

# Conversion and Separation of Wastewater



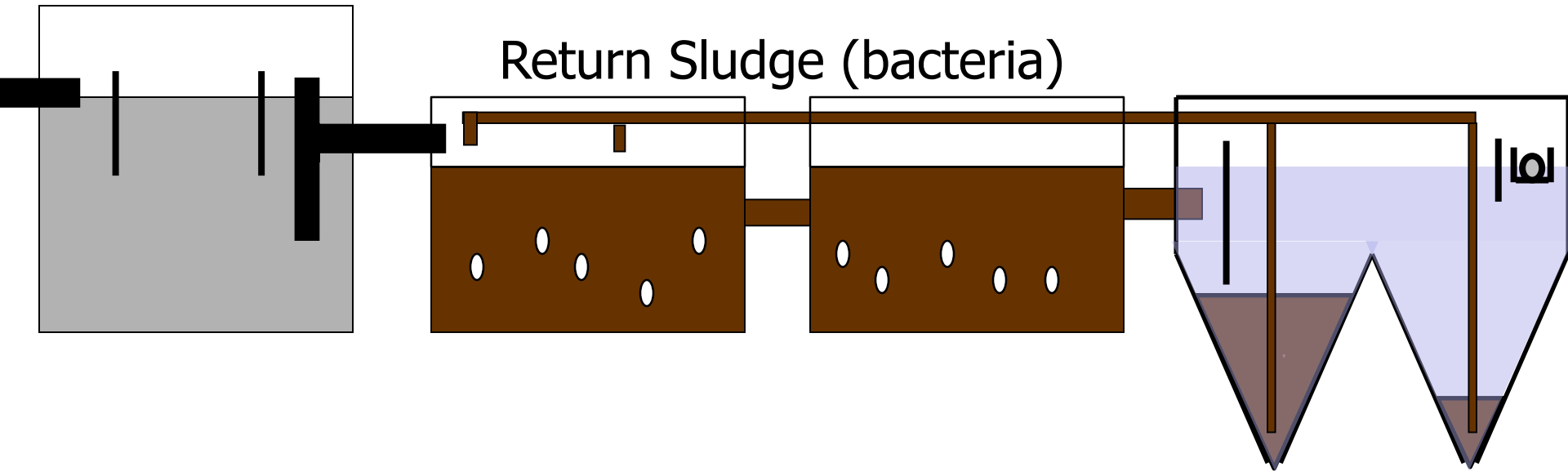
Fall 2015

# The Activated Sludge Process

Trash Trap

Aeration Basins

Clarifiers

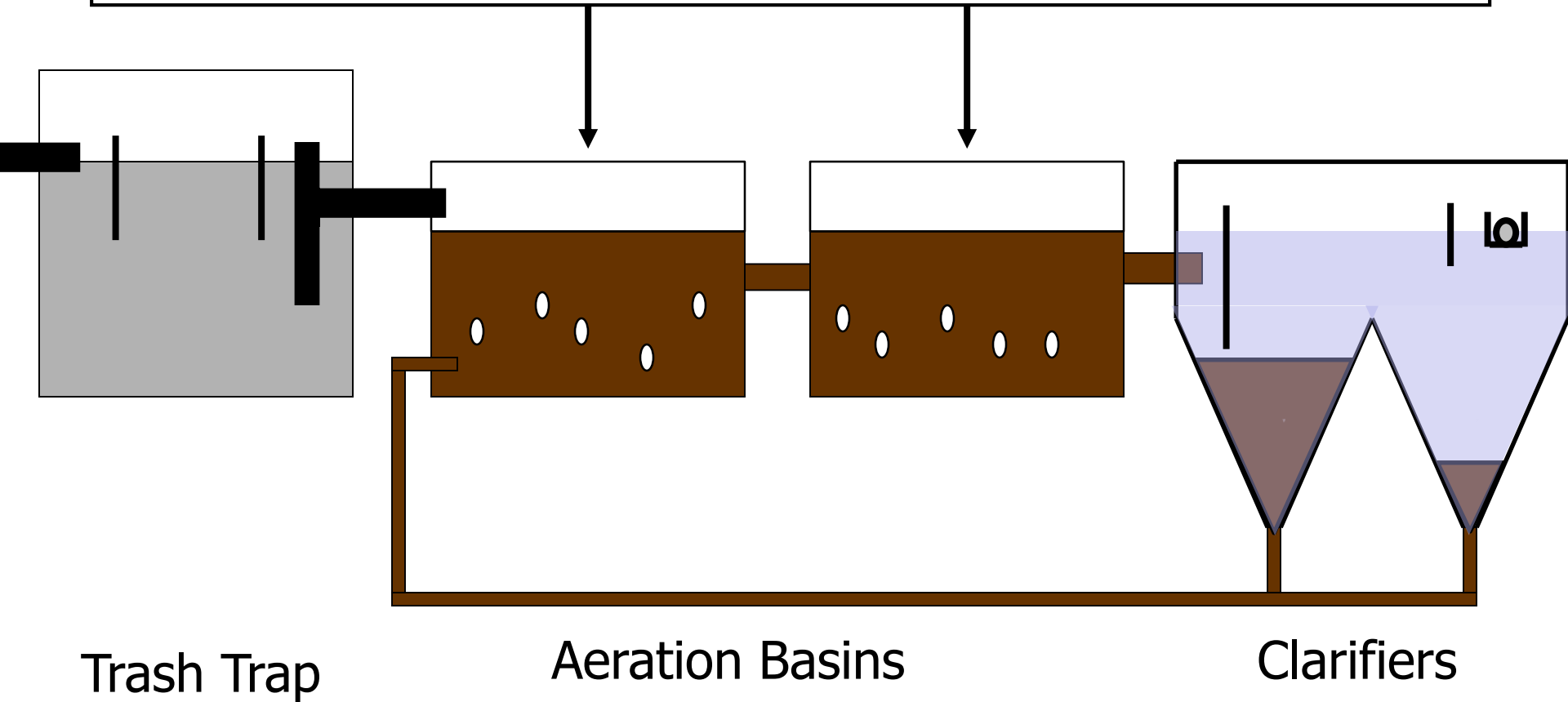






# The Activated Sludge Process

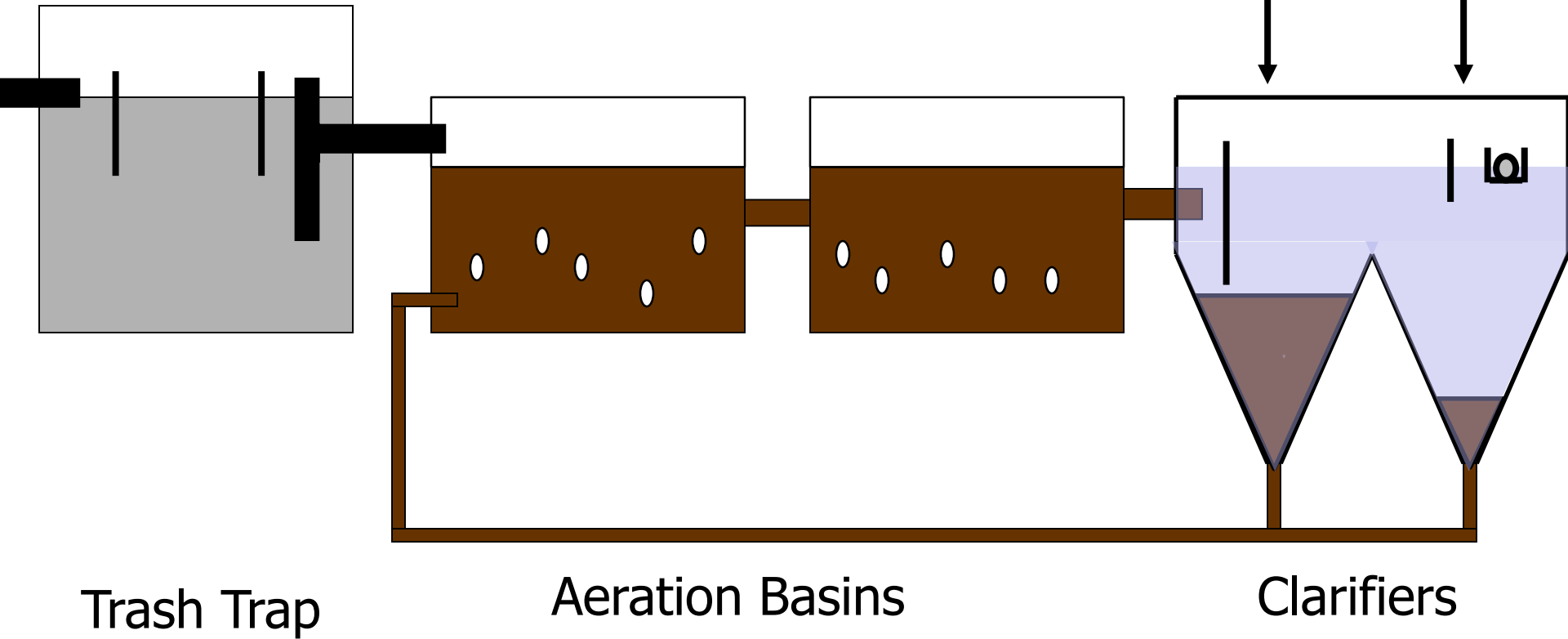
Raw wastewater converted to bacteria and water in basin.





# The Activated Sludge Process

Bacteria and water separates in clarifiers.



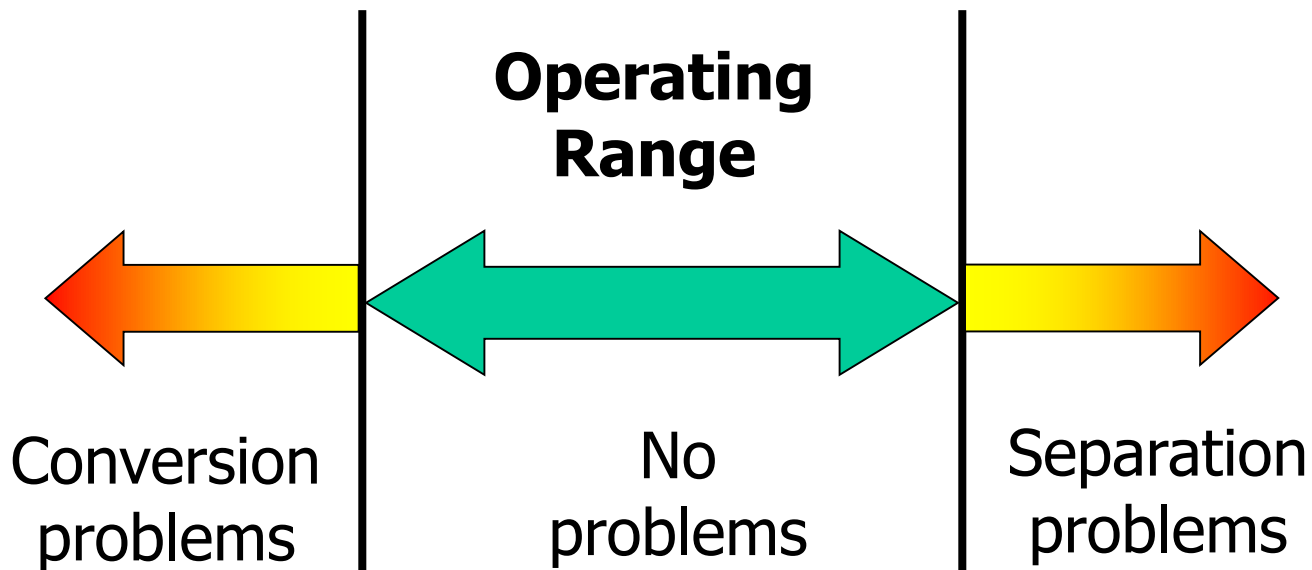






# Activated Sludge Process

1. **Convert** organic waste into bugs.
2. **Separate** bugs from treated water.



# Conversion and Separation

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## **5 environmental parameters needed for conversion of wastewater to bacteria:**

1. Dissolved Oxygen (DO)  $> 2$  mg/L in aeration tank
2. Enough bacteria to match organic load
3. Alkalinity  $> 120$  in clarifier
4. Sufficient detention time
5. Temperature  $> 10^{\circ}$  Celsius

# Conversion Tools: Ammonia Test Kit

- Cheap ? and Easy
  - \$461
  - 18 minute test
- Non-reportable
- Immediate response
- Indicates a problem
- Does not identify problem



# Conversion Tools: Ammonia Test Kit

- Cheap and Easy
  - \$12
  - 5 minute test
- Non-reportable
- Immediate response
- Indicates a problem
- Does not identify problem



# Conversion Tools: DO Probe

- Versatile and Easy
  - \$750 – \$1,200
  - Needed for permit
- Immediate response
- Measures Temp
- Indicates a problem
- Does not identify problem



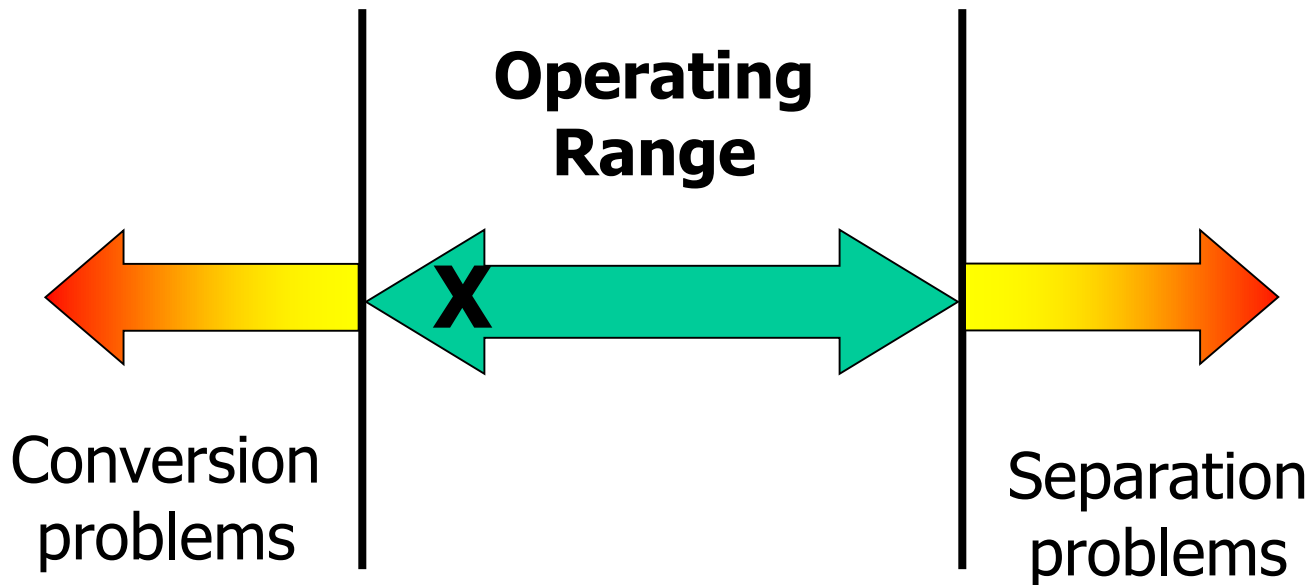
# Conversion Tools: Alkalinity Test Kit

- Cheap and Easy
  - \$46
- < 1 minute test
- Indicates a conversion problem
- Often overlooked



# Activated Sludge Process

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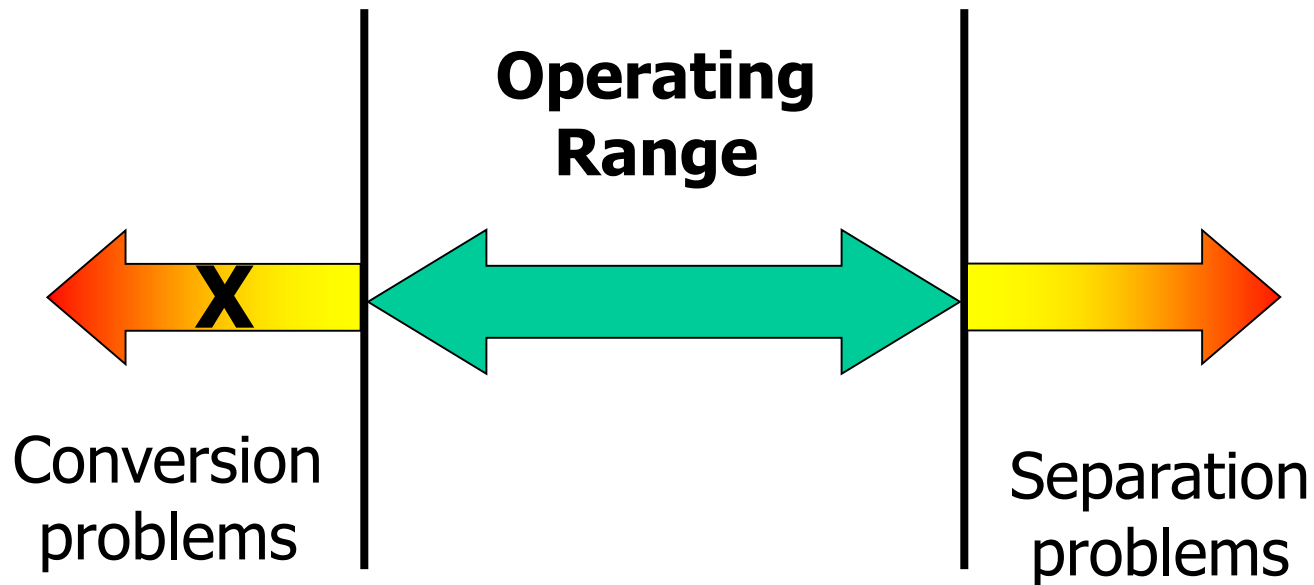




# Activated Sludge Process

**Incomplete** conversion

Through process of elimination, check each of the five environmental parameters needed for conversion



# Conversion and Separation

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# High Ammonia – DO

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- Measure DO through out aeration tank (>2)
- Blower timers
- Check bubble pattern for each drop leg
- Check valve positions on drop legs
- Do you hear any air leaks?
- Sludge holding tank
  - Is level low and air valve wide open?
- Skimmer stealing air?
- RAS wide open?



# HACH DR 900



\$1400

Multi-parameter  
Proven accuracy



\$10

Single Parameter

??????????

# HACH Pocket Colorimeter



\$441

Single Parameter  
Proven accuracy

**Low DO?**







**Air leak**







## Summer Conversion

Ammonia > 1 mg/L

Increase air cycle time.

Oxygen is less soluble in **warmer** water.

## Winter Conversion

Over-aeration in winter lowers water **temperature**.

Decrease aeration time to conserve heat.



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# High Ammonia - MLSS

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- Measure bug population
  - Settleometer
  - Centrifuge (bug quantity & location)
- Do you have enough bacteria (bugs)?
  - Wasted sludge recently?
  - Sand filters loaded recently
  - Trapped in clarifier or aeration tank (deposition)
- What to do?
  - Seed the plant
  - Grow more bugs

# Settleometer



\$69

# Centrifuge



\$1094



# Conversion and Separation

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## **5 environmental parameters needed for conversion of wastewater to bacteria:**

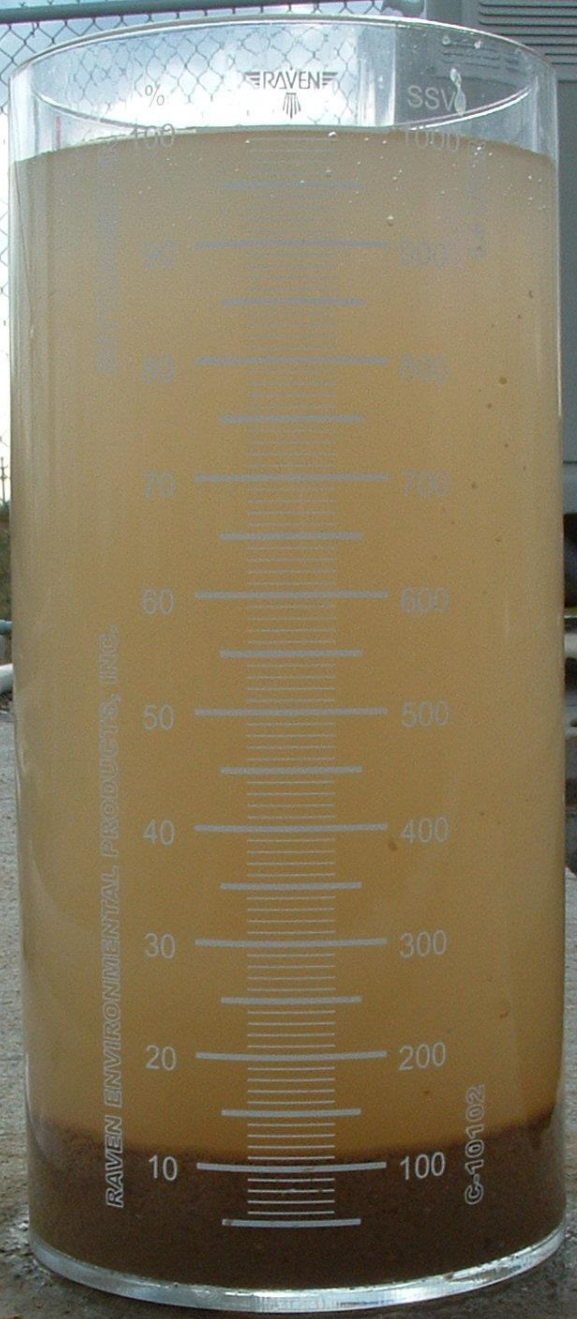
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# High Ammonia – Alkalinity

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- Measure Alkalinity in clarifier
- Should be  $> 120$  parts
- If you have low alkalinity:
  - Measure Ammonia in raw
  - Measure Alkalinity in raw
  - Raw Alkalinity  $> (\text{raw NH}_3 \times 8)$  plus 120
- What to do?
  - Feed Sodium Bicarbonate (BiCarb)
  - Found at farm feed stores
  - Cost: \$14 - \$16 per 50 # bag







# Sodium Bicarbonate

- How much to dose?
  - Depends on:
    - Incoming NH<sub>3</sub> level
    - Incoming Alkalinity
  - Trial and error
    - Feed ¼ bag
    - Measure next day
    - Still low?
    - Feed ½ bag
    - Measure next day...



# Conversion and Separation

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# High Ammonia – Detention Time

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- Measure flows daily
- Compare ADF with design flow
- ADF based on 24 hrs
- ADF should  $<$  design flow



# Conversion and Separation

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## **5 environmental parameters needed for conversion of wastewater to bacteria:**

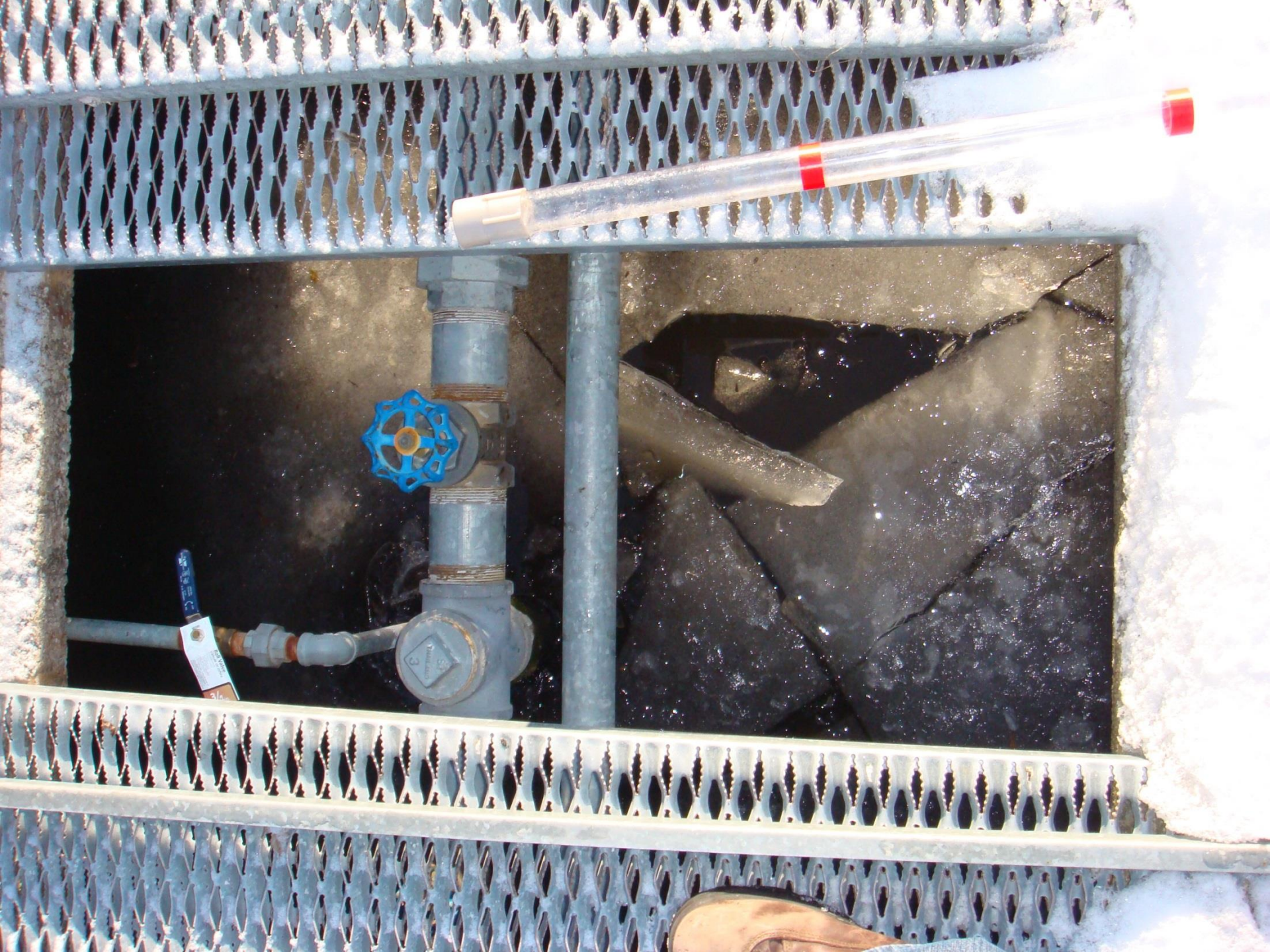
1. Dissolved Oxygen (DO)  $> 2$  mg/L in aeration tank
2. Enough bacteria to match organic load
3. Alkalinity  $> 120$  in clarifier
4. Sufficient detention time
5. Temperature  $> 10^{\circ}$  Celsius

# High Ammonia – Temperature

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- Measure temperature in aeration tank ( $>10^{\circ}$  C)
- Blower timers
- Insulate tank covers with foam board
- Carry higher bug population in cold winter months







**Cover'em up!**

**EQ basin**

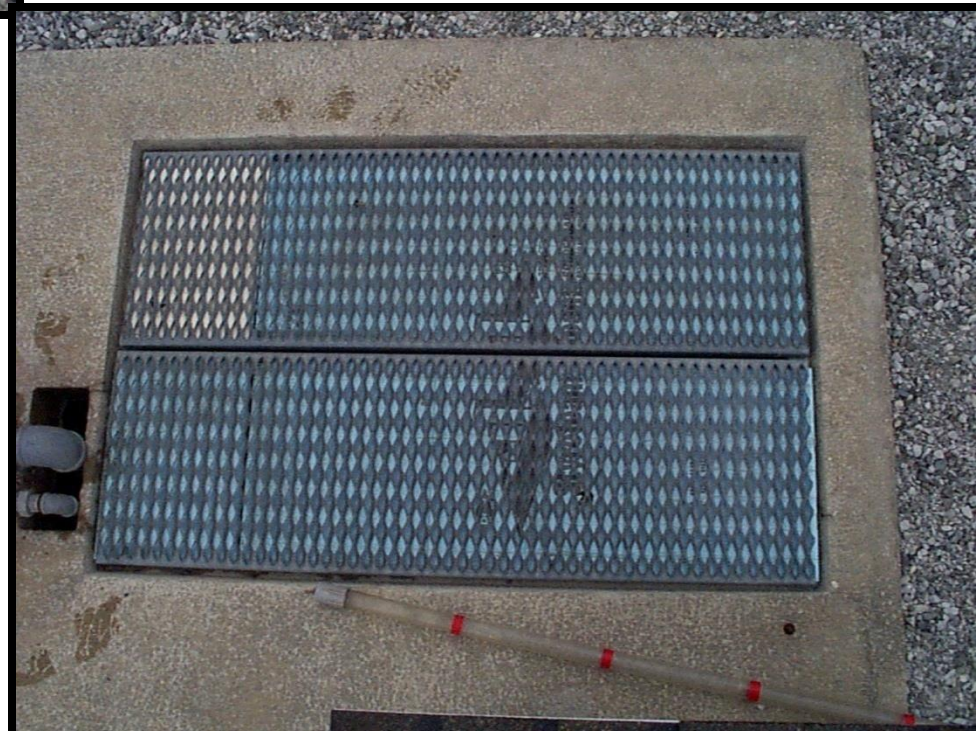
**Aeration**

**Clarifier**

**Styrofoam**

**Canvas**

**Tarps**





Over-aeration in winter lowers water temperature.  
Decrease aeration time to conserve heat.  
Especially at night





# Conversion and Separation

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Now lets look at separation...

What environmental factors are needed in the clarifier?

- Quiescent environment
  - Minimize induced currents
    - Weir
    - Baffles: Scum, Weir, and Denman baffles
- Clarifiers are designed based on:
  - Weir Overflow Rate (WOR)
  - Surface Overflow Rate (SOR)
  - Solids Loading Rate (SLR)

# Conversion and Separation

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What can cause the clarifier to fail and pass solids?

Overloading due to:

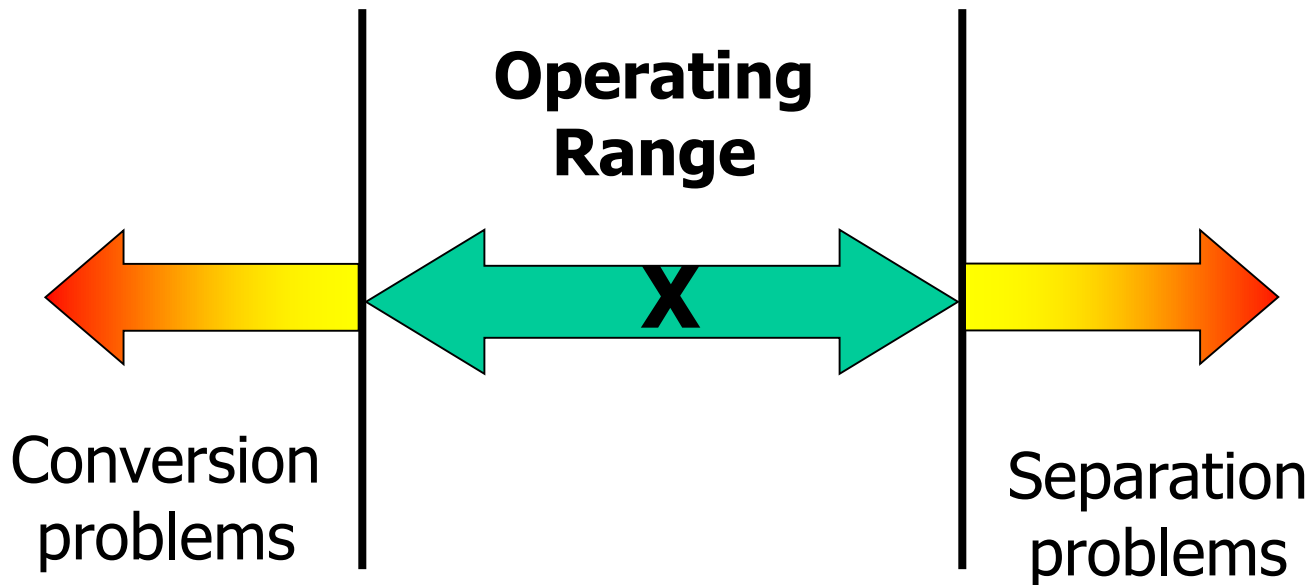
- High MLSS (SLR)
- I&I
- Air lift pumps (RAS & Skimmer)
  - Total flow should not exceed 150% of Design Flow
- Influent + RAS + Skimmer flows that, in total, exceed the design SOR and/or WOR

What to do?

- Shut off skimmer! If you need it...
- Reduce RAS flow
- Waste sludge, either by truck or by shovel

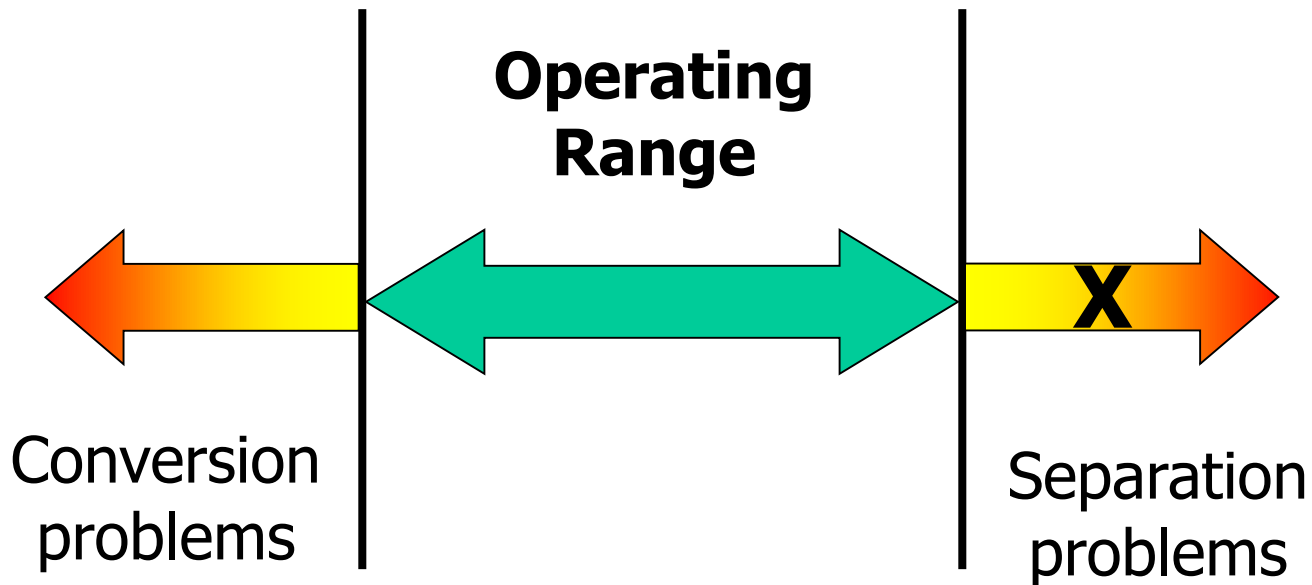
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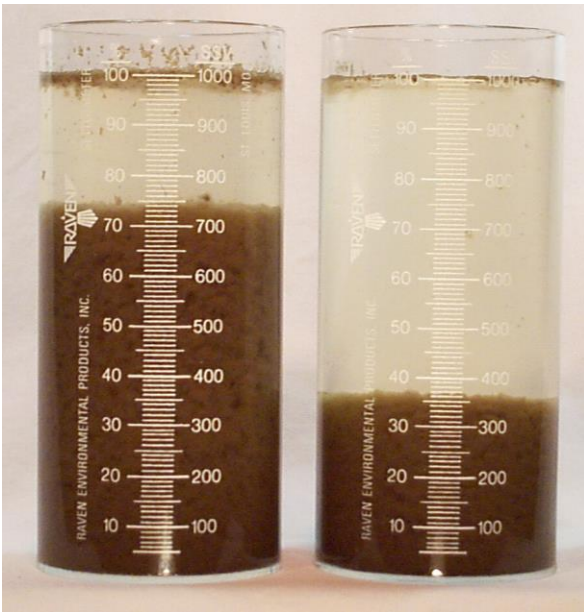


# Settleometer Analysis

## Top: "Good" Settling Characteristics

Left: 5 Minutes; Less Than 800 mL

Right: 30 Minutes; Less Than 400 mL



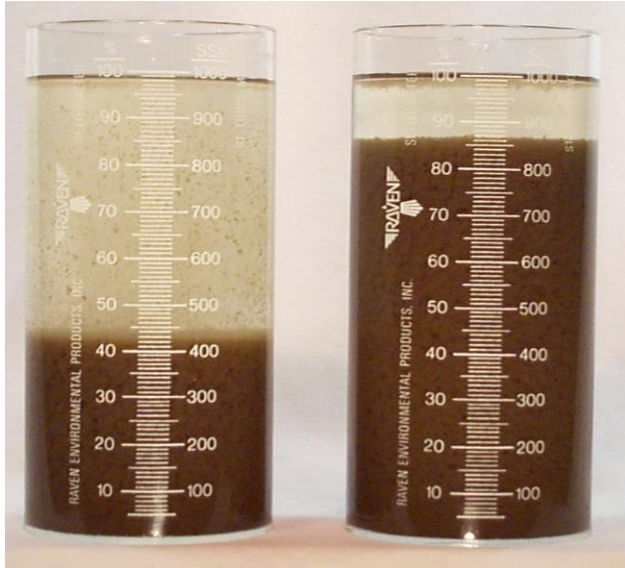
## Bottom: "Slow" Settling Characteristics

Left: 5 Minutes; Greater Than 800 mL

Right: 30 Minutes; Greater Than 400 mL



# 2 Minute Diluted Settleometer



## Top: Excessive Solids Concentration

Left: Diluted 50% Clarifier Effluent and 50% Mixed Liquor Suspended Solids

Right: No Dilution of Mixed Liquor Suspended Solids



## Top: Excessive Filamentous Growth

Left: Diluted 50% Clarifier Effluent and 50% Mixed Liquor Suspended Solids

Right: No Dilution of Mixed Liquor Suspended Solids



ENVIRONMENTAL PRODUCTS, INC.

20

30

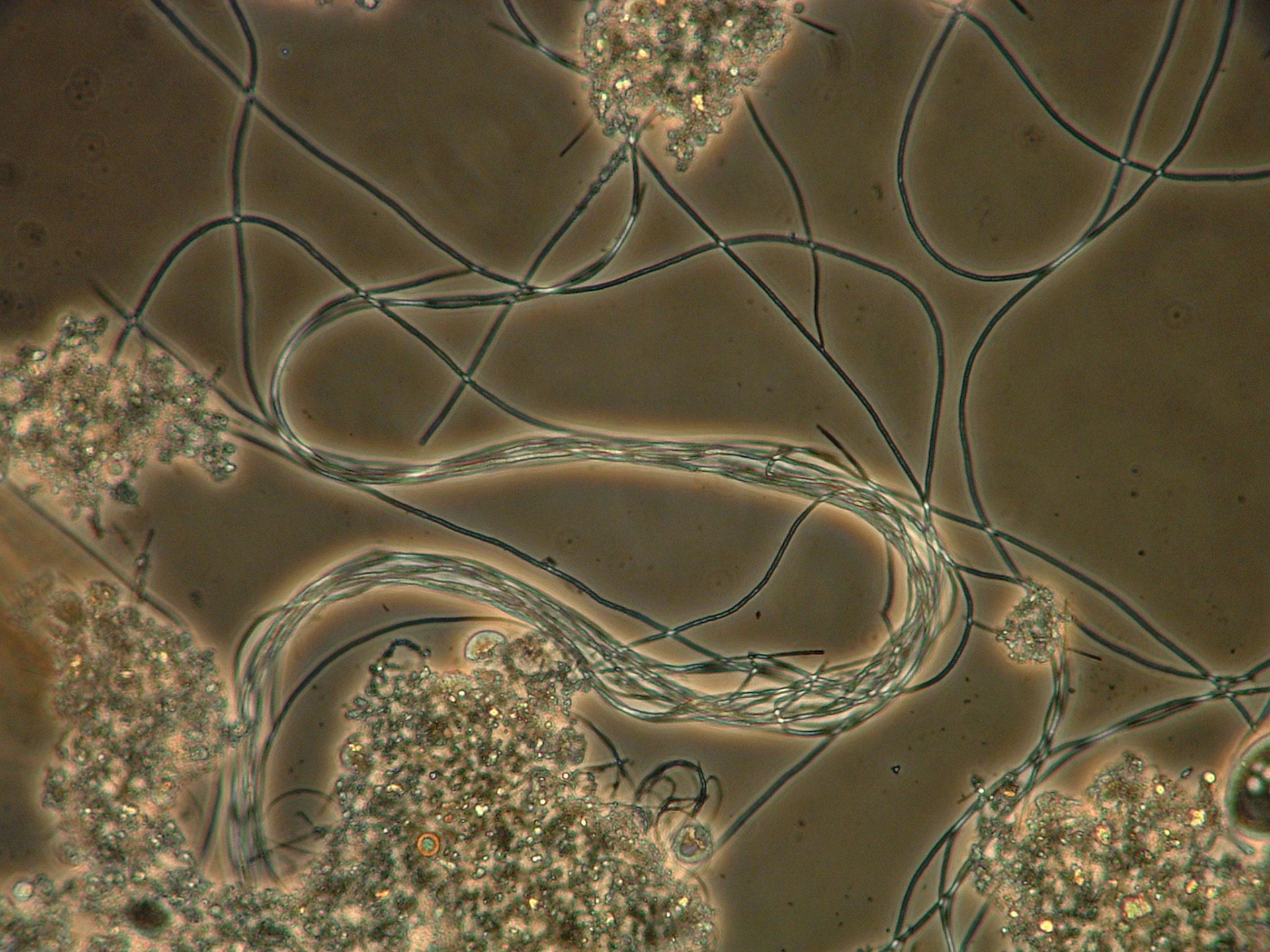
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50

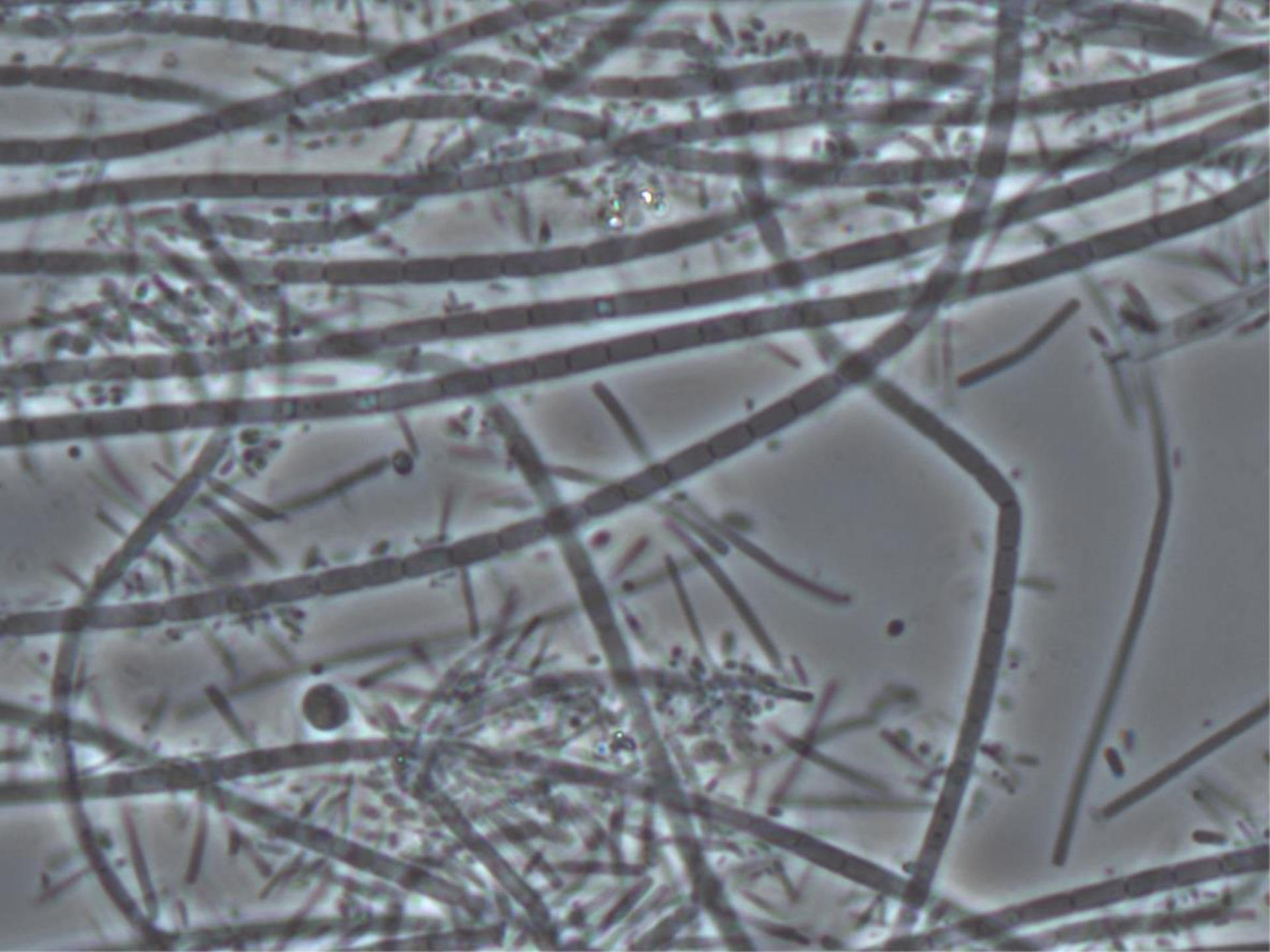
60

70

RA







# Low F/M

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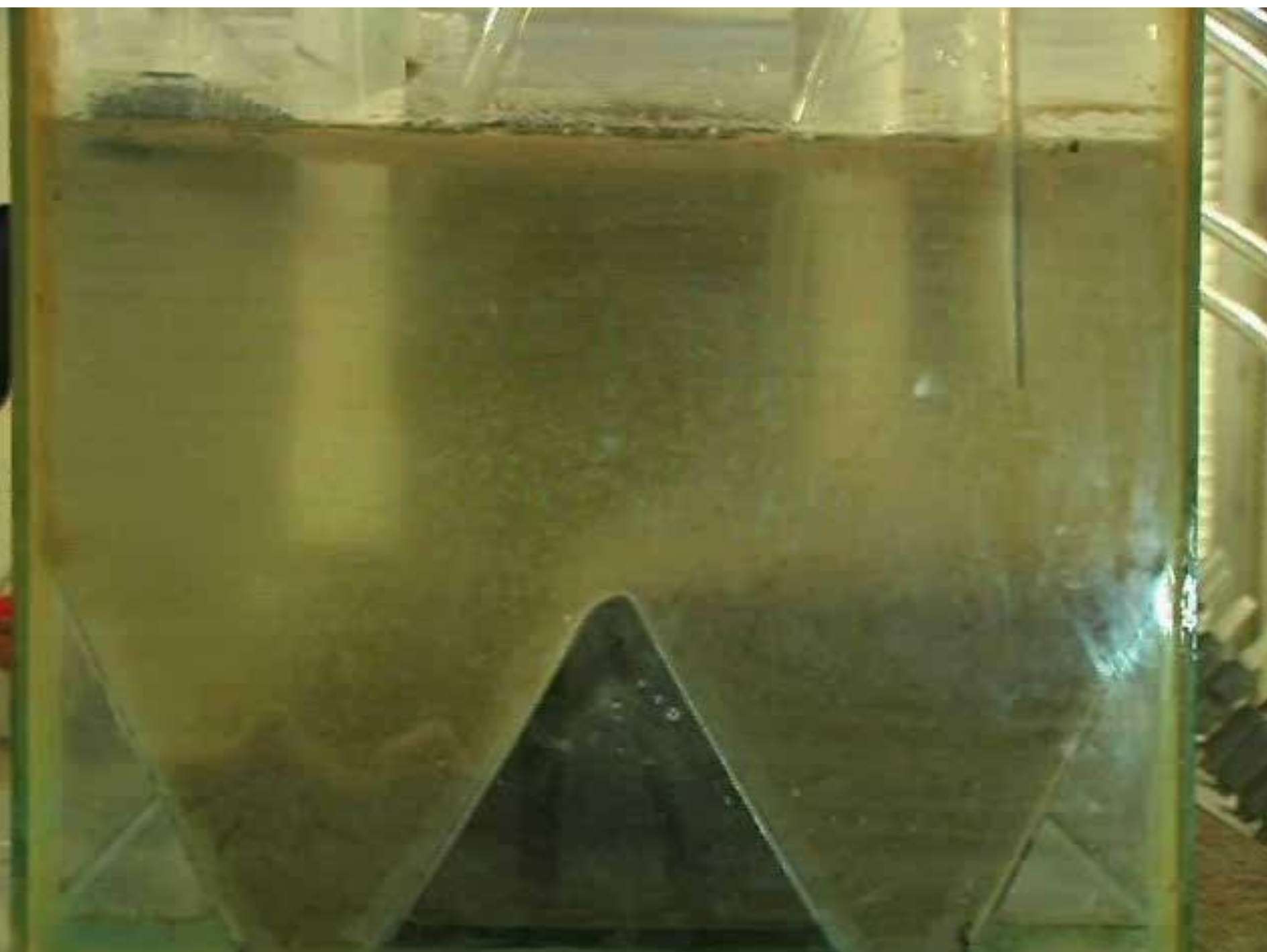
- Too many bugs and not enough food (sewage) to feed them all
- Foaming in the aeration tank
- Slow settling
- Filaments!!!!!!!!!!!!



# Optimize Clarifier Performance

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- Control solids concentration by wasting excess solids
  - Keep 5 minute settleometer between 200 and 500, depending on your plant loading
- Partially treated water does not settle!
- Modify clarifier to improve performance
  - Denman baffle
  - Extend scum baffle
  - Inspect clarifier for obstruction and verify RAS pump position
  - Slow down the flows (EQ, RAS, and skimmer)
  - Clean and balance the weir







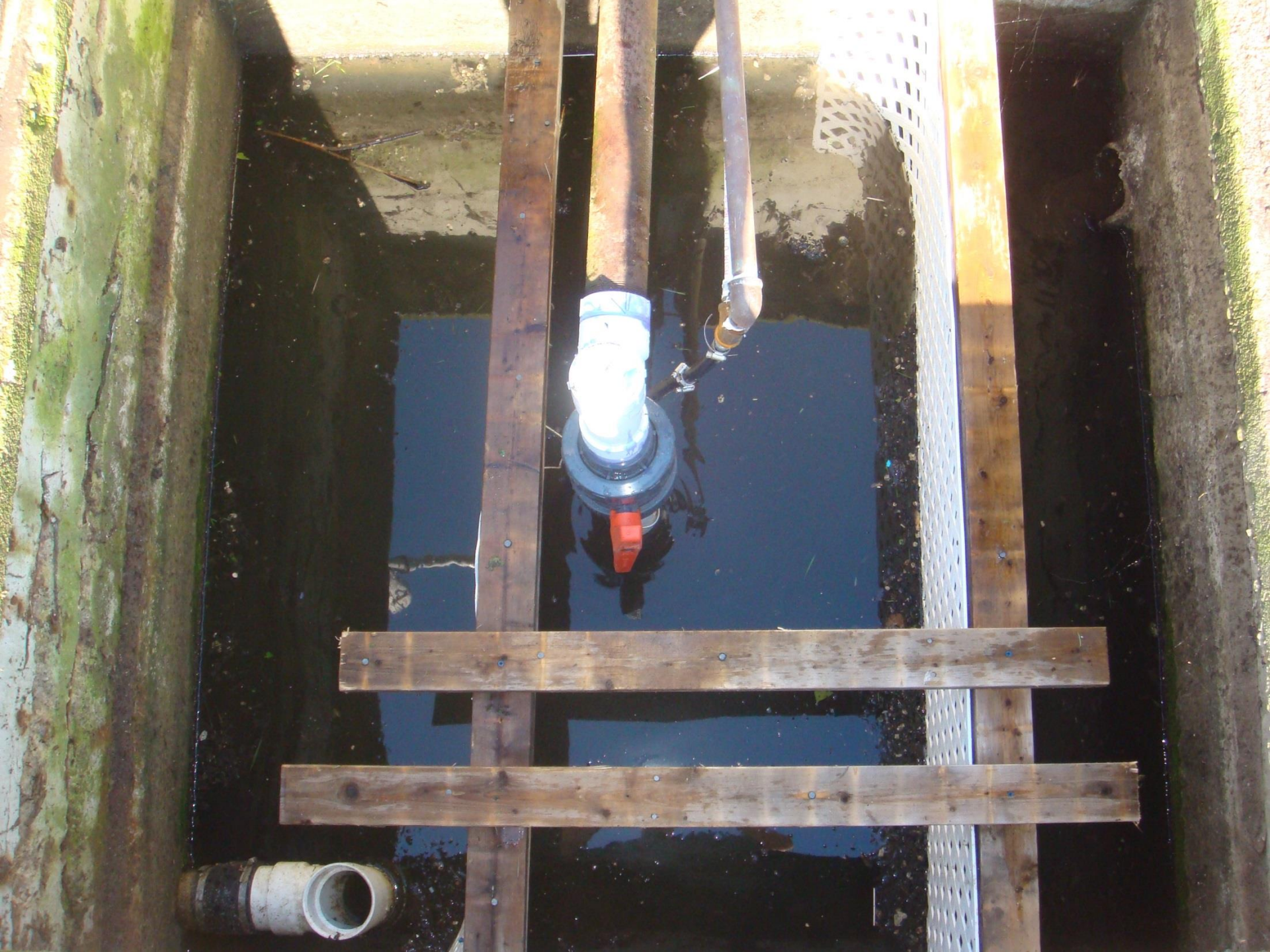
















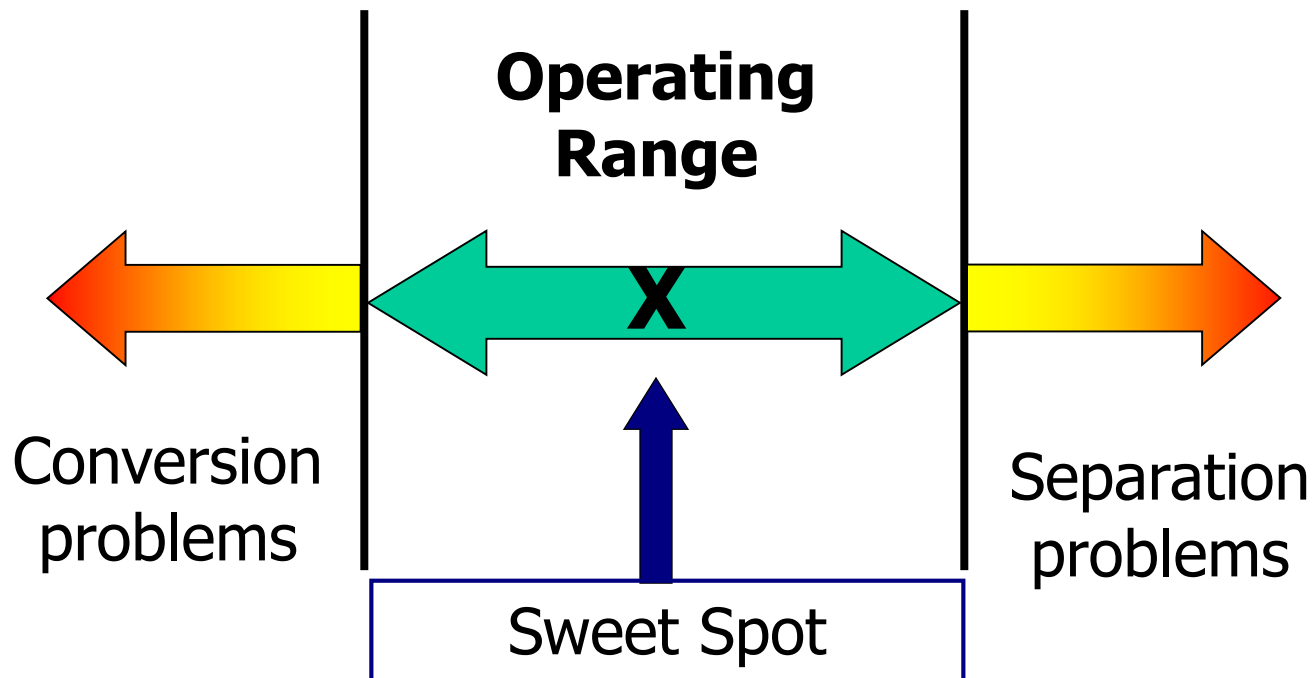
Over the weir and. . .

. . . its out of here.



# Activated Sludge Process

1. Convert organic waste into bugs
2. Separate bugs from treated water



# Conversion and Separation

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Summary:

Like any profession:

- You need to have the proper tools,
- You need to take the time to use them,
- And you need to record your results.

Key points to remember:

1. Measure Ammonia to verify treatment
2. Maintain your plant equipment
3. Keep track of your bug population growth
4. Waste sludge
5. Do not leave your skimmer running
6. Do not run your RAS rate at full blast

**Run your plant, don't let your plant run you!**



# Any Questions?



Blower off circuit

Bottom ball at same elevation as “Off” ball for pumps.

### SW1

Top ball just below 2<sup>nd</sup> call ball.

### SW2

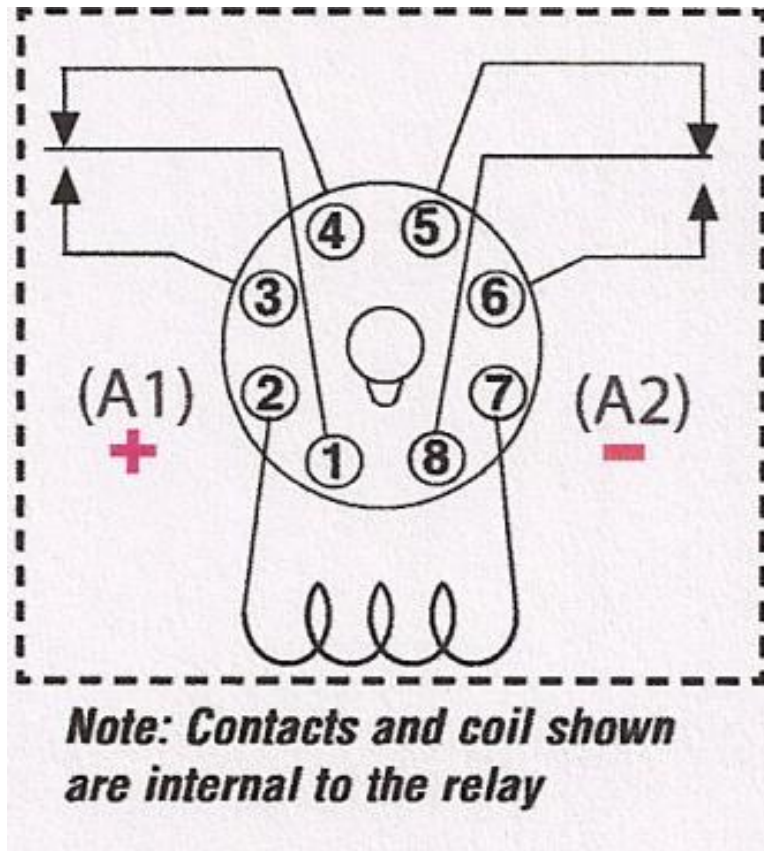
Power from “Auto” to one side of SW1 & SW2

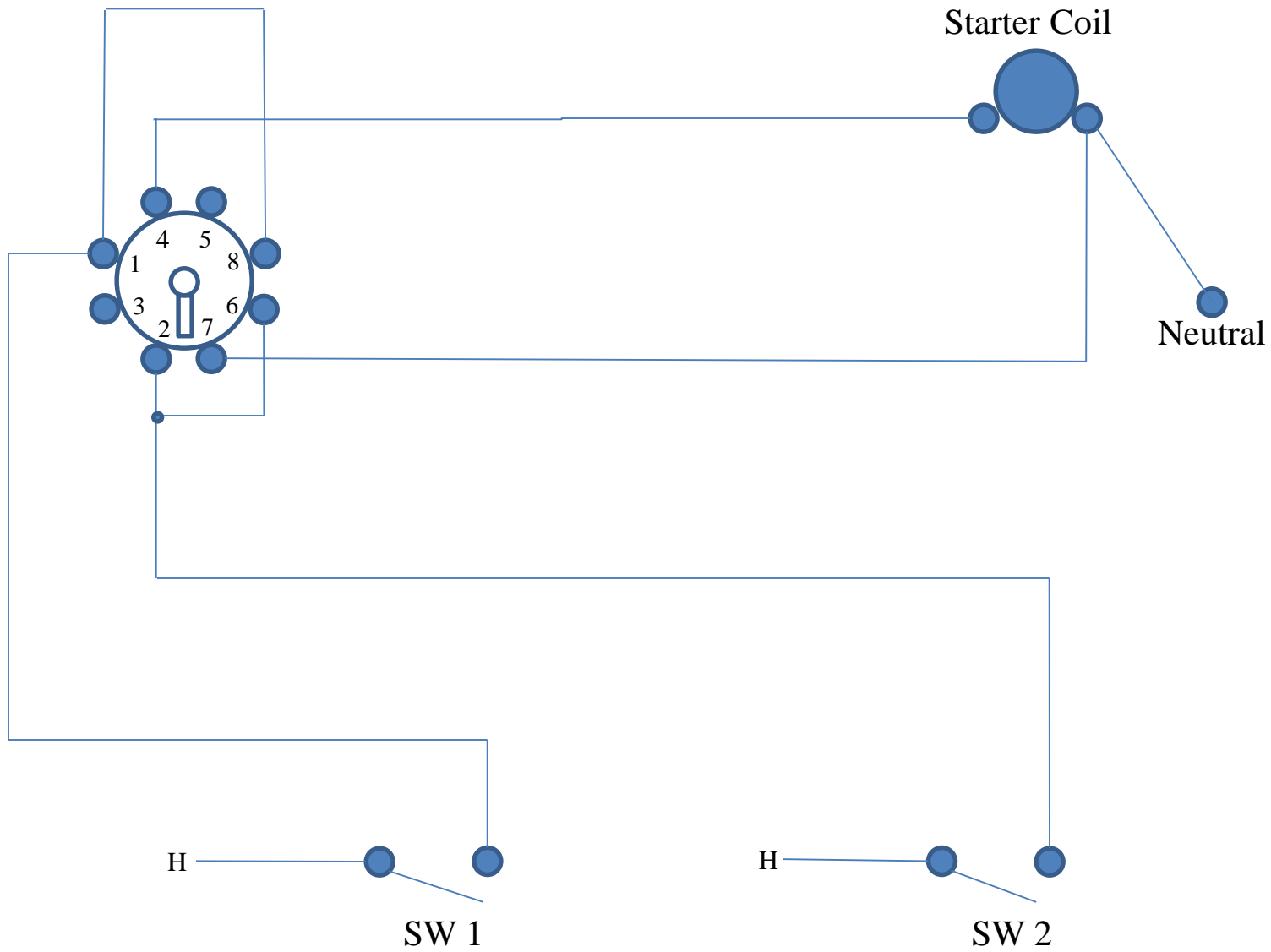
Other side of SW1 to #1 & #8

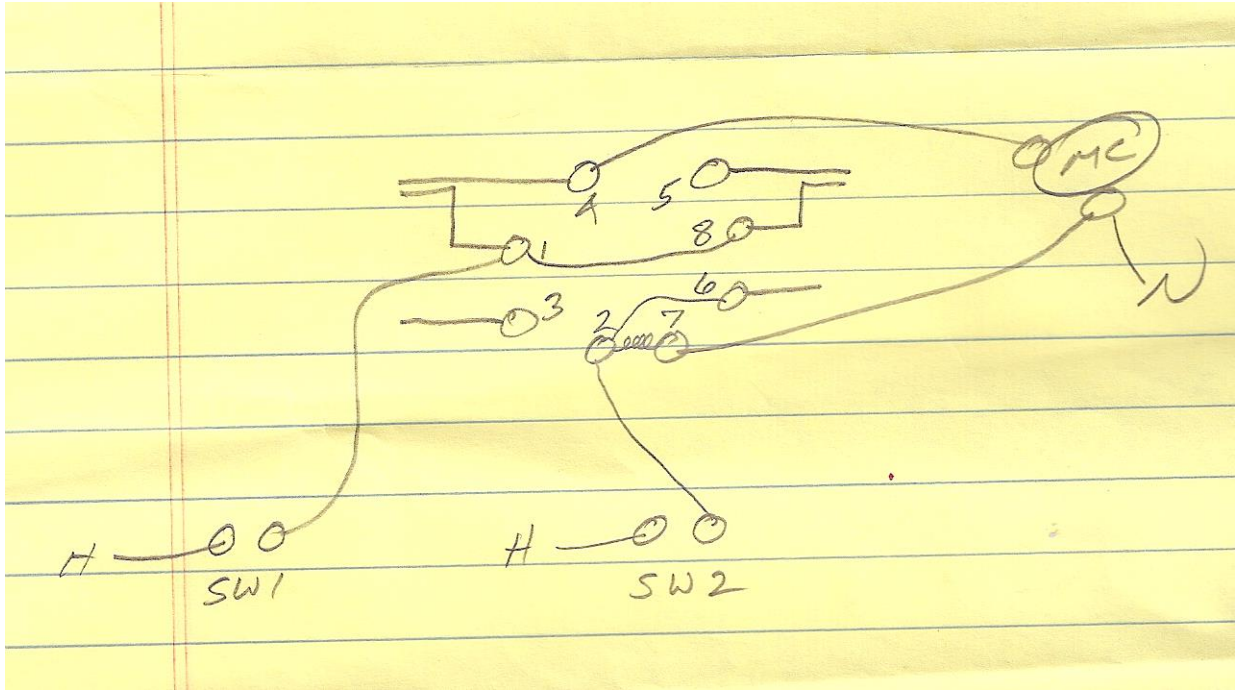
Other side of SW2 to #2 & #6

#4 to starter coil

#7 and other side of starter coil to Neutral







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**Course #: S469699**