

SECTION 11451

CHEMICAL FEED SYSTEM

PART 1 - GENERAL

1.01 SCOPE

- A.** Work under this section includes a complete Bioxide[®] chemical feed system for the control of hydrogen sulfide. The system shall consist of a chemical feed system composed of chemical feed pumps, feed controls, liquid storage tanks, eye wash station, chemical fill station and all piping and appurtenances required to feed Bioxide[®] into the wastewater system, and one full load of Bioxide[®] product to facilitate start-up and system optimization. All materials shall be provided in accordance with these specifications.
- B.** All components of the system shall be compatible with the conditions and chemicals to which they are subjected to during the normal operation of the system. Compounds with which the materials must be compatible include, but are not limited to:
- 1.** Hydrogen Sulfide
 - 2.** Bioxide[®] solution

1.02 PROCESS DESCRIPTION

The system shall provide for bulk storage of Bioxide[®] and metering of the Bioxide[®] from the bulk storage tank to the wastewater collection system. The system shall contain controls as necessary to facilitate seven discrete dosing profiles that vary in 1-hour increments over a 24-hr period. A calibration cylinder shall be permanently installed to facilitate calibration of feed pumps.

The Bioxide[®] material shall utilize the inherent ability of the facultative bacteria normally present in wastewater to metabolize hydrogen sulfide and other odor-causing, reduced sulfur containing compounds. The material shall provide nitrate-oxygen to the wastewater to support this biochemical mechanism. This nitrate-oxygen shall be applied via nitrate salts. The material shall be chemically stable, allowing continuous removal of sulfide contributed by side streams downstream of the application point. As a result of the biochemical process, the material shall provide the additional benefit of biochemical oxygen demand (BOD) reduction in the wastewater. Utilizing the Bioxide[®] chemical feed system will reduce chemical usage by at least 10% versus typical 2-timer systems.

1.03 QUALITY ASSURANCE

A. Test Standards and Specifications

All referenced standards and specifications shall be the latest versions.

- 1.** ASTM D638, Standard Test Method for Tensile Properties of Plastics
- 2.** ASTM D746, Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact
- 3.** ASTM D790, Standard Test Methods for Flexural Properties of Unreinforced & Reinforced Plastics and Electrical Insulating Materials
- 4.** ASTM D883, Standard Terminology Relating to Plastics
- 5.** ASTM D1505, Standard Test Method for Density of Plastics by the Density-Gradient Technique
- 6.** ASTM D1525, Standard Test Method for Vicat Softening Temperature of Plastics
- 7.** ASTM D1693, Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics
- 8.** ASTM D1928, Standard Practice for Preparation of Compression-Molded Polyethylene Test Sheets and Test Specimens
- 9.** ASTM D1998, Standard Specification for Polyethylene Upright Storage Tanks
- 10.** ASTM F412, Standard Terminology Relating to Plastic Piping Systems
- 11.** ANSI B-16.5, Pipe Flanges and Flanged Fittings
- 12.** UBC Code, Uniform Building Code
- 13.** ARM Standards, Low Temperature Impact Resistance (Falling Dart Test Procedure)
- 14.** NSF/ANSI Standard 61, AWWA – Drinking Water System Components

1.04 DESIGN CRITERIA

- A.** The Chemical Feed System shall be designed to reduce dissolved hydrogen sulfide concentrations from a pump station with the following characteristics. Specific design quantities and sizes are listed in the Special Provisions.
 - 1.** Peak Future Flow
 - 2.** Peak Start-up Flow
 - 3.** Average Start-up Flow
 - 4.** Force main diameter
 - 5.** Force main length (downstream of injection point)
 - 6.** Force main length (upstream of injection point)
 - 7.** Force main maximum pressure
 - 8.** Number of wet wells
 - 9.** Wet well footprint (each)
 - 10.** Wet well liquid level elevation: As indicated on Drawings
 - 11.** Top of chamber elevation: As indicated on Drawings
 - 12.** Treated substance
 - 13.** Location: outdoors

1.05 PERFORMANCE CRITERIA

- A.** Chemical
 - 1.** The chemical material shall be capable of reducing the dissolved hydrogen sulfide concentration in wastewater to less than 0.1 mg/l.
- B.** Storage Tank
 - 1.** The chemical storage tank shall have a minimum capacity equal to 10 days usage of the chemical at summer time high usage rates.
 - 2.** The maximum height of the tank and appurtenances shall not exceed 11 ft above odor control pad.
- C.** Chemical Feed Pumps
 - 1.** As specified in the Special Provisions.
- D.** Eye Wash System
 - 1.** An emergency eye wash system shall be included with the chemical feed system and installed on the concrete pad which supports the chemical feed equipment.
- E.** Chemical Fill Station

1. A chemical fill station shall be integrated into the chemical feed system for tank refilling purposes.

1.06 MANUFACTURER

- A. All components of the feed system shall be provided by a single manufacturer who shall have sole-source responsibility for the system.
- B. The manufacturer of this equipment shall be one recognized and established in the design, production, and operation of chemical feed injection systems. The manufacturer shall provide, with the submittal data, a list of 10 systems in operation using Bioxide® for the control of hydrogen sulfide and other odor causing components associated with municipal wastewater. These systems must have been in operation at least five years. The list shall include correct names, phone numbers, length of service, and design criteria.
- C. The manufacturer shall maintain regular production facilities at their place of business. These facilities shall be open for inspection by a representative of the Owner or Engineer at any time during construction and testing of this equipment.
- D. The manufacturer of the feed system shall be an Underwriters Laboratories listed manufacturer of Enclosed Industrial Control Panels.

1.07 SUBMITTAL

- A. The manufacturer shall submit complete shop drawings and engineering data to the Owner or Engineer, upon request. These submittals shall include, at a minimum:
 1. Drawings showing plan and elevation views of the feed system
 2. Control system layout drawing
 3. Control systems electrical diagram
 4. Manufacture's catalogue information on major system components including, but not limited to:
 - a. Chemical Feed Pumps
 - b. Bioxide® Chemical Feed Controls
 - c. Liquid Storage Tanks
 - d. HMIs
 5. Statement of design conditions and performance guarantee
 6. Statement of warranty
 7. Reference list as described in section 1.03, B above

- B.** The manufacturer shall submit complete Operation and Maintenance manuals to the Owner. These manuals shall include at a minimum:
- 1.** Information in hazards associated with the system and the appropriate safety precautions
 - 2.** Material Safety Data Sheet- Bioxide®
 - 3.** Equipment installation instructions
 - 4.** Equipment startup instructions
 - 5.** Equipment maintenance procedures
 - 6.** Troubleshooting guide
 - 7.** Individual operation and maintenance information on major system components, including but not limited to:
 - a.** Chemical Feed Pumps
 - b.** Bioxide® Chemical Feed Controls
 - c.** Liquid Storage Tanks
 - d.** HMIs
 - e.** PLCs

1.08 SUBSTITUTIONS

Any substitutions or deviations in equipment or arrangement from that shown on the drawings specified herein shall be the responsibility of the Manufacturer or Contractor. Any deviations must be accompanied by detailed structural, mechanical, electrical drawings and data for review by the Engineer. All costs associated with review of the substitutions or deviations and costs associated with project drawing changes as a result of approval shall be borne by the Manufacturer or Contractor. There shall be no additional costs to the Owner due to substitutions or deviations.

1.09 DELIVERY, STORAGE AND HANDLING

- A.** Materials are to be marked or tagged with part number and order number for field assembly requirements.
- B.** Touch-up paint with instructions for applications is to be supplied by the Manufacturer for application by the Contractor.
- C.** All supports, members, and miscellaneous parts shall be packaged for shipment in such manner to prevent abrasion or scratching.

PART 2 - PRODUCTS

2.01 BIOXIDE® PRODUCT INFORMATION

- A.** Technical Requirements

1. The material supplied shall be an aqueous solution of calcium nitrate containing a minimum of 3.5 pounds of nitrate-oxygen per gallon.
2. The material shall be capable of reducing the dissolved hydrogen sulfide concentration in wastewater to less than 0.1 mg/l.
3. The material shall be free of any objectionable odor-producing compounds.
4. The pH of the material shall not be less than 4.0 nor greater than 7.5.

B. Safety Requirements

1. The material shall contain no hazardous substances as defined by both the Federal EPA's and State CERCLA lists.
2. The material shall be exempt from Federal DOT placard requirements.
3. Recommended handling procedures for the material shall require protective gloves and safety glasses only. Any material recommending more sophisticated equipment (i.e., face shield, body suit, etc.) during routine handling shall not be considered.

2.02 CHEMICAL STORAGE TANKS - GENERAL

The chemical storage tank shall be constructed of Rotationally Molded High-Density Crosslinked Polyethylene (HDXLPE). No other material of construction shall be acceptable.

- A.** High density crosslinked polyethylene tanks shall be manufactured by the rotational molding process in accordance with ASTM D 1998-93 Standard Specification for Polyethylene Upright Storage Tanks, Type 1 only. Rotational Molding shall be defined as a three-stage process consisting of loading the mold with powdered resin, fusing the resin by heating while rotating the mold about more than one axis, and cooling and removing the molded article.
- B. Plastics.** The molding powder used shall be Marlex CL-250 or CL-200 as manufactured by Phillips 66, or powders of equal physical and chemical properties.
1. The polyethylene shall preferably be virgin material. Any use of regrind, recycled, or reprocessed materials or combinations of such materials shall not rely upon the performance data of their original constituents, but must meet the requirements of this standard in its own right.
 2. The polyethylene shall have a stress-cracking resistance of 500 h minimum F50 in accordance with Test Method D 1693, Condition A, full-strength stress-cracking agent. The test specimens may be compression molded or rotationally molded. If compression molded, Procedure C of Practice D 1928 shall be followed for both types of polyethylene with a minimum platen

temperature of 350 °F (177 °C). If it is crosslinkable polyethylene the temperature shall be 390 °F (197 °C) and the platen shall be kept closed under full pressure for 5 minutes at the specified temperature in order to bring about the crosslinking reaction. If the test specimens are rotationally molded, the conditions for rotational molding shall be similar to the conditions used for molding a vessel from this polyethylene.

C. Fillers and Pigments. The plastic shall contain no fillers. All plastic shall contain an ultraviolet stabilizer at a level adequate to give protection for the intended service life of the vessel, minimum of 0.25%. This stabilizer shall be compounded in the polyethylene. Pigments must be compounded at the same time of resin manufacture.

D. Vessel Construction

1. Mechanical properties. The nominal value for the properties of the materials shall be based on the molded parts:

Property	ASTM	Value	Units
Density	D105	59(0.937-0.944)	Lb/ft ³ (S.G.)
ESCR spec. thickness 0.125"	D1693	900-1000	Hrs.
Tensile Strength Ultimate 2"/min.	D638 Type IV	2600	PSI
Elongation at Break 2"/min.	D638 Type IV	450	%
Vicat Softening Temp.	D1525	255	°F
Brittleness Temp.	D746	-180	°F
Flexural Modulus	D790	100,000-110,000	PSI

2. Design Parameters.

a. Hoop Stress. The vessels shall be designed with a hoop stress value no greater than 600 psi at 100 °F with a safety factor of no less than 2, using the Barlow Formula for calculating wall

thickness.

b. Wall Thickness. The minimum required wall thickness of the cylindrical shell at any fluid level shall be determined by the Barlow Formula. The wall thickness shall be based on the maximum temperature of the service.

- 3.** Cut edges. All edges where openings are cut into the vessel shall be trimmed smooth.
- 4.** Appearance. Type 1 finished vessel walls shall be free, as commercially practicable of visual defects such as foreign inclusions, air bubbles, pinholes, pimples, crazing, cracking, and delaminations that will impair the serviceability of the vessel.
- 5.** Dimensions and Tolerance. The vessel diameter shall be measured externally. The tolerances on the outside diameter, including out of roundness, shall be plus or minus 3 percent. Measurement shall be taken in a vertical position.

E. Fittings

- 1.** All fittings with the exception of the overfill protection site glass, shall be located on the tank top or dome. No penetration of the tank side-wall shall be made.
- 2.** Plastic Fittings. Plastic fittings shall be "bulk-head" or "two-flange" style and shall be constructed of PVC. There shall be 4 bolts on any bolted flanges up to and including 3 inch, 8 bolts on fittings 4 inch - 8 inch diameter, and 12 bolts on 10 inch - 12 inch fittings. All bolts shall be all thread design with heads completely encapsulated in polyethylene. The polyethylene encapsulation shall fully cover the bolt head and a minimum of 1/4" of the threads closest to the bolt head. The polyethylene shall be color coded to distinguish bolt material: (Green-316 grade S.S., Red-Hastelloy "C", Blue-Monel, Black-Titanium). Each bolt shall have a gasket, which is on the inside of the vessel.
- 3.** Openings that are cut in vessel to install fittings shall not have sharp corners. Holes shall have minimum clearance to insure best performance of fittings.
- 4.** For all flanged connectors, the flange drilling and bolting shall be in accordance with ANSI/ASME B-16.5 for 150-psi pressure class straddling the principle centerline of the vessel.

F. Tank Manway Covers

1. Manway covers shall be 10-24 inch diameter, and will be dependent upon the tank dimensions
 2. Manway covers shall have either a threaded or bolted cover or gasket
- G.** Tank Tie Downs.
1. Tank shall be supplied with a Seismic Zone 4 restraint system.
 2. Restraints and base clips shall be hot dip galvanized carbon steel.
 3. Contractor shall provide all hardware to mount the system to the pad.

2.03 CHEMICAL STORAGE TANK – SPECIFICATIONS

Nominal Gallon Double-Wall Tank:

The chemical storage tank shall have the capacity and approximate dimensions (+/- 5%) as listed in the Special Provisions.

2.04 BIOXIDE® CHEMICAL FEED CONTROLS

- A.** General. The operation of the Chemical Feed System shall be controlled from a Control Panel. All equipment control switches, pilot lights, controllers, etc. shall be housed in this panel. The control system shall be UL Approved and shall bear the UL Listed Enclosed Industrial Control Panel Label.
- B.** Enclosure. The control panel enclosure shall be constructed of 316 stainless steel and shall be rated NEMA 4X. The hinged door shall have two quarter-turn latches and shall be capable of locking via a padlock. All components shall be mounted on a swing-out door. A shade screen shall be provided to protect and shield the control panel display. The enclosure shall be mounted on the calibration skid.

The Calibration Skid shall contain the following:

- 1- Control Enclosure
- 2- Chemical Dosing Pumps
- 1- Pressure relief valve
- 1- Back Pressure Valve
- 1- Calibration Cylinder
- 2- Pulsation Dampeners
- 1- Main Disconnect Switch

- C.** Components. The Control Box Shall Contain the following:
- 1- Color Touchscreen HMI
 - 2- Hand/Off/Auto Switches with LED Indicator Lights
 - 1- Set of Contacts with isolator to accept RTD Temperature device
 - 1- Set of Contacts with isolator to accept Tank Level device
 - 1- Set of Contacts with isolator to accept Flow Signal device
 - 8- Set of Contacts for alarm outputs, including: Temperature, Tank High, Low, and Low Low, Delta Dose, Flow, Communication, Leak (if applicable)
 - 2- Variable Frequency Drives
 - 1- 24 VDC Power Supply
- D.** Controls Layout. All manually operated controls (control switches, pilot lights, etc.) shall be located on a panel behind the enclosure door. The panel shall be outfitted with a main power disconnect located in the Calibration Stand.
- E.** Standards. All control system design, fabrication, and wiring shall conform to the standards of Underwriter's Laboratories, National Electrical Code, and any other applicable federal, state, or local codes.
- F.** System Operation. Chemical Feed Pumps. The bellows pump shall be controlled by a three-position HAND/OFF/AUTO switch. Control systems utilizing less than 168 discrete flow set points per week shall not be acceptable.
- 1.** When in the AUTO position the pump shall be controlled by the advanced dosing controller. The advanced dosing controller shall vary the feed rate in 1-hour increments as specified by the user. The pump(s) speed shall be varied by the advanced dosing controller to match the specified dose curve. The system shall have the capability to automatically adjust the feed rate based on wastewater temperature.
 - 2.** When in the HAND position the pump shall run, regardless of the preset curve.
 - 3.** System shall automatically calculate and dose the specified volume of product with either one pump or two pumps activated. System shall have the capability to verify the volume dosed matches the preset curve via the tank level and shall alarm at three preset tank levels.
 - 4.** Automatic functions shall be protected by two-level security (supervisory and user).

5. Flow set points shall be linearly interpolated to provide for smooth flow curve for each day
 6. Systems shall be capable of dosing from seven different flow curves.
- G.** Control Stand. Pump control box shall be mounted on a 316 stainless steel pedestal.
1. Calibration Cylinder. The stand shall be used to house a calibration cylinder used to measure the chemical being injected into the system. A 3 way valve shall be located at the top and bottom of the calibration tube to facilitate flow measurement. Access inside this pedestal shall be accomplished through a door located on the front of the pedestal. Instructions for use of this cylinder shall be permanently affixed to the interior of the enclosure.
 2. Disconnect Switch. A main power disconnect shall be located in the control stand.
 3. Pressure Relief. The skid shall be equipped with a pressure relief valve. The pressure relieve valve shall be preset for 20 p.s.i. The pressure relief valve shall be field adjustable from 0 – 150 p.s.i. via the adjustment screw with a special tool.
 4. Back Pressure. The skid shall be equipped with a back pressure valve. The back pressure valve shall be preset for 20 p.s.i. The back pressure valve shall be field adjustable from 0 – 150 p.s.i. via the adjustment screw.
 5. Pulsation Dampeners. The skid shall be equipped with two pulsation dampeners. Each pulsation dampener shall be rated to 150 p.s.i.

2.05 CHEMICAL FEED PUMPS

- A.** As specified in the Special Provisions.
- B.** Controls. Capacity adjustment shall be via a manual stroke length control knob. Stroke length shall be adjusted only while the pump is running.
- C.** Pump Motor shall be inverter duty.
- D.** Pump Enclosure. The pump drive shall be encased in a water-resistant

housing constructed of chemically resistant glass-filled polyester. The electronic circuitry shall be mounted in a case consisting of both a PPO-blend and aluminum

2.06 PIPING & APPURTENANCES

- A.** All suction and discharge piping shall be standard $\frac{3}{4}$ ", Schedule 80 PVC. All valves, fittings, and connectors shall be Schedule 80 PVC.
- B.** All fill line piping shall be 2" Schedule 80 PVC. All fill line valves, fittings, and connectors shall be Schedule 80 PVC.
- C.** Fill line shall have a 2" stainless steel male camlock with a 2" plastic female camlock cap.
- D.** All chemical feed seals shall be compatible with the chemicals to be used in the regular operation, maintenance, and cleaning of the feed system.
- E.** All fittings shall be solvent-welded or threaded.
- F.** Contractor must install chemical feed discharge lines so that the product is injecting directly into the waste streams and not onto structures or equipment. Contractor shall install a shut-off valve on discharge lines prior to entering the designated discharge pipe or wet well.

2.07 LEVEL DETECTION

Provide one pressure transducing tank level indicator. The system shall utilize an pressure sensing device to measure the tank liquid level. A digital display shall be provided indicate liquid level. The level will have the capability to be accessed via the internet. The system shall contain 3 adjustable relays to allow for alarms and other electrical uses as well as one 4 – 20 mA output. This shall be combined with a Siemens Water Technologies HI LO Kit or approved equal. The HI LO Kit shall utilize three of the relays on the ultrasonic unit to indicate HI Level, Refill Level, and Empty Warning. The liquid level shall be indicated by the pressure transducing unit and an audible alarm system with indicator lights that will sound when the tank level reaches the predetermined setpoints. The audible alarm shall operate an adjustable time delay, sounding for a limited period of time upon the high level condition. The visual indicator shall remain illuminated until the level condition is eliminated.

2.08 TESTING AND OPTIMIZATION EQUIPMENT

The Manufacturer shall provide the following testing and optimization equipment:

1. Dissolved sulfide field test kit that is capable of measuring dissolved sulfide less than 0.1 mg/L. The test kit shall use an industry accepted method for field testing dissolved sulfide in wastewater.
2. Nitrate field test kit that is capable of measuring nitrate nitrogen less than 0.1 mg/L

PART 3 - EXECUTION

3.01 SITE AND UTILITIES

The feed system, Bioxide[®] tanks, and other appurtenances shall be located on a foundation as shown in drawing. The following utilities shall be provided at the feed system site and located as shown on the drawing. Site preparation, utility service, and installation are not provided by the Manufacturer under these specifications.

- A. Electrical. One 120 VAC, 60 Hz, 15 amp single-phase electrical service shall be required.
- B. Drain - A minimum 2-inch P.V.C. gravity pad drain to sewer is recommended.

3.02 EQUIPMENT SHOP TESTING

Before shipping the equipment, the Manufacturer shall perform shop tests. These tests shall include at a minimum:

- A. Visual inspection of all equipment.
- B. Complete assembly, start-up, and "wet-test" of feed pumps and calibration piping.

3.03 INSTALLATION

The system shall be installed in accordance with the manufacturer's instructions. All installation personnel shall be trained and qualified in the areas of plumbing, electrical work, and instrumentation as required to complete the installation.

3.04 FIELD TESTS

- A. The performance of the system shall be demonstrated to reduce hydrogen sulfide to meet with the odor control levels set forth in these Specifications per manufacturer's standard practice.
- B. If required, Manufacturer shall make any changes to the system, at his own expense, that may be necessary to assure satisfactory and efficient operation

of this system.

3.05 MANUFACTURER'S FIELD SERVICES

- A.** The system manufacturer's representative shall be present at the job site, in accordance with Section 1750, to insure proper installation and start-up of the chemical feed system for the following time period; travel time excluded:
 - 1.** Sixteen hours for inspection of the installation and training of Owner's staff in operation of the system.
 - 2.** Provide one trip for two days for these tasks.

3.06 - WARRANTY

The Manufacturer shall guarantee that the Chemical Feed & Storage system will perform as described in these Specifications. The Manufacturer shall warrant the system, complete, to be free from defects in materials or workmanship for a period twelve (12) months from acceptance or eighteen (18) months from shipment, whichever occurs first. The Manufacturer shall repair or provide replacement for any defective components under this warranty.

PART 4 MEASUREMENT AND PAYMENT

4.1 Measurement

- A.** No measurement will be made for this item, Chemical Feed System.

4.2 Payment

- A.** Payment will be made at the contract lump sum price bid and shall be considered full payment for providing labor and materials to perform this work.

**** END OF SECTION 11451 ****