IS “DESIGNER” RECLAIMED WATER IN NORTH CAROLINA’S FUTURE?

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INTRODUCTION
WATER RESOURCES IN NORTH CAROLINA

- NC is the 9th most populous state
- Current population on 7-1-17 was estimated to be 10,310,371 residents
- Three metro areas constitute 60% of state population
Two of these metro areas are located at the headwaters of three major river basins.
FIT FOR PURPOSE
RECLAIMED WATER PRODUCTION
FIT FOR PURPOSE RECLAIMED WATER
OR “DESIGNER RECLAIMED WATER”

- Creating designer reclaimed water may have elevated levels of nutrients for crop or landscape irrigation.
- Typical reclaimed water is low in solids and nutrients and may be sufficient for cooling tower use.
- Some plants can produce highly treated reclaimed water for industrial use (RO quality water for example).
Secondary/Tertiary treatment to meet effluent discharge requirements may involve expensive operations such as nitrification/denitrification and biological or chemical phosphorus removal.

Running a similar system without having to meet stringent effluent requirements can save money (chemicals, energy, etc.) and produce a nutrient rich product for irrigation.

The issue is that most plants must meet both requirements because customers may not demand reclaimed water for irrigation year round, but effluent discharge requirements require low nutrient discharge.
HOW TO SERVE TWO MASTERS

- Nitrification is controlled by managing the system SRT. If the nitrifiers are wasted, the sludge age decreases and the nitrogen content in the effluent increases.
- Ah, but the converse is not true – it may take 2-3 weeks for nitrifiers to restart nitrification and it is temperature sensitive.
- Under these conditions a single train system is not flexible.
- Operating experience indicates an activated sludge system should be run between 1,500 and 3,000 mg/L MLSS. Can a WWTP operate at a lesser MLSS concentration and prevent nitrification?
EXPERIENCE AT A MID-WESTERN PLANT

The answer is YES
WHAT ABOUT PHOSPHORUS?

- If a facility is practicing Biological phosphorus removal (BPR) Simply make the anaerobic zones not anaerobic
- However, restarting BPR is not as simple as turning the BPR switch to "on".
- It may take several weeks to reestablish good phosphorus accumulating organisms (PAO) populations
- There are lots of operating considerations
  - To meet Regulatory requirements for discharge – Plan Ahead! It will take several weeks to get Nitrifiers and BPR working again
  - Customer and Utility communication is essential
WHY CAN'T WE MAKE DESIGNER RECLAIMED WATER YEAR-ROUND

- It is certainly possible to make nutrient rich reclaimed water year-round and never have to discharge the reclaimed train effluent to the permitted outfall.

- There are two considerations:
  - Unpredictable weather conditions (Here in the East Coast that is nor'easter's and hurricanes)
  - Algal growth in the reservoirs due to high nutrient concentrations
  - Phosphorus is generally considered the culprit here and often needs to be removed before long-term storage.
OTHER SYSTEMS HAVE THEIR CHALLENGES

- Fixed film systems such as MBBRs and BAF are replacing trickling filters (which are fading into the sunset).
- MBBRs can be designed for nitrification and denitrification with relative ease. However, bringing the MBBR system back into nitrification and denitrification is very similar to restarting an activated sludge system.
- BAF systems can be configured in a variety of different ways.
- Both systems must use chemical phosphorus removal.
An old rule of: when progressing from only BOD removal to nitrification, double the aerator capacity.

Turning off some blowers to produce a higher nitrogen concentrations in the effluent saves $.

Chemical costs are reduced.
York is a suburb (region) of the province of Ontario
A 40 MLD (10 MGD) WRRF is being designed to meet a 0.02 mg/L annual effluent phosphorus concentration
The treatment train is illustrated in the following figure
YORK RECLAIMED WATER TREATMENT TRAIN

Headworks → Primary Clarifier → Chem Feed & Biological Treatment → Secondary Clarifier → Partial Biological Treatment Bypass → Cloth Disk Filters → UV Disinfection → Chlorination → Reclaimed Water → Bulk Loading → Storage Pond and Tree Farm → Customer
2 of the 4 biological treatment trains are designed to allow the portion of the train to be used for short SRT operation in the summer.

Trains can be isolated, allowing the plant operators to manage two totally independent systems.

Reclaimed water is to be produced during the irrigation system (May to October).

The utility also has forested land; snow machines produce snow allowing reclaimed water to be produced/used year round.
A NORTH CAROLINA EXAMPLE

- The town of Cary has been producing reclaimed water since 2001 and was the 1st such system in the state.
- The most recent addition to the facilities producing reclaimed water is the Western Wake Regional Water Reclamation Facility.
RECLAIMED WATER USE

- Reclaimed use in Cary
- Commercial irrigation (27%) and cooling tower/toilets (13%) are the major non-plant bulk uses

- Typical Reclaimed Water facilities generally all provide for these uses
- But in this paper we are suggesting it well might be possible to modify the WWRWRF to produce designer reclaimed water
WWRWRF MODIFICATIONS

- Design effluent: 18 MGD capacity, and most recently discharging a BOD5 of 2.5 mg/L and a TSS of 2.5 mg/l using VIP process.
- If the plant were modified, the VIP process certainly lends itself to more modifications as previously described in other plants.
- There are a sufficient number of filters that could be isolated so that one train could produce more nutrient rich reclaimed water for irrigation and the other train could be used to produce reclaimed water from the unmodified VIP process for other uses.
CONCLUSIONS
WHAT HAVE WE LEARNED?

- The state is growing rapidly and the major metro areas will need to look to alternative water supplies.
- Reclaimed wastewater can fill that portion of the water resources portfolio.
- Utilities and designers water reclamation Facilities should evaluate the potential for creating biological and tertiary treatment methods which can produce a variety of different reclaimed waters.
- A variety of treatment options are available to meet these needs.