Optimization of the San Elijo Water Reclamation Facility

High Quality Effluent for a Fraction of the Cost

Trussell TECHNOLOGIES INC

SAN ELIJO JOINT POWERS AUTHORITY

Background

Introduction

The San Elijo Water Reclamation Facility (SEWRF) is owned and operated by the San Elijo Joint Powers Authority (SEJPA) and is achieving extremely efficient and reliable treatment through an optimized high rate conventional carbon oxidation process. Historically, the SEWRF has struggled with sludge bulking issues (e.g. high sludge volume index (SVI)) and partial nitrification that caused periods of poor effluent quality. To actively manage these process conditions, chemicals were routinely applied to control these upsets and maintain effluent quality for effluent discharge and recycled water production. Sodium hypochlorite was frequently dosed to the return activated sludge line to combat high SVI values and bulking filaments and cationic polymer was relied upon to improve settleability and achieve discharge requirements. Polymer and coagulant were also required to ensure that the filtration process achieved Title 22 turbidity requirements. Trussell Technologies has worked closely with SEJPA staff over the past few years to determine the most effective and innovative techniques to address the treatment issues at the SEWRF and maximize treatment while minimizing operational costs. With consultation from Trussell Technologies, SEJPA has successfully implemented the following innovative practices:

(1) Designed and installed an anaerobic selector and implemented dissolved oxygen controls

(2) Identified the primary clarifier hoppers as a septic source and employed preventative techniques to eliminate bulking filaments

(3) Developed an operations plan to provide guidelines to eliminate guesswork and maximize treatment while preventing nitrification by operating based on a solids retention time (SRT) target that depends on temperature

These innovative practices have virtually eliminated all previous issues and now SEWRF is setting the precedent of how efficient and effective wastewater and recycled water treatment can be.

Plant Overview

- Type of Facility: Activated Sludge and Tertiary Treatment
- Location: San Diego, California
- Design Capacity: 5.25 MGD ADF
- Current Flow: 2.9 MGD ADF
- Biological Process: High Rate Conventional Carbon Oxidation
- Key Characteristics: Effective Recycled Water Production at Minimal Cost

High Rate Activated Sludge

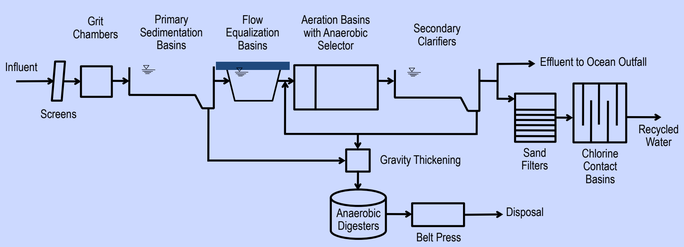
Benefits:

- Energy Efficient
- Low O&M Costs
- Compact Reactor Volume
- Reliably Produces Title 22 Recycled Water

Disadvantages:

- No Nitrogen Removal
- Lower CEC Removal
- Increased Solids Waste
- Effluent Quality May Vary

Process Flow Diagram

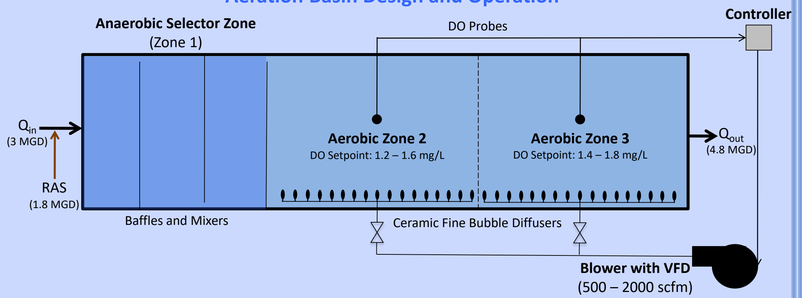


Some of the key process characteristics that improve performance and/or the efficiency of SEWRF include: (1) chemically enhanced primary sedimentation to reduce the biological demand and solids loading to the biological process and to enhance biogas production, (2) primary effluent flow equalization to maintain consistent loading to downstream processes, (3) anaerobic selector zones to promote flocculation, control filaments, and remove phosphorus (4) DO controls to insure adequate and consistent aeration, (5) automated filter chemical controls minimize chemical use (6) self sufficient anaerobic digesters that are heated with biogas methane.

A single aeration basin (420,000 gallons) treats 3 MGD efficiently and effectively (HRT = 3.3 hours)

Key Process Improvements

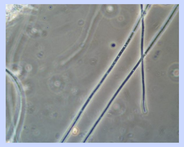
Aeration Basin Design and Operation



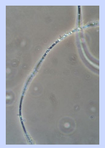
In 2009 SEJPA upgraded and optimized their biological process by constructing an in-tank anaerobic selector zone and installing DO controls. The first 33% of the aeration basin is equipped with baffles and is operated with mixing to maintain anaerobic conditions. The anaerobic selector zone has reduced the overall aeration demand by over 25% and promotes good floc formation, promotes phosphorus removal, and discourages nuisance filaments. The remaining 66% of the tank is aerated using automated DO control to maintain ideal conditions for healthy biology. These innovative practices have created a stable biological process that possesses the necessary controls that have enabled SEJPA to optimize treatment and minimize operating costs.

Septic Filaments Associated with In Tank Sludge Thickening

SEJPA has struggled with bulking filament control since the plant commissioned secondary treatment in the early 1990's. In addition to implementing the anaerobic selector in 2009, the SEJPA had to address a source of septicity in the plant that was causing Thiothrix, Spirillum, and Type 1863 filaments to flourish. After a detailed investigation of the plant's processes, septic conditions were located in the primary sludge hoppers. By increasing the raw wasting in the primary clarifiers to ensure thorough sludge removal from the hoppers, the prevalence of nuisance filaments significantly diminished in the mixed liquor. As a result, maintaining adequate raw wasting rates has proven to be critical to prevent these septic filaments.

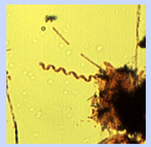


Thiothrix Filaments



Thiothrix with Sulfur Granules

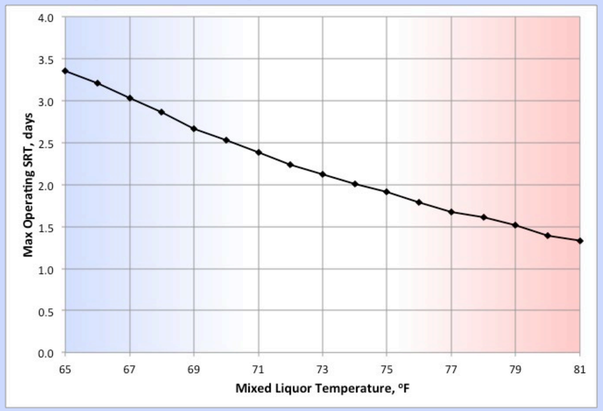
Type 1863 Filaments



Spirillum Filament

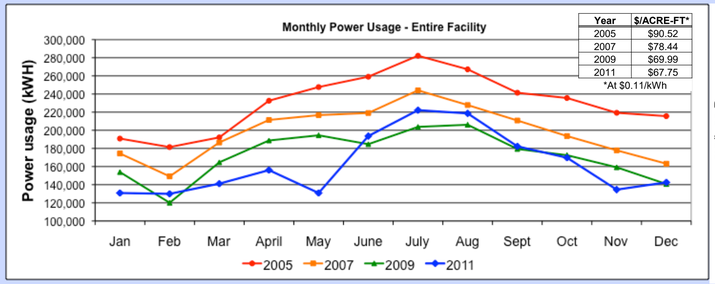
Maximizing Treatment with SRT Optimization

Since May 2011 the SEWRF's biological process has been operating based on a SRT target determined by mixed liquor temperature. Biological modeling was utilized to accurately determine the relationship between temperature, SRT, and nitrification at SEWRF. The SRT is adjusted to the highest allowable SRT target that avoids nitrification as the biological reactor temperature changes. This results in optimal treatment while preventing the additional energy demand associated with nitrification. Prior to the development of this operations plan, the SEJPA adjusted SRT seasonally but would often encounter biological foam events or deterioration in water quality during transitions. Gradually adjusting the SRT with precision provides stability throughout the year and eliminates severe seasonal transitions. This SRT-temperature correlation provides operations staff with a detailed and structured guideline that eliminates guesswork and maintains optimal treatment and biological performance. So far these SRT guidelines have resulted in fewer upsets, improved water quality throughout the year, reduced reliance on chemical aid, and has promoted healthier biological treatment including stalked ciliates and nematodes.



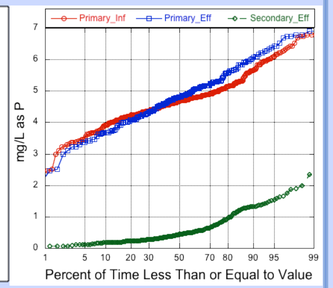
Results and Conclusions

Anaerobic Selector Zone and DO Controls – Reduced Power and Provides Phosphorus Removal

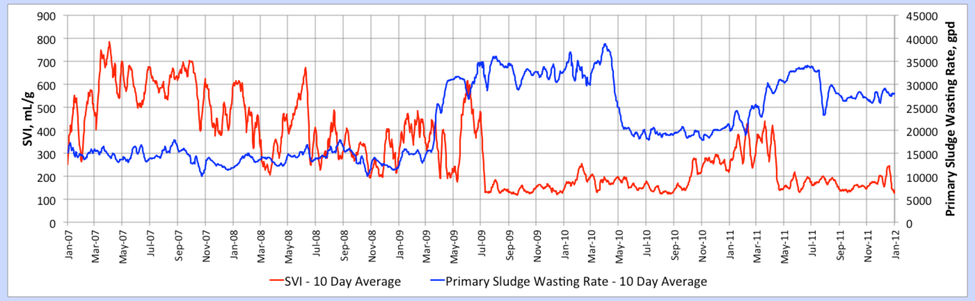


Year	$/ACRE-FT*
2005	$90.52
2007	$78.44
2009	$69.99
2011	$67.75

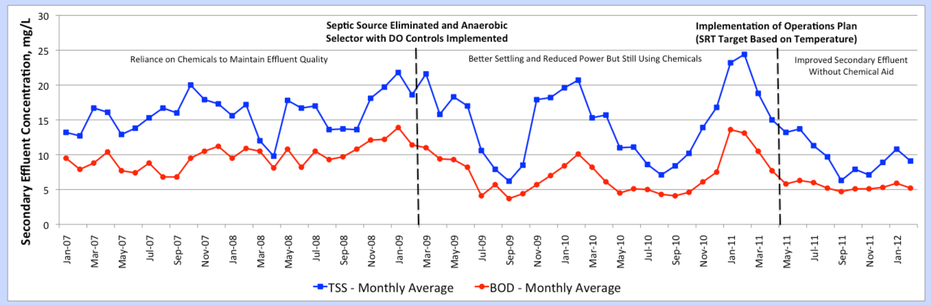
*At $0.11/kWh



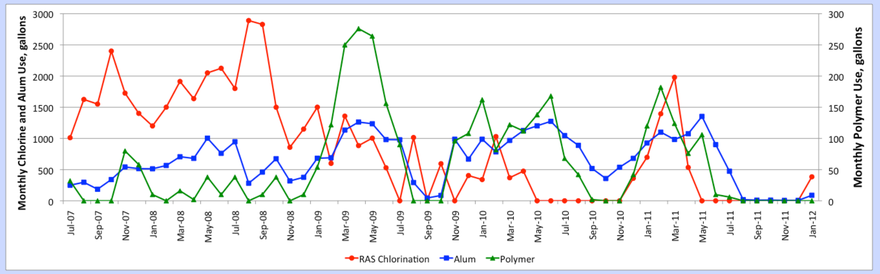
Adequate Primary Wasting Essential to Eliminate Septic Filaments Responsible for High SVI



Secondary Effluent Quality Improvements



Eliminated Reliance on Chemical to Enhance Treatment



Conclusions

- Preventing septicity upstream of the biological process is critical for healthy biology and effective treatment
- The anaerobic selector effectively reduces phosphorus concentrations from 5.7 to 0.5 mg/L-P due to the anaerobic selector zone, while no nitrogen is removed
- The power use of the SEWRF has been reduced by 25% through process optimization
- SEWRF no longer relies on chemical aid for SVI control, improving settling, or to enhance filtration. Use of these chemical aids has been reduced by 99%
- Maximizing SRT while avoiding partial nitrification provide superb treatment reliably without the additional aeration demands and reactor volume associated with nitrification