Proposed Orange County Sanitation District

Chemical Sustainability Policy

Summary Policy Statement

The Sanitation District has a need to use chemicals in its treatment process to improve plant performance, reduce odor and corrosion potential, and meet its regulatory requirements. These commodity chemicals are provided by outside vendors through the purchasing process. Some of these chemicals are subject to price swings due to market condition changes such as energy cost impacts, raw material cost changes, commercial competition changes, and transportation cost changes. The Sanitation District will identify chemicals key to its operation, investigate the market risks for those chemicals and devise strategies to mitigate identified risks to availability and pricing.

Background

The Orange County Sanitation District (Sanitation District) treatment plants and collection system use several bulk chemicals. A sustainable supply of these chemicals is critical to maintaining an acceptable level of treatment and for ensuring compliance with all regulatory requirements. The Sanitation District spends about $13 million annually on the procurement of eight key chemicals which generally can be broken down into four categories: coagulants, odor/corrosion control, disinfection, and boiler water treatment. Boiler water treatment chemicals are low volume and readily available and will not be considered here.

Coagulant Chemicals

Coagulant chemicals include ferric chloride, anionic polymer, and cationic polymer. These chemicals are the workhorses of the sewage treatment process. Coagulant chemicals work to clump together organic material so it can more readily be separated from water. Ferric chloride is the first chemical added in the treatment process. It is a powerful settling agent that causes organics to clump together and settle to the bottom of primary basins. It is a double-duty chemical in that it also controls the formation of hydrogen sulfide gas, which is a major odorant, by binding to suspended sulphur compounds and causing them to settle before they can be converted by natural bacterial processes to hydrogen sulfide.

Ferric chloride is an iron salt that is produced by reacting iron with hydrochloric acid. It is generally a byproduct of steel treatment, a leftover pickling agent. Ferric chloride is commonly used in the water and wastewater industries. Historically, this chemical has been the subject of a limited supplier base in Southern California. The Sanitation District has been actively splitting supply contracts to multiple vendors to ensure multiple vendors are available. On-site generation of the chemical is impractical due to the hazardous nature of the manufacturing process and acid handling, the bulk steel handing logistics, and waste products disposal.

Anionic polymer works with ferric chloride to further aid in the coagulation or settling of organic compounds in the primary treatment process. These long-chain molecules are designed to be negatively charged to attract or collect positively charged ferric chloride induced organic clumps or flocculant. The use of ferric chloride and anionic polymer is called Chemically Enhanced Primary Treatment or CEPT. The Sanitation District has been using CEPT for more than thirty years.

Anionic polymers are specially designed chains with many potential variants and multiple vendors. Part of the purchasing process for polymers involves polymer trials to document the efficacy of different products from different vendors to get the best cost-performance balance.

Cationic polymer is generally used to thicken sludge or biosolids in centrifuges or dissolved air floatation thickeners (DAFT). These long-chained, positively charged molecules are essential to the proper operation of centrifuges and DAFT units. Part of the purchasing process for these polymers also involves polymer trials to document the efficacy of different products from different vendors to get the best cost-performance balance. It is important to note that it is entirely possible that four different cationic polymers will be used to optimize the performance of Plant No. 1 dewatering centrifuges, Plant No. 1 thickening centrifuges, Plant No. 2 dewater centrifuges, and Plant No. 2 DAFTs, because the performance can vary greatly depending on the equipment or process. Each process will have its own polymer trial to determine the cost-performance balance for each application.

Odor Control Chemicals

The Sanitation District uses several chemicals in the collection system and the treatment plant to reduce the odors normally attributed to sewage and sewage treatment. These chemicals can either prevent the formation of odor causing compound, called odorants, or they can destroy odorants that already exist. Chemicals that prevent the formation of odorants include ferrous chloride, calcium nitrate, magnesium hydroxide, and caustic.

Chemicals used in the collection systems tend to be more benign than chemicals used in the treatment plants due to their proximity to the public. Ferrous chloride is closely related to Ferric chloride as described above. It is a powerful settling agent that prevents the formation of hydrogen sulfide by tying up and settling sulfide compounds in the collection system. It is a preferred chemical because of its dual role, but it isn't as benign as other choices.

Calcium nitrate is another choice for collection system odor control. It works in a different way. Calcium nitrate alters the biological equilibrium in sewage. Generally, bacteria that live by respirating oxygen are the most robust organisms, followed by nitrogen respirating bacteria, and finally sulfur respirating bacteria. Adding calcium nitrate to sewage creates an environment where sulfur loving bacterial don't thrive or create hydrogen sulfide.

Magnesium hydroxide is a third choice for collection system odor control. It works primarily by raising the pH of sewage to a point that is not conducive for odor causing bacteria to thrive. Magnesium hydroxide is the most benign of the chemical choices as itis the main ingredient in Milk of Magnesia.

All three of these chemicals are continuously fed into sewer systems at different points to consistently control the formation of odorants in the system. Where the Sanitation District doesn't have the ability to site a chemical dosing station and persistent odors are being experienced, the Sanitation District has the ability to utilize caustic slug dosing. Caustic slug dosing involves using tanker trucks to discharge up to 6,000 gallons of sodium hydroxide into a sewer manhole structure. The very high pH has the effect of killing the bio slime layer on sewer pipes that creates hydrogen sulfide. This treatment has an instant benefit that reduces hydrogen sulfide production for days to weeks depending on system conditions.

The final major odor fighting chemical is bleach. Bleach is used in treatment plant chemical scrubbers to oxidize odorants in air scrubber units. Bleach is an effective neutralizer of hydrogen sulfide, methyl mercaptan, methyl disulfide, dimethyl disulfide, and many others.

Disinfection

The Sanitation District successfully discontinued disinfection of its effluent to the long outfall. This means that thousands of gallons of bleach and sodium bisulfate are no longer required to be purchased or discharged to the ocean. However, in the event of a discharge to the short outfall or river overflow, disinfection by bleach will be required. Significant on-site storage of bleach and dichlorination chemical, sodium bisulfite, is necessary for this emergency contingency.

Bleach does have a shelf life of about six months. The Sanitation District rotates its disinfection supply to its odor control and plant water treatment systems to prevent product waste.

Process Specific Chemicals

The Sanitation District uses pure oxygen to support its activated sludge secondary treatment process for Plant No. 2. The Sanitation District previously self-generated pure oxygen using a cryogenic oxygen plant rated at 70 tons per day. This plant was removed because it was inefficient at its current average utilization of 35 tons per day and was at the end of its useful life. The Sanitation District contracts for delivery of liquid oxygen and uses a vaporization system to deliver pure gaseous oxygen to the activated sludge process.

Chemical Supply – Purchase vs. Make

The Sanitation District has relied on purchasing bulk commodity chemicals to its treatment plant and collection system. This has proven to be an effective strategy for operational flexibility and to allow concentration on core business. Operationally, the types and volume of chemicals change over time. Over time the types of polymers that are most efficient change. There is a need for more or less volume of chemicals based on sewage flow, sewage quantity, and flow splits between plants. Managing the generation of specialized chemicals using hazardous materials imposes a significant training burden on staff, increases the regulatory oversight and requirements, and increases overall risk to the organization.

The Sanitation District has maintained a policy to split the volume of orders between two vendors to assure competition exists in the marketplace for ferric chloride. While the Sanitation District generally cooperates with other public agencies to pool purchasing power to secure the lowest possible cost through high volume purchasing, some specialty chemicals like ferric chloride require split orders to maintain competitive market forces.

Current Situation

The Sanitation District is constantly changing and improving its facilities to meet new challenges. Each of the facility changes offer new opportunities to reconsider how the Sanitation District operates its processes and how chemicals are used. The best chemical stability outcome is to cost-effectively eliminate the use of the chemical. This is the strategy behind cessation of bleach disinfection of the outfall effluent.

Staff are in the process of studying the potential to operate the treatment plants differently to minimize or eliminate use of selected chemicals. Facilities like centrifuge sludge thickening provide new opportunities to adjust ferric chloride and anionic polymer usage. Opportunities for substitute chemicals will be explored to understand overall cost and efficiency savings potential. This includes iron vs. aluminum coagulant studies, anionic polymer trials, and cationic polymer trials. Staff will also reevaluate operating parameters such as in-basin sludge co-thickening, primary basin sludge blanket level parameters, as well as the greater loading of the secondary treatment systems.

When optimized chemical types and dosages are confirmed, staff will review the market conditions for each important chemical. This will serve as the basis for a procurement strategy for each chemical.

Future Policy Statement

The Sanitation District will thoroughly understand its treatment processes, the potential modes of operation, and the benefit and cost of chemicals to improve or stabilize its process. The Sanitation District will create a list of necessary chemicals for optimal treatment operations which will consider chemical cost, chemical availability, treatment stability, energy utilization, energy creation, nuisance odor control, biosolids generation/cost, and regulatory permit compliance risks.

Chemicals that are deemed most beneficial will be procured at the lowest overall cost from market providers to the extent possible. Where there are market stability concerns, the purchasing division will devise procurement strategies to mitigate procurement risks. Where procurement risk cannot be satisfactorily mitigated, technical staff will evaluate alternatives such as alternate operating methods, substitute chemical usage, or on-site generation of a chemical if feasible.

Initiatives to Support Progress Toward the Policy Goal:

Initiative: Reduce reliance on any particular chemical or vendor and establish flexibility to utilize other chemicals/processes to accomplish the same operational objectives.

Initiative: Update the Sanitation District's Chemical Sustainability Study and incorporate the results in future procurement recommendations.