Trouble Shooting Fixed Film for Ammonia and Nitrate Removal

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Plant Overview

- Screening
- EQ Basin
- Trickling Filter
- Nitrification Tanks
- Clarifiers
- Contact
 Chamber



Summer 2004 Conditions

- TDEC inspection
 - Effluent ammonia violations
 - Solids accumulation in stream
 - Trickling Filter media dry
 - Sections of nitrification tanks without aeration
- Permit Challenges
 - Ammonia limits dropped from 2.0 to 1.24mg/L
 - Total Nitrogen limit of 5.0 mg/L added

Summer 2004 Conditions

- Other challenges
 - High influent ammonia, average ~45 mg/L
 peaks ~ 100mg/L
 - Low water alkalinity, 30-50 mg/L
 - BOD bleed through to nitrification tanks
 - Solids accumulation in nitrification tanks
 - Solids accumulation in contact chamber
 - All solutions must consider winter weather

Initial Operation Conditions



Initial Operational Conditions

Sewage entering

the tank but the

arms are not

turning!

One of three sections where lack of aeration resulted in solids accumulation

Ammonia Removal Basics

- Factors needed for effective Ammonia Removal
 - Low BOD
 - Adequate oxygen
 - Adequate alkalinity, pH
 - Nitrifying organisms
 - Optimum temperature
 - Absence of toxic materials

Solutions

- Reestablish flow through trickling filter arms 24/7
- Clean solids from nitrification tanks
 - Repair diffusers in nitrification tank
 - Mfg designed return flow from clarifier but this appeared to contribute to solids accumulation in media.
- Add Sodium Bicarbonate as alkalinity source.

Filter Operation Repair electrically controlled valve



Recirculation pumps operating on "Hand" flow valve to nitrification tanks controlled by level in the Filter.

Substantial Ammonia Compliance

- Filter arms operating 24/7
- BOD and NH₃ reduction in filter
- Effluent NH₃ generally <1.0
- Until.....





- New higher operating level in Trickling Filter resulted in the accumulation of solids and a septic layer in the bottom of the Trickling Filter.
- Solution: Waste from TF once per week

Solids Management



- Solids were always in the wrong place
 - Stream
 - Contact Chamber
 - Nitrification Tanks
 - Trickling Filter
- Manual Cleaning
 - Contact Chamber 1/wk
 - Trickling Filter 1/wk
 - Nit. tank clar. 1/wk

Digester Overload

- With regular wasting, digester size limited aerobic stabilization
- Land Application requirement now met by lime addition to pH > 12 su
- Additional sites app.
- New truck loading



Additional Modifications





Other Operator Changes

 Install Sewage distributor at TF.

 Convert one nitrification tank section to clarifier.



Partial Success by Fall of 2005

- BOD Compliance
- TSS Compliance
- Ammonia Compliance
- Solids under control

• Next Step Total Nitrogen

Total Nitrogen

• Permit Limit = 5.0 mg/L, May to October.

- Effluent Data 2005
 - TKN: average 1.6, range 0.82- 2.7mg/L
 - NO_{2&3} average 12.7, range 9.6- 22 mg/L

Nitrate Removal Basics

- Denitrification Factors
 - Nitrate present
 - Anoxic environment, DO = 0.0 mg/L
 - Readily available BOD
- EQ tank is the only realistic anoxic zone
 BOD present
 - Septic sewage conditions for anoxic zone

Denitrification Strategy

Return of Nitrate rich underflow to EQ Basin

On site lift station



Underflow recycle



Denitrification

- Increasing Final Clarifier underflow to Primary Clarifier has worked in other TF locations, where TN limit is >10.0 mg/L
- With a modest amount of plumbing and a larger pump in the onsite lift station a recycle system was devised.
- By reducing aeration time in the EQ basin an anoxic tank was established for denitrification.
- Alkalinity additions can be reduced also.

Total Nitrogen, Limit 5.0 mg/L

2005

- TKN 1.6 mg/L
- NO_{2&3} 12.7 mg/L
- TN 14.3 mg/L
- NH₃ <1.0 mg/L
- 2006
 - TKN 3.2 mg/L
 - NO_{2&3} 7.3 mg/L
 - TN 10.5 mg/L
 - NH₃ <1.0 mg/L



Results

- 2006, Limited data, two months
 - Nitrite/ Nitrate reduced 40%
 - Denitrification is working, but not enough...
 - TKN increased 100%
 - Ammonia remains low <1.0, organic nitrogen has increased. TSS is ~ 6mg/L lower than 2005, so we assume an increase in soluble organic nitrogen, possibly due to lower hydraulic detention time.
 - Alkalinity additions stopped
 - Effluent TSS lower

Ammonia Removal

- Operator Solutions
 - Proper TF operation.
 - Engineer and Electrician required
 - Add alkalinity source.
 - Clean solids from nitrification tanks.
 - Service nitrification tank diffusers.
 - Waste solids from TF.
 - Modify Digester operation and get additional site approval for Class B biosolids.
 - Install new biosolids loading system.
 - Install Sewage distributor at TF.

Total Nitrogen Removal

- Operator Solutions
 - Establish effluent recycle to EQ basin (anoxic zone)
 - Improvement, but not compliance, plant modifications needed.
 - Additional Plant Capacity needed.
 - Full denitrification
 - Effluent filtration
 - Engineering needed.

Questions / Comments?

• Ammonia Removal

• Total Nitrogen Removal

Contributors to the Success of this project

- John Condra, Plant Operator
- Charles Rollins, Mayor, Town of Monteagle
- Bobby Nolen, Nolen Engineering Group, Birmingham AL
- Angela Young, Water Pollution Control
- Bob Borneman, Arcadis G&M, Chattanooga