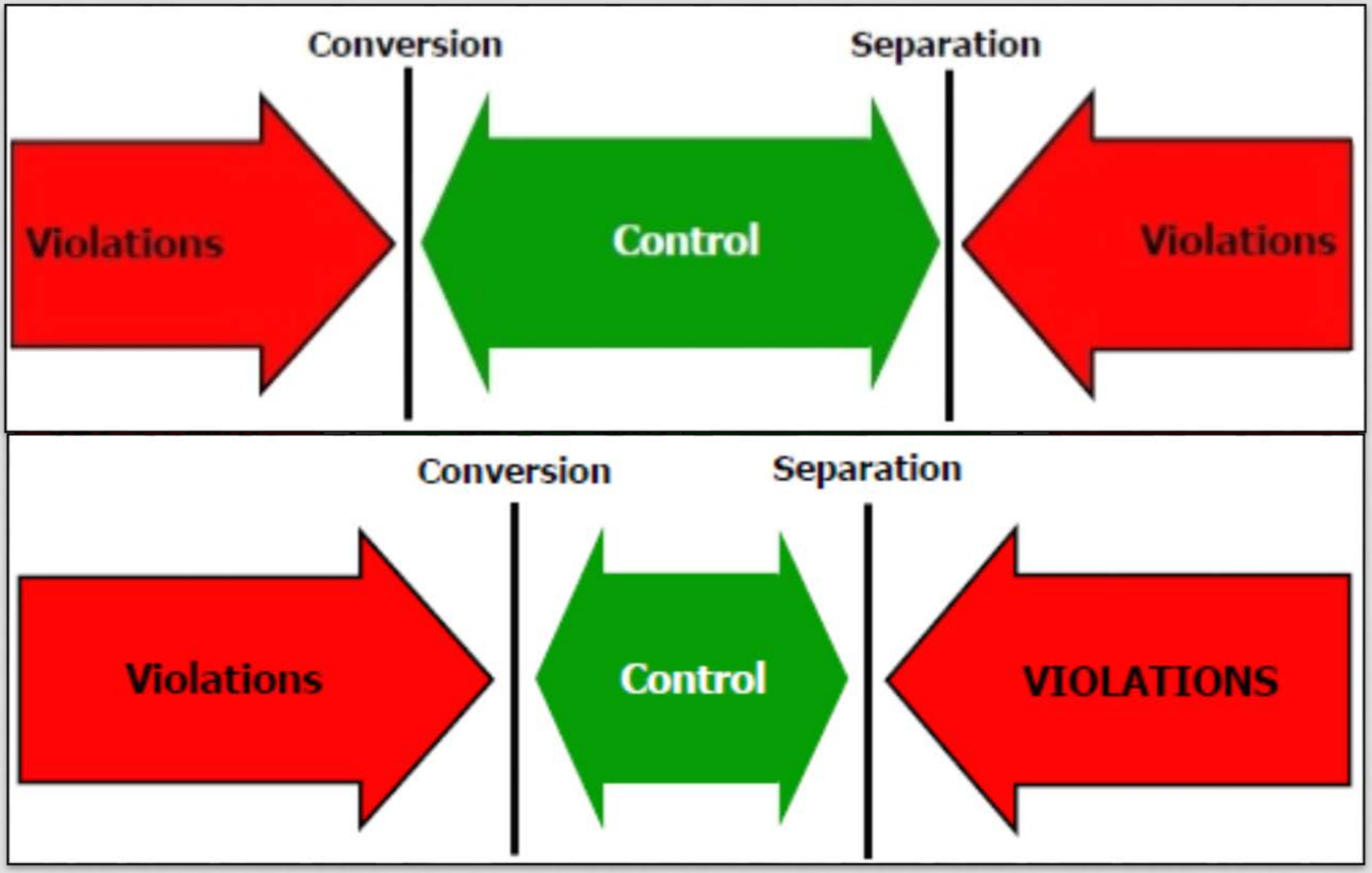
- Conversion Complete
- Separation Analysis
  - "Perfect Clarifier"
  - < 80 % in 5 minutes
- Inhibited Settling
  - High concentration mass (too crowded)
  - Low density mass (too buoyant)

BOX # 23 **CLARIFIER EFFLUENT: SOLIDS LOSS OBSERVED**

- Observed Loss
  - Clarifier Weir
  - Effluent
- Unobserved Loss
  - Life Expectancy
    - Birth
    - Aged
    - Deceased
  - 2-3 months?

BOX # 24

COMPLIANCE



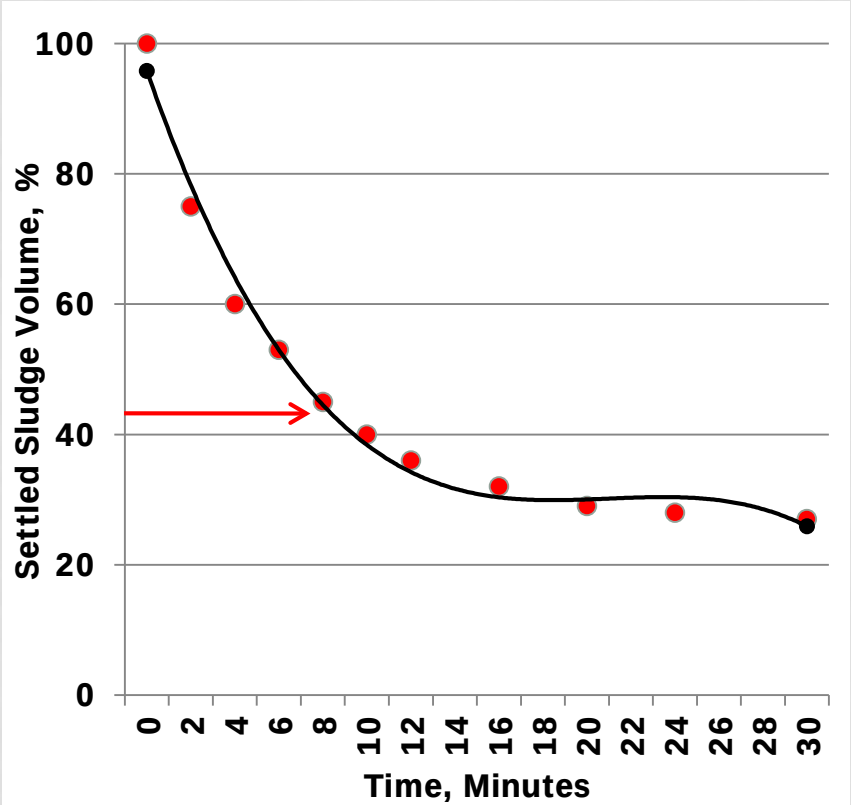
BOX # 25 **CLARIFIER:**
SLUDGE BLANKET < 30% WATER DEPTH

- Blanket Depth
- High blanket, less capacity
- Range: 20% to 30%
- Reduce blanket
  - RAS rate correct?
  - Too much biomass?

BOX # 27 **CLARIFIER: HYDRAULIC ISSUE IN CLARIFIER**

- Flow Splitting
- Density Currents
- Effluent Weir
  - Location
  - Elevation

BOX # 26 **CLARIFIER: RAS RATE CORRECT**



- RAS rate
  - Slow settling/slow rate
  - Fast settling/fast rate
- Chart settling rate
- Locate “knee”
- Spin Aeration & RAS
- Calculate
  - Increase/decrease
  - Adjust

CALCULATING CORRECT RAS RATE

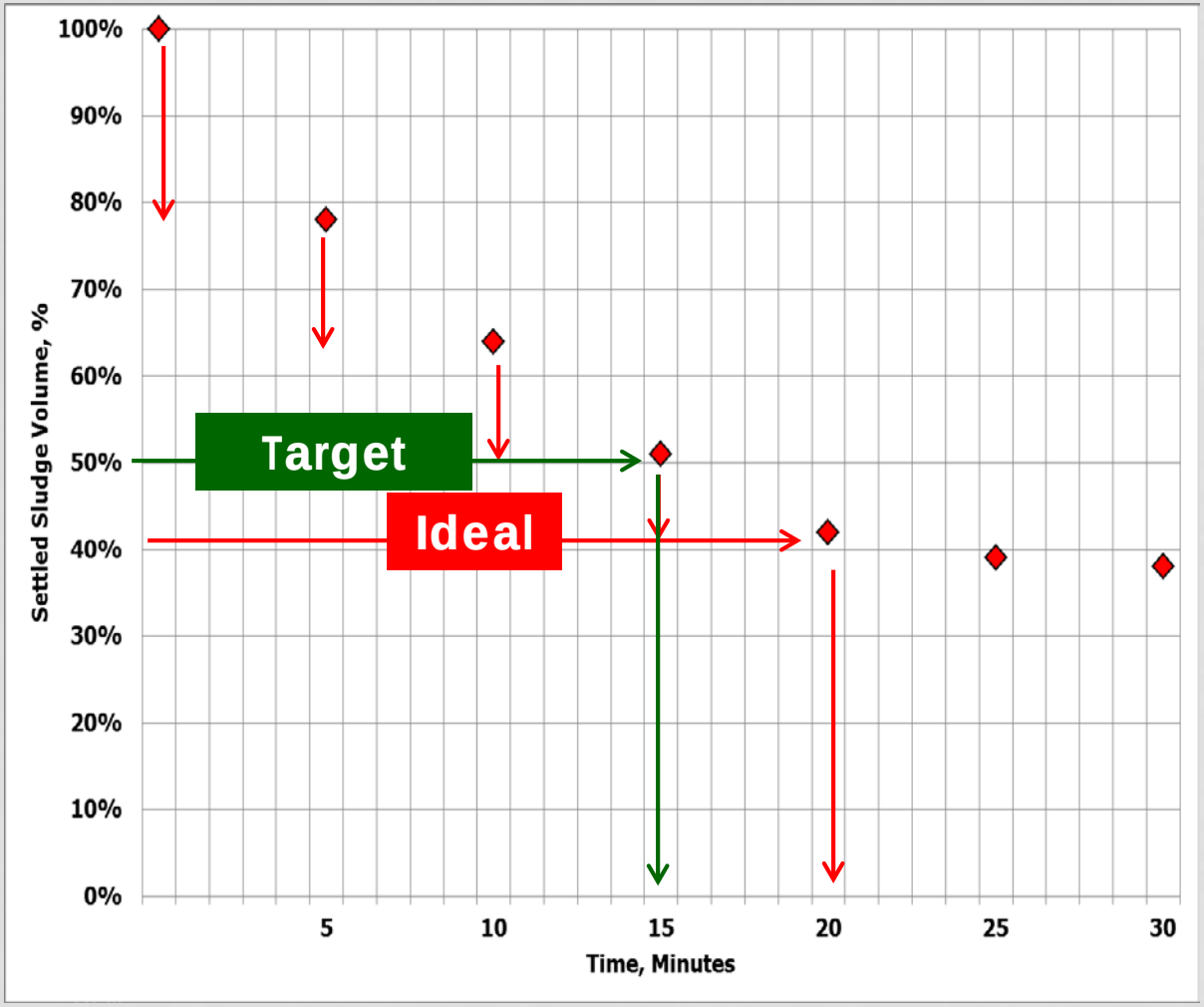
Spins:

AT = 3.2 %

Actual RAS = 8.8 %

Settleometer Results

Time,mins.	SS, %
0	100
5	78
10	64
15	51
20	42
25	39
30	38



CALCULATING CORRECT RAS RATE

Spins:

AT = 3.2 %

Actual RAS = 8.8 %

Target RAS = 6.3 %

Settleometer Results

Time,mins.	SS, %
0	100
5	78
10	64
15	**51**
20	42
25	39
30	38

Calculating Correct RAS Rate

1. Volume of Settleometer at start of analysis: 100

2. Aeration Tank Spin: 3.2

3. Settled RAS volume (from Chart): 51

Target RAS Spin: 6.3%

$$\frac{100 \times 3.2}{51} =$$

What adjustment is required to the RAS?

BOX # 29 **CLARIFIER: SOR OR SLR > DESIGN CAPACITY**

- SOR
  - Surface overflow rate
- SLR
  - Solids loading rate

BOX # 29 **CLARIFIER: SOR OR SLR > DESIGN CAPACITY**

Hopper clarifiers 600 gpd/ft^2

- SOR
  - Surface overflow rate

Clarifier 6’ x 15’
= 90 ft^2

Flow Rate 40,000 gpd

$$\frac{40{,}000 \text{ gpd}}{90 \text{ ft}^2} = 444 \text{ gpd/ft}^2$$

BOX # 29 **CLARIFIER: SOR OR SLR > DESIGN CAPACITY**

Hopper clarifiers 25 lbs./d/ft^2

- SLR
  - Solids loading rate

Clarifier	90 ft^2
MLSS	3,000 mg/L
Inf. Flow	0.04 MGD
RAS Flow	0.04 MGD

$$\frac{3{,}000 \times 0.08 \times 8.34}{90\ ft^2} =$$

22.2 lbs./d/ft^2

BOX # 28 **CLARIFIER: ADJUST RAS RATE**

- Evaluate Rate
- RAS% 1.5x to 2 x AT%
- RAS% 3 x AT %
  - Possible
  - Problems can occur
- Confirm with Core

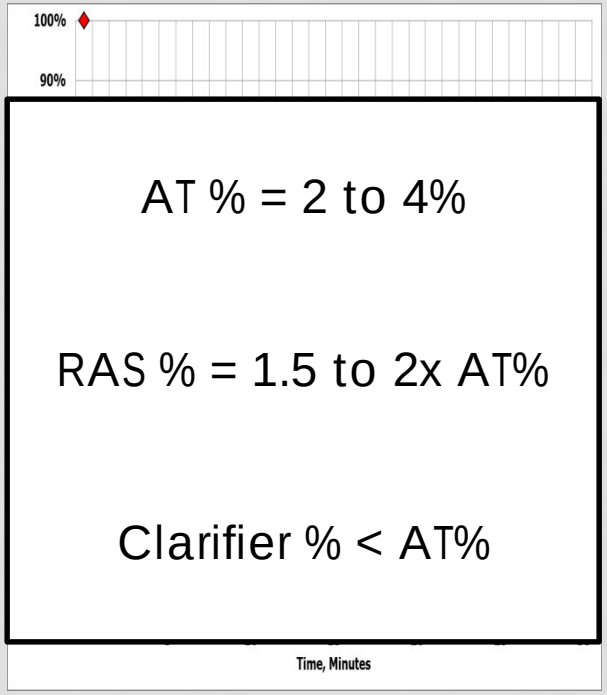
EVALUATE CORRECT RAS RATE

Spins:

AT = 3.2 %

Actual RAS = 8.8 %

Target RAS = 6.3 %



Evaluate Correct RAS Rate

Compare ratio of AT, RAS and Clarifier Spins

Typical Spin Ratios

RAS% 1.5 to 2 x greater than AT%

RAS > 2x could be RAS too slow

Clarifier % greater than AT % ?

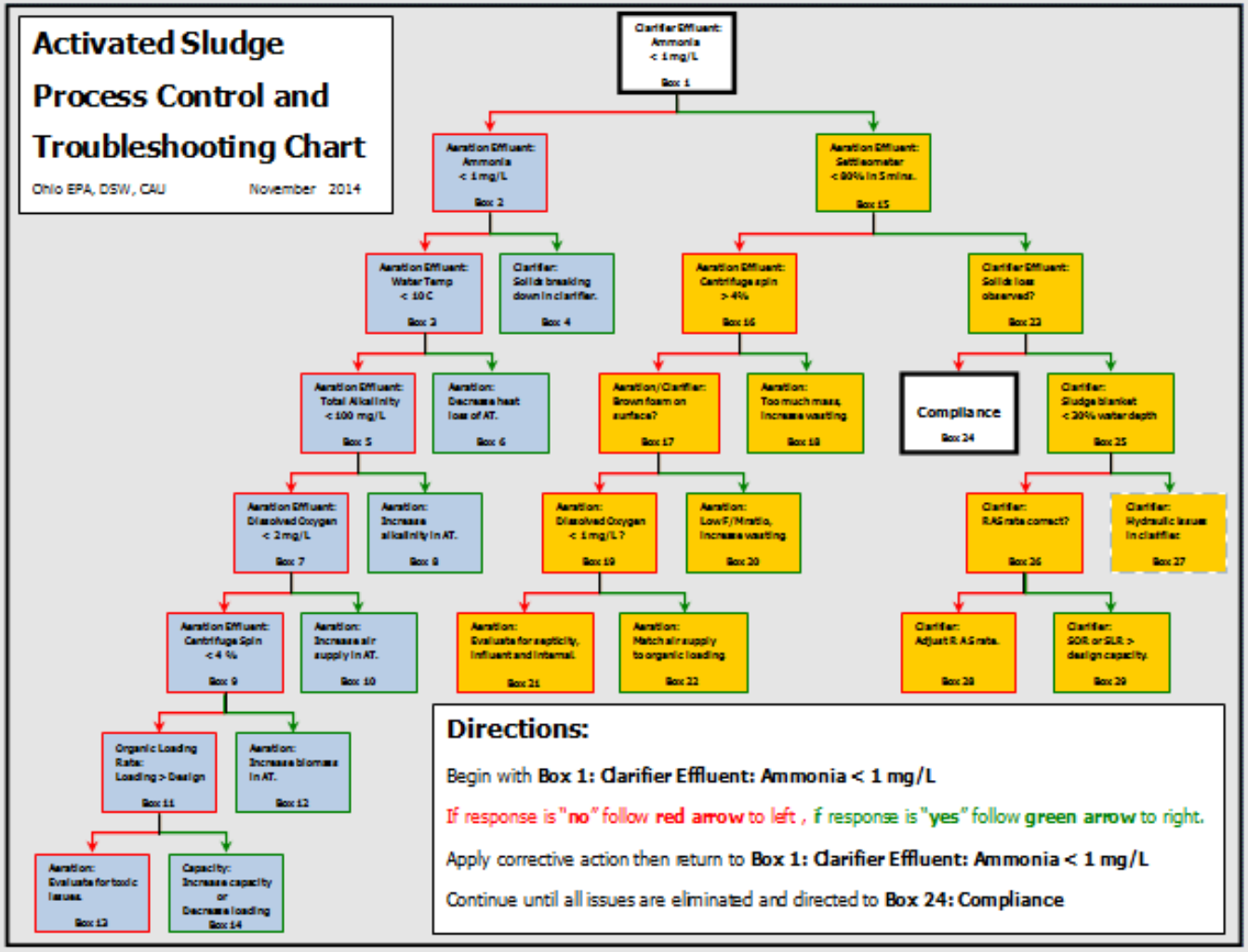
indicates solids stored in clarifier

RAS too slow

Too much mass in system

Develop a trend for “standard” operations, evaluate periodically, calculate if necessary

ACTIVATED SLUDGE PROCESS CONTROL



http://epa.ohio.gov

Divisions and Offices

Surface Water

Wastewater Treatment Plants:

Get Free Technical Assistance to Improve Compliance

Technical Resources

Activated Sludge Process Control and Troubleshooting Chart

Or email me at: jon.vandommelen@epa.ohio.gov

ACTIVATED SLUDGE PROCESS CONTROL

TROUBLESHOOTING CHART

Clarifier Ammonia = mg/L

Aeration Ammonia = mg/L

Aeration Water Temp = C

Aeration Total Alkalinity = mg/L

Aeration D.O. = mg/L

Aeration Centrifuge = %

Aeration O.L.R.
= lbs/d/1000 ft3

Aeration Toxicity Indicators:
1.
2.
3.

Peace Pipe Campgrounds WWTP
10,000 gpd design/5,000 gpd ADF
Aeration = 10,000 gals./2 AT/series
Clarifier = 12' x 6'/ 2-dual hopper units
Flow EQ w/out aeration, sand filters, Cl2

Settleometer , 5 mins = %

Brown Foam in System =

AT DO diurnal profile =

Septicity Sources
1.
2.
3.

Solids Loss observed
1.
2.
3.

Sludge Blanket Depth = %

RAS Rate
Target = %
Actual = %

RAS Ratio
RAS vs AT = %
AT vs Clarifier = %