Acidification Protocol for Compliance with the Surface Water Treatment Rule at the Bloomington, IL Water Treatment Plant

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H2O'C ENGINEERING

Objective

To scientifically establish a protocol for the acidification of turbidity samples to eliminate interferences from particles formed during lime softening

IESWTR

40 CFR Parts 9, 141, and 142

National Primary Drinking Water Regulations: Interim Enhanced Surface Water Treatment; Final Rule

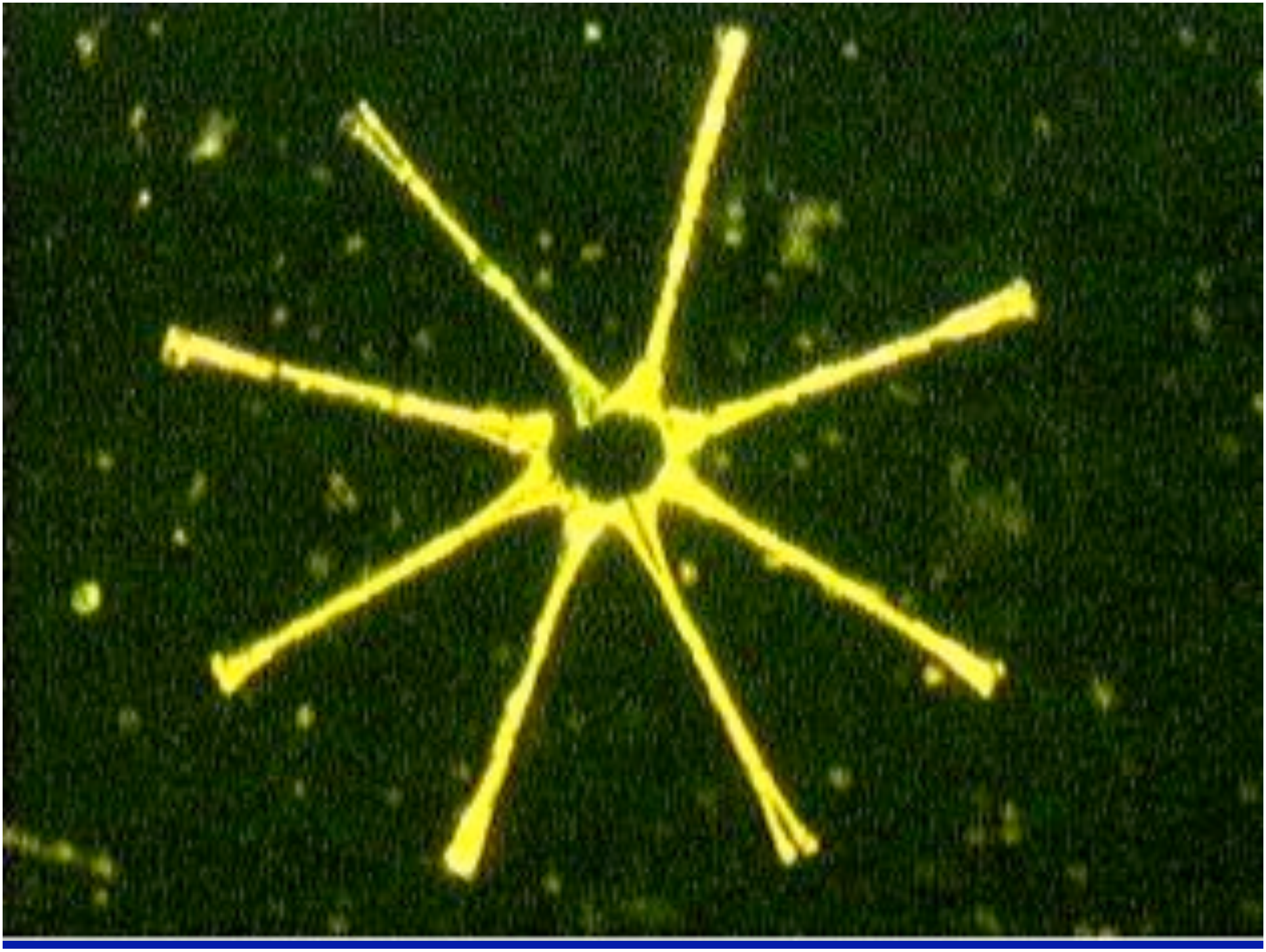
Sec. 141.173 Filtration.

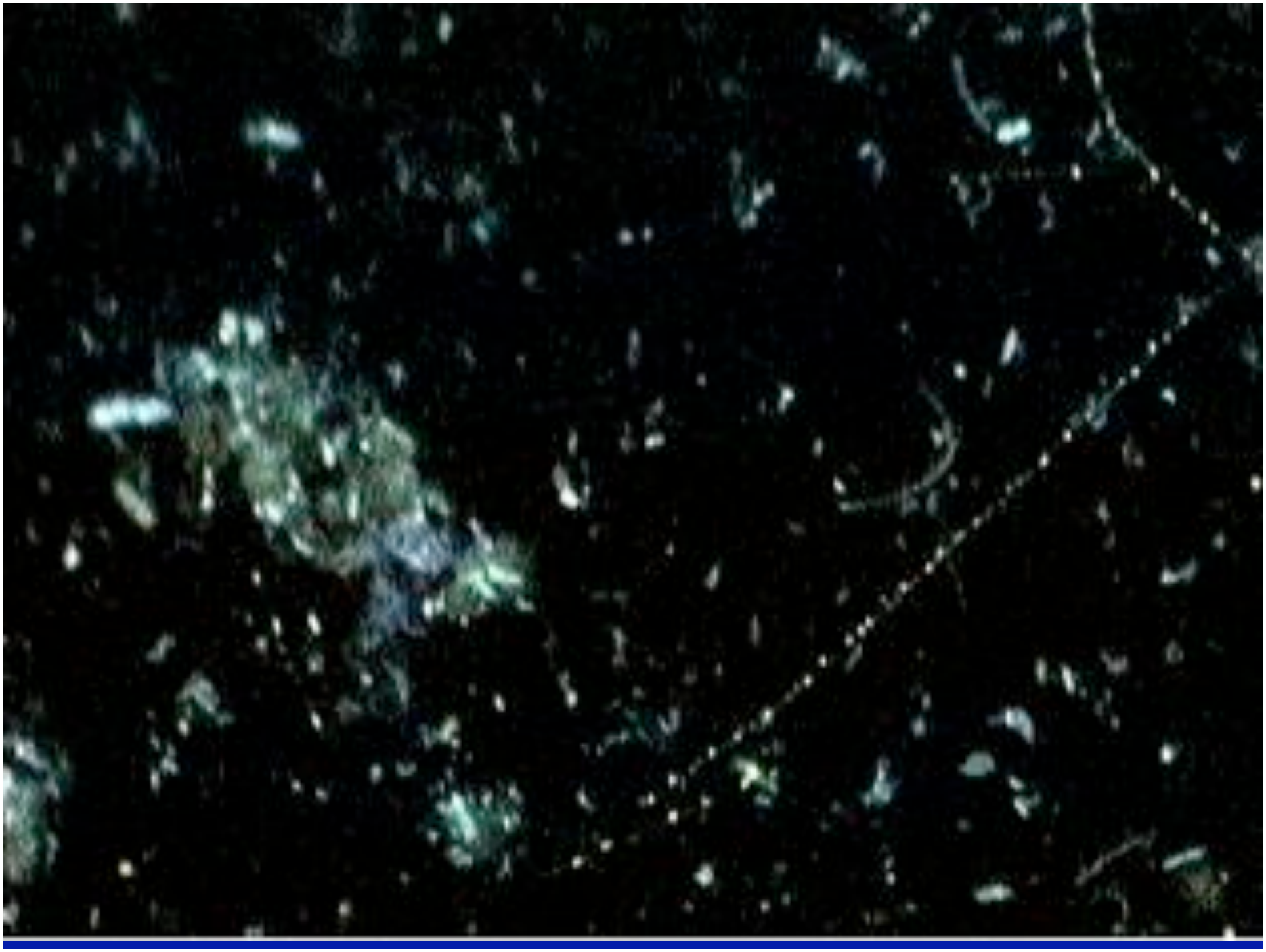
(3) A system that uses lime softening may acidify representative samples prior to analysis using a protocol approved by the State.

Systems that use lime softening may apply to the State for alternative exceedance levels for the levels specified in paragraphs (b)(1) through (4) of this section if they can demonstrate that higher turbidity levels in individual filters are due to lime carryover only and not due to degraded filter performance.

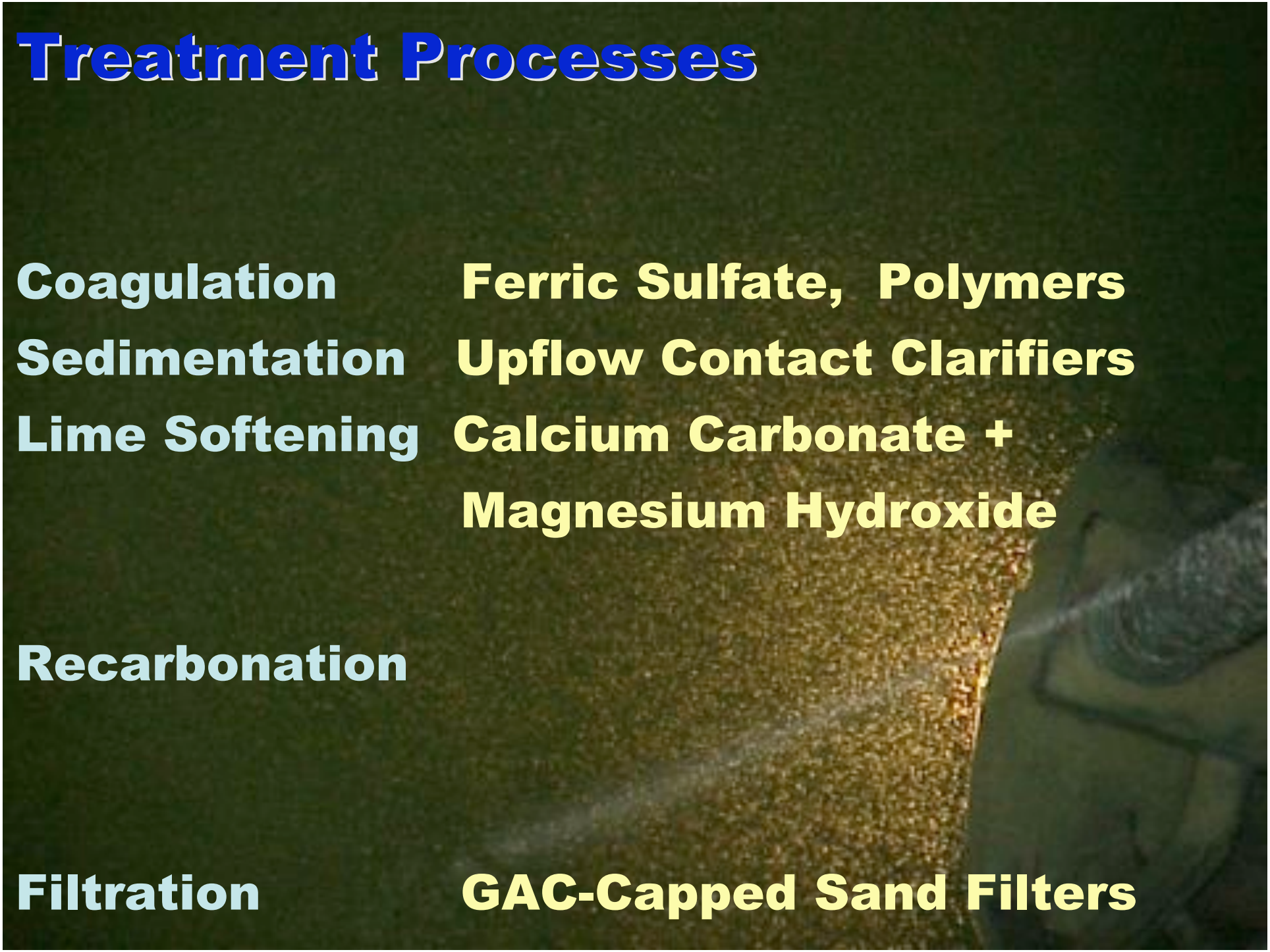
Bloomington Water Treatment Plant

Lake Bloomington





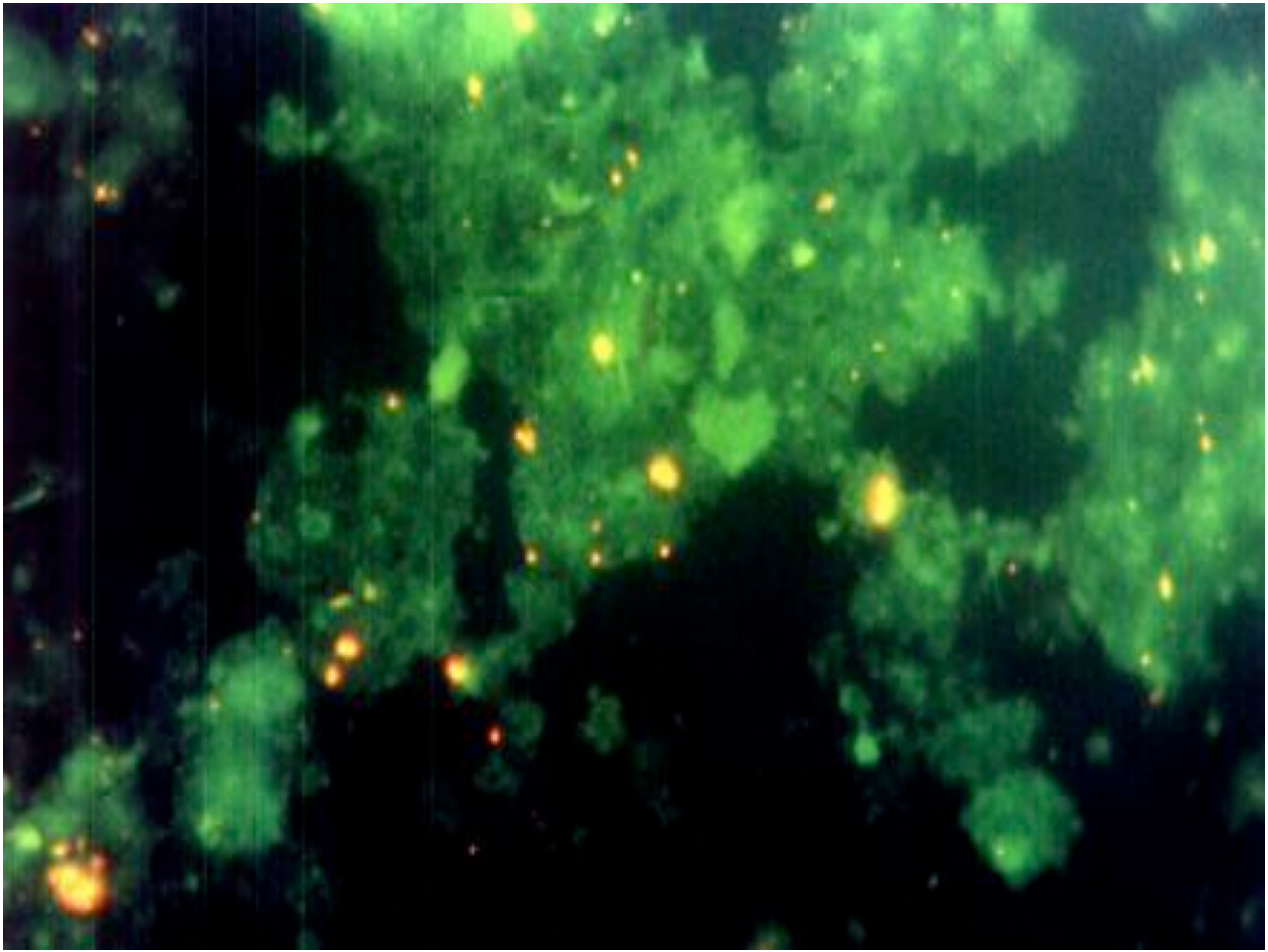
Treatment Processes

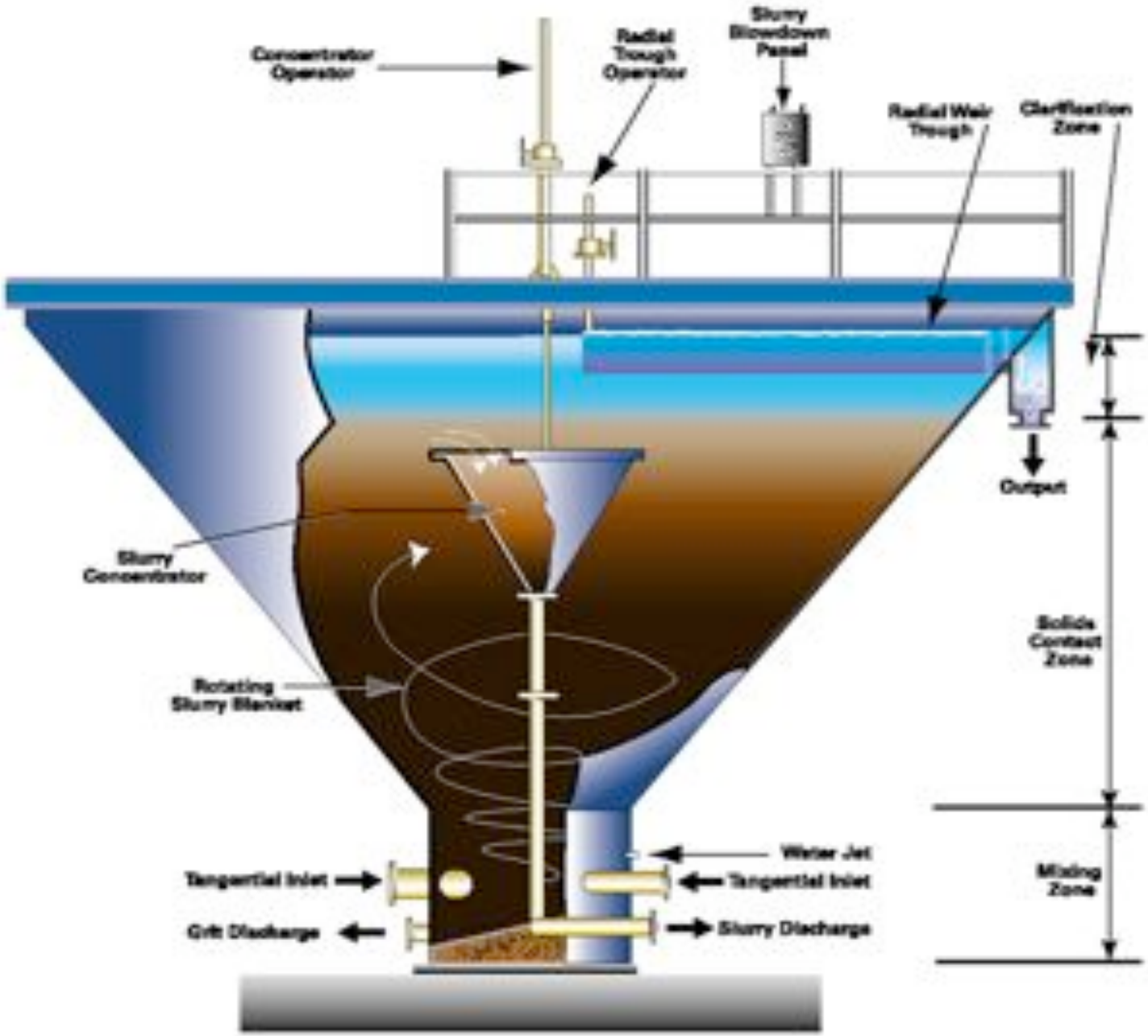


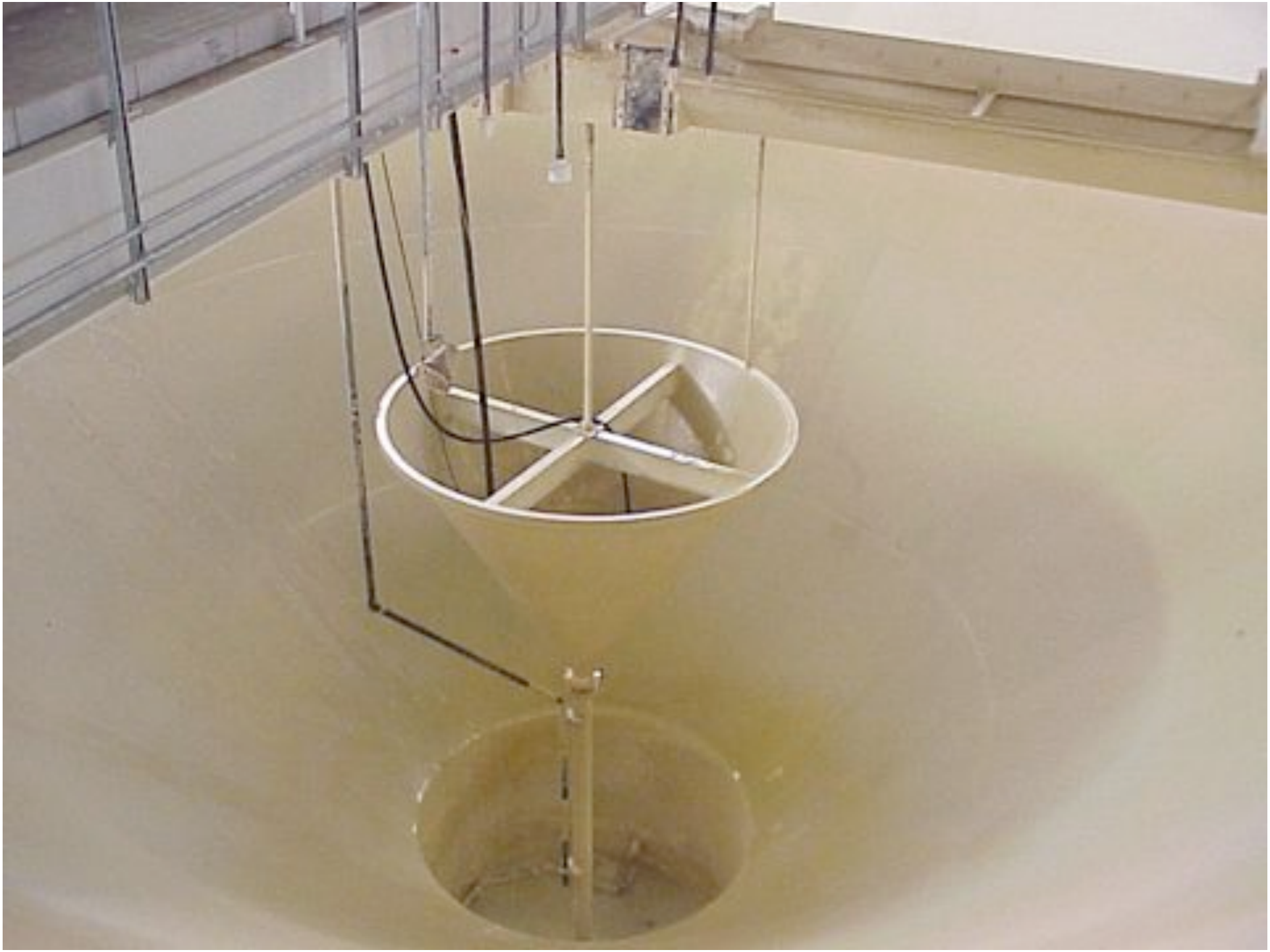
Coagulation	Ferric Sulfate, Polymers
Sedimentation	Upflow Contact Clarifiers
Lime Softening	Calcium Carbonate + Magnesium Hydroxide
Recarbonation	
Filtration	GAC-Capped Sand Filters

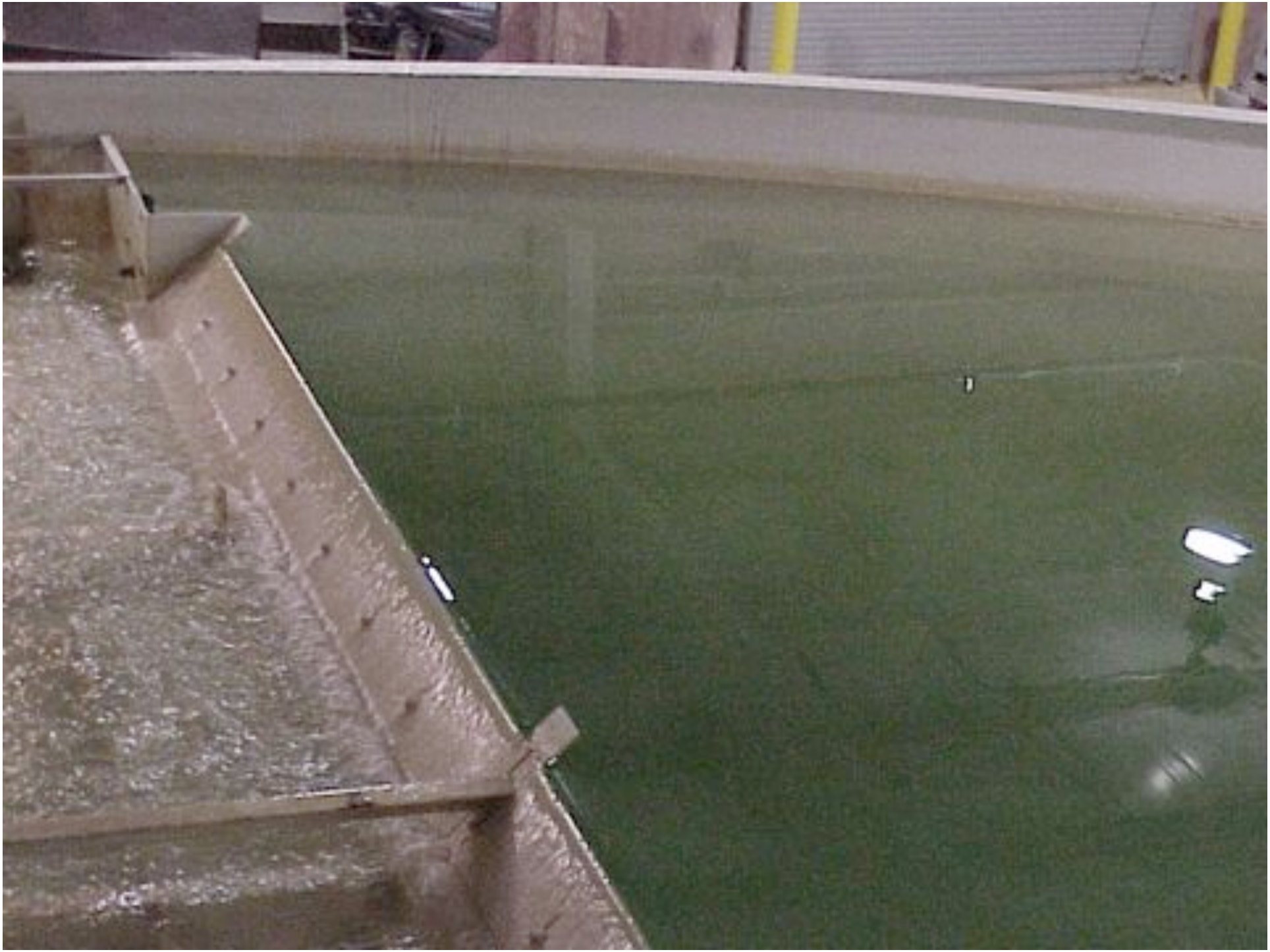
Lime Precipitation

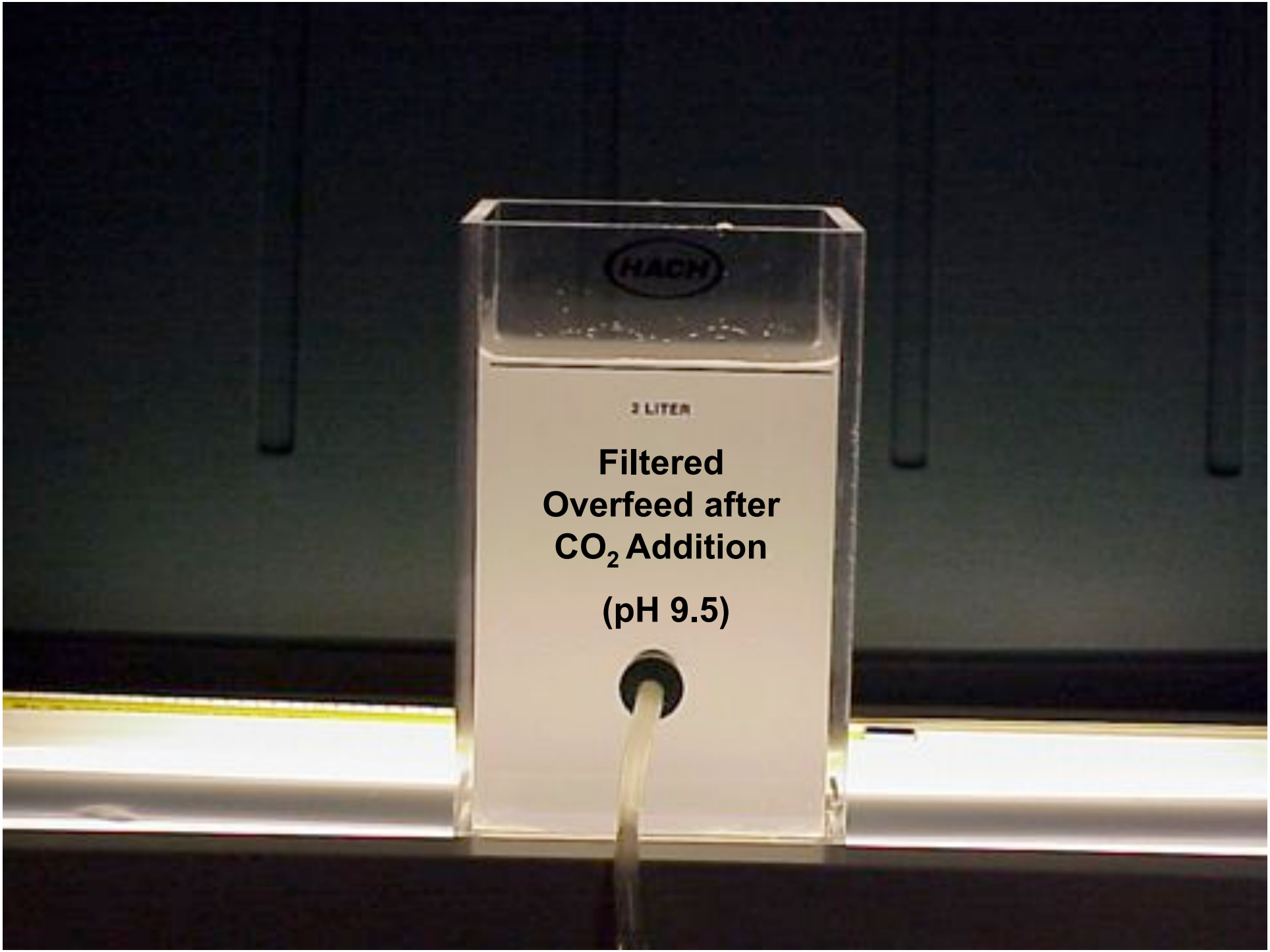
Calcium Carbonate + Magnesium Hydroxide



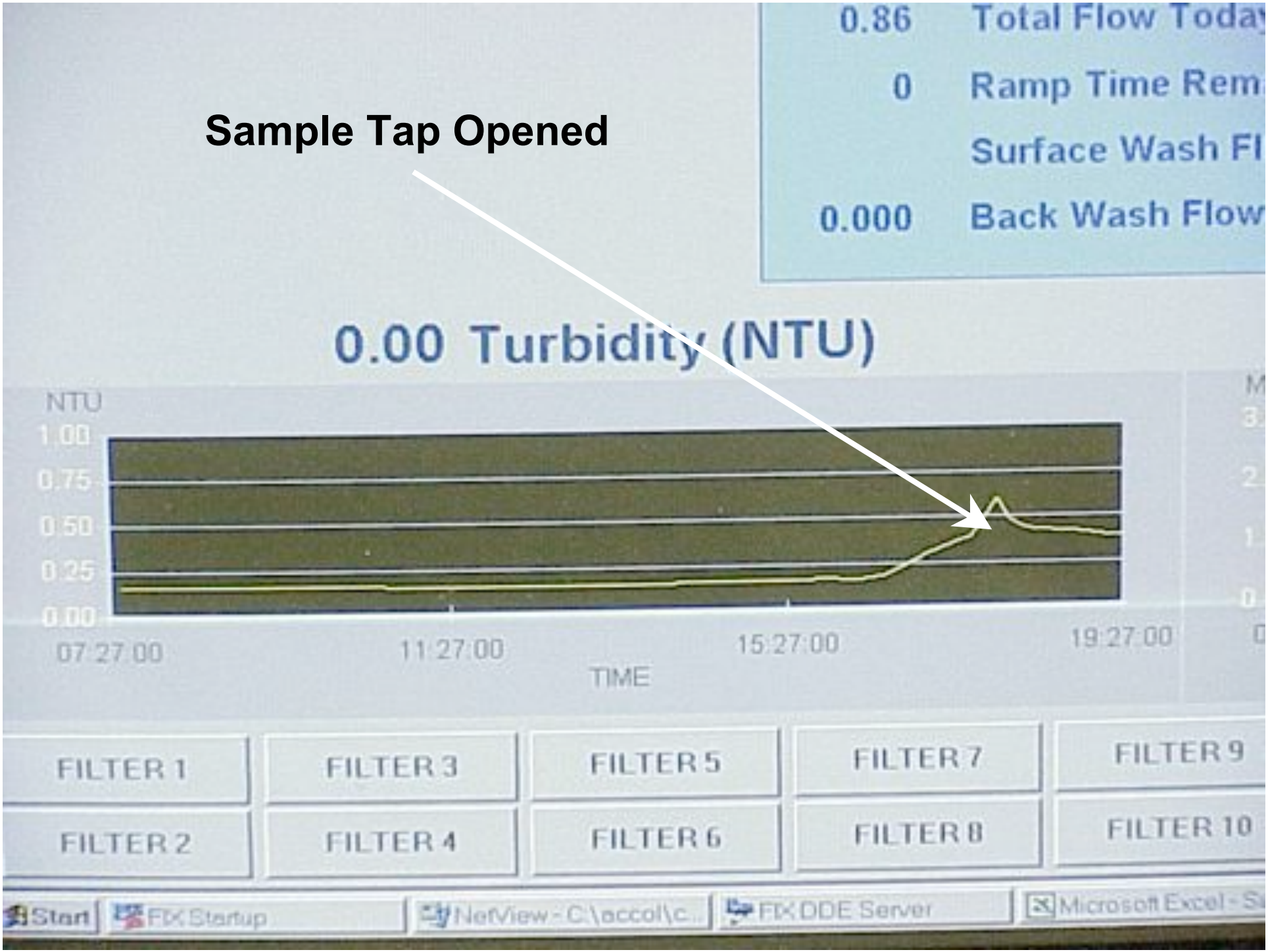

Concentrator Operator
Radial Trough Operator
Slurry Blowdown Panel
Radial Weir Trough
Clarification Zone
Output
Slurry Concentrator
Rotating Slurry Blanket
Solids Contact Zone
Mixing Zone
Water Jet
Tangential Inlet
Tangential Inlet
Grit Discharge
Slurry Discharge

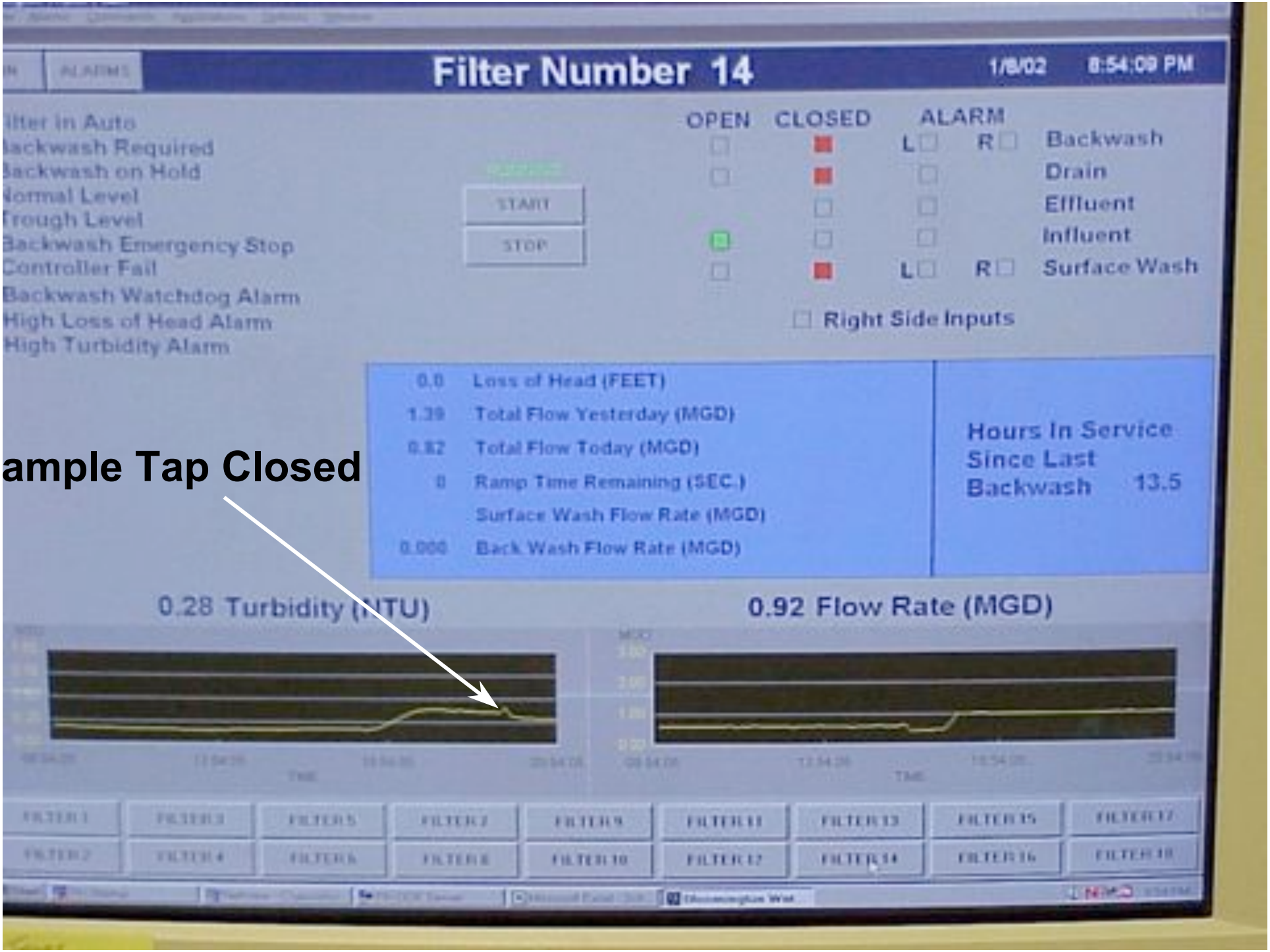





HACH
2 LITER
Filtered
Overfeed after
CO_2 Addition
(pH 9.5)

Granular Activated Carbon in Totes

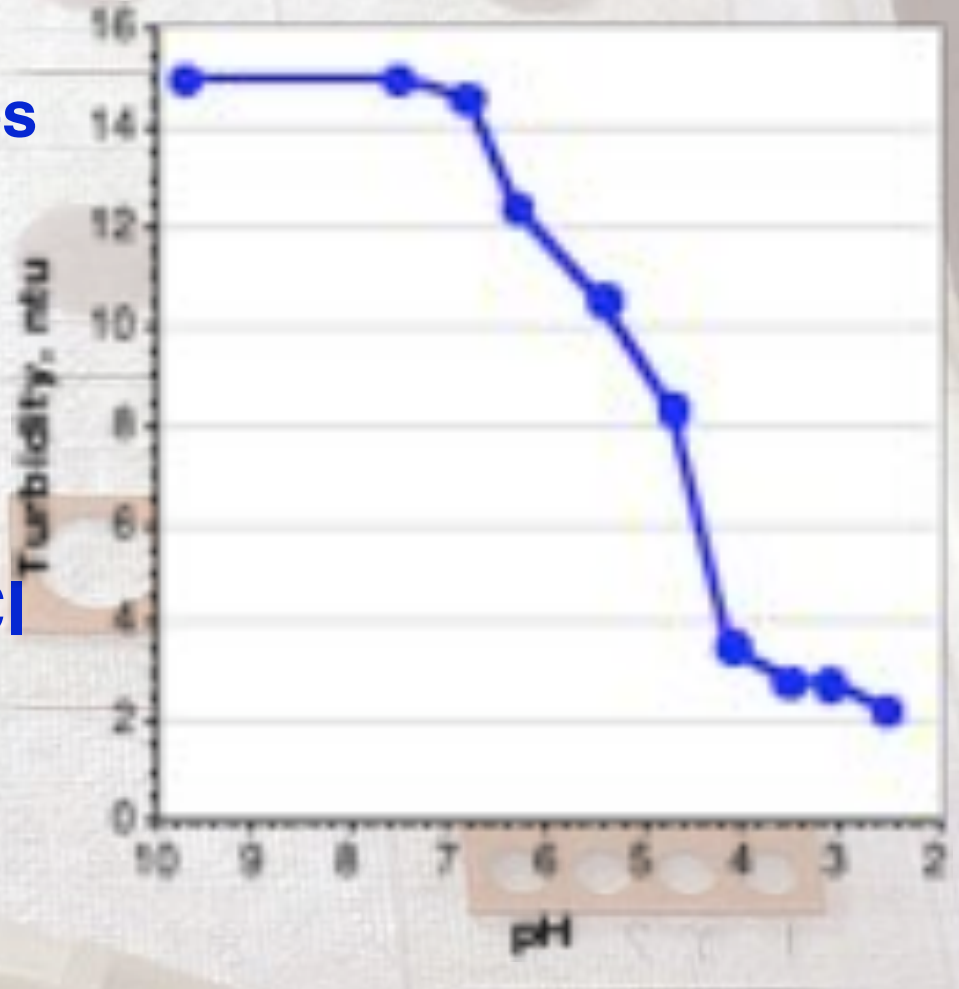

Sample Tap Opened
0.86 Total Flow Today
0 Ramp Time Rem
Surface Wash Fl
0.000 Back Wash Flow
0.00 Turbidity (NTU)
NTU
1.00
0.75
0.50
0.25
0.00
07:27:00
11:27:00
15:27:00
19:27:00
TIME
FILTER 1
FILTER 3
FILTER 5
FILTER 7
FILTER 9
FILTER 2
FILTER 4
FILTER 6
FILTER 8
FILTER 10
Start
FIX Startup
NetView - C:\accol\c...
FIX DDE Server
Microsoft Excel - Si


Filter Number 14
1/8/02 8:54:09 PM
OPEN CLOSED ALARM
Backwash
Drain
Effluent
Influent
Surface Wash
START
STOP
Right Side Inputs
0.0 Loss of Head (FEET)
1.39 Total Flow Yesterday (MGD)
0.82 Total Flow Today (MGD)
0 Ramp Time Remaining (SEC.)
Surface Wash Flow Rate (MGD)
0.000 Back Wash Flow Rate (MGD)
Hours In Service Since Last Backwash 13.5
0.28 Turbidity (NTU)
0.92 Flow Rate (MGD)
ample Tap Closed

Effect of Acidification

Sludge Blanket Samples

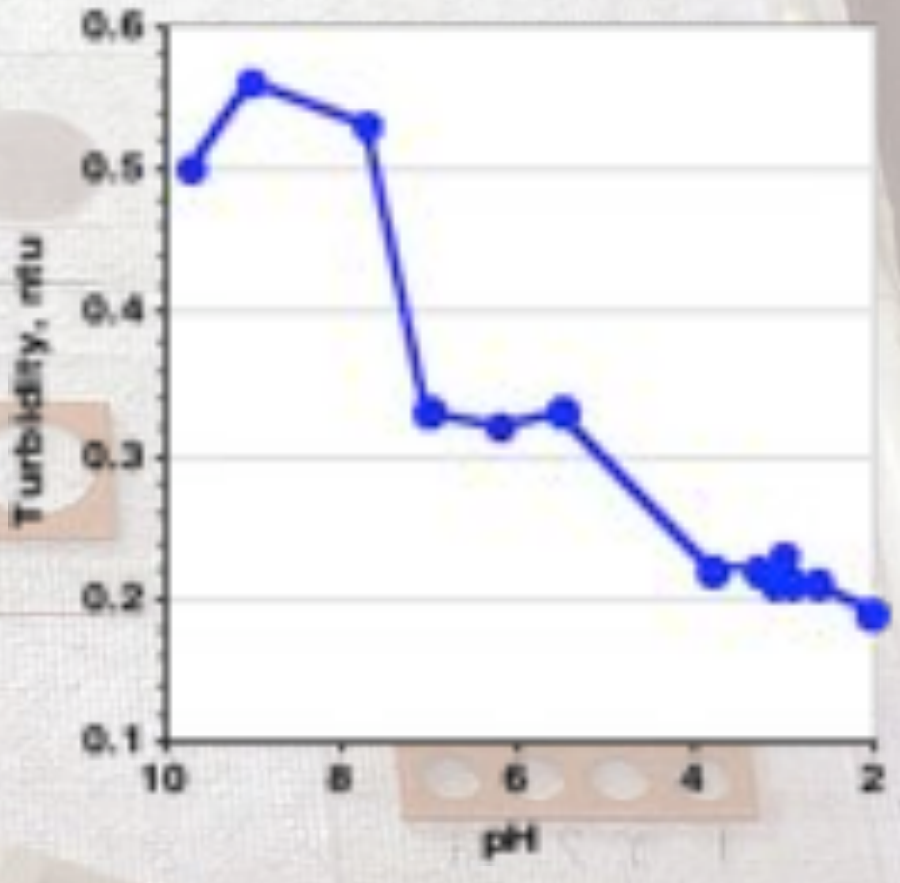
- **high initial turbidity**
- **progressive addition of 1:1 HCl**



Effect of Acidification

Filter Influent

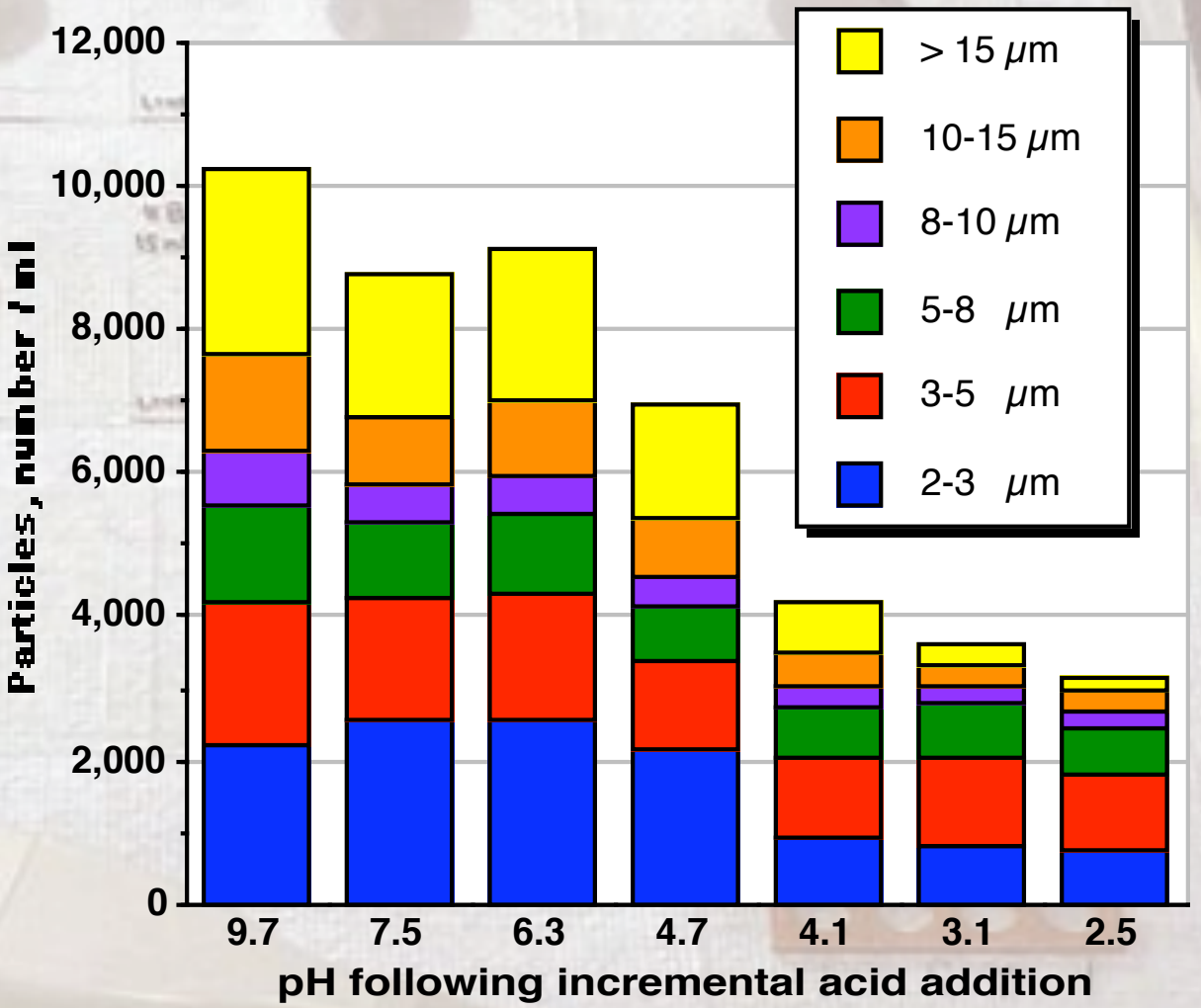
- low initial turbidity
- four-liter sample
- addition of 1:1 HCl



MetOne Particle Counter

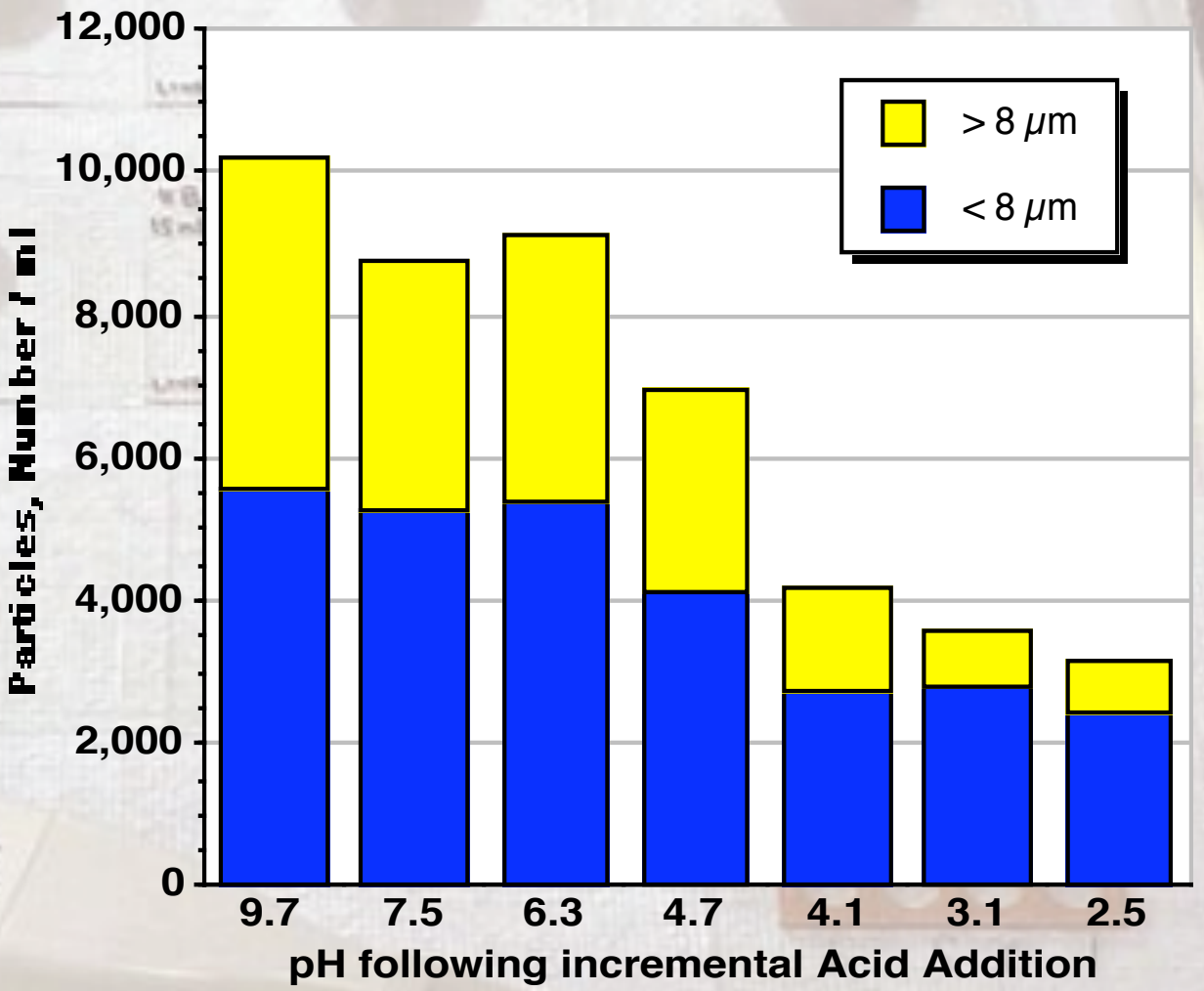
Particle Counts

Clarifier Effluent



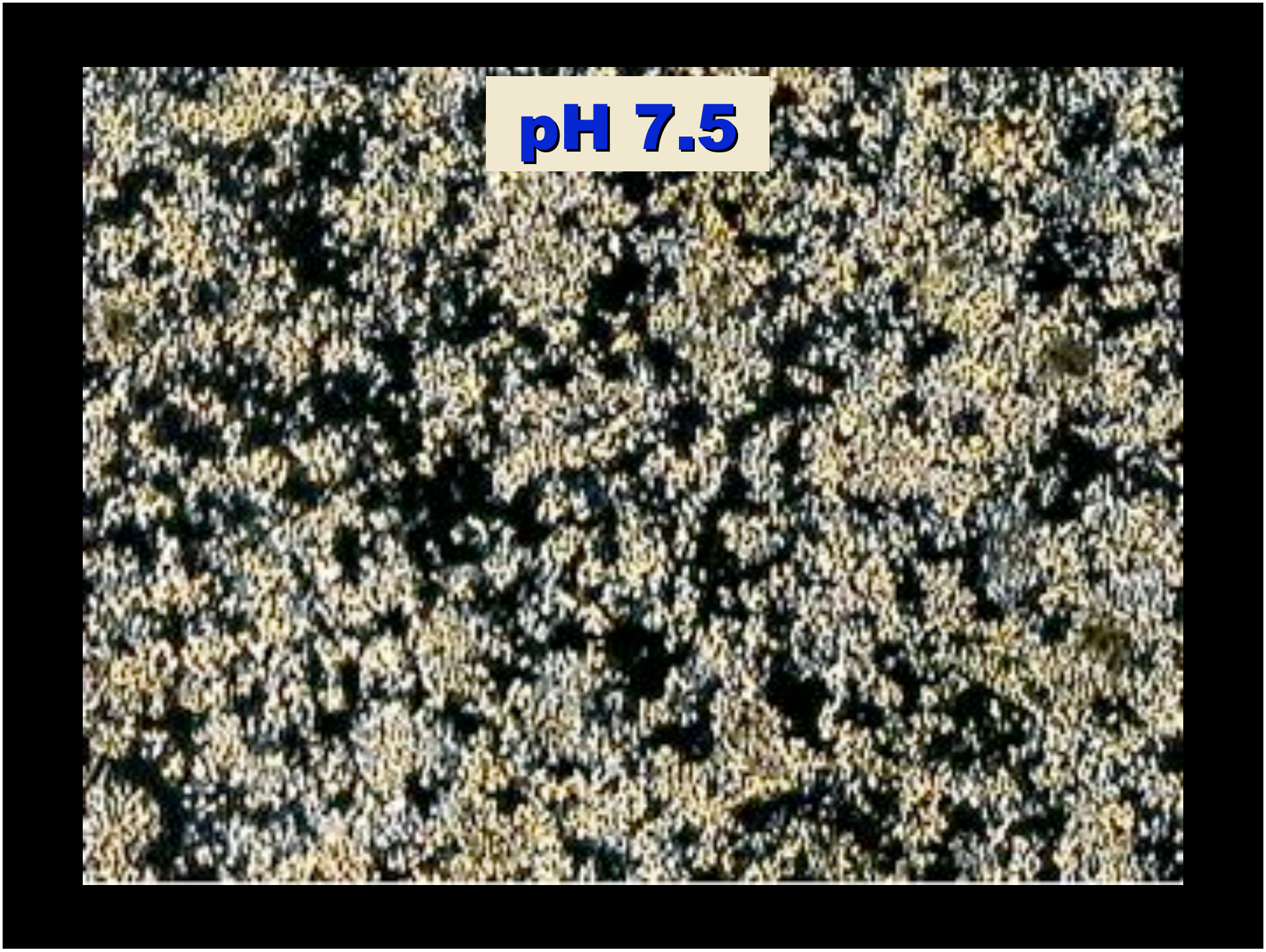
Particle Counts

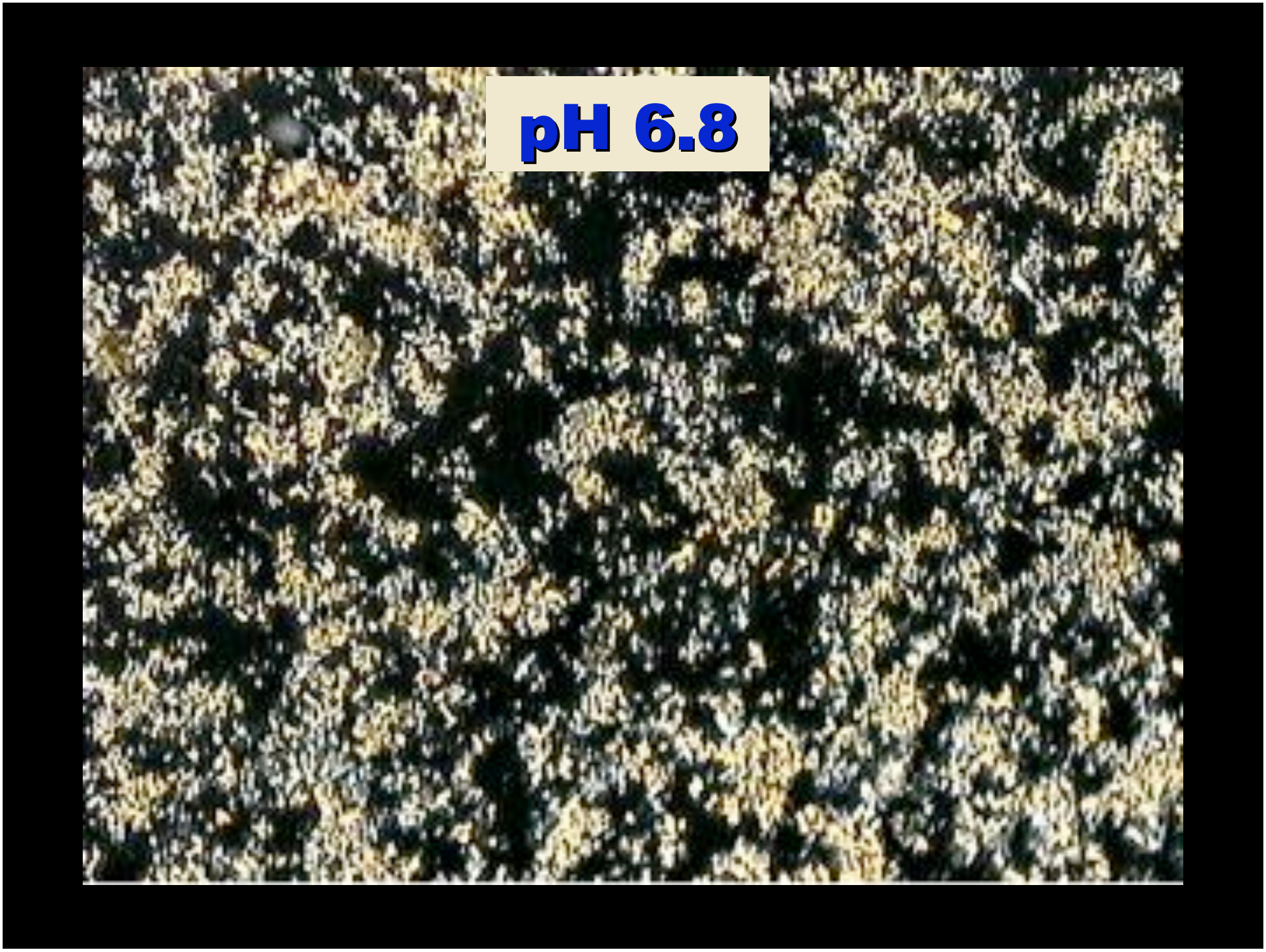
Clarifier Effluent

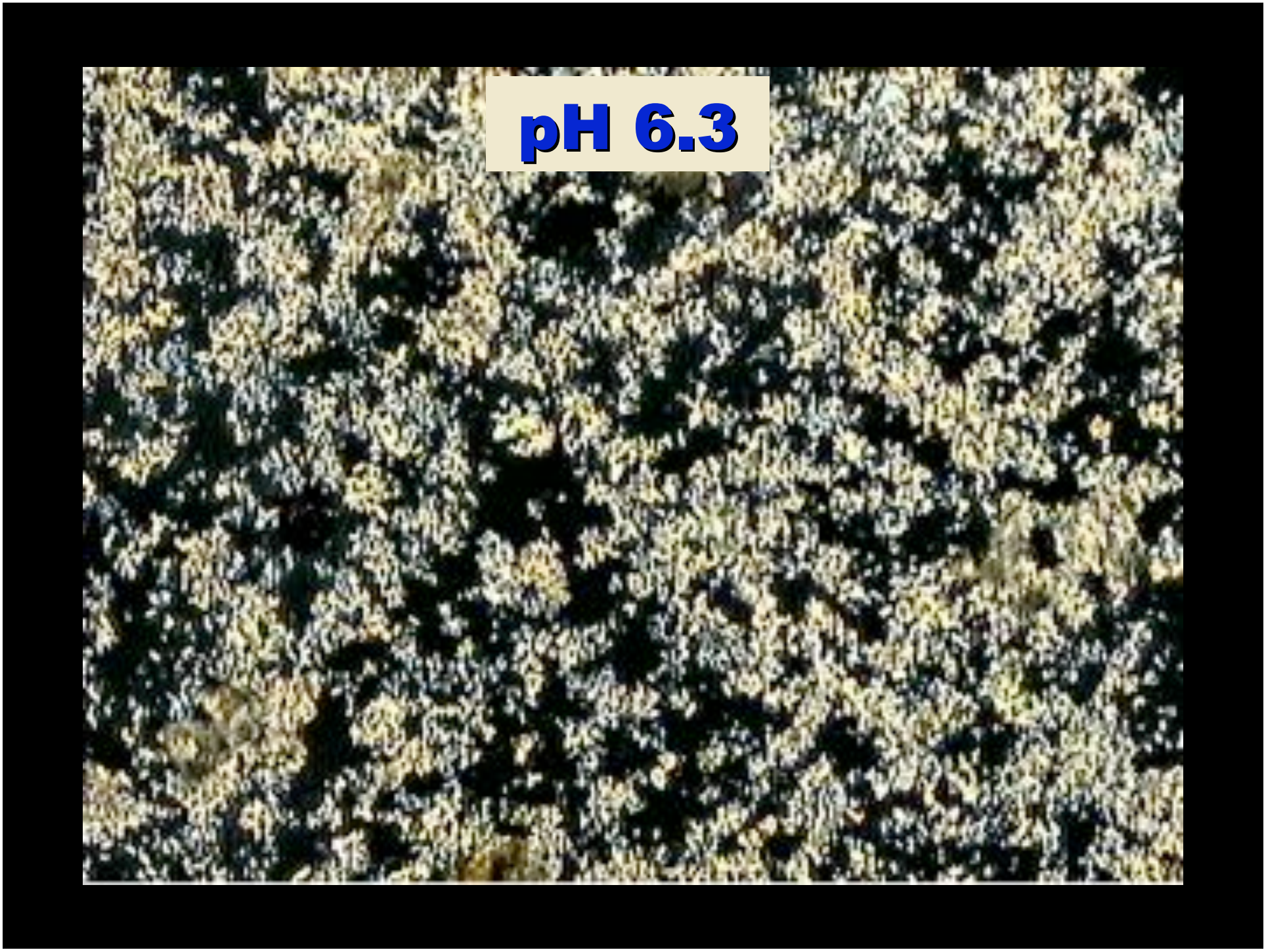


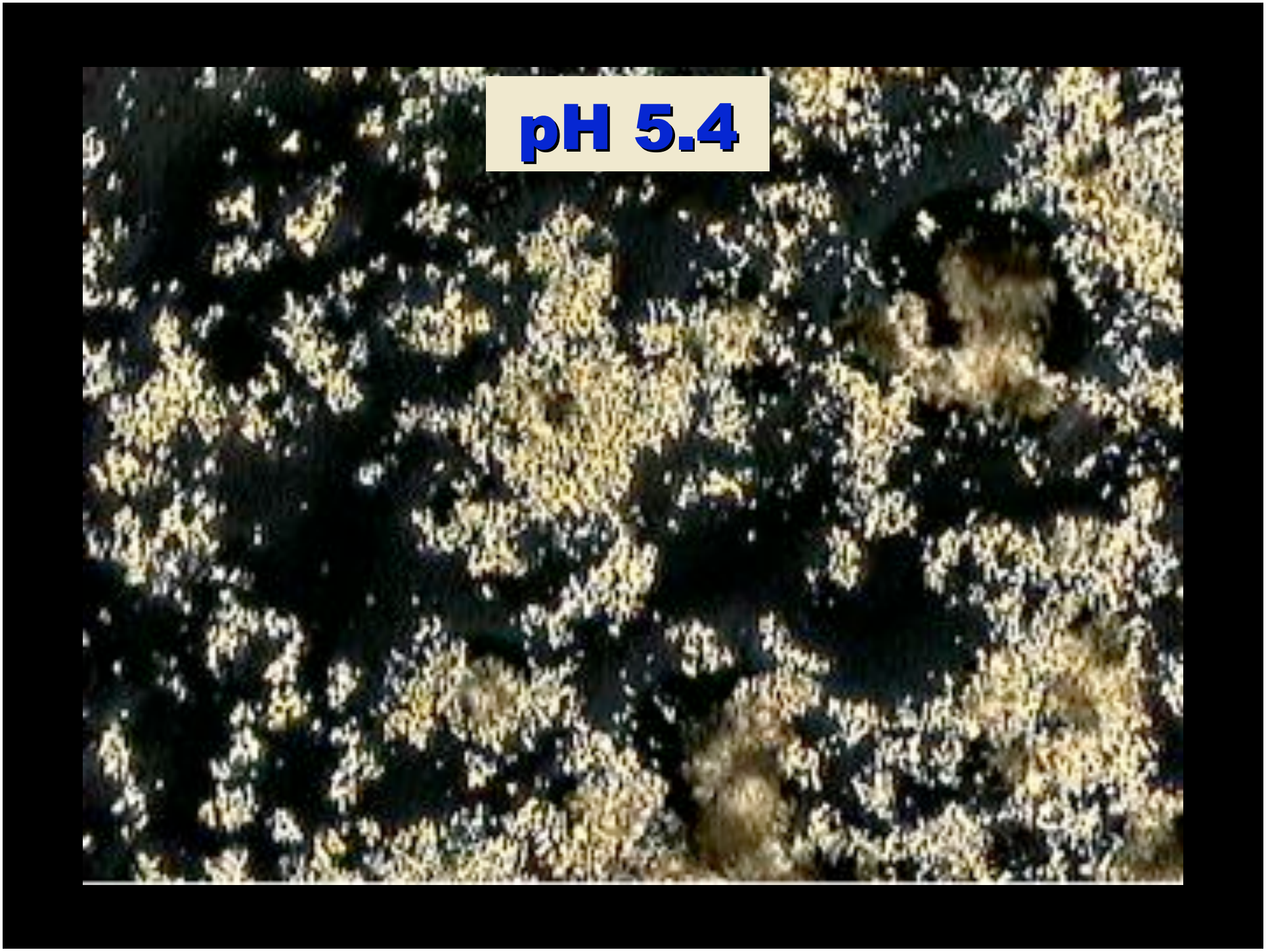

pH 9.7


pH 9.0

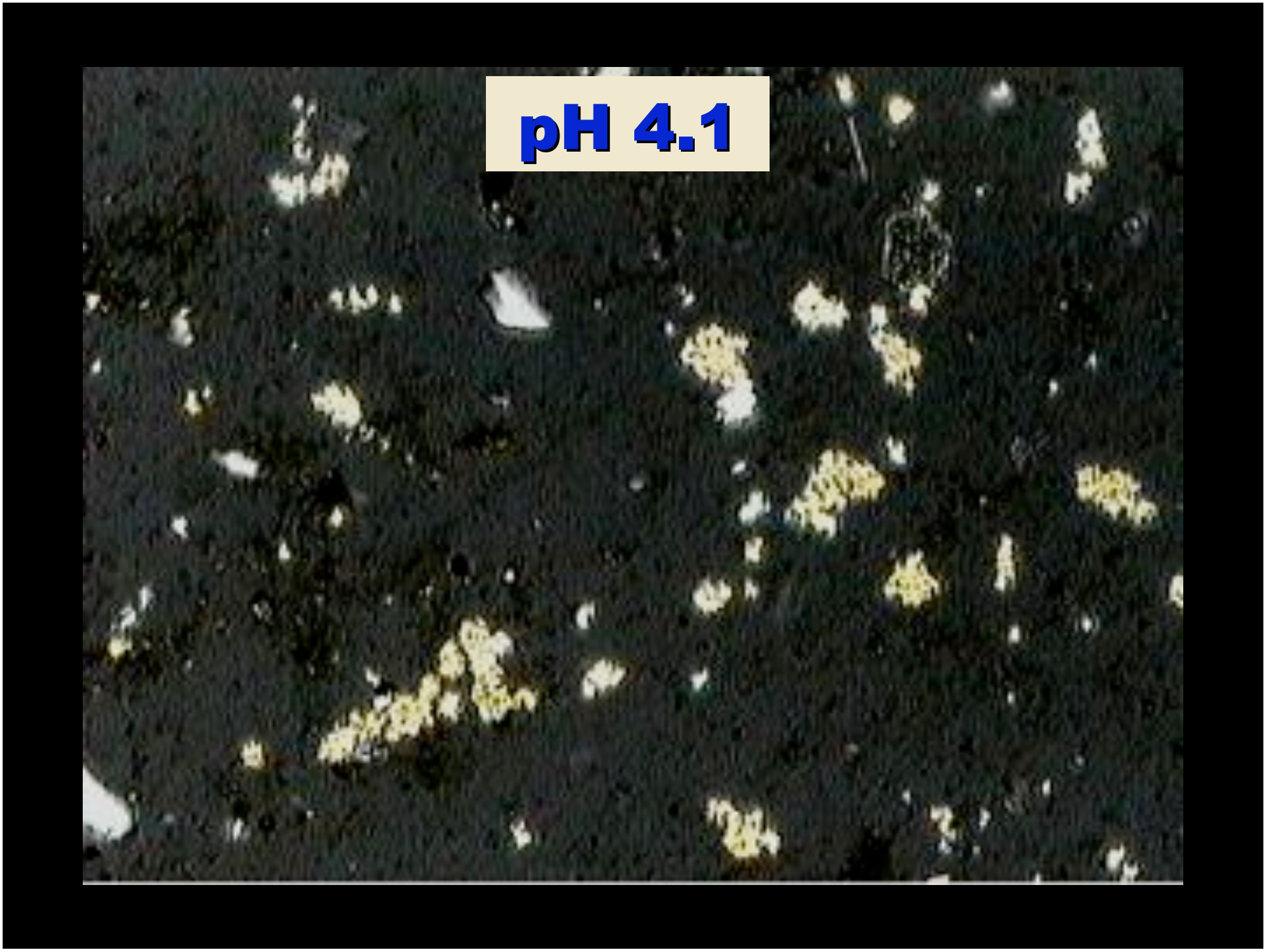

pH 7.5


pH 6.8


pH 6.3

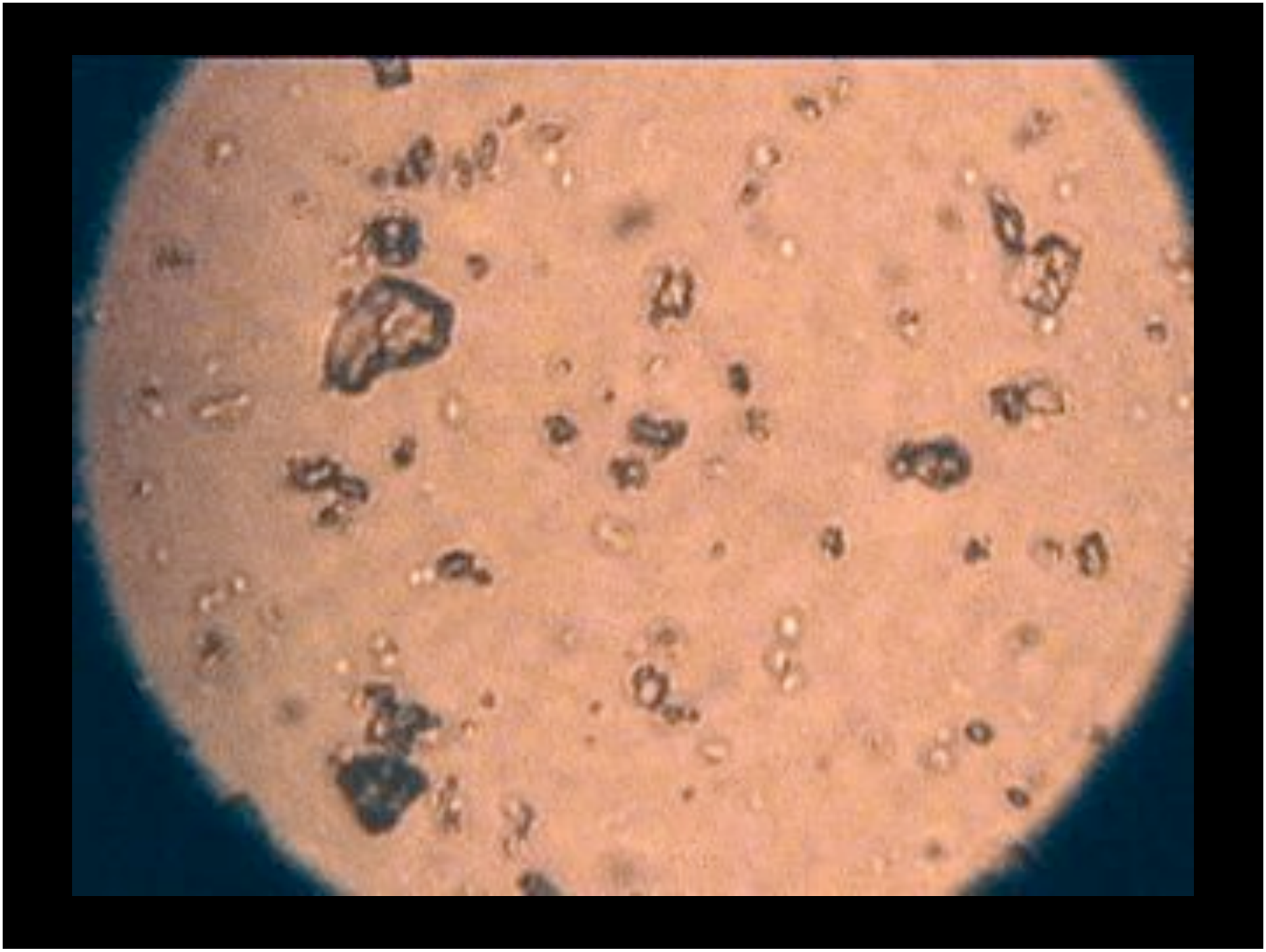

pH 5.4

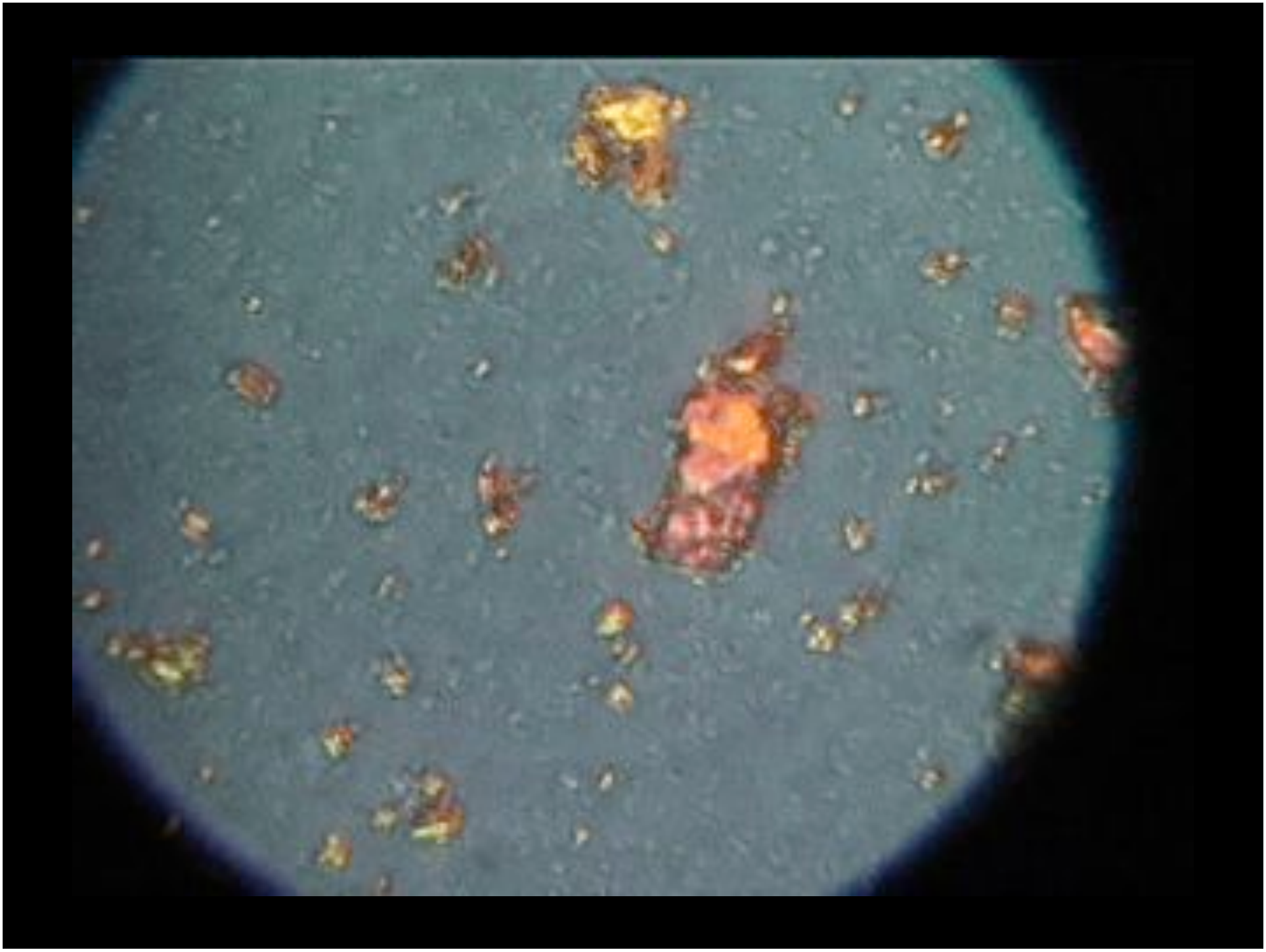

pH 4.7

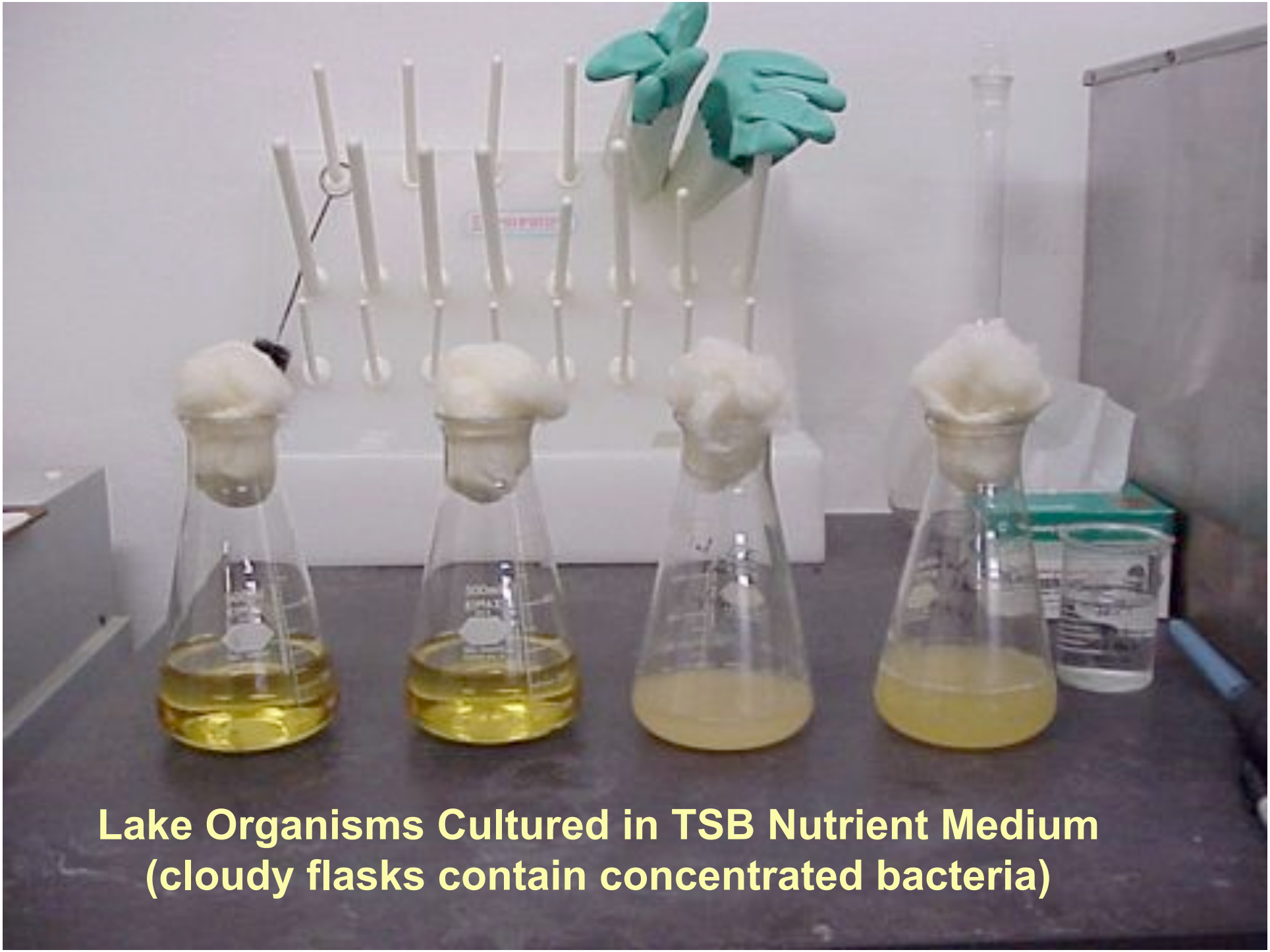

pH 4.1


pH 3.1

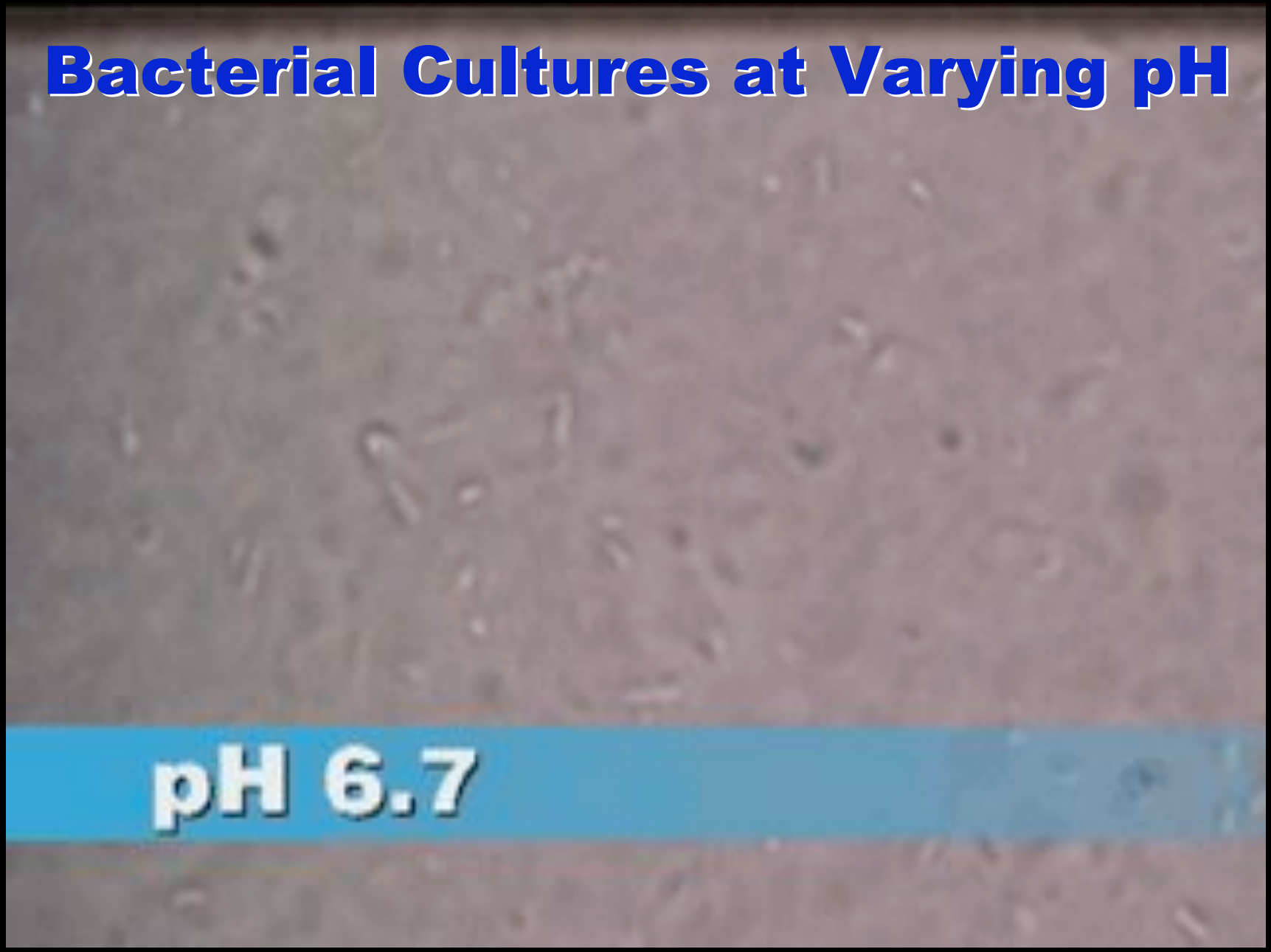

pH 2.5






Lake Organisms Cultured in TSB Nutrient Medium
(cloudy flasks contain concentrated bacteria)

Bacterial Cultures at Varying pH



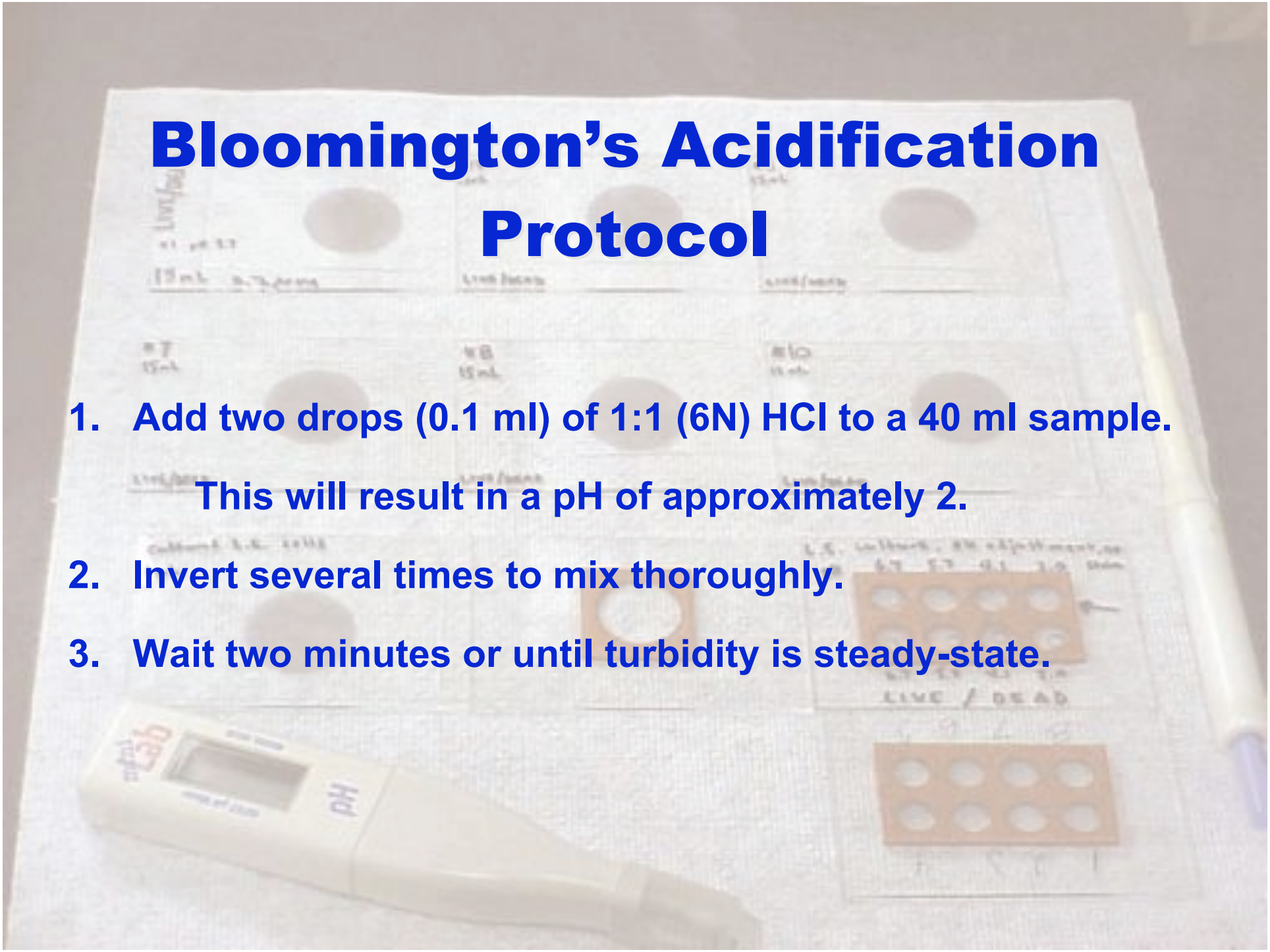
Bloomington's Acidification Protocol

1. Add two drops (0.1 ml) of 1:1 (6N) HCl to a 40 ml sample.

   This will result in a pH of approximately 2.

2. Invert several times to mix thoroughly.

3. Wait two minutes or until turbidity is steady-state.



Basics of Turbidity Measurement

Make sure the turbidimeter is properly calibrated with appropriate standards.

Eliminate factors that would affect the measurement of turbidity:

- condensation
- flocculation
- sedimentation
- air bubbles

Report turbidity readings as follows:

TURBIDITY RANGE, ntu	REPORT TO NEAREST
0 - 1.0	0.05
1 - 10	0.1

Effect of Acidification

In the Bloomington experiments, the dissolution of lime-softening precipitates by acidification to pH 2 reduced turbidity values by 60 to 87%.

Only 13 to 40% of finished water turbidity was due to particles other than calcium carbonate.

Acidification of Turbidity Samples

Utilities practicing lime softening may acidify water samples to redissolve calcium carbonate prior to turbidity measurement.

This allows turbidity measurements to be made, primarily, of those classes of particles that were initially in the source water rather than those that were formed as a by-product of the softening process.

Alternate Exceedance Levels

In the Bloomington experiments, the dissolution of lime-softening precipitates by acidification to pH 2 reduced turbidity values by 60 to 87%.

Only 13 to 40% of finished water turbidity was due to particles other than calcium carbonate.

Therefore, in the absence of acidification of the finished water samples, alternate exceedance levels of 2 to 4 times the standard exceedance levels would appear to be appropriate.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