SECTION 11397 - CENTRIFUGES

City of San Diego, CWP Guidelines

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NTS: This Specification has been written on the basis of sludge dewatering centrifuges manufactured by KHD Humboldt-Wedag (Alternative 1) and Sharples, Inc. (Alternative 2). It is the intent of this Specification to limit the choices to these two manufacturers only, since experience at Hyperion Wastewater Treatment Plant has indicated these two machines to be the best for the intended application.

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PART 1 - GENERAL

1.1 WORK OF THIS SECTION

A. The WORK of this Section includes providing sludge dewatering solid bowl, scroll type centrifuges complete with vibration isolators, drive motor, backdrive system, belt guard, lubrication system, electrical components, electrical control panel and all necessary components, complete and operable.

B. The WORK also includes coordination of design, assembly, testing and installation.

1.2 RELATED SECTIONS

A. The WORK of the following Section applies to the WORK of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this WORK.

1. Section 11000 Equipment General Provisions

1.3 SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted in compliance with Section 01300:

1. Electrical details including horsepower.
2. Sizes and locations of external connections such as sludge feed, cake discharge, centrate discharge and polymer feed.
3. Vibration analysis by a specialist experienced in this type of work and his written recommendations for keeping the vibration at a safe limit.
4. Logic and control system diagrams.
5. List of [ten] installation using identical equipment, with addresses and telephone numbers.

1.4 SERVICES OF MANUFACTURER

A. **Inspection, Startup, and Field Adjustment**: An authorized representative of the manufacturer shall visit the site and witness the following for not less than [15] days in

three separate trips to the job site scheduled with the approval of the CONSTRUCTION MANAGER.

1. Installation of the equipment including alignment and leveling.
2. Inspection, checking, and adjusting the equipment.
3. Startup and field-testing using sludge to verify performance.
4. Performing field adjustments to ensure that the equipment installation and operation comply with the Specifications.

Items 3 and 4 can only be satisfied approximately 6 months after plant startup, when the operation has stabilized. The CONTRACTOR, in the presence of the manufacturer's service representative, shall then perform the indicated field tests and adjustments to the satisfaction of the CONSTRUCTION MANAGER. After satisfactory conclusion of the testing, the manufacturer shall issue a written statement that the centrifuges satisfy all indicated criteria, and the service warranty shall start form that date.

B. **Instruction of OWNER'S Personnel**: The authorized service representative shall also instruct the OWNER'S personnel in classroom and field settings in the operation and maintenance of the equipment, including step-by-step troubleshooting procedures with necessary test equipment for not less than [10] days in two separate trips to the job site scheduled with the approval of the CONSTRUCTION MANAGER.

C. The manufacturer shall submit a written training program to the CONSTRUCTION MANAGER for approval. Training shall not commence until 20 days after written approval by the CONSTRUCTION MANAGER and shall be scheduled at least [15] days prior to startup. All trainees, minimum of [5] shall receive a training manual specific to their trade as follows:

1. Mechanics
2. Electricians
3. Instrument Mechanics
4. Operators

The training manuals will be retained by the trainees, and not returned to the manufacturer.

PART 2 - PRODUCTS

2.1 GENERAL

A. General: The CONTRACTOR shall provide the equipment indicated herein. The equipment shall be fabricated, erected, assembled and placed in proper operating condition in full conformity with the drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer.

2.2 PERFORMANCE AND DESIGN CRITERIA

A. The centrifuge(s) shall be designed for the following conditions:

1. Feed rate - [ ] gpm

2. Type of sludge - [Primary] [Secondary] [Primary [ ] percent and secondary [ ] percent] from municipal sewage treatment plants

3. Feed solids concentration - [2.5 to 4 percent]

4. Volatile solids content - [60 to 70 percent]

5. Alkalinity - [3000 to 3500 mg/l]

6. Operation - [24 hours/day]

7. Minimum G-force - [2500 g's]

B. The centrifuge(s) shall achieve the following performance:

1. Minimum solids capture - [90% of the sludge feed total suspended solids]

2. Minimum sludge cake conc. - [25 percent]

3. Maximum polymer dosage - [20 lbs per ton of feed total suspended solids]

[4. Polymer - Specify type of polymer]

2.3 MATERIALS

A. **Bowl**: The bowl shall be constructed of stainless steel and shall provide for adjustable pool depth through the use of adjustable weir plates located on the centrate discharge side of the bowl. The bowl shall provide for discharge of sludge cake through ports protected by hard surfacing. A replacement rear hub wear plate shall be provided in the bowl rear hub.

B. **Scroll**: The scroll shall be constructed of stainless steel and shall serve to convey sludge cake along the inside of the bowl to the sludge cake discharge ports. The scroll conveyor shall provide for even distribution of sludge and polymer into the centrifuge through a feed zone and feed ports lined with hard surfacing. The tip of the scroll conveyor shall be protected by permanent attachment of hard surfacing.

C. **Bearings**: Bearings for the centrifuge(s) shall be spherical roller bearings mounted in pillow blocks. Bearings shall have a minimum L-10 life of 100,000 hours and shall be rated for continuous, 24 hour per day service. All bearings shall be lubricated by a forced oil lubrication system.

D. **Hard Surfacing**: All parts subject to wear from process material shall have hard surfacing mechanically or chemically attached. These areas shall include:

(Alternative 1):

Bowl Wall: Protected by longitudinal strips, evenly spaced and extending over the full length of the bowl.

Feed Compartment Walls: Tungsten-carbide hard surfacing

Feed Ports: Tungsten-carbide hard surfacing

Conveyor Flights: Flame Sprayed nickel-boron-silicon alloy containing a minimum 50 percent tungsten-carbide particles

Solids Discharge Ports: Field replaceable tungsten-carbide wear plates

Solids Discharge Casing: Replaceable adriprene liner

(Alternative 2)

Feed Ports: Sintered tungsten-carbide tiles or inserts

Solids Discharge Ports: Sintered tungsten-carbide tiles or inserts

Conveyor Blade Tips: Sintered tungsten-carbide tiles or inserts

E. **Lubrication System**: An external oil lubrication system shall be provided for the centrifuge pillow block bearings. The system shall consist of the following:

1. oil reserve with sight glass level indicator
2. oil pump and motor
3. heat exchanger
4. pressure gauge
5. lube oil flow indicators for each bearing
6. oil temperature gauges for oil supply and return line for each bearing
7. pressure relief valve
8. dual 10 micron filter
9. 100 mesh strainer for each bearing
10. oil temperature regulator
11. all required tubing/hosing for connection of lube system to centrifuge
12. solenoid valve for heat exchanger water flow
13. oil return temperature switches
14. lubrication oil reserve low level switch

The system shall be designed to maintain bearing temperature below 150 degrees F.

F. **Main Drive Motor**: The centrifuge shall be provided with a [ ] hp heavy duty electric main drive motor and V-belt drive system. All belt and pulley guards shall be provided. The motor shall be 460 volt, 3 phase, 60 Hz TEFC 1800 RPM motor with Class F insulation, 1.15 service factor and a maximum temperature of 155 degrees C. The motor shall be NEMA B rated for continuous duty with a hydraulic turbo-coupling for soft start for Alternative 1 and Wye-Delta start for Alternative 2. Maximum allowable current in-rush for starting shall be [ ] amps for [ ] min. The motor shall be rated at a noise level not to exceed [85] dBA at a distance of [3] feet. The motor shall be provided with a space heater which is energized when the motor is not running.

G. **Backdrive System**: A hydraulic backdrive system (Alternative 1) or a DC backdrive system (Alternative 2) shall be supplied to provide infinite speed variation between the conveyor and the bowl shell of the centrifuge. The backdrive system shall allow the scroll speed to be controlled by torque, absolute speed, or differential speed, to maximize cake solids concentration. A torque sensor shall be provided such that, upon sensing excessive torque, the sensor would provide a signal that would stop the sludge feed to the machine.

H. **Vibration Isolation**: The centrifuge shall have restrained spring type or rubber type vibration isolators upon which it shall be mounted. Flexible connectors shall be provided for all pipelines leading to and from the centrifuge and the centrate and sludge cake discharge chutes.

I. **Base**: The centrifuge shall be mounted on a single, skid-type base frame with drives mounted separately, in accordance with the vibration analyst's and the manufacturer's recommendations.

2.4 ELECTRICAL COMPONENTS

A. All electrical components shall be mounted in a stainless steel panel with NEMA rating in accordance with the area designations of Section 16050 [suitable for outdoor installation]. The panel shall have two 1/8-inch NPT female fittings for nitrogen purge. The panel and all electrical components shall be UL listed.

B. The panel shall contain motor starters for the main drive, backdrive, and oil pump motors. Terminals shall be provided for incoming power connections. A ground lug shall be supplied on the panel.

C. A DC power transformer suitable for outdoor installation shall be provided (Alternative 2).

D. **Controls**: The panel shall include a Programmable Logic Controller (PLC) and manual controls to operate the machine in the event the PLC fails. Controls shall provide for single point startup, shutdown and restart, including permissive signals for start/stop of feed systems, sludge conveyance, polymer feed system, and flushing water. Automatic centrifuge shutdown and feed pump shutdown shall be interlocked with appropriate malfunction alarms. Manual startup controls shall also be provided. An interface for remote control shall also be provided.

E. **Monitoring/Alarms**: A monitoring system shall be provided to detect and indicate centrifuge malfunctions. When a malfunction occurs, the machine shall be shut down, or polymer and sludge feed systems shut off as appropriate, and an alarm light indicating the nature of the malfunction shall be illuminated. Alarms provided shall include:

1. Lubrication oil high temperature and low pressure
2. Vibration
3. Bearing high temperature
4. High motor temperature (main drive motor and backdrive motor)
5. High scroll torque
6. Sludge cake conveyor malfunction (indicated by zero speed switch on conveyor)
7. Cooling water high temperature and low pressure
8. Lubrication oil reservoir low level

F. **Monitoring/Display**: The control system shall monitor and display the following information:

1. Bowl speed
2. Scroll speed
3. Differential speed
4. Scroll torque
5. Drive motor amps
6. Main bearing vibration acceleration
7. Sludge feed flow rate

8. Polymer feed flow rate
9. KWH meter and totalizer for total centrifuge system
10. Lubricating oil temperature
11. Cooling water temperature
12. Bearing temperature

2.5 SHOP INSPECTION/SHOP TESTING

A. The CONSTRUCTION MANAGER and the OWNER shall have the option of inspecting the centrifuge system equipment at the factory during the fabrication process.

B. Shop testing of the equipment shall be defined as operation of the centrifuge with its electrical panel, while feeding potable water to the machine. The purpose of the shop test shall be to test mechanical and electrical systems, and make necessary adjustments or repairs prior to shipment. If the machine is to be stored at the manufacturer's factory, the shop test shall be successfully completed prior to storage. The centrifuge system shall not be shipped until it has successfully been shop tested.

C. The CONSTRUCTION MANAGER and OWNER shall have the option of sending representatives to witness each shop test. The manufacturer shall provide written notice to the CONSTRUCTION MANAGER at least 15 days prior to the shop test date.

2.6 TOOLS AND SPARE PARTS

A. **Tools**: The CONTRACTOR shall supply one complete set of special tools for adjustment, disassembly, and service of the centrifuge equipment, as follows:

1 [Bowl lifter]
2. [Conveyor lifter]
3. [Wrenches and tool box for disassembly]
4. [Bowl truck]
5. [Scroll extracting tool]
6. [Scroll shaft extracting tool]
7. [Hydraulic bearing puller]
8. [Pulley thrust bearing puller]
9. [Dowel pin extractor]
10. [Dowel pin sleeve extractor]
11. [Pillow block bearing remover]
12. [Plate dam removal wrench]
13. [Tension bar nut wrench]

B. **Spare Parts**: The following spare parts shall be included:

1. One complete set of O-rings, seals and gaskets
2. One set of all equipment and motor bearings (thrust and main)
3. One set of main drive belts
4. One revolution of sintered tungsten-carbide tiles (approximately 30 tiles)
5. Two sets of inspection port fasteners
6. Two sets of case cover fasteners
7. One set of weir plate fasteners
8. One vibration switch
9. One main bearing temperature switch

10. One set of solids discharge port replaceable tungsten-carbide wear plates (Alternative 1 only)
11. One set of essential spare parts for hydraulic backdrive unit including all required hydraulic hoses (Alternative 1 only)
12. One set of all flexible connectors
13. Six filter elements for external lubricating oil system and hydraulic backdrive system (Alternative 1 only)

C. The CONTRACTOR shall supply all necessary oil and grease for startup and acceptance testing. Sufficient oil and grease shall be provided for one year of operation following acceptance.

2.7 MANUFACTURERS

A. Products shall be manufactured by one of the following:

1. KHD Humboldt-Wedag
2. Sharples, Inc.

PART 3 -- EXECUTION

3.1 GENERAL

A. The installation shall be done in accordance with the manufacturer's written procedures and instructions.

3.2 STARTUP TESTING/ACCEPTANCE

A. The manufacturer shall provide written notice to the CONSTRUCTION MANAGER that the centrifuge system has been properly installed, and is ready for startup.

B. The manufacturer shall be allowed 30 days to start up and fine tune its machine prior to acceptance testing.

C. The acceptance test shall consist of continuous operation of the centrifuge system, with sludge feed, for a period of 48 consecutive hours. The CONSTRUCTION MANAGER will arrange for samples to be collected and analyzed at four-hour intervals as follows:

Sludge Feed	Total Suspended Solids Concentration Volatile Suspended Solids Concentration
Centrate	Total Suspended Solids Concentration
Sludge Cake	Total Suspended Solids Concentration

D. Acceptance of the system by the CONSTRUCTION MANAGER is contingent upon all samples meeting or exceeding guaranteed performance parameters during the test period.

** END OF SECTION **