SECTION 46 33 00
POWDERED ACTIVATED CARBON DRY FEEDER SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope of Work:

Furnish all labor, materials, equipment and incidentals required and install complete, ready for operation, and field test the powdered activated carbon (PAC) dry feeder system as shown on the Drawings and as specified herein.

B. Related Work Described Elsewhere

1. Mechanical piping, valves, pipe hangers, accessories, and appurtenances are included under Division 40.

2. Electrical work is included under Division 26.

C. General Design

1. All of the equipment specified herein shall be furnished by a single manufacturer and shall be in complete conformity with these Specifications. All of the equipment specified herein is intended to be standard equipment for use in a PAC dry feeder system and shall include the following:

a. Volumetric screw feeder with VFD and explosion-proof motor.

b. Feeder supply hopper.

c. Wetting cone for PAC wetting.

d. Eductor to create PAC solution and supply to feed point.

e. Steel support frame.

f. Bag loading system including:

i. 1-Ton hoist with trolley motors.
ii. Bulk bag lifting adapter.
iii. Safety shield.

g. System control panel.

h. Air fluidizing system.

i. Miscellaneous associated equipment required for the proper operation of the system, including but not limited to valves, piping, couplings, fittings, gauges etc.

2. System Operations

a. Dry PAC will be delivered in a 900-lb bag. The 900-lb bag shall be manually attached to the chain hoist by the four straps on the bulk bag using the bulk bag lifting adapter. The bag will be lifted and positioned over the volumetric feeder hopper and lowered to rest on the safety shield using the hand held hoist control pendent and the electric trolley.

b. Once the bag is in place, the bottom flaps will be manually untied, releasing the built-in discharge chute. The inner liner of the discharge chute is placed inside the bag chute adapter and the outside shell of the discharge chute is placed around the outside of the hopper connector. A bag clamp is used to secure the bag to the connector to create a dust tight seal. The bag is raised slightly to tighten the chute, then the retainer strap around the discharge chutes can be released to allow PAC to flow into the feeder hopper.

c. The feeder hopper will provide PAC to the volumetric screw feeder which will discharge into the wetting cone by means of the drop tube and mix with plant make-up water to wet the carbon.

d. The PAC solution in the wetting cone will flow into the eductor by the vacuum created by the make-up water supply to the eductor.

e. The PAC solution from the eductor will flow to the location shown on the Drawings.

3. The PAC feeder system will be located outdoors in the location shown on the Drawings. The PAC solution shall be injected into the 42" raw water main in the location shown on the Drawings.

1.02 QUALITY ASSURANCE

A. The PAC dry feeder system equipment manufacturer shall have experience in the design and manufacture of equipment of similar size and capacity and shall

present proof of successful operations involving each piece of equipment furnished.

1.03 SUBMITTALS

A. Materials and Shop Drawings: Submit to the Engineer for approval, as provided in Section 01 33 00: Submittal Procedures, copies of all materials required to establish compliance with these Specifications. Submittals shall include at least the following:

1. Certified shop drawings showing all important details of construction, dimensions and anchor bolt locations.

2. General arrangement and plan drawings of the system.

3. Descriptive literature, bulletins, and/or catalogs of each item of equipment.

4. The empty weight and maximum operating weight of each major item of equipment.

5. A complete total bill of materials for all equipment.

6. A list of the manufacturer's recommended spare parts. Include gaskets, packing, and other parts on the list.

7. System piping and wiring diagram.

8. Complete wiring diagrams and schematics of each control panel, controller, control device, and operator's station furnished under this Section.

9. Control panel layout drawings.

10. Complete wiring diagrams and schematics of all power and control systems showing wiring requirements between all system components, motors, sensors, control panels, and related systems including connections to work of other Sections.

11. PLC ladder logic.

12. Written description of system operation and maintenance.

13. Prepare the above information as a single packaged shop drawing submittal.

B. Additional Information

1. In the event that it is impossible to conform with certain details of the specifications due to different manufacturing techniques, describe completely all nonconforming aspects.

C. Operating Instructions

1. Operating and maintenance manuals shall be furnished. The manuals shall be prepared specifically for this installation and shall include all required cuts, drawings, equipment lists, descriptions, etc. that are required to instruct operation and maintenance personnel unfamiliar with such equipment. The number and special requirements shall be as specified in Section 01 78 23: Operation and Maintenance Data.

2. A factory representative of the PAC feed system equipment manufacturer who has complete knowledge of proper operation and maintenance shall be provided for a minimum of one (1) eight-hour working day, travel time excluded, to instruct representatives of the Owner and the Engineer on proper operation and maintenance. With the Owner's permission, this work may be conducted in conjunction with the inspection of the installation and test run as provided under PART 3 - EXECUTION. If there are difficulties in operation of the equipment due to the manufacturer's design or fabrication, or the Contractor's installation, additional service shall be provided at no cost to the Owner.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. All products shall be handled as specified in Section 01 61 00: Common Product Requirements.

1.05 WARRANTY AND GUARANTEES

A. The equipment shall be warranted to be free from defects in workmanship, design and materials. If any part of the equipment should fail during warranty period, it shall be replaced at no expense to the Owner.

B. Refer to Section 01 74 00 for specific guarantee and warranty requirements.

1.06 SPARE PARTS

A. Special tools required for normal operation and maintenance shall be supplied for each piece of equipment furnished.

B. Each piece of equipment shall be furnished with the manufacturer's recommended spare parts for the first year of operation.

C. The following spare parts are shall be provided at a minimum:

1. One (1) eductor.
2. One (1) point level probe.
3. One (1) 2-way silo fluidizing air solenoid valve.
4. One (1) 3-way switching solenoid valve.
5. One (1) feeder drive motor.
6. One (1) volumetric feeder auger & gasket.

D. All tools and spare parts shall be furnished in containers clearly identified with indelible markings as to their contents. Each container shall be packed with its contents protected for storage. All tools shall be furnished in steel tool boxes.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with the requirements of these Specifications, manufacturers offering products which may be incorporated into the work include, but are not limited to, the following:

1. Norit Americas Inc.

2. Acrison.

3. Metcon Sales and Engineering.

4. Approved equal.

2.02 GENERAL

A. These Specifications are intended to give a general description of what is required, but do not cover details of construction which may vary in accordance with the exact requirements of the equipment as offered. They are, however, intended to include the furnishing, shop testing, delivery, installation, supervision, and field testing of all materials, equipment and appurtenances for the PAC dry feeder system equipment as herein specified, whether specifically mentioned in these Specifications or not. Also included in these Specifications is the instruction of the regular operating personnel in the care, operation and maintenance of all equipment.

B. All necessary accessory equipment and auxiliaries required for the proper functioning of the PAC dry feeder system installation incorporating the highest degree of standards for the specified type of service shall be furnished by the PAC dry feeder system supplier whether or not specifically mentioned in these Specifications or shown on the Drawings.

C. Construction shall meet NSF codes and requirements

D. The entire system shall be suitable for outdoor installation in the configuration shown on the Drawings.

2.03 MATERIALS AND EQUIPMENT

A. Volumetric Feeder

1. The volumetric auger-type feeder shall be designed with an AC induction motor, gearbox and hopper assembly on a tubular steel support frame.

2. The hopper shall have a minimum capacity of 3 cubic feet and shall be constructed of Type 304 stainless steel.

3. The metering mechanism shall consist of a large "conditioning auger" or "intromitter", concentrically mounted around a smaller "metering auger", independently driven at dissimilar speeds in a fixed proportion to each other by a single variable speed single gearmotor drive.

4. The feeder shall be supplied with a low hopper level switch.

5. An air fluidization system shall be provided to partially fluidize the PAC to prevent bridging and other flow problems and to provide uniform flow out of the bulk bag. The fluidization nozzle shall be placed in the feeder hopper inlet duct to promote reliable flow of PAC from the bulk bag. Air fluidization shall be controlled by a solenoid valve. Alternatively a vibrator may be provided to promote reliable PAC flow into the hopper.

6. The drive mechanism shall be enclosed to comply with OSHA safety requirements for rotating machinery (OSHA Section 1910.212 and .219 Machine Guarding).

7. The volumetric feeder shall be driven by a 1.0 HP AC induction motor with a VFD providing finite local adjustment of the PAC feeding rate. The VFD shall allow a 30:1 turndown ratio providing a wide range of dosing levels. The VFD shall be a PowerFlex 40 drive or equal. The feeder controller shall be programmed to allow feeding of the carbon at a constant rate in pounds per hour or to follow a 4-20 mA analog signal,

representing 0% to 100% of the maximum feed rate, provided from a remote location.

8. The feeder shall have the following general specifications:

a.	Feed Auger Size:	1 1/8"
b.	Conditioning Auger Size	10"
c.	Feed Rate Adjustment:	Manual via local HMI or remote signal
d.	Volumetric Capacity	0.03 to 0.9 ft^3/hr (0.56 to 16.6 pounds per hour)
e.	Materials of construction:	
	- Supply Hopper:	Type 304 Stainless Steel
	- Metering Auger	Type 316 Stainless Steel
	- Conditioning Auger	Type 316 Stainless Steel
	- Drop Tube	Type 304 Stainless Steel
f.	Feed Accuracy:	2% of full scale

9. The feeder shall be equipped with a removable drop tube, located between the volumetric feeder outlet and the inlet to the wetting cone to direct the PAC to the wetting cone.

B. PAC Wetting Cone

1. Materials: Type 304 stainless steel.

2. Connections: Provide a make-up water supply connection at the top of the wetting cone for wetting the carbon and a connection to the eductor at the bottom of the wetting cone.

3. Water shall be added tangentially to the wetting cone, which shall form a vortex to sweep the inner surfaces of the wetting cone, preventing bridging and subsequent blockages.

4. Mounting: Wetting cone shall be mounted directly below the screw feeder discharge through the drop tube.

5. Provide a high liquid level switch to indicate when high liquid level is sensed and provide an alarm.

6. A piped overflow shall be provided to keep water from backing up into the feeder.

C. Eductor

1. A 1½" eductor shall be installed to mix and convey the PAC slurry. The eductor shall be suitable for mixing carbon slurry with make-up water where the make-up water serves as the motive and the slurry is drawn into the eductor from the partial vacuum created by the high velocity stream in the eductor.

2. Selection of the eductor shall be based on the following parameters:
   a. Motive water flow of 65 gpm, maximum

   b. Motive water pressure of 100 psig, maximum

   c. Water flow into the wetting cone of 3 gpm (included in motive water flow)

   d. Injection point backpressure of 25 psig

   e. 2" PVC discharge pipe with length as shown on the Drawings

3. Materials: Type 316 stainless steel.

D. Water Control

1. Control of flow through the eductor shall be provided by a motive liquid pressure switch, motive liquid supply ball control valve, slurry discharge ball control valve, and a drain ball control valve which shall be controlled by the PLC in the system control panel.

E. Bulk Bag Lifting and Positioning Equipment

1. Electric Chain Hoist with Trolley: An electric chain hoist with an electric trolley shall be provided to lift the bulk bags from the floor and to position and hold the bulk bags above the feeder hopper inlet connection.

   a. The chain hoist shall be rated for one-ton capacity.

   b. All bearings shall be heavy duty, permanently sealed with lifetime lubrication.

   c. Hoist Motor: Single speed, 1/2 HP, 120 VAC, 1 phase, 60 Hertz.

d. Trolley Motor: Single Speed, ¼ hp, 120 VAC, 1 phase, 60 Hertz.

e. Chain hoist shall be CM Lodestar or equal. Trolley shall be CM Series 635 Motor Driven Trolley or equal. Chain hoist and trolley shall be provided by the same manufacturer.

f. A single pendent push-button control station with push-buttons to control all operations of the hoist and the trolley shall be provided. The pendent control station shall be easily accessible from the operating floor.

2. Bulk Bag Lifting Adapter: A bulk bag lifting adapter or "spider" frame shall be provided to evenly lift and position the bulk bags.

a. The lifting adapter shall be a tubular steel lifting cross for use with the chain hoist.

b. The adapter shall be used for a 900 pound (net) woven polypropylene bulk bag with a plastic liner.

4. Safety Shield: A safety shield shall be provided on the frame to support the bulk bag and protect the operator when releasing the feed chute.

5. Bulk Bag Connector: The outer bag chute shall be connected to the hopper inlet opening using an adjustable clamp to form a dust-tight connection.

F. Support Frame

1. The feeder system shall be supplied with a support frame designed to support the full weight of feeder, hopper, full bulk bag, bag loading equipment, product in the feeder hopper, wetting cone, drop tube, eductor, control panel, and associated valves, instruments and piping.

2. The frame shall be fabricated from 3" square (minimum) ASTM A-36 carbon steel tubing and structural steel members, 16 feet tall and divided into two (2) eight-foot sections. The upper and lower tower sections shall be provided with mating flanges, which will allow the upper section to be set on top of the lower tower section and bolted in place. Four (4) base plates with at least 16 anchoring points shall be provided to anchor the system to the concrete foundation. The PAC feed equipment with associated piping and instruments shall be mounted in the lower tower section and the monorail and hoist equipment shall be mounted in the upper tower section.

3. The frame shall include a monorail for the trolley and chain hoist.

4. Anchor bolts shall be provided and installed by the Contractor. Anchors shall be designed by the PAC system manufacturer to resist overturning loads associated with the lifting of a full bulk bag and applicable wind loads pursuant to the local building code. Anchor bolts shall be of Type 316 stainless steel.

5. All external carbon steel surfaces shall be blasted per SSPC SP6 commercial blast to obtain a 1.5 mil average profile, prime coated with Sherwin Williams Dura-Plate Multi-Purpose Epoxy Primer (4-8 mils DFT) and finish coated with Sherwin Williams Acrolon 218 HS Acrylic Polyurethane (3-6 mils DFT) in black, at the factory. Equivalent paint products manufactured by Koppers, Tnemec, or Glidden are also acceptable.

G. Instrumentation

1. Pressure Switch: Pressure switches shall be installed to monitor the motive water pressure and the wash water pressure and shall stop the feeder when insufficient water pressure is available. The pressure switches shall be interlocked to prevent the feeder from starting until sufficient water pressure has been established. Pressure switches shall be Ashcroft Series B or equal.

2. Pressure Gauges/Indicators: Pressure indicators shall be installed to monitor the supply/motive water pressure, the slurry discharge pressure and the wash water pressure. Pressure gauges shall be Ashcroft Duragauge or equal. The PAC system manufacturer shall supply all pressure gauges associated with the system.

3. Point Level Switch: A point level probe shall be installed to sense the PAC level in the feeder hopper and to provide an alarm signal when the level falls below the probe. The probe shall be of the tuning fork type. A 1½" half coupling shall be provided for mounting the probe to provide easy removal. The point level probe shall be the VEGAWAVE series by Vega Americas, Inc. or equal.

4. Vortex Water Level Switch: An ultrasonic level switch shall be provided to monitor the water level in the wetting cone. The switch shall be mounted in the wetting cone overflow and shall provide an alarm signal if the water level covers the probe. The level switch shall be Echotel Model 961 by Magnetrol or equal.

H. Piping and Valves

1. Motive water and slurry piping within the system frame shall be Type 304 stainless steel, threaded or socket welded and suitable for a pressure of 150 psi.

2. Valves shall be stainless steel or bronze, threaded, minimum of ANSI 150 pound class, unless specified otherwise.

3. Pneumatic Actuated Ball Valves: Three (3) 3-piece 1½" pneumatically actuated stainless steel ball valves shall be installed to control the flow of liquids within the system. Individual valves shall control the flow of motive water, control the discharge of the carbon slurry, and drain the system. The valves shall be pneumatically actuated and shall require an air supply pressure of no more than 80 psig. The valves and ¼ turn actuators shall be manufactured by NIBCO or equal.

4. Wash Water Regulator: A pressure regulating valve shall be provided to maintain a relatively constant flow of wash water into the wetting cone. The regulator shall be manufactured by Watts or equal.

5. Two (2) pressure regulators shall be installed to insure acceptable compressed air pressure to the various subsystems. The regulators shall be manufactured by Watts or equal.

6. Solenoid Valves: Two (2) brass body, electric solenoid valves shall be installed to control operation of the three (3) pneumatic ball valves. Solenoid valves shall be brass body, soft-seated, with 120V AC solenoid coils. Solenoid operators shall be molded coil in NEMA 4 enclosures. Valves shall be ASCO Red Hat, or equal.

7. Compressed air tubing and instrument sensing lines shall be black polyethylene tubing and fittings.

8. The PAC solution line outside the packaged system and in the yard shall be Schedule 80 PVC as specified under Section 40 27 00.10: PVC Pipe and Fittings, and sized as shown on the Drawings. The solution and plant water lines in the PAC area shall be supported as specified in Section 40 05 15: Piping Support Systems. Long radius elbows shall be used where 90 degree bends are required, and a clean-out tee shall be provided at each change of direction.

9. The Contractor shall install a 1-inch compressed air line from the plant compressed air system to supply compressed air to the system at a rate of 2 scfm at 100 psig.

I. All electrical equipment and instrumentation located inside or inserted into enclosed areas containing PAC including bulk bag, supply hopper, volumetric feeder, drop tube and wetting cone and the volumetric feeder motor shall be rated for a Class II, Division 1 environment.

2.04 CONTROLS

A. A programmable logic controller (PLC) and Human Machine Interface (HMI), with input from remote sensors, shall control the sequences of events throughout the system and provide alarms to annunciate problems and interlocks to protect the system. The system shall be configured to feed a constant pounds per hour of PAC or to vary the feed rate via an analog signal provided from a remote source. During normal operation, operator attention shall not be required, as the system shall operate automatically once the mode of operation and the feed rate have been selected.

B. System Control Panel

1. The PAC system controls shall be contained within a dedicated control panel, including disconnect switches, breakers, PLC, power supply, transformer, feeder VFD, control relays, Human Machine Interface (HMI), terminal blocks, switches, etc. The panel shall be compliant with all applicable NEC and NEMA requirements.

2. Control wiring philosophy shall meet the following requirements:

a. The control wiring philosophy shall be such that all field control devices utilize normally closed contacts during normal operating conditions.

b. A contact opening or an open circuit shall result in an alarm condition for the specific device.

c. Loss of power to a control device shall result in an alarm condition.

3. The control panel shall be provided with the following items and/or features:

a. Panel shall be constructed of Type 316 stainless steel and rated NEMA 4X.

b. Terminal blocks shall be installed for termination of external connections.

c. Terminal blocks for voltage of 120 volts and less shall be equal to Allen Bradley 1492-W10.

d. All selector switches, pilot lights, push buttons and other devices that will be visible on the front of the control panels shall have Lamacoid nameplates, which shall be white with black letters.

e. All wiring shall be installed in Panduit or similar wireways and separated into categories (i.e. 120 volt control, 24 volt DC, digital & analog signal, etc.) to the extent practical. All terminal strips for all wiring terminations shall be numbered.

f. Wiring shall be stranded copper, 600 volt, THHN insulated, extra flexible type. As a minimum wire size shall be #12 AWG for all power wiring, #14 AWG for all external control wiring, #16 AWG for all control panel internal control wiring and #18 AWG twisted shielded pair for analog signal conductors. Wiring shall be color coded as follows:

i. Ground wiring shall be green.
ii. 120 volt AC, 480 volt AC and 90 volt DC power wiring shall be black.
iii. Neutral wiring shall be white.
iv. 120 volt AC control wiring shall be red.
v. 24 volt DC control wiring shall be blue.

g. Wiring at all terminals within panels, junction boxes, and field devices shall be numbered with shrink fit, machine printed labels.

4. The following control switches shall be located on the control panel:

a. Emergency stop pushbutton switch.

b. Main disconnect switch.

C. Programmable Logic Controller: The PLC for control of the system shall be a Siemens S7-1200 style PLC with Profibus, or a PLC system with the following:

1. Support connection to Profibus network. (all equipment and configuration required to connect to the network shall be included in with the system).

2. Simatic optical link module for connecting the RS 485 to fiber.

3. PLC programmed to send and receive information remotely from the Profibus networks to the master S7-1500 processor.

4. Code written in STEP 7 (TIA Portal) and configuration settings for a S7-1500 controller to communicate and pull information from the system.

5. All PLC inputs and outputs, along with all alarms, runtimes, and setpoints shall be available in the S7-1500 controller.

D. Electrical Components

1. 120 Volt Circuit Breakers: Allen Bradley 1492-CB or equal.

2. Control Relays: Allen Bradley Type HA, Potter Brumfield Type KRP, Square D Type KP, or equal.

3. Selectors and Push Buttons: 30.5 mm, heavy duty, NEMA 4X rated; contacts rated 10 amps continuous, 6 amps break at 120 VAC, equal to Allen-Bradley Type 800H.

4. Indicating Lights: 30.5 mm, heavy duty, NEMA 4X rated, 6 volt transformer type, equal to Allen-Bradley Type 800H.

E. Human Machine Interface: The HMI for control of the system shall be an Allen Bradley PanelView 400 Plus I, or equal.

1. The following status and alarms shall be shown on the HMI:

   a. Feeder Malfunction.
   b. Vortex Water Level High.
   c. Motive Water Pressure Low.
   d. Wash Water Pressure Low.
   e. Feeder Hopper PAC Level Low.

2. The following control functions shall be on the HMI:

   a. System Operation Local/Remote Selector.
   b. Local Start PAC System.
   c. Local Stop PAC System.
   d. Feeder Off/Auto Selector.
   e. Alarm Acknowledge.
   f. System Mode Non-Paced/Paced Selector.
   g. Fluidizing Cycle On/Off/Auto Selector.
   h. Trip Reset Selector.
   i. PAC Feed Rate Selection.

3. The SYSTEM OPERATION selector on the control panel HMI shall select whether the system is started and stopped via local selection on the HMI (LOCAL) or remotely by energizing a relay inside the System Control Panel (REMOTE).

4. The SYSTEM MODE selector on the control panel HMI shall select whether the feeder runs at a constant rate (NON-PACED) or will follow a 4-20 mA DC signal (PACED).

5. The FLUIDIZING CYCLE selector on the HMI shall select whether each pulse is manually initiated (ON) or automatically pulse on a timed basis when the feeder is in operation (AUTO).

F. The control panel shall require a 120 volt, 1 phase, 60 Hertz electrical power supply.

PART 3 - EXECUTION

3.01 PREPARATION

A. Prior to prime coating, all metal surfaces of the equipment within the PAC dry feeder system shall be thoroughly clean, dry, and free from all millscale, rust, grease, dirt, paint, and other foreign substances to the satisfaction of the Engineer.

B. All metal surfaces except factory finished equipment surfaces and those obviously not to be painted such as aluminum and stainless steel shall be shop primed as specified in Section 09 90 00: Painting and Coating.

C. Finish coating except on factory finished manufacturer's equipment shall be compatible with the prime coating used and shall be as specified in Section 09 90 00: Painting and Coating.

3.02 INSTALLATION

A. Each unit shall be installed in accordance with the manufacturer's instructions and accurately aligned in orientation with related equipment.

B. The Contractor shall supply all necessary anchor bolts, temporary lifting equipment, power, water, labor and all other requirements for satisfactory installation.

3.03 INSPECTION AND TESTING

A. PAC Dry Feed System

1. Upon completion of installation, the Contractor, in the presence of the Engineer and a qualified manufacturer's representative, shall perform an initial field test on the PAC dry feed system to ensure the functioning of all component parts to the satisfaction of the Engineer. The Contractor shall furnish all labor, equipment, water and power required to perform each test. The Owner shall supply the necessary PAC bags for the test.

2. Approval of the initial field test by the Engineer shall not constitute final acceptance of the equipment furnished.

B. After the plant is in operation, a full load operating test shall be performed in the presence of the Engineer and a qualified manufacturer's representative. The Contractor shall furnish all labor, materials and equipment required for such test and shall correct any deficiencies noted, by repairing or replacing the defective component, and retesting as required until the equipment meets the satisfaction of the Engineer. The services of a competent and experienced representative shall be furnished by the manufacturer for a minimum of one (1) complete 8-hour day to satisfy the full load operating test requirements. A 48-hour operating period of the PAC dry feed system will be required before final acceptance.

3.04 START-UP AND INSTRUCTION

A. The equipment manufacturer shall furnish the services of a competent and experienced representative who has complete knowledge of proper operation and maintenance of the equipment for a period of not less than two (2) days to inspect the installed equipment, supervise the initial test run, and to provide instructions to the plant personnel. This instruction period shall be scheduled at least ten days in advance with the Owner and shall take place prior to plant start-up and acceptance by the Owner. The final copies of operation and maintenance manuals specified in Section 01 78 23: Operation and Maintenance Data must have been delivered to the Engineer prior to scheduling the instruction period with the Owner.

END OF SECTION

SECTION 46 33 33
POLYMER BLENDING EQUIPMENT

PART 1 GENERAL

1.01 DESCRIPTION

A. Scope of Work:

1. Furnish materials, equipment, and incidentals required for installation of two (2) self-contained neat polymer feed systems to be located as shown on the Drawings.

2. Furnish the required feed equipment, complete with controls, specified options, and other appurtenances necessary for a complete system.

3. The Contractor shall supply the required labor for installation of the unit. Provide a field representative for the specified start-up and inspection services.

B. Equipment required for each self-contained polymer system shall include:

1. Stainless steel support frame and housing.
2. Mixing chamber.
3. Diaphragm neat polymer dosing pump.
4. Dilution water solenoid valve and pressure reducing valve.
5. Rotameters.
6. Motors/gear reducers.
7. Instruments.
8. Electrical distribution panel.
9. Pump controller.
10. Stainless steel pedestal.
11. Drum mixer and dryer.

C. Each wet polymer feeder system shall produce completely activated polymer solution from neat emulsion or dispersion polymer. The polymer mixing system shall be specifically designed to invert, disperse, and activate in solution emulsion and dispersion polymers with viscosities from 200 to 6,000 cps.

D. The polymer solution shall be fed into the waste sludge line upstream of the gravity thickener, into the raw water line downstream of the static mixer before it discharges into the flocculation basins, and into the filter influent channel.

E. Provide complete, skid mounted, coordinated systems, delivered pre-tested, pre-wired and pre-piped.

F. Operation:

1. The polymer system shall meter polymer dosage, regulate mixing water, provide uniform dilution and activation, operate on-line continuously, and feed solution to the point of use.

2. Neat polymer from the metering pump and dilution water controlled by the solenoid valve shall enter the mixing chamber. Dilution and activation occur, yielding prepared solution ready for use. The solution is mixed with post dilution water in the static mixer.

3. Neat polymer dosage rate is adjusted at pump face or at electronic controller. Primary dilution and post dilution water are controlled by individual manual flow control valves.

1.02 QUALITY ASSURANCE

A. The equipment shall be produced or provided by a single manufacturer who is fully experienced, reputable and qualified in the manufacture of the equipment to be furnished. The system components shall be designed, constructed, and delivered in accordance with the best practices and methods. Manufacturer shall be experienced in the manufacture of the specified equipment for a minimum of five (5) years.

B. The supplier shall have a permanent organization of office and field technical personnel and facilities necessary for fulfilling all requirements of this Specification.

C. The systems shall be furnished by a single supplier who shall be responsible for the coordination of the system design and who shall assume complete responsibilities for the proper operation of the system. The layout, sizes, equipment configuration, and electrical wiring specified is based on equipment furnished through UGSI ChemFeed, Inc. The system shall be as furnished by UGSI ChemFeed, Inc., Prominent, Fluid Dynamics or an approved equal.

1.03 SUBMITTALS

A. Submittals of all materials required to establish compliance with these Specifications shall be submitted in accordance with the provisions of Section 01 33 00. Submittals shall include at least the following:

1. Detailed shop and erection drawings showing all important details of construction, dimensions and anchor bolt locations.

2. Descriptive literature, bulletins, and/or catalog cut sheets of each item of equipment.

3. Electrical schematics and interconnecting wiring diagrams showing extent of factory prewiring and required field wiring.

4. The empty weight and the maximum operating weight of each major item of equipment.

5. A complete total bill of materials and parts list for all equipment.

6. A list of the manufacturer's recommended spare parts and special tools. Include gaskets, packing and other parts on the list.

7. List of local facilities and service organizations to obtain parts and service labor.

8. Complete installation, handling, and storage instructions.

B. Prepare the above information as a single package shop drawing submittal.

C. Control layout and wiring interface shall be shown on the submittal drawings.

1.04 OPERATING INSTRUCTIONS

A. Six (6) copies of an operating and maintenance manual shall be furnished to the Engineer as specified herein and in accordance with Section 01 78 23. The manual shall be prepared specifically for this installation and shall include all required catalog cuts, drawings, equipment lists, descriptions and necessary information required to instruct operating and maintenance personnel unfamiliar with all of the equipment specified herein. A complete, corrected and approved copy of the shop drawing submittal shall be included with each manual provided.

B. A factory representative who has a complete knowledge of proper operation and maintenance requirements for the equipment shall be provided for a minimum of one (1) 8-hour working day to instruct representatives of the Owner on proper operation and maintenance of the equipment. Provide at least ten (10) days advance notice to the Owner before scheduling the instruction days. This work is in addition to, but may be conducted in conjunction with, the inspection of installation and test run as provided under Part 3. The operation and maintenance manuals shall be provided at a time in advance of the instruction/training period that is approved by the Owner. If there are difficulties in operation of the equipment due to the manufacturer's design or fabrication or the Contractor's

installation, additional service required to make approved modifications, repairs or corrections to the equipment shall be provided at no additional cost to the Owner.

1.05 TOOLS AND SPARE PARTS

A. Special tools required for normal operation and maintenance shall be supplied for each piece of equipment furnished.

B. Each piece of equipment shall be furnished with the manufacturer's recommended spare parts to include, as a minimum, the following:

1. Chamber Mechanical seal.
2. Mixing chamber o-rings.
3. Injection check valve.
4. Pump liquid end rebuild kit.

C. All tools and spare parts shall be furnished in containers clearly identified with indelible markings as to their contents. Each container shall be packed with its contents protected for long-term storage.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver a complete system ready to install by Contractor.

B. Handle during delivery, storage, and installation in a manner to prevent damage of any nature in accordance with manufacturer's approved instructions.

1.07 WARRANTY AND GUARANTEES

A. Refer to Section 01 74 00 for specific warranty requirements.

PART 2 PRODUCTS

2.01 GENERAL

A. Manufacturer: The dry polymer blending and feed system shall be a UGSI ChemFeed Polyblend PB1000 system as manufactured by UGSI ChemFeed, Vineland, New Jersey. Equivalent units manufactured by Prominent and Fluid Dynamics are also acceptable.

B. Capacity: The units shall be capable of feeding 0.045 to 4.5 gallons per hour (gph) of neat polymer and shall have a 60-1,200 gph dilution water flow range. The unit shall be designed to operate with a water supply pressure of 50-80 psi.

C. Electrical Requirements: The feeder system shall be suitable for operation from a 120 Volt, 1-phase, 60 Hertz power supply.

D. Materials of Construction: The system shall be constructed with a Type 304 stainless steel chassis or support frame. All hardware used for component attachment shall be Type 316 stainless steel. Any components in contact with polymer or water shall be constructed of electrodeless nickel-plated brass, stainless steel, or an inert plastic.

F. Mixing Chamber

1. The mixing chamber shall be multi-zone. The initial zone shall provide high energy or high shear mixing and uniform dispersion energy at the moment of initial wetting. The low energy zone shall continue to activate the hydrated polymer without destroying the fragile polymer chains.

2. The mixing chamber shall be constructed of acrylic or PVC.

3. Mixing energy shall be provided by a motor-driven stainless steel multi-bladed turbine.

   a. Turbine shall rotate on a stainless steel shaft supported by stainless steel bearings and seals.
   b. Mixing chamber shall be transparent.
   c. The high-shear mixing zone with a turbine impeller shall occupy not more than 30% of the total volume of the mixing chamber.
   d. All metallic materials of construction shall be Type 304 stainless steel or nickel-plated brass.
   e. Mixing chamber shall be capable of 100 psi working pressure.

4. The design shall include a motor-driven impeller that will create high fluid shear at point of polymer and water introduction. Systems that solely use a hydraulic means to activate polymer shall not be accepted.

5. The mix chamber shall be minimum 2.5 gallons to provide adequate mixing time for polymer to be fully activated prior to exiting polymer system.

6. In order to quantify the mixing intensity in the mix chamber, the applied horsepower shall be defined by measuring the difference in torque when the mix chamber is empty versus being full of water. This value shall be the basis of determining the mixing intensity defined as "G" value.

7. The G-value in the high shear mixing zone shall exceed 4,000/sec to effectively disperse polymer gels to prevent fisheye formation.

8. The G-value in the low shear mixing zone shall be lowered to 1,200/sec to avoid damaging polymer chains.

9. At no time shall prepared polymer come in contact with a propeller type mixer.

10. The mixing turbine shall be driven by a maximum 1 HP, 1,725 RPM, TEFC, washdown duty motor.

    a. The motor shall drive the impeller shaft by means of pulleys and a belt or be direct-coupled to impeller shafts
    b. The mixer motor shall be provided with a manually resettable thermal overload protector.

H. Pumps: Each system shall include a diaphragm metering pump capable of feeding emulsion or dispersion polymers over a flow range of 0.045 to 4.5 gph. Each pump shall be capable of satisfactory operation with polymers having viscosities of up to 10,000 cps.

1. Pump output shall be rated for a pressure of 100 psig.

2. The polymer pump shall be a microprocessor controlled solenoid driven diaphragm metering pump. All pump functions shall be accessible via an illuminated LCD screen and a membrane style keypad.

3. The pump shall be programmable so that the stroking speeds can be modified.

4. Polymer pump shall accept a 4-20mA signal for speed control. Pump will also accept a 0-10 VDC or pulse input for speed control.

5. The pump shall be equipped with a fault annunciating relay which will be monitored by the system controller.

6. The pump shall supply a pump running feedback signal which will be monitored by the system controller.

7. Provide a knob on the pump for manual stroke length adjustment.

I. Suction Tubing and Appurtenances:

1. A rigid drumstick or drum suction tube suitable for mounting in the neat polymer drum bunge or vent connection shall be supplied to completely evacuate the drums contents. The drumstick shall be supplied with 2 inch NPT and ¾ inch NPT connections for connection to either port and shall include 5/8-inch barbed suction tubing connections. Drumstick

construction shall be PVC. Suction tubes shall be "Drumstick" as manufactured by Stranco or equal.

2. Sufficient suction tubing shall be furnished by the polymer system manufacturer to provide complete functional systems as shown on the Drawings.

3. Calibration cylinder: A suitably sized calibration cylinder shall be supplied for the neat polymer feed pump. Cylinder shall be mounted to frame with PVC isolation ball valves. Cylinder shall be calibrated in mL, and be constructed of clear PVC with slip on cap and ½ inch NPT vent connection.

J. Accessories

1. Drum Mixer: A bayonet mount drum mixer shall be supplied for mixing neat polymer drum contents. Mixer shall include a ½ HP, 1,725 rpm TEFC motor with 28 inch long mixer shaft, (2) 4 inch long collapsible mixing blades, 8 foot power cord and on/off switch. Mounting plate shall include 2 inch bung mount and shall be constructed of mild steel with powder epoxy coating. Electrical requirements shall be 120 VAC/1 phase/60 Hertz.

2. Drum Dryer: A desiccant drum dryer shall be supplied to eliminate moisture laden air from entering the polymer drum. The drum dryer shall include a ¾ inch connection for mounting in the drum vent port.

3. Provide a stainless steel pedestal for mounting the unit to.

K. Mounting hardware shall be Type 316 stainless steel.

2.02 WATER FLOW

A. The system shall have a solenoid valve for on/off control of dilution water supply. Downstream of the solenoid valve, the dilution water supply shall be teed to two separate but identical rotameter-type flow indicators equipped with integral rate adjusting valves. The first adjustable indicator shall control water flow to the mixing and activation chamber and shall be adjustable over a rate of 60 to 600 gph. The second shall control water flow to the post-dilution assembly and shall have a flow rate of 60 to 600 gph.

B. Post-dilution flow shall meet the polymer stock solution exiting the mixing and activation chamber in an assembly configured so that adjustment of one rotameter will not affect the flow through the other. After stock solution and dilution water have been combined, they shall pass through a clear PVC static mixer for full blending of the two streams.

C. Each water supply input fitting shall be 1-inch FNPT. Each stock solution output fitting shall be 1-inch FNPT.

D. A differential pressure indicator/switch shall be provided across the rotameter/rate-adjusting valve to display water differential pressure. Low differential pressure shall shut down the dosing pump.

E. Minimum supply water pressure shall be 50 psi. Maximum inlet water pressure shall be 100 psi. Water supply temperature limits shall be 65°F to 80°F or as recommended by the polymer supplier.

F. Pressure reducing valve: A suitably sized pressure reducing valve shall be supplied for installation in the dilution water line. Pressure reducing valve shall be constructed of bronze with adjustable output pressure of 30-80 psig to reduce incoming line pressure variations. Pressure reducing valve shall be as manufactured by Watts or equal.

2.03 CONTROLS

A. Unit shall be controlled through an on-off-remote circuit controlled by a three-position switch.

1. In the remote switch position, the unit shall accept a run signal.

2. Unit is manually controlled in the on position.

B. Unit shall accept a 4-20 mA analog signal to pace the polymer metering pump.

1. This signal shall be processed by a pump controller that may be mounted remotely.

2. The controller shall have an LCD readout capable of displaying strokes per minute, strokes per hour, gallons per minute, gallons per hour, liters per minute, or liters per hour.

3. The controller shall have touchpad control for pump stroke frequency and a mode touchpad (internal-off-external) for pacing signal selection.

C. Unit shall detect loss of water flow, sensing that water flow has been interrupted for any reason, and place the polymer pump and mix chamber on standby and restart the units automatically when flow is restored.

D. An integral timer shall monitor loss of flow and energize contacts indicating alarm after 15 seconds of continuous loss.

E. A terminal strip shall be provided to allow contacts for remote indication and control for the following:

1. Run status for system (running and off)

2. Dosing pump rate

3. Individual status for system alarms

F. The polymer feeder manufacturer shall furnish the Contractor with sufficient electrical information for the unit in order to have complete coordination in the electrical wiring connections.

G. Access and Identification:

1. Provide laminated plastic nameplates for all front-face panel mounted controls to completely define their use.

2. Provide plastic, permanent identification tags and wire number tags for all internal components, wires, and terminals.

H. Electrical:

1. Provide a main circuit breaker and internal branch circuit breaker for each branch circuit as required to distribute power within each panel from the main power feed. Provide terminal board for termination of all wiring. Provide access to the branch breakers when the panel door is open. Do not exceed a current capacity of 12 amps for any branch circuit.

2. Design, furnish and install all wiring within the system and furnish complete wiring diagrams showing the electrical circuits inside the system and interconnections between the system and the external instruments and components. Identify and number all terminals and wires. Attach plastic, snap-on numbered tags to each panel wire for identification. Provide a copy of the wiring diagram. No power shall be applied until the supplier has approved the installation.

3. Wiring within system shall meet the following requirements:

   a. Discrete wiring shall be 300-volt, type THWN stranded copper, sized for the current carried, but not smaller than No. 16 AWG.
   b. Power wiring shall be 300-volt type THWN stranded copper, No. 14 AWG size, for 120V service.
   c. Analog signal wiring shall be 300-volt, stranded copper in twisted shielded pairs, no smaller than No. 16 AWG.

d. Restrain wiring with plastic ties or ducts. Hinge wiring shall be secured at each end with bend area protected with a plastic sleeve.
e. Separate analog or dc circuits at least six inches from any ac power

4. All relays shall be the compact, general-purpose, plug-in type. Contacts shall be rated for not less than 10 amperes at 120V. Provide relays with neon status lights and test buttons. Time delay relays shall have integral adjustment knob and rangeability of at least 10:1. All relays shall have permanent, legible identification.

5. Terminal blocks shall meet the following requirements:

a. Provide unused spare terminals as indicated on the Drawings.
b. Provide terminal blocks for analog signals separate from AC circuit terminal blocks.
c. Screw-type terminal connections shall be with locking, fork-tongue or ring-tongue lugs crimped with proper sized anvil. Terminate no more the two lugs per terminal with no more than one wire per lug.
d. Compression clamp terminal connections shall be stripped and prepared per manufacturer's recommendations. Terminate no more than one wire per screw and yoke.

6. Provide the system with an isolated copper grounding bus to ground all signal and shield connections. Ground analog signal shield. Properly ground all surge and transient protection devices. Coordinate grounding system with Division 26, Electrical.

7. Provide a power distribution panel (PDP) as a separate enclosure. The panel shall accept 120VAC, 1 phase, 60 Hertz power (see Drawings for available current) and distribute it to all the components/equipment of the system. All equipment shall have an easily accessible and lockable disconnect.

I. Panel Instrument Components: For instrumentation interfacing with the plant SCADA System, the system manufacturer shall comply with the requirements of Section 40 91 00, Process Control and Instrumentation.

J. Changes to the field wiring requirements shall be fully coordinated by the Contractor and all modifications to field wiring shown on the Drawings, as a result of these changes, shall be provided by the Contractor at no additional cost to the Owner.

PART 3 EXECUTION

3.01 GENERAL

A. The manufacturer shall furnish the services of a competent and experienced representative who has complete knowledge of proper operation and maintenance of the equipment for a period of not less than two (2) eight hour days in two (2) separate visits to inspect the installed equipment, supervise the initial test runs and to provide instructions to the plant personnel. The first visit will be for checking and inspecting the equipment after it is installed. The second visit will be to operate and supervise the initial field tests for start-up and instruct the Owner's personnel.

B. The duties of the service representative shall be as follows: After the equipment has been installed but before it is operated by others, the representative shall inspect the completed installation for soundness (no damaged or cracked components), completeness, correctness of setting and alignment, and for the adequacy and correctness of packing, sealing, and lubricants. The service representative shall start up the equipment and instruct the Owner's personnel in proper operation and maintenance procedures. The responsibility of the Contractor with regards to start-up shall be fulfilled when the start-up is complete, the equipment is functioning properly and has been accepted by the Owner.

3.02 INSTALLATION

A. The wet polymer feeder system shall be installed in strict accordance with the manufacturer's written installation instructions. The equipment shall be accurately set and oriented as shown on the Drawings.

B. The Contractor shall supply all necessary anchor bolts, temporary lifting equipment, power, water, labor and all other requirements to install, start-up and test the equipment for a satisfactory installation.

C. Anchor bolts used to anchor the polymer feeder system shall be Type 316 stainless steel anchor bolts.

3.03 WORKMANSHIP

Skilled labor shall be used in the construction and assembly of the wet polymer feeder system. The polymer feeder system shall be factory assembled to the maximum extent practicable. Care shall be taken during delivery and installation of equipment so as not to damage factory painted surfaces.

3.04 FIELD WORK

Each polymer feeder system shall be shipped preassembled to the job site in such a manner that the Contractor need only connect the water line, neat polymer line, power feeds, control wiring, and feed piping. Connections for power, control and other electrical leads shall be clearly labeled. The Contractor shall install the feeder units, piping, drains, and vents and perform all field installation requirements necessary for complete, ready to operate, polymer feed systems. All damaged factory coatings shall be repaired using manufacturer approved methods and touch-up paint supplied by the manufacturer.

3.05 INSPECTION AND TESTING

A. Each polymer feeding system shall be completely assembled and tested at the factory. Field tests shall be conducted to demonstrate that the equipment is correctly installed and is operating properly. Any defects in the equipment shown by these tests shall be promptly corrected.

B. Materials and equipment shall be tested or inspected as required by the Engineer, and the cost of such work shall be included in the cost of the equipment.

C. Field tests shall not be conducted until the entire installation is complete and ready for testing.

D. After the equipment has been completely installed, the Contractor shall conduct, in the presence of the Engineer, field tests to indicate that the equipment conforms to the Specifications. The Contractor shall supply all oil, grease, electric power, water and all other material necessary to complete the field tests. The Owner shall supply neat polymer required for field tests.

E. If the equipment performance does not meet the Specifications, corrective measures shall be taken by the Contractor, or the equipment shall be removed and replaced with equipment which satisfies the conditions specified.

F. Equipment Field Testing:

1. Upon completion of all the mechanical and electrical work, the Contractor shall make adjustments to the equipment and conduct testing, as specified herein, to demonstrate that the equipment performs in accordance with all specifications.

2. The Contractor shall perform initial testing of the equipment to insure that the tests listed in the Demonstration Test paragraph below can be completed.

3. The Demonstration Test shall demonstrate that all items of these Specifications have been met by the equipment, as installed, and shall include the following tests:

   a. That the equipment can deliver the specified polymer feed rates at the polymer concentrations specified.
   b. That the equipment controls perform satisfactorily.
   c. That the equipment performs satisfactorily in each manual, automatic and shutdown mode specified.
   d. That the equipment can function over the full range of feed rates, from the minimum to the maximum equipment design rates.

4. In the event that the equipment does not pass the Demonstration Test, the Contractor shall, at no cost to the Owner, make such changes and adjustments to the equipment deemed necessary and shall conduct further tests until written certification is received from the Engineer.

5. Following successful completion of the initial start-up and demonstration testing, the unit shall be placed into continuous service for a period of 48 hours under normal operating conditions and shall perform satisfactorily prior to acceptance by the Owner. Any deficiencies noted shall be corrected by repairing or replacing the defective component and retesting for successive 48 hour periods, until the equipment meets these specifications and the satisfaction of the Engineer. Polymer for all required testing will be supplied by the Owner.

G. The Contractor shall submit to the Engineer six (6) copies of a certified report from the factory service representative of the results of the representative's inspections, adjustments, testing and start-up. The report shall include descriptions of the inspection, adjustments made, and the start-up. The report shall also include a statement that the equipment is ready for permanent operation and that nothing in the installation will render the manufacturer's warranty null and void.

H. The Contractor's attention is directed to the fact that the services specified represent an absolute minimum acceptable level of service, and are not intended to limit the responsibilities of the Contractor to comply with all requirements of the Contract Documents. The Contractor shall procure, at no additional cost to the Owner, all services required, including additional or extended trips to the jobsite by manufacturer's representatives, to comply with said requirements.

END OF SECTION

SECTION 46 41 10
POLYETHYLENE CHEMICAL STORAGE TANKS

PART 1 GENERAL

1.01 DESCRIPTION

A. Scope of Work:

1. This Section covers the furnishing and installation of polyethylene chemical tanks for the storage of the chemicals required for proper operation of the treatment facilities.

2. Tanks furnished and installed under this Section shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with drawings, specifications, engineering data, instructions, and recommendations of the fabricator unless exceptions are noted by the Engineer.

3. The Contractor shall coordinate the work between the suppliers of equipment to be used with or connected to the storage tanks to ensure that all required provisions for mounting the accessories are included.

1.02 QUALITY ASSURANCE

A. The tank manufacturer shall have a record of at least ten (10) installations during the previous five (5) years for the tank sizes indicated. The manufacturer must be capable of furnishing names and telephone numbers of individuals that can be contacted as references.

B. Factory Testing

1. Material Testing: Material taken from each tank shall be tested for the following:

Parameter	Test Standard	Value
Impact	ASTM D1998	120 ft-lb, minimum
Gel Content, minimum	ASTM D1998	1/32-inch of inner wall: 65% outer wall: 85% total wall: 70%

2. Following fabrication, the tanks, including factory applied inlet and outlet fittings, shall be hydraulically tested with water. The factory test shall compensate for the difference in specific gravity between the test water and chemical stored to simulate actual maximum operating pressures. Test methods may include adding an air pad to a filled tank or filling the tank with standpipes, raising the maximum water surface higher than the normal maximum tank level. The test duration shall be 24 hours and no leakage shall be allowed during the test. Following successful testing, the tank shall be emptied and dried prior to shipment.

3. An affidavit signed by the tank manufacturer shall be furnished indicating that the factory tests have been performed and the indicated conditions have been met.

1.03 SUBMITTALS

A. Materials and Shop Drawings

1. Complete drawings, details, and specifications covering the storage tanks and accessories shall be submitted in accordance with Section 01 33 00: Submittal Procedures.

2. The data shall include full information on basic materials and test data confirming the chemical resistance of the proposed materials to the intended tank contents.

3. The data shall also indicate the sizes of all major tank components, including tank diameter, wall thickness, overall length, manways, ladders, nozzle details and locations, anchor bolt locations and details, support stands and full information and details concerning field assembly and installation.

4. Fabricator's catalog information, descriptive literature, specifications, and identification of materials of construction. Include complete resin system information.

5. Detailed fabrication drawings.

6. Complete design calculations for tanks, supports, and appropriate accessories.

7. Tank capacity chart indicating gallons for each inch of depth and cumulative total from bottom.

8. Fabricator's detailed requirements for tank foundations.

9. Recommended bolt torques for all bolted connections.

B. Quality Control Submittals

1. Fabricator's certificate of compliance with fabrication requirements.

2. Qualifications of fabricator's quality assurance supervisor.

3. Copy of the fabricator's quality assurance program.

4. Certification of factory testing.

5. Certification that the tank supports and access nozzles have been coordinated with the actual equipment being furnished.

6. Special shipping, storage and protection, and handling instructions.

7. Fabricator's written/printed installation and tank support instructions.

8. Manufacturer's Certificate of Proper Installation.

C. Contract Closeout Submittals: Service records for repairs performed during construction.

D. Additional Information

1. In the event that it is impossible to conform to certain details of the Specifications due to different manufacturing techniques, describe completely all nonconforming aspects.

2 Approved Materials: All materials that come into contact with the stored chemicals shall conform to NSF Standard 61 for the intended service.

E. Operating Instructions

1. Operating and maintenance manuals shall be furnished. The manuals shall be prepared specifically for this installation and shall include all required cuts, drawings, equipment lists, descriptions, etc., that are required to instruct operation and maintenance personnel unfamiliar with such equipment. The number and special requirements shall be as specified in Section 01 78 23: Operation and Maintenance Data.

2. A factory representative who has complete knowledge of proper operation and maintenance shall be provided to instruct representatives of the Owner

and the Engineer on proper operation and maintenance. With the Owner's permission, this work may be conducted in conjunction with the inspection of the installation and performance test as provided under PART 3 - EXECUTION. If there are difficulties in operation of the equipment due to the manufacturer's design or fabrication, additional service shall be provided at no cost to the Owner.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. The tanks and components shall be adequately protected during transportation, in storage at the job site, and during subsequent installation and construction activities. Damaged units will be rejected and shall be replaced with undamaged units at no expense to the Owner.

1.05 WARRANTY AND GUARANTEES

A. The tanks shall be warranted for five (5) years to be free of defects in material and workmanship. The warranty period shall begin at final completion.

PART 2 PRODUCTS

2.01 SINGLE WALL POLYETHYLENE STORAGE TANKS

A. General

1. Provide rotationally molded, vertical, polyethylene storage tanks with dome covers complete with all specified appurtenances and accessories. The polyethylene storage tanks and all related appurtenances shall be suitable for the intended service.

2. The tanks shall be designed in accordance with applicable design standards referenced herein. Design calculations shall be provided for the tanks and shall be signed and sealed by a professional engineer registered in the State of Alabama.

B. Fabrication and Manufacture

1. Resins: The tanks shall be molded from virgin high density, cross linked polyethylene resin. The resin finish color on both the interior and exterior shall be white. Resins shall include all additives necessary to make the tanks suitable for the various chemicals and to resist degradation from exposure to ultraviolet light.

2. Design and Fabrication: All tanks shall be designed in accordance with ASTM D1998-96. The hydrostatic design stress shall be 600 psi at 73 degrees F as determined by ASTM D2837 using rotationally molded samples. The hydrostatic design stress shall be derated for service above 100 degrees F. The wall thickness of the cylinder straight shell must be sufficient to support its own weight without external support. The tank top head shall be integrally molded with tank shell. Finished tanks shall be free from visual defects such as foreign inclusions, air bubbles, pinholes, crazing, cracking, and delaminations. All cut edges shall be finished smooth.

3. Material Properties: The tanks shall be constructed with materials having the properties listed below. The procedure used in determining these properties shall be in accordance with the latest revision of the applicable ASTM Standards noted. The manufacturer shall maintain a continuous quality control program and shall furnish certified test reports to the Engineer in accordance with specified submittal procedures.

Parameter	Value	ASTM Test Method
Density (Resin)	0.940-0.948 g/cc	D-1505
Tensile Strength (Yield Stress)	2,950 psi	D-638
Elongation @ Break	>1,000%	D-638
Vicat Softening Temp.	235 degrees F	D-1525
Flexural Modulus	129,000 psi	D-790
Melt Index	3.5 g/10 min	D-1238
ESCR	550 hours (100%)	D-1693
ESCR	48 hours (10%)	D-1693

C. Tank Schedule

Parameter	Corrosion Inhibitor Bulk Storage Tank	23% Hydrofluorosilic Acid Day Tank
No. of Tanks	1	1
Tank Volume, Each	5,000 gallons	50 gallons
Specific Gravity of Contents for Tank Design	1.5	1.5
Tank Diameter	8'-0"	1'-11"
Tank Height	9'-4"	3'-3"
Fill Size	2" side	2" top
Overflow Size	3" side	2" side
Vent Size	6" top	2" top
Outlet/Drain Size	3" side	Outlet: 1" side Drain ½" side
Level Sensor	6" top	N/A
Manway Size	24" top	N/A
Ladder, Platform & Railings	Yes	No

2.02 ACCESSORIES

A. Accessories shall be provided on each tank as indicated on the Drawings and as specified herein.

1. Nozzles:

a. Nozzles for connecting piping and accessories shall be provided on each tank at the locations and of the sizes indicated on the Drawings and specified herein.

b. Each nozzle for connecting piping and accessories 2-inches in diameter and larger shall be flanged, with flange diameter and drilling conforming to ANSI B16.5, Class 150. Nozzles shall extend at least 3 inches from outside face of tank to face of flange. Gaskets for flanged connections shall be full face, 1/8 inch thick, and of suitable elastomeric material to resist the attack of the chemical being stored.

c. Nozzles for connecting piping and accessories less than 2-inches in diameter shall be female NPT extending at least 2 inches from the outside face of the tank. Bulkhead fittings may be used in lieu of nozzles for connections to the top of the tanks.

d. The level element mounting flange on the top of the corrosion inhibitor tank shall be above the maximum liquid level at a distance recommended by the level sensor manufacturer. The length of the nozzle shall be as recommended by the level sensor manufacturer. The centerline of the nozzle shall be at least 12 inches from the tank sidewall, fill nozzle, and other obstructions.

e. A fill pipe extension shall be provided for the corrosion inhibitor tank from the tank dome to a point 12 inches above the tank bottom. Four 3/8-inch holes shall be drilled in the extension just below the dome to prevent a siphon condition.

2. Flexible Expansion Joint: Chemical tanks shall be provided with a flanged expansion joint on the tank outlet/drain connection where shown in the Drawings. All materials of the flexible expansion joint shall be compatible with the liquid being stored. Flexible expansion joint shall have minimum axial compression/extension, and lateral and angular deflection as recommended by the tank manufacturer.

3. Vents: The chemical tanks shall be provided with a vent as shown on the Drawings to prevent drawing a vacuum inside the tank during pumping or draining. The outside of the vent shall be equipped with an insect screen of material compatible with the chemical stored.

4. Nameplates: Each tank shall be provided with a nameplate to identify the chemical stored. The nameplates shall be made of Type 316 stainless steel with engraved lettering one inch high and shall be mounted on the tank at a location acceptable to the Engineer. The chemical designation to be engraved on the nameplate shall be as specified herein.

5. Certification Plates: A Type 316 stainless steel certification plate shall be installed below each storage tank nameplate. The following data shall be included on the certification plate:

a. Name of tank fabricator.

b. Date of manufacture.

c. Product to be stored.

d. Maximum allowable concentration, specific gravity and temperature of the specified chemical solution that can be stored safely.

e. Equipment identification number shown listed herein.

6. Gaskets for nozzles and tank cover flanges shall be supplied by the tank manufacturer and be of an elastomeric material compatible with the chemical to be stored.

7. The corrosion inhibitor tank shall be furnished with top manway and cover. The manway shall be liquid tight for maximum loading conditions, suitable for the intended chemical use, and a minimum 24-inches in diameter. Cover shall be fume tight furnished with EPDM or Viton full face gaskets and Type 316 stainless steel bolts. Boss flange type flush manway shall not be used. Tolerance on flatness shall be the same as for the flanges.

8. Day Tank Scales: Provide chemical scale suitable for the service intended for the hydrofluorosilicic acid day tank where shown on the Drawings. The chemical scale shall be of the digital readout/electronic single load cell type. The scale platform shall be sized to accept the tank size for which it is intended and shall be equipped with four (4) adjustable hold down lugs to increase lateral stability. The platform scale coating system shall be a minimum dry film thickness of 80 mils and shall be resistant to moisture, chemicals, abrasion, impact, and UV light. The day tank scale shall be equipped with a 4-20 mA output signal with a remote mounted LCD indicator. The indicator shall be housed in a NEMA 4X fiberglass UL approved enclosure with a power requirement of 120 VAC. The indicator display shall give the operator the ability to monitor the chemical by weight (lbs) or volume (gallons) and shall display the percent (0-100) of net contents. The indicator shall output net weight via a 4-20mA signal and full scale output shall be user adjustable via the keypad. The indicator shall have four adjustable set points to display low or high level conditions on the indicator. Day tank scales shall be Force Flow Chem-Scale or approved equal.

9. Ladders: The corrosion inhibitor storage tank shall be furnished with an external access ladder and access platform to facilitate access to the manway. Ladder shall meet applicable OSHA standards and the building code applicable to the project.

a. Ladder shall be FRP construction. Uncoated or exposed carbon steel parts or fasteners will not be acceptable. The ladder shall be

supported on and anchored to the concrete base and bracketed to the tank shell as required.

b. Ladder shall be provided with necessary assembly and mounting hardware. Mounts shall not penetrate tank wall. All mounting hardware shall be Type 316 stainless steel.

c. The ladder shall include safety rails across the top of the tank to the access manhole, attached to the ladder side rails, and anchored to the tank head as required.

d. The ladders shall have a clear width of at least 16 inches, with rungs at least ¾-inches in diameter and spaced not more than 12 inches apart and a clearance of at least 12 inches between the back of the ladder and the tank wall. Ladder shall extend beyond tank bottom to within 6 inches of concrete tank pad.

e. Safety rails and platform shall be fabricated of fiberglass reinforced plastic shapes and shall be fabricated and installed in accordance with OSHA regulations and the building code applicable to the project. Safety railings with 3 rails and kick plate or skirt-style handrail shall be provided around the perimeter of each manway opening, attached to the ladder side rails and anchored to the tank head as required.

10. Sight Gauge: The corrosion inhibitor tank shall be equipped with an external sight gauge made using 2-inch threaded PVC fittings, true-union PVC ball valves, and clear Schedule 40 PVC pipe. Mounted on the tank adjacent to the sight gauge shall be a gauge board of corrosion-resistant construction calibrated with corrosion resistant marking in 100-gallon increments.

11. Lifting Lugs: Provide suitably attached lugs for all tanks.

12. Anchor Bolts: Provide Type 316 stainless steel in services other than hydrofluorosilicic acid and Hastelloy-C in hydrofluorosilicic acid service, sized by the manufacturer and be at least ½-inch in diameter.

13. Anchor Lugs: Anchor lugs shall be provided and shall be designed to withstand all anticipated load conditions. No less than 8 anchor lugs shall be provided. Details of anchors shall be shown on fabrication Drawings. Anchor lugs shall be of Type 316 stainless steel in services other than hydrofluorosilicic acid and Hastelloy-C in hydrofluorosilicic acid service.

2.03 QUALITY CONTROL

A. Contractor shall follow manufacturer's and supplier's product quality control specifics as required for this project.

PART 3 EXECUTION

3.01 INSTALLATION

A. The tanks shall be installed at the locations as indicated on the Drawings in accordance with the manufacturer's recommendations, the requirements of the applicable governing standard, and to the satisfaction of the Engineer, and made ready for the installation of piping and other appurtenances as indicated on the Drawings and specified under other Sections. Grouting under the tank, if required by the tank manufacturer, shall be done with non-shrinking grout.

3.02 ONSITE INSPECTION AND TESTING

A. After completion of installation, the tanks shall be filled with water to the top overflow opening and allowed to stand full for a period of not less than 48 hours. During testing flanged or threaded connections may be plugged by the installation of temporary blind flanges or threaded plugs on the outside of the tank but shall not be blocked or plugged on the inside. All leaks or indications of leaks shall be repaired and made completely watertight. A leaking tank, upon repair, shall be retested to the satisfaction of the Engineer.

B Cleaning: When installation has been completed and all connections have been made, all tank surfaces, interior and exterior, shall be thoroughly cleaned as recommended by the fabricator and to the satisfaction of the Engineer. Abrasive cleaning agents shall not be used. The tank and wetted accessories shall be completely dried before being placed into service.

3.03 START-UP AND INSTRUCTION

A. A representative of the manufacturer shall certify in writing that the tank has been installed in accordance with the manufacturer's recommendations. Certification shall be submitted.

END OF SECTION

SECTION 46 41 17
IN-LINE STATIC MIXERS

PART 1 GENERAL

1.01 DESCRIPTION

A. Scope of Work

1. The Contractor shall furnish all labor, materials, equipment and incidentals required to install two in-line static mixers as shown on the Drawings and specified herein.

2. Each mixer is intended to rapidly mix chemical solutions into the process water to provide a homogeneous stream at the mixer outlet.

1.02 QUALITY ASSURANCE

A. The static mixing equipment manufacturer shall have experience in the design and manufacture of equipment of similar size and capacity and shall present proof of successful operations involving each piece of equipment furnished. All equipment shall be as manufactured by Komax Systems, Inc., or Chemineer.

1.03 SUBMITTALS

A. Materials and Shop Drawings

1. Submit shop drawings and product data for equipment furnished under this section in accordance with Section 01 33 00: Submittal Procedures.

2. Submit mixing calculations for each static mixer demonstrating the mixing achieved at the minimum and maximum conditions as listed in Table A.

B. Additional Information

1. Equipment Installation Certificate: The manufacturer shall provide a written report, through the Contractor and endorsed in writing by the Contractor, certifying that the equipment has been properly installed and checked and is ready for placement into routine permanent service.

C. Operating Instructions

1. Operating and Maintenance Manual: Furnish Operation and Maintenance Manuals in accordance with Section 01 78 23: Operating and Maintenance Data.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. The equipment provided under this Section shall be shipped, handled, and stored in accordance with the manufacturer's written instructions, and in accordance with Section 01 61 00: Common Product Requirements.

1.05 WARRANTY AND GUARANTEES

A. Provide equipment (system) warranty in accordance with Section 01 74 00: Warranties and Bonds.

PART 2 PRODUCTS

2.01 GENERAL

A. The raw water static mixer will be used to blend 48 percent aluminum sulfate, 13.5 percent sodium hypochlorite, and 50 percent sodium hydroxide into a process stream of untreated surface water.

B. The finished water static mixer will be used to blend 23 percent hydrofluosilicic acid, 13.5 percent sodium hypochlorite, 50 percent sodium hydroxide, and corrosion inhibitor into a process stream of finished water.

C. Each mixer shall include injection nozzles that are capable of blending the chemicals and the process water into a homogeneous solution over a process water flow range of 6 MGD to 24 MGD. Mixer shall provide mixing efficiency specified in Table A three (3) pipe diameters downstream of the mixer across the entire dynamic range of flow rates. The pressure drop across the mixer shall not exceed the values listed at the maximum flow rate.

2.02 MATERIALS AND EQUIPMENT

A. Raw and Finished Water Static Mixers

1. Each mixer shall be furnished complete with carbon steel components, including the flanged end body, internal elements, and all other necessary appurtenances.

2. The mixer housing and mixing elements shall be constructed of carbon steel. The mixer housing shall have a 30-inch nominal diameter and be constructed of carbon steel with a minimum 3/8" wall thickness. The mixers shall be provided with an internal epoxy coating on all wetted surfaces. Viton full-face gaskets, 1/8-inch thick, shall be provided for raised-face flanges. The mixer shall be able to withstand an internal pressure of 150 psi. The mixer housing, mixing elements and injectors shall be able to withstand a temperature of 150°F and a minimum pH of 1.5. All coatings that will come into contact with the process water shall be in accordance with NSF Standard 61.

3. The number of mixing elements shall be as recommended by the mixer manufacturer for the use intended. A minimum of two (2) elements shall be provided. Overall length shall not exceed the criteria listed in Table A. Tab-style mixers or mixing elements shall not be allowed.

2.03 ACCESSORIES

A. Injector Connections: Provide 1½" flanged connections with injectors for injection of process chemicals as listed in Table A and as shown in the Drawings. Flanged connections shall be located on the same side of the mixer.

B. The injectors shall be Schedule 80 PVC, multiple orifice type to distribute the injected stream evenly across the profile of the pipeline to promote blending. The injectors shall be removable for inspection and service. A ball valve shall be provided to shut off the main line after removal of the injector. The quantity, size and location of the orifice holes in the injection quill shall be designed to promote a high velocity and injection pressure to prevent the primary stream from entering the injector nozzle. The injector size shall be as listed in Table A in this Specification and noted on the Drawings for each chemical being injected. Injectors shall be as manufactured by Saf-T-Flo or equal.

2.04 SPARE PARTS

A. All of the manufacturer's recommended spare parts necessary to maintain the unit in operation for a period of one (1) year shall be provided.

B. Provide one (1) spare injector for each service.

C. All tools and spare parts shall be furnished in containers clearly identified with indelible markings as to their contents. Each container shall be packed with its contents protected for storage. All tools shall be furnished in steel tool boxes.

D. Spare parts shall be delivered at the same time as the equipment to which they pertain. The Contractor shall properly store and safeguard such spare parts until completion of the work, at which time they shall be delivered to the Owner.

2.05 QUALITY CONTROL

A. Perform Manufacturer's and Supplier's product quality control specifics as required for this project.

PART 3 EXECUTION

3.01 INSTALLATION

A. Installation shall be in strict accordance with the manufacturer's instructions and recommendations using proven construction techniques in the location shown on the Drawings.

3.02 INSPECTION AND TESTING

A. Upon completion of installation, the Contractor, in the presence of the Engineer and a qualified manufacturer's representative, shall perform a preliminary test on the system to ensure that all component parts are functioning to the satisfaction of the Engineer.

B. Approval of the preliminary test by the Engineer shall not constitute final acceptance of the equipment furnished.

C. After the system is in full operation, a full operating test shall be performed in the presence of the Engineer and a qualified manufacturer's representative.

3.03 START-UP AND INSTRUCTION

A. Furnish services of manufacturer's technical representative to inspect the completed installation, correct or supervise correction of any defects or malfunctions, and instruct operating personnel in proper operating and maintenance procedures as described in this Section.

TABLE A
STATIC MIXER UNIT DESIGN REQUIREMENTS

Item/Design Conditions	Raw Water	Finished Water
Mixer Finish (Internal):	Conform to NSF Standard 61, Epoxy	Conform to NSF Standard 61, Epoxy
Mixer Type:	Triple Action	Low dp Triple Action
Diameter:	30 inch	30 inch
Design Working Pressure:	50 psi	8 psi
End Connections:	150 lb Flanged	150 lb Flanged
Water Rate of Flow, Min/Max:	6.0 / 24 MGD	6.0 / 24 MGD
Maximum Length:	9.0 feet	10.5 feet
Maximum Pressure Loss at Maximum Flow:	3.4 psi	1.5 psi
Number of Injector Ports	4	5
Chemical Feed Rate of Flow, Min/Max: (Injector Size)		
13.5% Sodium Hypochlorite, S.G. = 1.21	2.5 / 50 gph (1")	2.0 / 40 gph (1")
23% Hydrofluosilicic Acid, S.G. = 1.27	NA	0.2 / 4.0 gph (1/2")
50% Sodium Hydroxide, SG = 1.53	1.5 / 30 gph (1")	1.5 / 30 gph (1")
48% Aluminum Sulfate, SG = 1.33	6.0 / 120 gph (1")	NA
Corrosion Inhibitor	NA	0.1 / 1.0 gph (1/2")
Percent Mixing Efficiency (Coefficient of Variation, CoV)	90% (0.10)	90% (0.10)

Note: Provide one (1) 1 ½" spare injector port on each static mixer. The spare port is included in number of injector ports given in the table above.

END OF SECTION

SECTION 46 41 20
FIBERGLASS REINFORCED PLASTIC TANKS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope of Work:

1. This Section covers the furnishing and installation of fiberglass reinforced plastic (FRP) tanks for the storage of chemicals required for proper operation of the treatment facilities.

2. Tanks furnished and installed under this Section shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with drawings, specifications, engineering data, instructions, and recommendations of the fabricator unless exceptions are noted by the Engineer.

3. The Contractor shall coordinate the work between the suppliers of equipment to be used with or connected to the tank to ensure that all required provisions for mounting the accessories are included.

1.02 QUALITY ASSURANCE

A. Governing Standards: Except as modified or supplemented herein, all materials and construction methods shall comply with the applicable provisions of the following standards and requirements:

1. ASTM C581, “Chemical Resistance of Thermosetting Resins Used in Glass Fiber Reinforced Structures”.

2. ASTM C582, "Standard Specification for Contact-Molded Reinforced Thermosetting Plastic (RTP) Laminates for Corrosion Resistant Equipment".

3. ASTM D3299, "Standard Specification for Filament-Wound Glass-Fiber Reinforced Thermoset Resin Chemical-Resistant Tanks".

4. ASTM D4097, "Standard Specification for Contact-Molded Glass-Fiber Reinforced Thermoset Resin Chemical-Resistant Tanks".

5. Applicable building code.

6. Fabricator's Quality Assurance Supervisor: Minimum of five (5) years experience in the fabrication of fiberglass structures.

7. Tanks shall be designed by a professional engineer licensed in the State of Alabama. The shop drawings shall include calculations and drawings signed and sealed by the engineer responsible for design of the tanks.

8. The tanks shall be ASME RTP-1 certified.

9. The tanks shall meet the requirements of NSF Standard 61 for chemical storage vessels that contain liquids that will be added to potable water.

10. All tanks shall be specifically designed to contain the chemicals listed herein and shall provide long-term dependable service without corrosion, leakage, or product degradation.

B. The tank manufacturer shall have a record of at least ten (10) installations during the previous five (5) years for the tank sizes indicated. The manufacturer must be capable of furnishing names and telephone number of individuals that can be contacted as references.

C. Factory Testing

1. Following fabrication, the tanks, including factory applied inlet and outlet fittings, shall be hydraulically tested with water. The factory test shall compensate for the difference in specific gravity between the test water and chemical stored to simulate actual maximum operating pressures. Test methods may include adding an air pad to a filled tank or filling the tank with standpipes raising the maximum water surface higher than the normal maximum tank level. The test duration shall be 24 hours. Following successful testing, the tank shall be emptied and dried prior to shipment.

2. An affidavit signed by the tank manufacturer shall be furnished indicating that the factory tests have been performed and the indicated conditions have been met.

1.03 SUBMITTALS

A. Materials and Shop Drawings:

1. Complete drawings, details, and specifications covering the storage tanks and accessories shall be submitted in accordance with Section 01 33 00: Submittal Procedures.

2. The data shall include full information on basic materials and test data confirming the chemical resistance of the proposed resins to the intended tank contents.

3. The data shall also indicate the sizes of all major tank components including tank diameter, wall thickness, overall length, nozzle details and locations, anchor bolt locations and details, and full information and details concerning field assembly and installation.

4. Fabricator's catalog information, descriptive literature, specifications, and identification of materials of construction. Include complete resin system information.

5. Detailed fabrication drawings.

6. Complete design calculations for tanks, supports, and appropriate accessories.

7. Tank capacity chart indicating gallons for each inch of depth and cumulative total from bottom.

8. Fabricator's detailed requirements for tank foundations.

9. Recommended bolt torques for all bolted FRP connections.

10. Recommendations for tank material selection and fabrication methods for services indicated herein.

11. ASME RTP-1 Certification.

12. Certified test data on representative samples of standard laminate materials which verify that their physical properties meet the requirements and service conditions specified. Include verification of structural design parameters.

13. Final Configuration of Tank Appurtenances: The final locations of tank appurtenances including, but not limited to, nozzles, manways, pipe supports, anchor lugs, ladder, and handrail will be confirmed by the Engineer during review of Contractor's submittals.

B. Samples: Submit laminate sample representative of production quality of surface finish.

C. Quality Control Submittals:

1. Fabricator's certificate of compliance with fabrication requirements.

2. Qualifications of fabricator's quality assurance supervisor.

3. Copy of the fabricator's quality assurance program.

4. Certification of factory testing.

5. Certification that the tank supports, and access nozzles have been coordinated with the actual equipment being furnished.

6. Special shipping, storage and protection, and handling instructions.

7. Fabricator's written/printed installation and tank support instructions.

8. Manufacturer's Certificate of Proper Installation.

9. ASME RTP-1 Certification.

D. Contract Closeout submittals: Service records for repairs performed during construction.

E. Additional Information: In the event that it is impossible to conform to certain details of the Specifications due to different manufacturing techniques, describe completely all nonconforming aspects.

F. Operating Instructions

1. Operating and maintenance manuals shall be furnished. The manuals shall be prepared specifically for this installation and shall include all required cuts, drawings, equipment lists, descriptions, etc., that are required to instruct operation and maintenance personnel unfamiliar with such equipment. The number and special requirements shall be as specified in Section 01 78 23: Operation and Maintenance Data.

2. A factory representative who has complete knowledge of proper operation and maintenance, shall be provided to instruct representatives of the Owner and the Engineer on proper operation and maintenance. With the Owner's permission, this work may be conducted in conjunction with the inspection of the installation and test run as provided under PART 3-EXECUTION. If there are difficulties in operation of the equipment due to the manufacturer's design or fabrication, additional service shall be provided at no cost to the Owner.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. The tanks and components shall be adequately protected during transportation, in storage at the job site, and during subsequent installation and construction activities. Damaged units will be rejected and shall be replaced with undamaged units.

1.05 WARRANTY AND GUARANTEES

A. The tank shall be warranted for five (5) years to be free of defects in material and workmanship. The warranty period shall begin at final completion of the project.

PART 2 - PRODUCTS

2.01 GENERAL

A. The tanks shall be as manufactured by Augusta Fiberglass, Inc., Xerxes, Raven, Southeastern Fiberglass Products, Inc. or approved equal.

2.02 MATERIALS AND EQUIPMENT

A. Basic materials shall be as follows:

Resin	Vinyl ester resins shall be Hetron 922 suitable for use with the specified chemicals, or approved equal. Use same resin throughout tank.
Reinforcement	Glass fiber with a suitable coupling agent.
Surfacing Mat	Burlington Formed Fabrics "Nexus Veil", Nicofibers "Surmat 100", or equal.
Plastic Laminate	In conformity with the applicable governing standards.
Exposed Metal	ANSI Type 316 stainless steel, in services other than sodium hypochlorite. Hastelloy-C in sodium hypochlorite service.
Exposed Assembly and Bolts, Nuts, and Washers	ANSI Type 316 stainless steel, in services other than sodium hypochlorite. Hastelloy-C in sodium hypochlorite service.

Protected Metal — Carbon steel, ASTM A36, with fiberglass reinforced plastic coating.

B. Performance and Design Requirements

1. Conditions of Service: Each tank will normally be used to store the specified chemical at atmospheric pressure. The tanks shall be designed for the storage of the following liquid chemicals:

Tank Number	21-T-1&2	22-T-1&2	23-T-1
Chemical	Alum	Sodium Hypochlorite	Sodium Hydroxide
Location	Main Process Building - Chemical Feed Room	Main Process Building - Chemical Feed Room	Main Process Building - Chemical Feed Room
Concentration Percent by Weight	48	15	50
Chemical Specific Gravity	1.33	1.21	1.53
Max. Ambient & Liquid Temp., Degrees F	100	100	100
Min. Ambient & Liquid Temp., Degrees F	40	40	40

2. Design Criteria:

a. Each tank shall be designed to withstand the hydrostatic head which would result with the tank and fill line surcharged with the liquid chemical to 6 inches above the top of the tank.

b. The tanks shall conform to the following requirements:

Tank Number	21-T-1&2	22-T-1&2	23-T-1
Service	Alum	Sodium Hypochlorite	Sodium Hydroxide
Orientation	Vertical	Vertical	Vertical
Location	Main Process Building - Chemical Feed Room	Main Process Building - Chemical Feed Room	Main Process Building - Chemical Feed Room
Nominal Capacity, Measured to Top of Tank, Gal.	14,000	14,000	6,000
Max Diameter, Feet	13	13	10
Max Tank Height, Feet	15	15	11

c. Each tank shall be designed in accordance with the applicable design standards referenced herein. Design calculations shall be provided for each tank and shall be signed and sealed by a professional engineer registered in the State of Alabama.

C. Fabrication and Manufacture

1. Manufacture

a. The tanks shall be hand lay-up, spray-up, or filament wound construction in accordance with the applicable governing standard. All tank shells shall be shop fabricated in a controlled environment by the manufacturer and no vertical seams shall be allowed. The finished laminate shall be constructed using a single generic type of thermoset resin throughout and shall not contain colorants, dyes, fillers, or pigments unless otherwise specified. Ultraviolet absorber shall be added to the resin used in the fabrication of tanks indicated on the Drawings or specified to be suitable for installation in exposed, exterior locations. After installation and testing, the tanks shall be painted as specified in Section 09 90 00: Painting and Coating, to shield the chemical contents from light.

b. The inner surface layer of the tanks shall consist of two (2) resin rich layers reinforced with surfacing mat and having a total combined thickness of not less than 110 mils.

c. Bracketed flat surfaces shall be provided on each tank for the installation of a nameplate, and a certification plate.

d. Minimum of four (4) lifting lugs shall be provided on each tank as required for handling and installation.

e. For sodium hypochlorite, the cure system for the corrosion liner shall be BPO/DMA with a four (4) hour post cure at 180°F. For all other tanks and for structural layers on the sodium hypochlorite tanks, the initiator used shall be of the type, manufacturing origin, and amounts specified by the resin manufacturer. The resins and curing shall comply with FDA Regulation 21 CFR 177.2420.

f. For sodium hypochlorite storage tanks, the inner surface of the tank shall have a double nexus veil of 20 mils with ECR banking for the corrosion liner. For all other chemical storage tanks, the inner surface of the tank shall have a single or double nexus veil of 20 mils as a minimum. Material used as reinforcing on the surface exposed to chemical attack shall be commercial grade chemical resistant glass fiber having a coupling agent.

3. Concrete Bases:

a. The concrete bases for the tanks shall be constructed in accordance with the Drawings and Specifications and shall be level and smooth to the tolerances recommended by the tank manufacturer. Concrete bases shall be coated in accordance with Section 09 90 00, Painting and Coating.

2.03 ACCESSORIES

A. Accessories shall be provided on each tank as indicated on the Drawings and as specified herein.

Tank Number	21-T-1&2	22-T-1&2	23-T-1
Chemical	Alum	Sodium Hypochlorite	Sodium Hydroxide
Location	Main Process Building - Chemical Feed Room	Main Process Building - Chemical Feed Room	Main Process Building - Chemical Feed Room
Fill	2" top	2" top	2" top
Outlet/Drain	3" side	3" side	3" side
Overflow	3" side	3" side	3" side
Vent	6" top	6" top	6" top
Manway	24" top	24" top	24" top
Level Sensor	6" top	6" top	6" top
Site Glass	1" side (2 ea.)	1" side (2 ea.)	1" side (2 ea.)

1. Flanged Nozzles:

a. Nozzles for connecting piping and accessories shall be provided on each tank at the locations and of the sizes indicated on the Drawings and specified herein.

b. Each nozzle shall be flanged, with flange diameter and drilling conforming to ANSI B16.5, Class 150. Nozzles shall extend at least 4 inches from outside face of tank to face of flange. Nozzles smaller than 6 inches in size shall be reinforced with plate gussets.

c. A fill pipe extension shall be provided from the tank dome to a point 12 inches above the tank bottom. Four 3/8-inch holes shall be drilled in the extension just below the tank dome to prevent a siphon condition.

d. The level gauge mounting flange shall be above the maximum liquid level at a height recommended by the level sensor manufacturer. The length of the nozzle shall be as recommended by the level sensor manufacturer. The centerline of the nozzle shall be at least 24 inches from the tank sidewall, fill nozzle, and other obstructions.

e. Flanged nozzles shall be fabricated of the same material as the tank and shall be gusseted to the tank as specified above or otherwise reinforced in accordance with the governing standard.

f. Each tank shall be provided with flanged nozzles with the orientations shown on the Drawings and specified above.

2. Flexible Expansion Joint: Chemical tanks shall be provided with flanged flexible expansion joint on the tank outlet/drain connection. All materials of the flexible expansion joint shall be compatible with the liquid being stored. Flexible expansion joint shall have a minimum axial compression/extension, and lateral and angular deflection as recommended by the tank manufacturer.

3. Overflow and Drains: Chemical tanks shall be provided with an overflow and drain line of the size as shown on the Drawing or as recommended by the manufacturer to provide means for draining the tank and to prevent spills in the event of overfilling.

4. Nameplates: Each tank shall be provided with a nameplate to identify the use of the tank. The nameplates shall be of orange phenolic material with black engraved lettering one inch high and shall be mounted on the tank at a location acceptable to the Engineer.

5. Certification Plates: A stainless steel certification plate shall be installed below each storage tank nameplate. The following data shall be included on the certification plate:

a. Name of tank fabricator.

b. Date of manufacture.

c. Product to be stored

d. Maximum allowable concentration, specific gravity and temperature of the specified chemical solution that can be stored safely.

e. Mechanical properties of the laminate.

f. Resin designation.

g. Equipment identification number shown listed herein.

6. Lifting Lugs: Provide suitably attached for all tanks.

7. Anchor Bolts: Provide Type 316 stainless steel bolts in services other than sodium hypochlorite and Hastelloy-C in sodium hypochlorite service, sized by the manufacturer and be at least 1/2-inch in diameter.

8. Anchor Lugs: Anchor lugs shall be provided and shall be designed to withstand all anticipated load conditions. No less than 8 anchor lugs shall be provided. Details of anchors shall be shown on fabrication Drawings. Anchor lugs shall be of Type 316 stainless steel in services other than sodium hypochlorite and Hastelloy-C in sodium hypochlorite service.

9. Vents: The chemical tanks shall be provided with a vent as shown on the Drawings to prevent drawing a vacuum inside the tank during pumping or draining. The exterior of the vent shall be equipped with an insect screen of material compatible with the chemical stored.

10. Ladders: Each bulk storage tank shall be furnished with an external access ladder and access platform to facilitate access to the manway. Ladders shall meet applicable OSHA standards and the building code applicable to the project.

    a. Ladders shall be FRP construction. Uncoated or exposed carbon steel parts or fasteners will not be acceptable. The ladders shall be supported on and anchored to the concrete base and bracketed to the tank shell as required.

    b. Ladders shall be provided with necessary assembly and mounting hardware. Mounts shall not penetrate tank wall. All mounting hardware shall be Type 316 stainless steel in services other than sodium hypochlorite and Hastelloy-C in sodium hypochlorite service.

    c. The ladder shall include safety rails across the top of the tank to the access manhole, attached to the ladder side rails, and anchored to the tank head as required.

    d. The ladders shall have a clear width of at least 16 inches, with rungs at least ¾-inches in diameter and spaced not more than 12 inches apart and a clearance of at least 12 inches between the back of the ladder and the tank wall. Ladder shall extend beyond tank bottom to within 6 inches of concrete tank pad.

    e. Safety rails and platform shall be fabricated of fiberglass reinforced plastic shapes and shall be fabricated and installed in accordance

with OSHA regulations and the building code applicable to the project. Safety railings with 3 rails and kick plate or skirt-style handrail shall be provided around the perimeter of each manway opening, attached to the ladder side rails and anchored to the tank head as required.

11. Each tank shall be furnished with top manway and cover. The manway shall be liquid tight for maximum loading conditions and suitable for the intended chemical use. Manways shall be a minimum 24 inches in diameter. Cover shall be fume tight furnished with EPDM or Viton full face gaskets. Type 316 stainless steel bolts shall be used in all services except for sodium hypochlorite. Hastelloy-C bolts shall be used in sodium hypochlorite service. Boss flange type flush manways shall not be used. Tolerance on flatness shall be the same as for the flanges.

12. Sight Gauge: Each tank shall be equipped with an external sight gauge made using 2-inch threaded PVC fittings, true-union ball valves, and clear Schedule 40 PVC pipe. Mounted on the tank adjacent to the sight gauge shall be a gauge board of corrosion-resistant construction calibrated with corrosion-resistant marking in 100-gallon increments.

2.04 QUALITY CONTROL

A. Inspection of all products fabricated to this Specification is required prior to shipment unless specifically waived in writing by the Engineer. This shall include:

1. Visual inspection to the requirements of ASTM C582-87 and ASTM D2563-87.

2. Barcol Hardness measurements per ASTM D2583-87.

3. Acetone sensitivity test for all internal secondary bonds.

4. Glass content by ignition loss on three (3) cutouts per ASTM D2584.

5. Hydrostatic leak tests.

B. Repairs authorized by the Engineer shall be reinspected before final acceptance unless specifically waived.

C. Identify and retain all cutouts. Engineer may select certain cutouts for testing for physical properties of the laminate.

D. Factory Test Reports: Certify, by signature, results of the following:

1. Inspections.

2. Results of testing.

3. Test reports of physical properties of standard laminates.

PART 3 - EXECUTION

3.01 INSTALLATION

A. The tanks shall be installed at the locations as indicated on the Drawings. The tanks shall be installed in accordance with the fabricator's recommendations, the requirements of the applicable governing standard, and to the satisfaction of the Engineer, and made ready for the installation of piping and other appurtenances as indicated on the Drawings and specified under other Sections. Grouting under the tank, if recommended by the tank fabricator, shall be done with nonshrinking grout.

3.02 INSPECTION AND TESTING

A. After completion of installation, the tanks shall be filled with water to the top access manhole opening and allowed to stand full for a period of not less than 48 hours. During testing, flanged connections may be plugged by the installation of temporary blind flanges on the outside of the tank but shall not be blocked or plugged on the inside. All leaks or indications of leaks shall be repaired by the manufacturer and made completely watertight. A leaking tank, upon repair, shall be retested to the satisfaction of the Engineer.

3.03 START-UP AND INSTRUCTION

A. When installation has been completed and all connections have been made, all tank surfaces, interior and exterior, shall be thoroughly cleaned as recommended by the manufacturer and to the satisfaction of the Engineer. Abrasive cleaning agents shall not be used. The tank and wetted accessories shall be completely dried before being placed into service.

B. Provide manufacturer's representative at site in accordance with Section 01 91 14: Equipment Testing and Facility Start-Up for installation assistance, inspection and certification of proper installation and start-up assistance for specified component, subsystem, equipment, or system.

C. Manufacturer's Authorized Representative: Present at work site designated by the Contractor for the minimum person-days listed below, travel time excluded.

1. Services to include but may not be limited to:

   a. One (1) person-day for installation assistance, inspection, and certification of installation for each tank service.

2. Furnish assistance, inspection, and certification services at such times as requested by the Contractor.

END OF SECTION

SECTION 46 41 30
STEEL CHEMICAL STORAGE TANK

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope of Work:

1. This Section covers the furnishing and installation of a steel chemical tank for the storage of hydrofluorosilicic acid required for proper operation of the treatment facilities.

2. The tank furnished and installed under this Section shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with drawings, specifications, engineering data, instructions, and recommendations of the fabricator unless exceptions are noted by the Engineer.

3. The Contractor shall coordinate the work between the suppliers of equipment to be used with or connected to the storage tank to ensure that all required provisions for mounting the accessories are included.

1.02 QUALITY ASSURANCE

A. Governing Standards: Except as modified or supplemented herein, all materials and construction methods shall comply with the applicable provisions of the following standards and requirements:

1. ANSI Z49.1 – Safety in Welding and Cutting

2. ASME Section IX – Qualification Standard for Welding and Brazing Procedures, Welders, Brazers and Welding and Brazing Operators.

3. ASTM A36 – Standard Specification for Structural Steel

4. Applicable building code.

5. Fabricator's Quality Assurance Supervisor: Minimum of five (5) years experience in the fabrication of tanks designed to store corrosive chemicals.

6. The tank shall be designed by a professional engineer licensed in the State of Alabama. The shop drawing submittal shall include signed and sealed calculations and drawings prepared by the engineer responsible for the tank design.

7. The tank shall be furnished, coordinated, and tested by one (1) supplier. The system shall be completely shop-assembled and shop-tested prior to shipment.

B. The tank manufacturer shall have a record of at least ten (10) installations during the previous five (5) years for the tank size indicated. The manufacturer must be capable of furnishing names and telephone numbers for references that can be contacted.

C. Factory Testing

1. The tank shall be subjected to a 1-hour pneumatic test at a pressure of 10 psi. Any leakage detected during the test shall be corrected and the tank shall be re-tested.

2. Following pneumatic testing, the tank, including factory applied inlet and outlet fittings, shall be hydraulically tested with water. The factory test shall compensate for the difference in specific gravity between the test water and chemical stored to simulate actual maximum operating pressures. Test methods may include adding an air pad to a filled tank or filling the tank with standpipes, raising the maximum water surface above the normal maximum tank level. The test duration shall be 24 hours. No leakage is allowed. Following successful testing, the tank shall be emptied and dried prior to shipment.

3. An affidavit signed by the tank manufacturer shall be furnished indicating that the factory tests have been performed and the indicated conditions have been met.

1.03 SUBMITTALS

A. Materials and Shop Drawings

1. Complete drawings, details, and specifications covering the storage tank and accessories shall be submitted in accordance with Section 01 33 00: Submittal Procedures.

2. The data shall include full information on basic materials and test data confirming the chemical resistance of the proposed materials to the intended tank contents.

3. The data shall also indicate the sizes of all major tank components, including tank diameter, wall thickness, overall length, manways, ladders, nozzle details and locations, anchor bolt locations and details, support stands and full information and details concerning field assembly and installation.

4. Fabricator's catalog information, descriptive literature, specifications, and identification of materials of construction. Include protective coating application procedures.

5. Detailed fabrication drawings.

6. Complete design calculations for tank, supports, and appropriate accessories.

7. Tank capacity chart indicating gallons for each inch of depth and cumulative total from bottom.

8. Fabricator's detailed requirements for tank foundations.

9. Recommended bolt torques for all bolted connections.

10. Recommendations for tank material selection and fabrication methods for service indicated herein.

12. Wall thickness (shell, head and base).

B. Quality Control Submittals

1. Fabricator's certificate of compliance with fabrication requirements.

2. Qualifications of fabricator's quality assurance supervisor.

3. Copy of the fabricator's quality assurance program.

4. Certification of factory testing.

5. Certification that the tank supports and access nozzles have been coordinated with the actual equipment being furnished.

6. Special shipping, storage and protection, and handling instructions.

7. Fabricator's written/printed installation and tank support instructions.

8. Manufacturer's certificate of proper installation.

C. Contract Closeout submittals: Service records for repairs performed during construction.

D. Additional Information: In the event that it is impossible to conform to certain details of the Specifications due to different manufacturing techniques, describe completely all nonconforming aspects.

E. Operating Instructions

1. Operating and maintenance manuals shall be furnished. The manuals shall be prepared specifically for this installation and shall include all required cuts, drawings, equipment lists, descriptions, etc., that are required to instruct operation and maintenance personnel unfamiliar with such equipment. The number and special requirements shall be as specified in Section 01 78 23: Operation and Maintenance Data.

2. A factory representative who has complete knowledge of proper operation and maintenance shall be provided to instruct representatives of the Owner and the Engineer on proper operation and maintenance. With the Owner's permission, this work may be conducted in conjunction with the inspection of the installation and performance test as provided under PART 3 - EXECUTION. If there are difficulties in operation of the equipment due to the manufacturer's design or fabrication, additional service shall be provided at no cost to the Owner.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. The tank and components shall be adequately protected during transportation, in storage at the job site, and during subsequent installation and construction activities. Damaged units will be rejected and shall be replaced with undamaged units at no expense to the Owner.

1.05 WARRANTY AND GUARANTEES

A. The tank shall be warranted for five (5) years to be free of defects in material and workmanship. The warranty shall begin at final completion of the project.

PART 2 - PRODUCTS

2.01 GENERAL

A. The tank shall be as manufactured by Protective Coatings, Inc., ASST ACME Inc. or approved equal.

2.02 MATERIALS AND EQUIPMENT

A. Performance and Design Requirements

1. Conditions of Service: The tank will normally be used to store the specified chemical at atmospheric pressure. The tank shall be designed for the storage of the following liquid chemicals:

Tank Number	24-T-1
Chemical	Hydrofluorosilicic Acid
Location	Main Process Building Chemical Room
Max. Concentration Percent by Weight	23
Max. Specific Gravity	1.27
Max. Ambient & Liquid Temp., Degrees F	100
Min. Ambient & Liquid Temp., Degrees F	40

2. Design Criteria:

a. The tank shall be designed to withstand the hydrostatic head which would result with the tank and fill line surcharged with the stored liquid chemical to 6 inches above the top of the tank. The design shall also address test pressures.

b. The tank shall conform to the following requirements:

Tank Number	24-T-1
Tank Type	Vertical
Nominal Capacity Measured to Top of Tank (gal.)	6,000
Maximum Diameter, Feet	10
Maximum Tank Height, Feet	11

B. Fabrication and Manufacture

1. Hydrofluorosilicic Acid Bulk Storage Tank (24-T-1)

a. The hydrofluorosilicic acid bulk storage tank shall be constructed of welded steel with a 3/16-inch minimum thickness natural rubber lining. All fittings and interior piping shall also receive the rubber lining. The welded steel shall be at least 3/8-inch thick and shall meet ASTM A36 and ASTM A285, Grade C flange quality. The rubber lining shall be cured after application to all interior tank surfaces and connection surfaces. Linings shall extend to cover all flange faces. Design and construction shall comply with Underwriters Laboratories, API, or ASME standards.

b. The tank shall be constructed utilizing single plate ring design with full penetration continuous butt welding inside and out and shall be in accordance with NACE standards. The vessel shall be completely shop welded with no field welding permitted. The tank shall be fabricated from a minimum number of pieces. All longitudinal shell seams shall be staggered. Welding seams shall be located to clear all nozzle openings. All welding on the tanks shall be completed prior to the application of the interior lining and exterior coatings. All welded and machined edges shall be ground smooth to a minimum 1/8-inch radius to facilitate application of lining and coating.

c. The natural rubber lining shall be suitable for the intended service and applied in accordance with lining manufacturer's recommendations. Provide manufacturer's lining and application Specifications to the Engineer prior to tank fabrication.

2.03 ACCESSORIES

A. Accessories shall be provided on the tank as indicated on the Drawings and as specified herein.

1. Nozzles:

a. The nozzle locations, quantities, and sizes shall be as shown on the Drawings. These nozzles shall be Schedule 80 carbon steel and shall meet ASTM A53, Grade B seamless. All nozzles shall extend 8 inches outside the surface of the tank unless noted otherwise. Flanges shall meet ASTM A181, Class 70 and ASTM A285, Grade C flange quality to conform to NACE standards. Flanged bolt hole

dimensions and drilling patterns shall correspond to ANSI Specification B16.5 for 150-pound steel flanges. Bolts shall be of Hastelloy-C. Gaskets shall be 1/16-inch thick Halon or TFE.

b. The fill line shall include a pipe extension that runs from the tank dome to a point 12 inches above the tank bottom. Four 3/8-inch holes shall be drilled in the pipe just below the tank dome to provide venting and prevent development of a siphon condition. Due to the size of this pipe and the corrosivity of the tank contents, the pipe extension may be fabricated from Schedule 80 PVC.

c. The level element mounting flange on the top of the tank shall be a distance above the maximum liquid level recommended by the level sensor manufacturer. The length of the nozzle shall be as recommended by the level sensor manufacturer. The centerline of the nozzle shall be at least 12 inches from the tank sidewall, fill nozzle, and other obstructions.

c. The tank shall be provided with the following nozzles with the orientation as shown on the Drawings:

Quantity	Connection	Nozzle Size, Inches	Location on Tank
Hydrofluorosilicic Acid Bulk Storage Tank (24-T-1)			
1	Fill	2	Top
1	Overflow	3	Side @ Top
1	Feed Pump Suction/Drain	2	Side @ Bottom
1	Vent	6	Top

2. Vent: The tank shall be provided with a vent as shown on the Drawings to prevent drawing a vacuum inside the tank during pumping or draining. Outside of the vent shall be equipped with an insect screen of material compatible with the chemical stored.

3. Nameplates: The tank shall be provided with a nameplate to identify the chemical stored. The nameplate shall be made of Type 316 stainless steel with engraved lettering one inch high and shall be mounted on the tank at a location acceptable to the Engineer. The chemical designation to be engraved on the nameplate shall be as specified herein.

4. Certification Plates: A stainless steel certification plate shall be installed below each storage tank nameplate. The following data shall be included on the certification plate:

a. Name of tank fabricator.

b. Date of manufacture.

c. Product to be stored.

d. Maximum allowable concentration, specific gravity and temperature of the specified chemical solution that can be stored safely.

e. Equipment identification number shown listed herein.

5. Gaskets for nozzles and tank cover flanges shall be supplied by the tank manufacturer and be of an elastomeric material compatible with the chemical to be stored.

6. The tank shall be furnished with top manway and cover. The manway shall be liquid tight for maximum loading conditions and suitable for intended chemical use. Manways shall be a minimum 24 inches in diameter. Cover shall be fume tight and furnished with EPDM or Viton full face gaskets, and Hastelloy-C bolts. Boss flange type flush manway shall not be used. Tolerance on flatness shall be the same as for the flanges.

7. Ladder: The storage tank shall be furnished with an external access ladder and access platform to facilitate access to the manway. Ladder shall meet applicable OSHA standards and the applicable building code.

a. Ladder shall be of FRP construction. Uncoated or exposed carbon steel parts or fasteners will not be acceptable. The ladder shall be supported on and anchored to the concrete base and bracketed to the tank shell as required.

b. Ladder shall be provided with necessary assembly and mounting hardware. Mounts shall not penetrate tank wall. All mounting hardware shall be Hastelloy-C.

c. The ladder shall include safety rails and a platform across the top of the tank to the access manhole, attached to the ladder side rails, and anchored to the tank head as required. Safety rails and platform shall be fabricated of fiberglass reinforced plastic shapes and shall be fabricated and installed in accordance with OSHA regulations and the building code applicable to the project. Railings shall include three (3) horizontal rails and toeboards.

d. The ladder shall have a clear width of at least 16 inches, with rungs at least 3/4-inch in diameter and spaced not more than 12 inches apart and a clearance of at least 12 inches between the back of the

ladder and the tank wall. Ladder shall extend beyond tank bottom to within 6 inches of bottom of concrete tank pad.

e. Safety rails and platform shall be fabricated of fiberglass reinforced plastic shapes and shall be fabricated and installed in accordance with OSHA regulations and the applicable building code requirements.

8. Anchors: Provide lugs, anchor bolts, nuts, and anchor bolt templates for the tank. Anchor bolts shall be of Hastelloy-C.

9. Lifting Lugs: Provide suitably attached lifting lugs.

10. Sight Gauge: The tank shall be equipped with an external sight gauge made using 2-inch threaded PVC fittings, true-union PVC ball valves, and clear Schedule 40 PVC pipe. Mounted on the tank adjacent to the sight gauge shall be a gauge board of corrosion-resistant construction calibrated with corrosion-resistant marking in 100-gallon increments.

2.04 PAINTING

A. The exterior of the tank shall be shop primed and coated in the filed in accordance with Section 09 90 00, Painting and Coating.

PART 3 - EXECUTION

3.01 INSTALLATION

A. The tank shall be installed at the location as indicated on the Drawings. The tank shall be installed in accordance with the manufacturer's recommendations, the requirements of the applicable governing standard, and to the satisfaction of the Engineer, and made ready for the installation of piping and other appurtenances as indicated on the Drawings and specified under other Sections. Grouting under the tank, if needed per the manufacturer's recommendations, shall be done with non-shrinking grout.

3.02 ONSITE INSPECTION AND TESTING

A. After completion of installation, the tank shall be filled with water to the top overflow opening and allowed to stand full for a period of not less than 48 hours. During testing, flanged or threaded connections may be plugged by the installation of temporary blind flanges or threaded plugs on the outside of the tank but shall not be blocked or plugged on the inside. All leaks or indications of leaks shall be

repaired by the fabricator and made completely watertight. A leaking tank, upon repair, shall be retested to the satisfaction of the Engineer.

B. Cleaning: When installation has been completed and all connections have been made, all tank surfaces, interior and exterior, shall be thoroughly cleaned as recommended by the fabricator and to the satisfaction of the Engineer. Abrasive cleaning agents shall not be used. The tank and wetted accessories shall be completely dried before being placed into service.

3.03 START-UP AND INSTRUCTION

A. A representative of the manufacturer shall certify in writing that the tank has been installed in accordance with the manufacturer's recommendations.

END OF SECTION

SECTION 46 41 36
WALKING BEAM FLOCCULATION EQUIPMENT

PART 1 GENERAL

1.01 SCOPE

A. Furnish all labor, materials, equipment, and incidentals required to install, place in operation, and field test walking beam flocculation equipment for two (2) basins. Flocculation equipment shall be of the type and size specified herein and shown on the Drawings, complete with all the appurtenances required to provide complete systems ready for operation.

B. All equipment included in this section shall be furnished by a single supplier who shall be responsible for the design, coordination, and the satisfactory operation of the system.

1.02 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Bearing Manufacturers Association (ABMA):

   a. 9, Load Ratings and Fatigue Life for Ball Bearings.
   b. 11, Load Ratings and Fatigue Life for Roller Bearings.

2. American Gear Manufacturers Association (AGMA):

   a. 2004-B89, Gear Materials and Heat Treatment Manual.
   b. 6001-D97, Design and Selection of Components for Enclosed Gear Drives.
   c. 6010-F97, Standard for Spur, Helical, Herringbone and Bevel Enclosed Drives.

3. American Iron and Steel Institute (AISI).

4. American Society of Mechanical Engineers (ASME)

   a. B1.20.1, Pipe Threads, General Purpose (Inch).
   b. B16.1, Cast Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250.
   c. B16.5 Pipe Flanges and Flanged Fittings NPS 112 Through NPS 24.

5. ASTM International (ASTM):

   a. A36/A36M Standard Specification for Carbon Structural Steel.
   b. A276, Standard Specification for Stainless Steel Bars and Shapes.

6. National Electrical Manufacturers Association (NEMA): MG 1, Motors and Generators.

7. The Society for Protective Coatings (SSPC).

1.03 SUBMITTALS

A. Submit to the Engineer shop drawings and technical literature covering details of all equipment and accessories being furnished under this Section prior to fabrication of shipment. See Section 01 33 00, Submittal Procedures, for additional requirements.

B. Action Submittals:

1. Make, model, weight, and horsepower of each motor and calculations as may be required to support the proposed selection.

2. Manufacturer, model, weight and gear reducer size and calculations supporting the selection.

3. Manufacturer's catalog information descriptive literature, specifications, and materials of construction for all components included. Include installation, parts, finishes, piping and accessories, mounting requirements, anchors, supports, ballast required and connections.

4. Data and design computations upon which design of flocculation system is based, including mixing intensity (G), tip speed, power input, structural calculations, design stresses, and line shafting components. Provide design calculations showing design stresses and all line shafting components in accordance with the following stress levels:

   a. Allowable stress values for components subject to cyclic reversed loads shall have a 2.5 safety factor based on the following appropriate endurance limits:

      1) Reversed torsional load, endurance limit - 29% of ultimate tensile strength.

      2) Reversed axial load, endurance limit - 43% of ultimate tensile strength.

3) Reversed bending load, endurance limit - 50% of ultimate tensile strength.

b. Allowable stress levels for welds subjected to cyclic reversing loads shall be 5,000 psi.

c. Allowable stress levels for components subjected to static loads shall be in conformance with AISC specifications.

5. Data and design computations upon which design of drive mechanism's supports are based including maximum pullout and torque forces.

6. Detailed structural, mechanical, and electrical drawings showing equipment fabrications and interface with other items. Include dimensions, size, and details of anchorages and of connections to other work, and weights of associated equipment.

7. Provide design loadings for all load combinations transmitted to drive and bearing piers.

8. Template for anchor bolts and other connections.

9. Motor nameplate data, in accordance with NEMA MGI, motor manufacturer, and any motor modifications. Provide ampere and voltage operating characteristics for the motors. Indicate full load amperes, locked rotor torque, power factor, efficiencies, percent slip and temperature rise.

10. Power and control wiring diagrams, including terminals and numbers.

11. Information on proposed factory-applied coating system.

12. All calculations, including load combinations shall be signed and sealed by a professional engineer registered in the State of Alabama.

13. Include sufficient information to demonstrate conformance to specified performance requirements.

C. Information Submittals:

1. Storage, handling, and installation instructions.

2. Field installation and testing procedures.

3. Functional test results

4. Manufacturer's Certificate of Compliance for each flocculation mechanism

installed, in accordance with Section 01 43 33, Manufacturers' Field Services.

5. Manufacturer's Certificate of Proper Installation in accordance with Section 01 43 33, Manufacturers' Field Services.

1.02 OPERATION AND MAINTENANCE INSTRUCTIONS

A. Furnish to the Owner, six (6) copies of complete and detailed instructions for the operation, lubrication and maintenance of all equipment furnished and installed hereunder. Furnish manuals complete with piping and wiring diagrams as they apply to this installation consistent with the electrical schematics on the Drawings.

B. Provide Operation and Maintenance Data as specified in Section 01 78 23, Operation and Maintenance Data.

1.03 QUALITY ASSURANCE

A. Qualifications:

1. The Equipment Manufacturer shall be regularly engaged in the supply and service of this type of equipment.

2. Equipment manufacturers shall have not less than ten (10) years of experience in the selection, application, design, and manufacture of reciprocating walking beam type flocculators in municipal water treatment plant service and have a minimum of ten (10) installations in service for over five (5) years. References shall be provided upon request.

1.04 SPARE PARTS

A. Furnish, tag, and box for shipment and storage the following spare parts, special tools, and materials, as recommended by manufacturer.

1. One (1) complete set of spare parts recommended by manufacturer for 1-year of operation.

2. One (1) complete set of special tools required for the maintenance and operation of the equipment.

3. A one-year supply of each type of lubricant required for each piece of equipment, and one (1) grease gun for each type of lubricant.

1.05 WARRANTY

A. The manufacturer shall warrant all mechanism and parts of the flocculators provided for this project for continuous, 24 hour per day operation for a period of five (5) years after final completion. This warranty shall cover normal wear as well as defects in workmanship and materials so long as the equipment is properly installed and properly operated in accordance with the manufacturer's instructions. Worn or defective parts shall be replaced by the manufacturer at no charge under this warranty.

B. Provide equipment (system) warranty in accordance with Section 01 74 00: Warranties and Bonds.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Materials, equipment, and accessories specified in this section shall be products of JDV Equipment Corporation or Jim Myers and Sons, Inc.

2.02 MATERIALS AND WORKMANSHIP

A. Furnish equipment and materials which are new, suitable for the conditions of service to which they will be subject and equal to the best of their respective classes. Meet the applicable cited specifications and standards for grade and quality.

B. Provide workmanship of the highest quality and employ only competent and experienced workmen in executing the work. A neat and workmanlike appearance in the finish work will be required.

2.03 SERVICE CONDITIONS

A. The walking beam flocculators will be installed outdoors.

B. Flocculators shall be used in coagulated raw surface water. Aluminum sulfate, sodium hypochlorite, and sodium hydroxide are fed into the process stream just before it enters the flocculation tanks.

C. Basin Dimensions and Water Depths:
   1. 1st Stage: 55'-0" wide by 19'-5" long by 15'-0" deep.
   2. 2nd Stage: 55'-0" wide by 19'-5" long by 15'-0" deep (10" thick baffle wall at 15' – 7", 3'-0" channel on other side)

D. System (Total) Flow Rates:

1. Maximum: 24 MGD.

2. Average: 13.33 MGD.

E. Downstream Treatment Process: Sedimentation/granular media filtration.

F. Equipment Numbers:

1. 12-WBF-1

2. 12-WBF-2

G. Design Conditions and Requirements

Table 1
Process Design Conditions and Requirements

	Stage 1	Stage 2
Capacity, Gallons	120,000	120,000
Retention, Minutes	15	15
Basin/Stage Vol., ft^3	16,020	16,020
Number of Rows of Paddles	16	8
Paddle Length, ft	54	54
Design Min, G Value, sec^{-1}	50	36
Stroke Length, ft.	4.00	4.00
Cycles, RPM	3.5	3.5
Minimum Drive HP	5	
Motor Type	TEFC/Inverter Duty	

2.04 GENERAL

A. Each walking beam flocculator shall be furnished complete with all supports and mechanical equipment required for proper operation, including complete drive units; all steel, iron, and other metal construction specified herein; and all additional materials or fabrication as required by the supplier's design.

B. Locate all bearings, shafting, walking beams, drive mechanisms, connecting rods and drive arms above the liquid level.

C. Provide reciprocating paddle motion within the basins in order to achieve a wide range of velocities for flocculation of suspended solids. Vary linear paddle velocities cyclically from zero feet per second to a maximum sufficient for an effective flocculation of suspended solids and to prevent shear of floc already formed.

D. Provide the flocculation mechanism with an intermittent upstroke suction lift on the bottom of the entire basin to prevent floc fallout and to aid in seeding the newly forming floc with intermittent down-stroke turbulence to aid the formation of "tough floc". Transmit motion to all areas of the basin at all times to eliminate dead spots. Equipment employing less than the paddles shown on the Drawings will not be considered.

2.05 FLOCCULATOR DRIVE ASSEMBLIES

A. Provide each unit with a drive assembly consisting of a heavy duty gear reducer, a gear motor, shear bolt coupling and output crank arms. Anchor bolts shall be Type 316 stainless steel. Gear motor and gear reducer shall be factory assembled and tested on a common baseplate.

B. Provide gear reducers of double reduction, helical-worm gear type, with single output shaft.

C. All gear bearings shall be AGMA Class II bearings. Bearings shall be designed for the thrust loads from the fully loaded startup condition and shall have an AFBMA B10 life of 30,000 hours. The reducer shall be the standard air cooled unit with no auxiliary cooling. The gear reducer shall be sized with a torque service factor of 1.5 times the water horsepower or 1.1 times the motor nameplate horsepower, at the driven shaft speed, whichever is greater.

D. The gear motor shall have a service factor of 1.15 and shall be TEFC, Class B insulation, and rated for 460 volts, 3-phase, 60 Hertz AC, 50 RPM. Motor shall be compatible with VFD controller provided in electrical control panel. VFD shall be as specified in Section 26 29 23, Low Voltage Variable Frequency Motor Controllers.

E. The VFD shall provide overload protection for the gear motor and the gear reducer. The overload torque, at which the VFD torque overload trips and alarms, shall not be more than 150% of the normal running torque.

F. All exposed couplings shall be provided with removable, rigidly constructed and mounted protective safety guards, fully meeting the requirements of the OSHA standards, state safety standards and all local codes or ordinances that may apply. Guards shall be designed to facilitate access for lubrication and maintenance.

G. Each drive unit shall be protected by an emergency stop switch and cable operator. The cable shall be colored, plastic covered steel aircraft cable. Provide eyebolt supports for cable and low friction cable pulleys so that cable surrounds the entire drive assembly. Install the unit and accessories per manufacturer's recommendations. Switch shall be single pole, double-rated at 5 amps, and shall deactivate the system if the cord is pulled or cut. Safety stop switch shall be

Conveyor Component Company Model RS-1 or equal.

H. Each drive unit shall be equipped with a motion failure alarm unit. The location and mounting details shall be as recommended by the manufacturer. Motion sensors shall be the non-contacting type using a probe with a pre-amplifier and main electronic assembly. The main electronic unit shall operate on a 120 volt, single phase, 60 Hertz power supply.

2.06 FLOCCULATION TANK EQUIPMENT

A. Mount a series of horizontal paddles on paddle support frame assemblies. Employ several of these assemblies, as shown on the Drawings, to produce complete basin coverage. Support the frame assemblies from above at the apex by means of drop arms adequately sized to handle both static and dynamic loads. Connect the apex of each frame assembly together horizontally to form a rigid framework.

B. Paddles shall be of fiberglass reinforced isopthalic polyester resin, 2" x 6" size, channel construction. The paddles shall be constructed by the pultrusion method to ensure complete encapsulation of the glass fiber strands in resin. The glass filaments and mat shall run the full length of the paddle. The full member shall have 55 percent minimum glass by weight in compliance with ASTM D638. The resin shall contain protection against degradation from ultraviolet light. The use of extenders in the resin is prohibited.

C. Flights shall be designed such that normal maximum deflection will not allow any portion of the flight to contact the intermediate and bottom concrete slabs.

D. Paddles shall be attached by Type 316 stainless steel hardware. Paddles shall not be buoyant and shall not incorporate weights.

E. Fiberglass Reinforced Plastic (FRP) paddles shall be of composite construction. The paddles shall have a maximum water adsorption not exceeding 0.5 percent.

1. The finished composite shall have minimum tensile strength as follows when tested in accordance with ASTM D638.

    a. Longitudinal: 38,000 psi.
    b. Transverse: 10,000 psi.
    c. Shear: 14,000 psi.

F. All FRP paddles cut for any reason, including drilling shall be resin-sealed at the place and time of the cutting.

G. All mechanisms and parts located at or below the liquid level shall be capable of continuous operation without requiring lubrication, whether prior to installation, during installation, or during operating service life.

H. Paddle support assemblies, submerged angles, drop arms and other submerged bolts, nuts and washers shall be constructed of Type 316 stainless steel.

I. Design ballasting of the underwater assemblies for both buoyant and dynamic effects, and to prevent lateral displacement of the vertically reciprocating paddles. Provide concrete ballasting, if required, as directed by the flocculation equipment manufacturer.

2.07 FLOCCULATOR DRIVE MECHANISMS

A. Connect the drop arms for the tank equipment to a series of walking beams above at both ends of the beams. Space these walking beams laterally on horizontal drive shafts which are mounted on piers by means of a split case stainless steel pillow block bearing assemblies.

B. Structural concrete bearing piers shall be designed to provide the proper elevation for the pillow block bearings and line shaft. These support piers shall be designed by a professional engineer and the shop drawings shall be signed and sealed by a professional engineer responsible for the design. Anchor bolts shall be supplied by the equipment manufacturer. Piers shall be poured concrete by the Contractor in accordance with manufacturer's recommendations.

C. Construct each drive shaft with spindles at each bearing and tubular shafts between the bearings to minimize deflection. Connect spindles and tubular shafts together with flanges using ASTM A325 high strength bolts.

D. Actuate each drive shaft through an individual drive and connecting rod attached to the output crank arm of the gear reducer of the drive assembly.

E. Fabricate the walking beams and drive arms of ASTM A-36 carbon steel, rigidly attached to the drive shafts. Make suitable provisions for lubricated bearings at connection of the moving parts at both ends of the walking beams and at the end of the driving arms.

F. Design each drive shaft to withstand both torsional and bending movement without fatigue from cyclic rotation.

G. Fabricate spindles of medium carbon, cold rolled ASTM 1045 steel and fabricate the tubular shaft of ASTM A53, Class B, carbon steel pipe. All spindles shall be solid steel and shafts shall be pipe. All line shafts and pipes shall have 150 pound ANSI flanges with machined faces and step. All flanges shall be provided with

gussets as required, but shall have at least four (4) per flange to distribute the torsion.

H. Provide all main shaft bearings of the self-aligning split case, split race type ball bearing in pillow blocks. All anchor bolts for the pillow blocks shall be Type 316 stainless steel. Line or main shaft bearings shall be 3 inches in diameter. All bearings shall be supplied with Type 316 stainless steel mounting plates and tie plates for any concrete poured anchor bolts.

2.08 MOTORS

A. Provide motors in accordance with Section 26 20 00, Low Voltage AC Induction Motors.

1. Motor Horsepower: 5 HP.
2. Nominal Speed: 1,750 rpm, 460 volt, three-phase, 60-Hertz.
3. Application: Variable Speed.
4. Enclosure Type: Chemical industry severe duty TEFC enclosure.
5. Drive: Direct-drive with flexible couplings and guard.
6. Motor Efficiency: Premium efficiency.

2.09 LOCAL CONTROL PANELS

A. The walking beam flocculation equipment manufacturer shall provide a local control panel for each walking beam flocculator.

B. The local control panel shall be of Type 316 stainless steel construction conforming to NEMA 4X requirements and suitable for wall or stand mounting by the Contractor. The local control panels shall be mounted near the flocculator drives.

C. Local control panels shall be as specified in Section 40 99 90, Packaged Control Systems.

D. Each local control panel shall be provided with indication lights, pushbuttons, displays, etc. as described in this Specification and as shown in the Drawings for a complete and working system.

E. Each panel shall include:

1. Circuit Breaker.
2. VFD.
3. Motor Starter.
4. PLC .

5. Panel Front Mounted Devices.

    a. Local/Off/Remote Selection Switch
    b. Speed Potentiometer
    c. Drive Running Light
    d. Start Pushbutton
    e. Stop Pushbutton
    f. Motion Failure Alarm Light
    g. VFD Fault Alarm Light

6. Each panel shall include an ethernet port / switch for communication with the plant SCADA system. At a minimum, the following signals will be provided:

    a. Digital Outputs
        1) Speed Feedback
        2) Drive in Remote
        3) Motion Failure Alarm
        4) Drive Running
        5) Drive Off

    b. Digital Inputs
        1) Remote Start
        2) Remote Stop
        3) Speed Setpoint

7. Inputs from the following field devices:

    a. Motion Failure Alarm Unit
    b. VFD

8. Control description listed is to show general intent only. Details of control system and panels may vary depending on the flocculation equipment provided.

F. Each control panel shall be provided with an air conditioner to ensure the internal temperature will not exceed the maximum temperature rating of the panel mounted devices and VFD. The air conditioner shall be mounted on the side of the control panel and shall not violate the panels' NEMA 4X rating.

G. The control panel shall be factory wired and tested with clearly identified, industrial type terminal strips for all external field connections.

2.10 ACCESSORIES

A. Lifting Lugs: Provide suitably attached for equipment assemblies and components weighing over 100 pounds.

B. Equipment Identification Plates: Provide 16-gauge Type 316 stainless steel identification plate securely mounted on each separate equipment component and control panel in a readily visible location. Plate shall bear 3/8 inch high engraved block type black enamel filled equipment identification number indicated in this Specification.

C. Anchor Bolts: Type 316 stainless steel, sized by equipment manufacturer, 1/2-inch minimum diameter, and as specified in Section 05 50 00, Metal Fabrications.

2.11 FABRICATION

A. Shop Assembly:

1. All parts and components shall be factory-assembled in sections convenient for field handling and installation but requiring the minimum amount of work for field assembly. Any field assembly work shall be bolted. No cutting or welding shall be required on either field assembly or erection.

2. Gears and gear drives as part of an equipment assembly shall be shipped fully assembled for field installation.

3. All assembled parts and components ready for shipment shall be securely bundled, coiled, or crated and adequately protected from damage and corrosion during shipment and storage.

B. Shop Factory Finishing: Shop prepare and prime surfaces described herein in accordance with primer manufacturer's recommendations, Steel Structures Painting Council (SSPC) standards, and all applicable federal, state, and local codes. See Section 09 90 00, Painting and Coating, for further information.

C. Non-submerged cast iron and fabricated carbon steel components shall be shop blasted and painted per the following:

1. Shop Blasting: SSPC-SP10/NACE 2 near white blast cleaning with a 1.5 - 2.0 mil surface blast profile.

2. Shop Primer: TNEMEC Series V140F-1255 Potapox Plus, or equal, beige primer 4.0 – 6.0 dry mils.

3. Shop Coat: TNEMEC Series V140F-15BL Potapox Plus, or equal, white 4.0 – 6.0 dry mils.

2.12 SHOP TESTING

A. Test all components including control panels and electrical equipment. All variable speed and gear-reduction assemblies shall be shop tested prior to shipment. The speed reduction assemblies shall be run with rust-inhibiting oil.

B. Functional Test: Perform manufacturer's standard test on equipment.

PART 3 EXECUTION

3.01 INSTALLATION

A. Protect and store equipment delivered to site before installation in accordance with manufacturer's recommendations.

B. The Contractor shall install the flocculation equipment in strict conformance with manufacturer's instructions, and as shown on Contract Drawings.

C. Carefully and accurately align bearing supports for shafting vertically and horizontally to allow the shafts to be in proper alignment.

D. Anchor bolts, nuts, washers, and fasteners shall be furnished with the equipment herein specified and set in conformance with templates or drawings also supplied by the manufacturer. All anchor bolts, studs, fasteners, washers, and nuts shall be Type 316 stainless steel. The Contractor shall furnish all anchor bolts, studs, washers, nuts and fasteners required to complete the work of this Contract.

E. Suspend concrete ballast blocks from paddle support frame top angle where directed by manufacturer. Use blocks with two (2) 1/2-inch Type 316 stainless steel rods cast into the block. Each rod shall be bent into a "U" shape with hooked ends embedded in the block. Place Type 316 stainless steel angles on support frame to prevent ballast blocks from shifting.

3.02 FIELD PAINTING

A. Unless otherwise specified, all steel parts not embedded in concrete, cadmium plated, galvanized, or plastic covered, shall be shop primed with one (1) coat of paint recommended as compatible with finish coats by the manufacturer of paint used for field painting under Section 09 90 00, Painting and Coating, unless otherwise specified herein. Non-submerged steel parts shall be shop primed as described in Paragraph 2.11. Stainless steel, aluminum, brass, bronze, galvanized or cadmium plated steel, and plastic covered parts shall not be painted. Required

field painting of all surfaces shall be as specified under Section 09 90 00, Painting and Coating, and as specified herein. Machined and finished surfaces shall be protected with a suitable lubricant to prevent rusting.

B. Non-submerged cast iron and carbon steel fabricated components shall be field painted as follows:

1. Field Finish Coat 1: TNEMEC Series V140F-00WH Potapox Plus, or equal, gray 4.0 – 6.0 dry mils.

2. Field Finish Coat 2: TNEMEC Series 740 UVX, or equal, white 3.0 – 5.0 dry mils.

3. The finish coats of paint shall be applied in the field after installation of the walking beam flocculation equipment.

4. All nicks and scrapes from the installation and assembly process shall be addressed per the above requirements prior to adding the final finish coats of paint.

C. FRP paddles are not to be painted.

D. The Contractor shall, under this Section, remedy all damage to shop coatings after installation of equipment, and to the satisfaction of the Owner.

3.03 FIELD QUALITY CONTROL

A. Functional Tests: Conduct tests on each flocculator assisted by manufacturer's representative, as follows:

1. Alignment: Prior to facility startup, test complete assemblies for correct rotation, proper alignment and connection, quiet operation, excessive vibration, and satisfactory specified performance.

2. Manufacturer shall verify proper installation of flocculator system. Acceptance and approval of equipment installation and operation by manufacturer is required prior to startup. The manufacturer shall certify in writing that the installations are in accordance with the manufacturer's standards, conforms to the Specifications and is in proper working order and ready for start-up. Submit documentation to Engineer.

3.04 MANUFACTURER'S SERVICES

A. Furnish the services of a qualified factory trained manufacturer's representative for up to three (3) separate site visits, who shall instruct the installing personnel as to proper methods on all technical phases of installation; inspect and approve or

disapprove each phase as the installation progresses; report observations in writing to the Owner; and determine when the equipment is ready for start-up and operational checks. All work performed by the installing personnel will be subject to the approval of the manufacturer's representatives.

B. Provide the services of a qualified, factory-trained manufacturer's representative to supervise start-up, initial operation and operational tests, to supervise necessary adjustments, and to instruct the employees of the Owner in the proper operation and maintenance procedures.

C. Manufacturer's Representative: Present at site or classroom designated by Owner, for minimum person-days listed below, travel time excluded:

1. 3 person-days for installation assistance and inspection.

2. 1 person-day for functional testing and completion of Manufacturer's Certificate of Proper Installation.

3. 2 person-days for pre-startup classroom or site training.

4. 1 person-day for facility startup.

D. See Section 01 43 33, Manufacturers' Field Services and Section 01 91 14, Equipment Testing and Facility Startup for additional requirements.

END OF SECTION

SECTION 46 43 31
CLARIFICATION EQUIPMENT

PART 1 – GENERAL

1.01 SUMMARY

A. The Contractor shall provide all labor, materials, and equipment to install the sedimentation equipment including four (4) traveling submerged sludge collector systems, inclined plate settlers, collection launders and other accessories as necessary in the new settling basins for a complete and operational system.

B. At a minimum, the sludge collection systems shall consist of sludge collector header assemblies, electric drive assemblies, drive cable assemblies, sensors, sludge removal conduit, control system for fully automatic operation, and all other miscellaneous accessories and hardware as required for a complete installation. The full system shall be controlled by PLCs to allow flexibility in operation of the unit. The manufacturer shall provide all fixtures and fittings as needed for complete assembly and operation.

C. The plate settler system shall include, but not be limited to, inclined plate settlers with integrated side baffles, plate effluent flow control mechanism, collection launders, support structures, end baffles, mounting brackets, anchor bolts and fasteners, and related appurtenances.

D. All equipment and incidentals required shall be furnished as shown on the Drawings and as specified herein.

1.02 SYSTEM RESPONSIBILITY

A. The submerged sludge collector system equipment shall be provided as an integral package by a single manufacturer who shall take responsibility for coordination of all components to assure proper functioning of the submerged sludge collector equipment as a system. The submerged sludge collector system manufacturer shall supply all the necessary parts of the entire system, including all items listed in 1.01B above, and shall be responsible for the successful installation, start-up, and initial operation of the entire system.

B. The plate settler system shall be provided as an integral package by a single manufacturer regularly engaged in the production of this equipment who shall take responsibility for coordination of all components to assure proper functioning of the plate settler equipment as a system. The plate settler manufacturer shall supply all the necessary parts of the entire system, including all items listed in 1.01C above.

1.03 RELATED WORK

A. Painting requirements are included in Section 09 90 00, Painting and Coating.

B. Electrical requirements are included in Division 26.

1.04 SUBMITTALS

A. Submit to the Engineer, for review, shop drawings and technical literature covering details of all equipment and accessories being furnished under this section prior to fabrication of shipment. See Section 01 33 00, Submittal Procedures, for additional requirements.

B. Information specifically required for sludge collectors:

1. Basin design and layout of equipment indicating all dimensions.

2. Head loss calculation through the sludge collector.

3. List of spare parts which should be purchased and kept on hand.

4. Complete shop drawings of all equipment furnished.

5. Connection locations and attachment details.

6. Manufacturer's literature and cut-sheets for all equipment.

7. Weights for major component and materials of construction.

8. Power and control wiring diagrams, including terminals and numbers.

9. Shop drawings for electrical equipment and systems furnished herein shall be provided as specified under electrical work.

10. Any additional information, such as descriptive literature, manufacturer's specifications and other data, to demonstrate compliance with these specifications.

11. Statement indicating terms of the warranties.

C. Information specifically required for plate settlers and effluent launders:

1. Drawings of the proposed equipment giving general dimensions sufficient to determine how the equipment is to be supported and how it will fit with the space available.

2. Drawings showing complete dimensional data and weight of major components

3. Any additional information, such as descriptive literature, manufacturer's specifications and other data, to demonstrate compliance with these specifications.

4. A list of manufacturer's recommended spare parts with the manufacturer's current price for each item.

5. Complete description of any required surface preparation and shop prime painting.

6. Basic design and layout, including baffles, plates effluent launders, weirs, and support structures

7. A complete bill of materials

8. Design velocities including inlet velocity, velocity through plates, velocities at flow control points at top of plates, velocities at inlet to trough, and velocities in troughs

9. Head loss calculations through plate settling units at maximum and average design flow

10. A statement of the terms of the warranties

11. All ancillary equipment to be provided by the manufacturer

12. Complete shop drawings of all equipment furnished including cut-sheets describing sub-components with the specific components highlighted.

13. Drawings clearing showing any required modifications to the Drawings.

B. Submit operation and maintenance instructions in accordance with Section 01 78 23, Operation and Maintenance Data.

1.05 WARRANTY

A. The equipment manufacturer shall warrant the equipment against defects in design, material, and workmanship.

B. The equipment shall be warranted to be free from defects in workmanship, design and materials. If any part of the equipment should fail during the warranty period, it shall be replaced and the unit restored to service at no expense to the Owner.

C. See Specification Section 01 74 00 for specific warranty requirements.

1.06 DELIVERY, STORAGE AND HANDLING

A. Equipment shall be shipped, stored, and protected in accordance with the manufacturers' recommendations.

B. Plate packs shall be shipped on flatbed trucks to allow access by crane provided by the Contractor.

1.07 QUALITY ASSURANCE

A. Consideration will be given only to products of manufacturers who can demonstrate that their equipment fully complies with all requirements of the specifications and contract documents.

B. Sludge collector manufacturer shall have been in continuous business for a period of at least 10 years while engaged in the manufacture of water treatment equipment for municipalities. Said manufacturer shall have at least 10 years experience prior to the bid date of this contract in the design and building of submerged sludge collection equipment of the type specified hereinafter.

C. The plate settler manufacturer shall have at least 10 years of experience in the manufacture of water treatment equipment for municipalities. Said manufacturer shall have at least 10 years of experience in the design and building of high rate laminar flow clarification equipment.

D. All sludge collector manufacturers must provide a list of ten (10) sludge collector installations of a design complying with these specifications and used in municipal applications as described above. Provide names and phone numbers of at least five (5) references in operation for at least five (5) years to be contacted. Sludge collectors manufactured under different corporate identities or ownership will not be considered as meeting the experience qualifications. A list of non-cable driven sludge collection equipment not directly fabricated and supplied by the manufacturer will also not be acceptable.

E. All plate settler manufacturers must provide a list of ten (10) plate settler installations of a design complying with these Specifications and used in municipal applications as described above. Provide names and phone numbers of at least five (5) references in operation for at least five (5) years to be contacted.

F. Manufacturers must provide a certificate demonstrating compliance of NSF Standard 61. NSF approval on stainless steel by itself is not acceptable.

1.08 DEDUCTIVE ALTERNATES

A. The Roberts Filter Group Slyder Sludge Collector may be provided as a deductive alternate. This system shall be allowed with only three (3) current installations as an exception to the installation requirement stated previously in this specification.

B. Conventional effluent collection troughs may be provided as a deductive alternate to the plate settler system. Conventional effluent collection troughs shall be as specified herein.

PART 2 – PRODUCTS

2.01 GENERAL

A. Operational Description

1. Flow will enter the sedimentation basins through large ports located at the floor in the walls between the flocculation basins and the sedimentation basins as shown on the Drawings. A baffle wall located 3 feet upstream of the shared wall and downstream of the flocculation equipment prevents currents created by the flocculators from carrying through the ports into the sedimentation basin.

2. The settled solids to be removed from the sedimentation tank will contain compatible materials from a conventional water treatment process treating surface water. Sodium hydroxide, aluminum sulfate, and sodium hypochlorite are fed upstream of the flocculation basins.

3. The water entering the plate settlers shall be fed near the lower end of the plate from the side to allow the settled solids to fall to the floor of the clarifier without being re-entrained by the incoming flow. Clarified water will flow upward and into the effluent troughs while settled solids move downward and toward the basin floor.

4. The submerged sludge collection system shall remove, by means of suction, the settled sludge solids from the basin floor. The solids will be discharged through the sludge removal conduits which are connected to fixed piping outside the basin. The driving force suction shall be provided by differential head between the sedimentation tank and the sludge discharge point. Flow from the collection system shall be controlled by the automated pneumatic valves at the discharge of the removal piping. The automated valve will be on/off and controlled from within the sludge collection system control panel. Initiation of the valve will occur with movement of the sludge collection system. The equipment shall be designed to operate in the settling basins shown on the Drawings.

5. The submerged sludge collection system shall be capable of full operation in the space underneath the plate settlers.

6. The automated traveling sludge collection system shall be programmable to allow customization to the specific needs of the project. This customization shall allow variations in the frequency of removal of the sludge, and the speed of travel of the suction header device.

B. Service Conditions/Performance and Design Data

1. The sedimentation/clarification equipment shall be designed for the following conditions:

Number of Sedimentation Basins	2
Sedimentation Basin Width	55' – 0"
Sedimentation Basin Length	165' – 0"
Sedimentation Basin Depth	18' – 0"
Sedimentation Basin Side Water Depth	15' – 0"
Sedimentation Basin Bottom Configuration	Flat
Maximum Daily Flow through each Basin (Hydraulic)	12 MGD
Maximum Influent Turbidity (Raw Water)	45 NTU
Average Influent Turbidity (Raw Water)	10 NTU
Design Influent Turbidity (Raw Water)	20 NTU
Required Effluent Turbidity (Settled Water)	1 NTU
Sludge Flow per Collector	200 gpm
Maximum Differential Head Available for Suction[1]	12 ft

[1]Discharge pipe elevation as shown on the Drawings provides a differential head of 12 feet. Pipe elevation can be adjusted to accommodate head requirements of the equipment provided. Pipe elevation may be lowered to provide a greater differential head. Contractor shall coordinate with the manufacturer to determine the elevation at which the discharge pipe should be installed to meet the differential head requirements of the installed sludge collector system.

2. The sludge collection system shall be capable of 24-hour continuous service.

2.02 SLUDGE COLLECTION SYSTEM

A. Hoseless Collector and Shared Reel Drive Assembly

1. Hoseless sludge collector systems shall include tandem collector assemblies, electric drive assemblies, drive cables, sensors, rigid sludge conduit, cable pulleys, control system for fully automatic operation, and all other miscellaneous accessories and hardware as required for a complete installation.

2. The hoseless sludge collector assembly shall be manufactured entirely of Type 304 stainless steel, with the exception of non-metallic parts such as casters, bushings, orifices, etc. which will be manufactured of plastic, non-metallic materials.

3. Each hoseless collector assembly shall consist of four sludge collection pipes each equal to half the width of the serviced area (1/4 the width of the overall basin). Each header pipe shall have helical flow orifice blocks spaced by the manufacturer to insure proper sludge withdrawal across the length of the header. Each header shall have removable end caps for easy clean out.

4. The helical flow orifice blocks shall be designed to cause flow to enter tangentially into the header pipe for more efficient sludge removal. The orifices shall cause a spiral flow inside the header pipe to prevent solids from settling and shall point forward to remove the settled solids ahead of the pipe as it travels down the basin. The manufacturer shall determine the proper number, spacing and angle of the orifices for the most efficient removal of solids from the basin.

5. The collection chamber shall telescope over the smaller fixed sludge pipe conduit. The collection chamber shall be isolated against the horizontal telescoping pipe sludge conduit by means of a UHMW bushing.

6. The horizontal telescoping pipe sludge conduit shall include a UHMW flow balancing ring designed by CFD analysis to insure equal flow from the front and rear sludge collection headers.

7. Each header pipe shall be equipped with a "plow" blade which is triangular in shape and is equal in length to the header pipe. These "plows" shall remove the settled solids that have accumulated at the ends of the basins.

8. The hoseless collector assembly shall be guided by means of polyurethane rolling casters and side wall casters located near the end of the ends of the four sludge collection headers. All necessary mounting hardware shall be included.

9. Flow through the hoseless sludge collector shall be controlled by a sludge valve as directed by the collector control panel. Sludge control valves and actuators shall be provided separately under Section 40 27 02.

10. Stainless steel end stops are to be provided and anchored in the basin floor at the end of travel of each sludge collection assembly.

11. Stainless steel curbs shall be provided by the manufacturer where required and as shown on the Drawings.

12. All welds shall be continuous and brushed clean.

13. All underwater bearings shall be specifically designed for underwater use.

14. All components of the sludge collection system shall be fabricated from stainless steel or non-corrosive material complying with the following:

    a. Cross bracing - ASTM A276, AISI Type 304
    b. Header Assembly and Pipe - AISI Type 304
    c. Bushings, Flow Balancing Ring and Tangential Orifices – UHMW
    d. Cable Pulleys and Casters – Polyurethane
    e. Bolts, Nuts, Fasteners – IFI-104 GRADE 304

15. Drive Assembly

    a. Each drive assembly shall consist of a 230 volt, 3 phase, 60 Hertz ¼ HP, variable speed motor which will be coupled to a single rotating drum for manipulation of the cable that is attached to the tandem collector assembly.
    b. The cable shall be firmly attached to the rotating drum to prevent slippage. Tensioning the cable between multiple pulleys to prevent slippage will not be allowed.
    c. The cable shall store on the reel in a single layer, the placement of which shall be organized by the drive mechanism.
    d. The complete drive mechanism shall be packaged on a single base and provided with a powder coated aluminum safety enclosure.
    e. The drive cable shall be Type 304 stainless steel with a minimum diameter of 3/16". Pneumatic or steel tape drive systems are not acceptable.
    f. The drive assembly shall be capable of ceasing operation on an excessive motor load without physical damage to the drive unit. During an overload, protection built into the variable frequency drive shall cease operation and activate an alarm. Operation shall continue only after the alarm is reset. Backup protection in the form of a shear pin is required.

g. The drive assembly shall have integral position sensors which determine when the collector is at the end of the basin, the beginning of the basin and points in-between. No external or under-water position sensors shall be required or allowed.

h. Each drive shall have an emergency disconnect button prewired into the assembly which shall be a large, red palm operated single button.

i. Drive assemblies shall be provided with elevated drive stands as shown on the Drawings.

B. Control Panel

1. There shall be one (1) local control panel to operate each set of two (2) sludge collectors as shown on the Drawings. The manufacturer shall furnish as an integral part of the system, control panels based around a programmable logic controllers. Each header pipe collector shall have independent operation. The control panel shall be completely pre-wired and tested by the sludge removal system manufacturer for manual and automatic operation of the sludge removal devices prior to shipment.

2. Each of these local control panels shall be capable of communicating with the SCADA system via a fiber-optic communication connection which will be provided within the local panel. The local control panels shall also communicate open and close commands to the sludge valves and shall require confirmed open or close return signals from the sludge valve actuators.

3. Each local panel shall operate by a 120 VAC 20 amp or 40 amp circuit, depending on the equipment supplied, which will be furnished to each panel location. Contractor shall coordinate with equipment supplier to provide the power supply required.

4. Each local control panel shall consist of the following:

a. Real time clock for programmable run initiation.
b. Programmable logic controller.
c. Two (2) variable speed drives (one for each collector) with manual operation keys and speed control.
d. Power supply with control voltage of 24 VDC.
e. Properly sized protective circuit breakers and terminal blocks.
f. Ethernet port / switch for communication with the Plant SCADA system. At a minimum, the following signals will be provided:
    1) Remote start
    2) Run condition
    3) Alarm condition
    4) Home and End position indication

g. HMI Touchscreen shall display the following controls and indications:
   1) System mode – Hand/Off/Auto
   2) Manual start
   3) Drive mode – Reverse/Off/Forward
   4) Valve position
   5) Real time clock settings
   6) Collector speed control
   7) Alarm reset
   8) Drive direction
   9) Home and End position indication

h. Local-Off-Remote selector switches shall be provided in the control panel for each of the drive units. These switches shall be used to select the desired mode of operation.

i. Open-Close selector switches shall be provided in the control panel for each of the sludge valves.

j. A key operated door interlock system shall be installed on the control panel door.

k. A reversing mechanism shall be provided with time delay relays to change the header pipe direction of travel.

5. The control panel components shall be installed inside a NEMA 4X Type 316 stainless steel housing with stainless steel sun screens. It shall be the responsibility of the sludge collector manufacturer to provide all of the necessary control hardware, software and components as required for a complete installation.

6. All electrical components shall be labeled to agree with the electrical schematic. All wiring shall be in accordance with the National Electric Code.

7. The logic for control of the sludge removal unit shall include:

   a. Solid state controller for variable speed of the sludge removal collection header with a range of 0.4 ft/min to 12 ft/min.

   b. Time interval between trips, selectable for specific application customization.

   c. Area of coverage shall be selectable for short trips or long trips (complete round trip pass) for effective sludge removal.

   d. Alarm indication shall be provided.

8. A microswitch shall be affixed to the overload clutch to provide a signal source indicating drive overload condition

9. The control panel shall include relay contacts to show overload condition.

10. Control panels shall comply with Specification Section 40 99 90, Packaged Control Systems.

11. Control description listed is to show general intent only. Details of control system and panels may vary depending on the sludge collector system provided.

C. Manufacturers

1. Subject to compliance with the complete requirements of these Specifications, manufacturers offering products which may be incorporated into the work include, but are not limited to, the following:

a. Meurer Research, Inc. (Hoseless Cable – Vac)

D. Deductive Alternate: The Roberts Environmental, Inc. Slyder™ Hoseless Sludge Collection System may be provided as a deductive alternate. The following are the allowable exceptions or differences from the base bid equipment specified herein:

1. Each hoseless collector assembly shall consist of two sludge collection pipes with a connection in the middle to the central collection chamber. There shall be a seal to prevent leakage where the collection chamber connects to the telescoping pipe.

2. Each sludge collection header pipe shall have bidirectional flow control orifices. Bidirectional flow control orifices shall be drilled orifices staggered 15 degrees from the bottom centerline of the bottom of the collection arm. The manufacturer shall determine the proper number and spacing of the orifices for the most efficient removal of solids from the basin.

3. A flow balancing mechanism shall be provided to insure equal flow from the front and rear sludge collection headers.

4. The header pipes shall be connected at the end of the telescoping chamber to be capable of removing sludge from the full extent of the basin walls and corners. Plow blades shall not be required.

5. Provide a V-port control hub which shall balance flow for even collection of flow between both sides of header by applying a moderate back pressure.

2.03 PLATE SETTLERS

A. General

1. The work includes supplying, delivering, supervising the installation, commissioning, and training in use and maintenance of the plate settlers.

2. The manufacturer shall provide plate settling equipment that will provide the maximum settling performance in accordance with the process design.

3. The inclined plate settler system shall be comprised of the following elements:

   a. Stainless steel plates and frames with integral side baffles.
   b. Stainless steel effluent collections troughs with adjustable weirs.
   c. Stainless steel end baffles.
   d. Stainless steel support beams which span the basin to support the ends of the plate packs. Said beams shall be provided by the manufacturer of the plate settlers.
   e. All wall mounted brackets, anchors and hardware as required.

B. Process Requirements/Conditions: Each settling basin is designed for a flow of 12 MGD. Refer to Paragraph 2.01 B for other specific information related to the sedimentation basins. Additional design criteria related to the plate settlers are presented below.

1.	Effective Rise Rate (Loading Rate)	0.3gpm/SF
2.	Allowed Plate Efficiency	90 percent
3.	Angle of Inclination	55 degrees
4.	Inner Effluent Trough Loading, Design/Max	1,191 gpm/2,381 gpm
5.	Outer Effluent Trough Loading, Design/Max	595 gpm/1,191 gpm
6.	Design Velocity Between Plates	0.018 fps
7.	Design Velocity in Feed Channels	< 0.5 fps
8.	Number Modules per Bin	14
9.	Number Plates per Module	86

C. Materials of Construction

1. All components of the plate settler system shall be fabricated of stainless steel materials.

   a. Support Frame - ASTM A276, AISI Type 304L
   b. Plates - ASTM A276, AISI Type 304
   c. Troughs - ASTM A276, AISI Type 304
   d. Weirs - ASTM A276, AISI Type 304
   e. Support Beams - ASTM A276, AISI Type 304L
   f. Bolts, Nuts, Fasteners – IFI-104 GRADE 316

2. All fabricated stainless steel components shall be passivated to prevent future corrosion. All welded components shall be passivated by

mechanical cleaning and cleaning with an NSF approved acid solution. Nitric acid or other hazardous chemicals shall not be allowed for cleaning. Non-welded parts shall be supplied with standard mill finish.

D. Plates

1. The plate settling units shall operate in counter-current mode with clarified water flowing upward while settled solids move downward. The incoming water shall be fed near the lower end of the plate from the side to allow the settled solids to fall to the floor of the clarifier without being re-entrained by the incoming flow.

2. The plates shall be arranged in packs. The packs shall be supported from below on support beams provided by the manufacturer and installed by the Contractor.

3. The plates shall be inclined at an angle of 55^{o} from the horizontal. The plate settlers shall have no moving parts.

4. The effluent flow at the top of the plate shall be removed in at least four (4) points to insure even distribution across the full width of the plate. Plate settlers with less than four (4) take off points per plate are not acceptable.

5. The plates shall be removable individually for inspection or repair and to ease initial installation. No structures or troughs shall be required to be removed in order to extract the plates. The effluent troughs shall be located to the side of the plate rows.

6. If each plate has a tubular top support structure or folded form support structure, the plate shall be manufactured of 24 gauge (minimum), Type 304 stainless steel. If each plate does not have a top tube, the plate material shall be 22 gauge, Type 304 stainless steel.

7. The plate packs shall be self-supporting and shall not exceed the maximum allowable deflection limits stipulated below.

8. The plates shall be designed structurally for the following conditions:

   a. Loading of 30 lbs. per plate live load.
   b. A maximum deflection of 1/360 for all structures, troughs, etc.

   c. A concentrated load of 250 lbs. anywhere on the flow deck (top tubes) or top edge of plates.

9. The plate settlers shall be designed so that an operator may walk out onto the plates at any time, even during operation, without the need to remove any components. The entire top of each plate settler must be visible for inspection.

E. Effluent Collection Troughs

1. The effluent troughs shall be u-shaped and located to the side of the plate rows. Troughs located over the plate settlers obstructing access to the tops of the plates will not be accepted. Backwater along the entire length of each trough shall not exceed 2 inches.

2. The effluent weirs shall be of the flat crested "rectangle" design or V-notch design.

3. The effluent collection troughs shall be manufactured of Type 304 stainless steel. All brackets trough supports, reinforcing sections, stiffeners, flanges, weirs and fasteners shall be of Type 304 stainless steel.

F. Structural Support System Requirements

1. The manufacturer of the plate settlers shall provide stainless steel beams to support the plate settler packs.

2. Support frames and beams shall be adequately sized to carry the load of the plate settling system under both wet and dry conditions without exceeding a maximum deflection of L/360 of the span.

3. The manufacturer will be required to coordinate the structural details of the design with the Engineer. This will be required to determine the final location of beams through wall openings, sludge collection mechanism, and other design details which may affect the supply of structural support components.

G. Manufacturers

1. Subject to compliance with the complete requirements of these Specifications, manufacturers offering products which may be incorporated into the work include, but are not limited to, the following:

   a. Meurer Research, Inc.
   b. Jim Myers & Sons, Inc.
   c. Parkson
   d. Roberts Filter Group