"Municipal Wastewater Reuse – The Challenges Ahead"

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Introduction

Water resources are becoming more constrained. Obtaining surface or groundwater withdrawal permits is becoming increasing difficult. Often times deep well total dissolved solids (TDS) is often very high which requires pretreatment to reduce TDS thereby increasing operating cost. Salt water intrusion is occurring in coastal regions. Droughts routinely impact water quality and availability. Municipal waste water is becoming a viable option:

- California – Title 22
- Florida
- Palo Verde Nuclear Station

Municipal waste water is being used for:

- Cooling water
- Agricultural
- Scrubber
- Boiler Feedwater
- Other

Waste water quality may be better than available water sources in some cases or may contain more TDS, organics, microbial agents than available surface and ground water. Characterizing the water or waste water source every aspect over time is critical. There are benefits and challenges.

Why Reuse Water?

As our population grows and more power plants are built as well as other industries that require water increase the demands on our limited supply of water increases. Currently 200 billion gallons per day is withdrawn to support power generation. This is expected to increase by 50% by 2030. Twenty five watersheds are currently stressed by power generation activities. We must use water wisely and utilize alternate sources such as

treated waste water. Table 1 illustrates the amount of water withdrawn and consumed for various plant and cooling system type.

Plant Type	Cooling System	Withdrawal	Consumption
Fossil/biomass/waste	Once-through	20,000–50,000	~300
	Cooling tower	300–600	300–480
	Cooling pond	500–600	~480
Nuclear	Once-through	25,000–60,000	~400
	Cooling tower	500–1,100	400–720
	Cooling pond	800–1,100	~720
Geothermal steam	Cooling tower	~2,000	~1,400
Natural gas, combined cycle	Once-through	7,500–20,000	100
	Cooling Tower	~230	~180
Coal, integrated gasification combined cycle	Cooling tower	~250	~200
Source: DOE (2006).			

Information Resources Regarding Water Reuse

There are a number of sources available to obtain information regarding water reuse.

1. EPA
2. Selected state environmental protection agencies that regulate wastewater discharges.
3. Water Environment Federation (WEF).
4. Water Reuse Association.
5. National Association of Clean Water Agencies (NACWA).
6. Association of State and Interstate Water Pollution Control Administrators (ASIWPCA).
7. Electric Power Research Institute (EPRI).
8. Edison Electric Institute (EEI).
9. Utility Water Act Group (UWAG).
10. American Society of Mechanical Engineers (ASME) Water Management Committee

EPA (2004) includes suggested guidelines for reusing treated municipal wastewater in various applications. The portions of those guidelines relating to using reclaimed water for cooling are listed below.

1. The minimum treatment requirements include secondary treatment, disinfection, and possible chemical coagulation and filtration, if needed. Additional treatment may be performed by the user to prevent scaling, corrosion, biological growth, fouling, and foaming.
2. The reclaimed water should contain <30 mg/L of BOD and TSS, <200 fecal coliform/100 milliliters (ml), a minimum of 1 mg/L residual chlorine, and a pH range of 6.0–9.0.
3. Windblown spray should not reach areas accessible to workers or the public. This requirement can be met by providing a setback distance of 90 meters. The setback may be reduced or eliminated if a high level of disinfection is provided.
4. Pipes, pumps, and other components used to convey reclaimed water must be painted bright purple to distinguish them from other types of water.
5. In addition to federal and state regulations there may be local regulations that must be considered as well.

Issues and Concerns

As with surface and ground water, it is critical to characterize the chemistry of the water over a period of a year preferably. It is critical to identify variations in chemistry that occur throughout the year caused by season climate changes, seasonal agricultural and industrial activities impacting runoff and demand, and it is also necessary to determine the flow patterns over a year. Flows vary throughout the day, week, and seasonally. It is strongly recommended to perform a proper "pilot" study to evaluate the proposed water source for the application(s) intended to minimize the risk of failure and identify potential issues.

Potential Problems

Some of the chemical constituents may cause the following problems:

1. Mineral scaling from calcium carbonate, calcium phosphate, and other products.
2. Corrosion, pitting, and stress cracking damage to metal heat transfer surfaces and to structural metal surfaces (e.g., damage to copper, copper alloys, and other "yellow metals" from ammonia).
3. Biofouling of heat transfer surfaces and excessive biological growth on cooling tower fill material surfaces from BOD, phosphate, and ammonia.

In some cases the contract with the municipality is structured such that if the water does not meet the quality specified in the contract for parameters such as chlorine and phosphate, the customer does not have to pay or pays a reduced rate for the water. Some of the parameters one should consider routinely monitoring are:

1. pH
2. Chlorine residual
3. Conductivity
4. Phosphate
5. Ammonia
6. Chloride
7. Sulfate
8. Total iron
9. Manganese
10. Silica
11. BOD
12. COD
13. Scaling index

It is critical to do this to provide the design engineers and chemists with an accurate picture of the chemistry and flow patterns to determine:

1. If additional treatment process is required.

2. To properly design any required treatment system.
3. Determine if treatment is needed to avoid scaling or corrosion.
    a. Develop needed treatment concept.
4. Determine if storage capacity is required to compensate for flow variations.

Due to the variability of some key parameters some end users continuously monitor these parameters to adjust their process accordingly. Some of the parameters that may be continuously monitored are:

1. pH
2. Conductivity
3. Chlorine residual
4. Phosphate

Regulatory Concerns

In many cases the water from the plant processes are discharged into rivers, other bodies of water, or back to the treatment facility. The discharge is regulated under the Clean Water Act and requires a National Pollution Discharge Elimination System Permit. In some cases the regulated contaminants in the waste water can exceed the regulatory limit due to concentration in processes such as cooling towers. Therefore proper monitoring of the chemistry of the waste water and cycled water is necessary to ensure permit violations do not occur.

Conclusion

Water resources are becoming more stressed and demand continues to increase. This is forcing industry and regulators to evaluate technologies and alternative sources of water for non-potable use. Treated municipal waste water is abundant and is a viable option for use as cooling water, boiler feedwater makeup, FGD makeup, cooling pond makeup, and agricultural uses.

As the industry sites new plants or expands capacity at existing sites, it must identify sufficient supplies of water to cool the steam. Reclaimed water can help meet that need. California and Florida lead the movement toward waste water reuse.