Pretreatment Quick Guide **Number 1, June 2019**

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Salt and Chloride Discharges to the POTW

If you are asked to receive a high salt/chloride wastewater, there are at least seven areas of potential concern:

1. NPDES/Receiving Stream - Your permit requires notice to TDEC of new pollutants. Because there is no removal of salt/chloride within the treatment process, the loading could have stream impacts and thus possible permit limits.
2. Activated Sludge/Nitrification - There are many published “inhibition” levels for salt or chloride. The levels vary significantly from 180 mg/L to 14,000 mg/L. Acclimation to the salt or chloride and the duration and frequency of the discharge will be key factors in a plant’s ability to perform without adverse impact.
3. Activated Sludge Deflocculation - Salt and chloride may contribute to poor floc development and subsequent settling problems.
4. Whole Effluent Toxicity (biomonitoring) - Salt and chloride can be toxic to the two key organisms used in biomonitoring.
5. Phosphorus Removal - Salt and chloride may interfere with phosphorus removal in activated sludge processes.
6. Ultraviolet Disinfection - Salt and chloride can impede the UV disinfection process.
7. Corrosion - This actually may be the most significant impact of a salty or chloride-laden wastewater on sanitary sewer systems and municipal wastewater treatment plants (WWTPs). The corrosion of concrete and metal components of the collection system and at the WWTP could be severe depending upon the materials used and salt concentrations encountered.

NPDES/Receiving Stream Concerns:

NPDES permits in Section 2.2, Changes Affecting the Permit, state the “Permittee shall give notice …. alteration or addition could significantly change the nature or increase the quantity of pollutants discharged.” Recent industrial inquiries made to several Tennessee plants would have contributed to “significant changes” to their discharge. The Tennessee Water Quality Standards have a 500 mg/L TDS stream standard for industrial process usage and Drinking Water usage, and the discharge of large amounts to small streams may adversely impact aquatic life such that the NPDES permit may be changed to limit those discharges. The

NPDES effluent limit may be on chloride, Total Dissolved Solids (TDS), and/or conductivity. There also may be a requirement for in-stream conductivity monitoring downstream of the discharge point. In fresh water streams, chloride concentrations less than 1,000 mg/L should not adversely affect most fish species. However, aquatic species such as C. *dubia* (water flea) and C. *coloradensis* (mayfly) may be adversely affected at chloride concentrations as low as 250 mg/L. The secondary drinking water standards for chloride and TDS are 250 mg/L and 500 mg/L, respectively.

Activated Sludge/Nitrification Concerns:

The most common question related to receiving a salt or chloride-laden waste stream is, "How will it affect my plant?" Activated sludge will acclimate to the salt/chloride to an extent. There are many treatment plants along the seacoast that receive large volumes of salty infiltration and perform very well. Acclimation is critical and this occurs when the plant biomass receives a continuous dose of the salt/chloride pollutant. Intermittent or slug dosing is not recommended because shock loading can decrease oxygen uptake rate (OUR) and reduce BOD removal efficiency.

Selected Chloride Levels and POTW performance (Benefield & Randall 1985):

Sewage Strength	Strong	Medium	Weak
Chloride	100 mg/L	50 mg/L	30 mg/L

Seawater: 35,000 mg/L dissolved salt
19,400 mg/L Cl^- anions (ions with a negative charge)
10,800 mg/L Na^+ cations (ions with a positive charge)

- EPA Local Limit Guidance Manual
  Nitrification Inhibition 180 mg/ L Cl^- (Chloride)
- Illinois operator stated that a well acclimated plant fully nitrified at 1,000-3,000 mg/L Cl^-.
- Journal of Applied Sciences in Environmental Sanitation Vol 2# 3:85-95, 2007 reports nitrification acceptable to Cl^- levels of 500-2,500 mg/L.
- Journal of Environmental Engineering Vol 130, Issue 2, p 116-125 (Feb 2004) reports good nitrification to Cl^- levels >10,000 mg/L.
- South Florida plants operate at up to 14,000 mg/L Cl^-.

Activated Sludge Deflocculation Issues:

Levels of Total Dissolved Solids (TDS) >50,000 mg/L have been reported to deflocculate activated sludge. TDS, as found in Standard Methods 2540 C., include mostly mineral and nutrient solids such as calcium, magnesium, sodium, potassium, phosphate, sulfate, nitrate, bicarbonate, and also chloride and any dissolved organic materials.

Also causing activated sludge deflocculation is a high ratio of monovalent to divalent cations. Researchers report when the sum of sodium plus potassium divided by the sum of calcium plus magnesium is greater than two ($(Na + K)/(Ca + Mg) > 2$) there is risk of deflocculation. The ratios are calculated using meq/L for each cation.

Whole Effluent Toxicity Concerns:

Wisconsin reports chloride toxicity to C. *dubia* at LC_{50} = 2,500 mg/L, and IC_{25} = 840 mg/L. Environmental Science Corp (Pace Analytical) uses chloride as a quality assurance IC_{25} toxicant at the following levels.

Fathead minnow	950 mg/L not toxic; 1,200 mg/L toxic
C. *dubia*	180 mg/L not toxic; 250 mg/L toxic

Florida wastewater trainers report Na/Ca ratios > 20 contribute to C. *dubia* toxicity, and that a ratio of 15/1 is better.

Phosphorus Removal Issues:

The Journal of Applied Sciences in Environmental Sanitation, Vol 2, # 3:85-92, 2007, reports the following percentage biological phosphorus removals at various chloride concentrations.

Percent phosphorus removal	Chloride concentration
94%	150 mg/L
86%	500 mg/L
74%	1,500 mg/L
0%	2,500 mg/L

Ultraviolet Disinfection Concerns:

A technical support person for Trojan UV systems stated that chloride may be detrimental for UV disinfection systems. He would not specify a level of chloride, only that it is not good where elevated concentrations of chloride occur. Brown & Caldwell engineers report high chlorides also give false high COD test values.

Corrosion Concerns:

High salt or chloride levels will not impact PVC pipes but concrete and metal sewer equipment and structures will be at risk. Several sources stated concrete corrosion was aggravated by chloride levels > 500 mg/L. The State of Colorado specifies Type II Portland Cement for applications with Chloride > 500 mg/L and Type V where Chloride is > 1,000 mg/L. These types are called "sulfate resistant" concrete. Sherman Dixie, which manufactures concrete sewer pipes, states they use Type II cement unless otherwise specified. Oldcastle, which makes precast concrete structures including manholes, specifies Type III, which is a "high early strength" product.

Lift station pumps, rails, pipes, chains, and doors will all be at increased risk of corrosion when salt or chloride is introduced. Check manufacturers for specific capabilities of existing equipment. For aggressive environments, products made specifically for corrosive industrial processes may be the best choice. Even for stainless steel equipment, special coatings and zinc anodes can be installed to reduce the corrosion potential.

A common test that is often used in place of TDS is Conductivity. It is a measure of the capacity of the solution to conduct electricity. A TDS analysis takes a few hours; a conductivity analysis takes a few minutes. Waters with high TDS or high chlorides will more easily conduct electricity because of the large amounts of charged ions such as Cl^-, chloride. An estimate of the TDS of wastewater can be made as follows:

$$TDS = (0.6 \text{ to } 0.9) \times \text{Conductivity}$$

If salt/chloride pollutant is added to an existing municipal wastewater flow, corrosion may be accelerated because chloride ions accelerate rusting or corrosion of the wet components since the flow of electrons in salty water is faster. This is especially noticeable when dissimilar metals are interconnected in a pipe or pumping system. Zinc is often used as a sacrificial anode. It has a high galvanic index and corrodes fast; but once the zinc is gone, the next highest galvanic index metal will begin to corrode at an accelerated rate. This could be aluminum or iron and steel products.

Salt/chloride destroys concrete when chloride ions penetrate concrete to the depth of steel reinforcing, thereby beginning the rusting process; eventually the concrete is destroyed from the inside out. This generally occurs in conditions where water, salt and oxygen are present.