Acknowledgements

• Spring Hill, TN Staff

• Jerome Dempsey, Dempsey, Dilling, and Associates

• Dudney Fox

• CTI Engineers
Tennessee Is Implementing Very Strict Mass Based Nutrient Limits

- Rated Flow = 5 MGD
- BOD = 3 mg/L summer; 6 mg/L winter
- Ammonia 1.1 mg/L summer; 2.2 mg/L winter
- Total Nitrogen = 3.43 mg/L
- Total Phosphorus = 1.37 mg/L
Spring Hill, TN – Selection Criteria

- Low BOD Limit drove us to find a process that did not require supplemental carbon for denitrification
- Made Plant Visits
- Ovivo Carrousel® Bardenpho® System selected as core process
Spring Hill, TN – Upgrade

Plant Cost = $16 Million ($3.20/gallon)
Spring Hill, TN – New Equipment

- Huber Cylindrical Bar Screens
- S&L Pista Grit
- Ovivo Carrousel® Bardenpho®
- Ovivo Clarifiers
- Tetra Deep Bed Filters
- Wedeco UV System
- Phoenix Belt Filter Presses
- Moyno PC Pumps
- Kaeser Blowers
Spring Hill, TN – New FlowSheet
Nitrogen Removal

Q, BOD, TKN

ANOXIC REACTOR
DO= 0 mg/L

NO₃ → N₂
DENITRIFICATION
(ANOXIC)

NH₃ → NO₃
NITRIFICATION
(AEROBIC)

AEROBIC REACTOR
DO= 0.2 – 2.0 mg/L

INTERNAL RECYCLE
IR > 5 (but careful not to over-recycle)

RAS
Phosphorus Removal

Q, BOD, TKN

ANAEROBIC REACTOR
DO = 0 mg/L
NO₃ = 0 mg/L

ANOXIC REACTOR
DO = 0 mg/L

AEROBIC REACTOR
DO = 0.2 – 2.0 mg/L

P Uptake
Cells Oxidize COD

P Release
Cells Take in COD

INTERNAL RECYCLE
IR > 5 (but careful not to over-recycle)
Internal Recycle Is Free In An Ovivo Carrousel® System
Spring Hill, TN – Carrousel Bardenpho

From Headworks + RAS

ReAeration Basins

Second Anoxic Basins

Carrousel (Aerobic) Basins

First Anoxic Basins

Anaerobic Basins

Aerobic Digesters

Secondary Clarifiers
Aerobic Stage
$\text{NH}_3 \rightarrow \text{NO}_3$

Anoxic Stage
$\text{NO}_3 \rightarrow \text{N}_2$

Spring Hill, TN – Internal Recycle (IR)

Internal Recycle (IR)

ORP Probe
Spring Hill, TN – Dissolved Oxygen

Aerobic Stage
\[ \text{NH}_3 \rightarrow \text{NO}_3 \]

X
DO = 2 mg/L

Anoxic Stage
\[ \text{NO}_3 \rightarrow \text{N}_2 \]

X
DO = 0.2 mg/L
DO Probe

INF + RAS

Spring Hill, TN – Dissolved Oxygen

DO Probe
DO = 2 mg/L
DO = 0.2 mg/L
Spring Hill, TN – Ovivo Oculus Controller
Spring Hill, TN – SCADA System
Spring Hill, TN – Influent

Avg Influent BOD = 221 mg/L
Avg Influent TSS = 295 mg/L
Avg Influent NH3-N = 29 mg/L
Avg Influent TP = 6.0 mg/L

Q rated = 2.5 MGD (one train)
Spring Hill, TN Effluent (No Chemicals)

Spring Hill, TN Performance

- Effluent BOD (mg/L)
- Effluent TSS (mg/L)
- Effluent TN (mg/L)

BOD permit = 3.0 mg/L
TN permit = 3.43 mg/L (annual avg)

Actual Avg Eff BOD = 1.37 mg/L
Actual Avg Eff TN = 3.02 mg/L

DO Probe Out
Aerators in HAND
(Nov 14)
Spring Hill, TN Effluent (No Chemicals)

Spring Hill, TN Performance

- Effluent NH3-N (mg/L)
- Effluent TP (mg/L)

Qrated = 2.5 MGD (one train)
TP permit = 1.37 mg/L (annual avg)
NH3-N permit = 1.1 mg/L

Actual Avg Eff NH3-N = 0.03 mg/L
Actual Avg Eff TP = 0.49 mg/L
Spring Hill, TN – Effluent

- June 2015
  - TN = 0.65 mg/L
  - TP = 0.182 mg/L

- July 2015
  - TN = 1.95 mg/L
  - TP = 0.104 mg/L

- No Chemicals
Questions?