# Annexure- I of Addendum No. 3 (Vol-2) (Item 06- WTP): For sub-clause 6.6.35 to 6.6.45 Particular Technical Requirements – Water Treatment Plant

### 6.6.35. Compressor

The Contractor shall provide compressors required (1 working + 1 standby). An air receiver shall be provided on the discharge of the compressors. Each unit of the compressor shall be provided with a suction air filter and a pressure gauge on the discharge of the compressor.

A pressure switch shall be provided in the air receiver for detecting the pressure and generating the start/ stop signals for the compressor.

### 6.6.36. Centrifuge

Centrifuges shall be of the horizontal decanter type and consist of a high-speed rotating bowl containing a scroll conveyor. The scroll shall be designed to rotate in the same direction as the bowl but at a slightly faster speed. The bowl and the scroll shall be balanced independently. The speed differential will be provided and controlled using a two-speed motor system.

The centrifuge shall be designed for use with wastewater sludges. The bowl scroll and bearing hub of the centrifuge shall be manufactured in stainless steel SS 304 or higher grade. The bowl shall be centrifugally cast. All other parts in contact with sludge shall be constructed of stainless-steel Grade 304. Inlet and outlet parts, rotating parts and wear zones shall be designed with either replaceable wearing parts or from abrasion resistant materials.

The solids discharge shall be fitted with field replaceable stellite bushes. The differential speed adjustment between the bowl and the scroll conveyor shall be an energy efficient system driven by an electric motor.

The sludge inlet zone shall be low shear design to minimize floc destruction.

The centrifuge shall be balanced, and factory tested and the velocity of vibrations shall be within 4.5 mm/s as per relevant Hydraulic Institutes Standards and IS.

The centrifuge shall be equipped with rubber vibration dampers to minimise the transfer of vibration to structures. Stage one shall initiate a high vibration alarm warning displayed on the control panel and through the telemetry system. Stage two shall signal a high vibration alarm and initiate the automatic centrifuge shutdown sequence Noise level shall be limited to 85 dba at a distance of 2 m.

### 6.6.37. Agitator (Chemical Dosing Tanks)

Each chemical Dosing tank shall be provided with electrically driven turbine/paddle type agitators. The driving motor of suitable capacity including reduction gear and other accessories shall be provided for rotating the agitator at a speed as per bidder choice. The fan cooled driving motor and reduction gear shall be totally enclosed but easily accessible for maintenance.

The sweep area of turbine/paddle shall cover a minimum of 25% of the tank area. The shaft shall be freely suspended from the driving gear mounted on top of the tank. No thrust or guide bearing shall be located below the liquid level. The shaft of the agitator, the speed reduction gear of the motor and the paddles shall be of SS-304.

### 6.6.38. Agitator (Flash Mixer)

The mixers shall be sized to provide effective rapid mixing for the designed volume. The impeller assembly shall consist of three or four blades bolted to a shaft assembly. The mixer shall be of high shear mixer to accomplish rapid dispersion of the coagulant. The mixer shall have an intermediate guide support, if required. All seals and bearings shall be above the water surface.

The mixer shaft shall be designed for the maximum power output of the drive unit. The mixer shaft and its bearing shall be capable of withstanding the entire static and dynamic thrust load and radial load with a factor of safety of 2.0. The mixer's drive gear shall be a combination of helical and spiral bevel gear reducers constructed. The gear motor shall be driven by a 415V 3 phase TEFC motor.

### 6.6.39. Chemical Dosing Pump

Chemical dosing and metering pumps shall be piston, piston diaphragm or mechanical diaphragm type as specified. Pumps may be simplex or duplex arrangements to suit the capacity or process requirements. The pump design shall incorporate positive stroke return. Pump, motor and driving arrangement shall be mounted on a robust combined base plate. Pump liquid ends shall be selected for compatibility with the pumped liquid. Suction and discharge valves shall be the single ball type allowing a free flow self-cleaning action. Ball and seat materials shall be resistant to abrasion. Pumps shall incorporate a variable stroke mechanism to allow the output to be varied while the pump is running. Stroke adjustment shall be manual/ electrically controlled stroke positioned. A stroke length indicator and digital stroke counter shall be fitted. Pumps shall be driven by a flange mounted IP 55 motor, via an oil bath reduction gearbox and variable stroke mechanism giving step-less adjustment between zero and maximum stroke length. Where flow proportional dosing is required the variation of output shall be achieved by varying the speed of the pump motor and not the pump stroke length.

The normal operating range of dosing pump shall be not less than 10:1.

**(i) Mechanical Diaphragm:** Diaphragm rigidly coupled to the drive train. Single suction Pumps and discharge valves. Glandless. Accuracy: ± 3% of stroke.

**(ii) Piston Pumps:** Cylinder and piston with packed gland. Double suction and discharge valves can be fitted for greater accuracy at high pressure. Accuracy: ± 1% of stroke.

**(iii) Piston Diaphragm Pumps:** Diaphragm hydraulically operated by liquid displaced by a plunger and protected from excess pressure via a relief valve. Accuracy: ± 2% of stroke.

Materials shall be selected to suit the chemicals being pumped. Liquid ends MOC shall be based on the application. Diaphragm materials shall be butyl PTFE, or Hypalon and glands shall be PTFE or Neoprene.

Each pump shall be provided with inlet and outlet isolating valves and where necessary, with pressure relief and non-return valves. Dosing pumps shall be provided with back pressure loading valves and pulsation dampeners in the delivery lines depending on the downstream conditions.

### 6.6.40. Submersible Pump

Submersible pumps shall be submersible, vertical shaped, centrifugal, non-clog type, design for continuous operation in submerged / partially submerged condition and intermittent operation complete with motor control system, anchoring brackets, base elbow & power cable with control panel and level switches. The efficiency of the pump shall be high at duty point and remain reasonably high during the full duty range at the pumping system.

The pump should be capable of developing the required total head at rated capacity. Pumps should be suitable for single as well as parallel operation at any point.

The pump should deliver at least 125% of its rated capacity at 75% of the specified total head. The H and Q curve should be continuously rising towards shut off head.

Operating range – system curve

Velocity of vibrations shall be within 4.5 mm/s as per relevant Hydraulic Institutes Standards and IS. Noise level shall be limited to 85 dba at a distance of 2 m.

**Material of Construction**

| | |
|---|---|
| Pump casing: | Cast Iron |
| Impeller: | Stainless steel SS304 |
| Shaft: | SS ASTM A276 Type410/420 |
| Bearing Bracket: | Grey cast iron (CI IS: 210FG260/ Ductile iron) |
| Motor casing: | Grey cast iron (CI IS: 210FG260/ Ductile iron) |
| Bolts, nuts: | Stainless steel SS316 |
| Shaft protective sleeve: | Stainless steel SS316 |
| Casing wear ring: | Grey cast iron (CI IS: 210FG260/ Ductile iron) |
| O-ring: | Nitrile rubber (NBR) |

**Motor**

| | |
|---|---|
| Min. motor efficiency: | 92% |
| Degree of protection: | IP 68 |
| Insulation class: | F0 |
| Coolant temp: </= | 40 C |
| Starting mode: | Direct |
| Rated voltage: | 3ph, 415 V |
| Rated freq: | 50 Hz |
| Nominal speed: | Less than 1500- rpm (Synchronise) |
| Voltage tolerance: | ±10% |
| Motor casing: | Grey cast iron |
| Main cable: | complete with cable length as per requirement |

### 6.6.41. Screw Pump

These pumps shall be used for handling thickened sludge. Pumps shall be of the type in which a pumping action is generated by a helical rotating eccentrically within a resilient stator in the form of a double internal helix. The eccentric motion of the rotor shall maintain a constant seal across the stator as it travels through the pump to give a uniform positive displacement. Pumps shall be arranged generally with a single shaft seal at the suction end. Mechanical seals shall be used. If a flexible shaft is used to accommodate the eccentric motion, a corrosion resistant shroud shall be fitted to prevent fibre build-up on the shaft. Enlarged inspection access holes shall be fitted to the suction chambers of all pumps for periodic removal of accumulated debris.

The shaft bearing shall be positively isolated from the fluid being pumped. The rotor material shall be selected for corrosion and abrasion resistance for the fluid being pumped, and for prolonged service life. The stator shall be of a resilient material selected for chemical and abrasion resistance for the fluid being pumped. Pumps shall normally be driven by an electric motor through reduction gearing and the combined drive shall be continuously rated. Pump and motor shall preferably be mounted in-line on a common base plate. All motor enclosures shall be provided with ingress protection to IP55. Motor anti-condensation heaters shall be provided and shall be suitable for use on a 220V single phase, 50Hz supply. Pumps shall be fitted with individual dry-running protection to initiate pump trip.

**MATERIAL OF CONSTRUCTION**

| | |
|---|---|
| Pump Housing: | CI IS 210 GR. FG220 or FG260 |
| Rotor: | SS 316/410 |
| Shaft: | SS 316 /410 |
| Stator: | Nitrite black |
| Type of drive: | V belt & Pulleys |
| Base plate: | MS fabricated |
| Seal type: | Gland packing (Asbestos Free) |

### 6.6.42. Thickener

The thickener rake blades shall be manufactured in steel and shall be fitted with renewable synthetic rubber wearing strips (squeegees) to maintain contact with the floor surface, and to cope with possible minor undulations in the floor.

The fixed bridge structures shall be supported on the tank walls and constructed from rolled steel beam sections that span the tanks. One half of the bridge shall be provided with galvanised mild steel walkway, handrailing and toe boards. The fixed bridge structures shall be shot blasted and zinc sprayed after manufacture and painted with an approved paint system. The drive unit shall comprise of a variable or fixed speed electric motor as specified with coupling and totally enclosed reduction gear, arranged so that the shaft couplings are accessible, and the gear box easily removed and readily replaced without entry into the tank. Working access to all sides of the drive unit shall be possible. The drive shall be capable of producing free and uniform rotation without binding, when operating with excessive accumulations of thickened sludge on the tank floor. It shall be designed to start from rest following a sit-down condition such as start-up following restoration of power after a power failure. The drive unit shall be designed with a minimum service factor of 2 to withstand the blade loads and hydraulic drag on the scraper mechanism whilst operating under the specified performance criteria and at the maximum rotational speed recommended by the manufacturer.

Each drive unit shall be provided with a torque limiting coupling between the geared motor and the gearbox suitable for manual adjustment of the breaking torque. The coupling shall incorporate a limit switch to shut down the motor during an overload condition. Additionally, shear pin overload protection shall be provided in each drive unit as a back-up to the torque limiting coupling device. The shear pin protection shall be designed to fail at a torque 25% more than the torque limiting coupling maximum setting and also at not more than 75% of the torque for which the drive and scraper structure mechanism is designed. Shear pins shall be placed in an accessible location and shall not be subjected to bending stresses. All shear pins shall be full diameter type.

Gears shall be supported on anti-friction bearings and shall be oil lubricated. Oil fill, breather and level indication devices shall be provided. The reduction gear shall incorporate an oil dam so that the oil contained is not lost in the event of a seal failure. All points where oil leakage may occur shall be suitably trapped to prevent oil contamination of water. Greasing points shall be extended as necessary for readily accessible locations.

### 6.6.43. Submersible Mixer

Submersible mixers shall be of the axial flow type with shrouded propeller and horizontal motor and propeller shafts. The design requirements of the mixer shall be as follows: -

(a) Maintain solids in a uniform suspension throughout the tank without shearing the flocculated material.

(b) Operation in sludge of at least twice the specified solids content.

(c) Suitable for continuous operation in the sludge of specified physical and chemical characteristics without undue wear and tear.
(d) Capable of being operated at any depth and capable of angular positioning both in the horizontal and vertical planes with location stops at no greater than 30°. Mixers shall be designed to be raised or lowered and shall be easily removed from its working position without the need to enter the tank in which it operates. Each mixer shall be provided with a guide rail and post with integral davit fixed to the wall of the tank. Davit arms shall be at a height no greater than 2.25m above local platform or hardstanding. The base of the guide rail shall be fixed to the floor of the tank. The davit post shall be rotatable or pivoted and be provided with means for lowering the mixer on to the walkway adjacent to the tank when it is raised out of the tank. The davit shall be provided with all necessary ropes, shackles and pulleys. Pully block shall be suitable for exterior applicable without corroding. The complete lifting unit shall be rated for twice the maximum duty required. Mixer motors shall have a built-in cooling system which shall permit continuous operation at rated output both when submerged and not submerged. Motor cable terminations shall be provided with cable sleeve and strain relief. The cabling to the motor shall be securely sheathed to prevent fouling with the propeller. The cabling shall be of the correct length allowing only a minimum of excess length. Motor bearings shall be maintenance free. The propeller and propeller shaft shall be in stainless steel to BS EN 10090. All installation accessories including guide rail and wire rope shall also be in stainless steel.

### 6.6.44. Ventilation Fan

Fans:

Fans shall be built to a fully developed design and shall be capable of withstanding the pressures and stresses developed during continuous operation at the selected duty. Belt-driven fans shall be capable of running continuously at ten per cent in excess of the selected duty speed.

Wherever specified, or as necessary, fans shall be fitted in with variable inlet vanes which shall be matched to fan performance to give stable control. Vanes shall be interlocked to ensure movement in unison. Operation shall be manual or automatic as specified. Where manual control is specified, the operating device shall facilitate positive locking in at least five different positions.

Vane blades shall not vibrate or flutter in any possible operating condition, and the construction of the linkage system shall minimise friction and lost motion.

Unless otherwise specified, the shaft and impeller assembly of all fans shall be statically and dynamically balanced. All propeller fans shall be statically and dynamically balanced where the impeller diameter is 750mm or greater. Where indicated, limits of vibration severity shall be in accordance with BS 4675: Part 1.

**Axial-flow fans**:

Axial-flow fan casings shall be rigidly constructed of mild steel or aluminium alloy, stiffened, and braced where necessary. Mounting feet shall be provided where necessary for bolting to a base or to supports. Inlet and outlet ducts shall terminate in flanges to facilitate removal. For in-duct mounting fans, the length of the fan casing shall be greater than the combined length of the impeller(s) and motor(s) and electrical connections to the motors shall be through an external terminal box secured to the casing.

Impellers shall be of steel, aluminium or plastics and the blades shall be secured to the hub or the blades and the hub shall be formed in one piece. The hub shall be keyed to the shaft. Blades shall be aerofoil or laminar section, capable of pitch adjustment where specified.

For axial-flow fans driven by motors external to the fan casing, the requirements for drives and guards mentioned elsewhere in this Specification shall be met. Unless otherwise indicated, a guard is not required for any part of a drive which is inside the fan casing. An access panel with purpose-made air seals shall be provided in the fan casing. The access panel shall be sized to facilitate maintenance.

Where axial-flow fans of the bifurcated type are specified, the motors shall be out of the air stream. Motors may be placed between the two halves of the casing in the external air or may be placed within the fan casing, provided that effective ventilation is given to the motors.

**In-line centrifugal and mixed-flow fans:**

Mixed-flow fan casings shall be rigidly constructed of mild steel, or aluminium alloy stiffened and braced where necessary. Mounting feet shall be provided where necessary for bolting to a base or supports. Inlet and outlet shall terminate in flanges to facilitate removal. Stator vanes shall be of mild steel or aluminium alloy. The design shall facilitate access to the impeller. Where motors are mounted external to the casing, the requirements for drives and guards given elsewhere in this Specification shall be met. An access panel with purpose-made air seal shall be provided in the fan casing. The access panel shall facilitate maintenance.

**Air Filters:**

Filters shall be arranged to facilitate access for cleaning, removal and refitting. Purpose-made seals shall be provided to minimise air leakage around filters and the effectiveness of the seals shall not be impaired by periodic removal and refitting of the filter cells.

Where a flame-proof filter medium is required, the material shall comply with the requirements of BS 476.

The design air velocity at the face of the filters shall not exceed 2.5m/s. At the design airvolume flow rate the initial (clean) resistance shall not exceed 90Pa for filters.

Unless otherwise indicated, filters shall be selected from the following range of preferred nominal sizes:

(a) 600mm x 600mm.

(b) 500mm x 500mm.

**6.6.45. Conductivity Analyser**

| Sl. No. | DESCRIPTION | PARTICULARS |
|---|---|---|
| | SENSOR | |
| 1 | Type of Cell | Flow through |
| 2 | Conductivity range | As per approved instrument schedule |
| 3 | Cell constant | 0.01/ 0.1/ 1.0 depending upon range |

| | | |
|---|---|---|
| 4 | Temperature compensation | Manual and Automatic (integral) upto 0 to 100°C with PT-100 sensor |
| 5 | Process connection | Screwed |
| 6 | Wetted parts | Electrodes: Hastealloy<br>Insulators: KYNAR & VITON or better |
| 7 | Pressure rating | 10 kg/cm2 |
| 8 | Accessories | Tee/ Vessel (SS 316) |
| 9 | Cable | Up to transmitter in flexible conduit |
| | TRANSMITTER | |
| 1 | Type | Microprocessor based single channel |
| 2 | Mounting | Flush panel |
| 3 | Protection class | IP-55 or better |
| 4 | Output | 4-20 mA DC (isolated) |
| 5 | Display | a) Digital display of process variable in Engineering unit, Temperature, Alarm status<br>b) Backlit LCD<br>c) Character height 12 mm |
| 6 | Zero & Span adjustment | Front panel membrane type keyboard |
| 7 | Temperature compensation | Manual or Automatic – selectable through keyboard |
| 8 | Diagnostic | Self-diagnostic program for electronics, measuring electrode, open wiring etc. |
| 9 | Alarm | Dual alarm set point, hysteresis and time delay adjustable on membrane keyboard |
| 10 | Enclosure | Epoxy painted die cast aluminium |
| 11 | Cable termination | Internal (cable entry through conduit) |
| 12 | Accuracy | ± 1.0 % of measured range |
| 13 | Repeatability | ± 1 % output range |
| 14 | Stability | ± 1.0 % of output range/ month non-cumulative |
| 15 | Power supply | 240 V AC, 50 Hz (through UPS) |
| 16 | Operating temp | 0-45°C |
| 17 | Accessories | a) For cation conductivity analyser Dual Ion-exchange column, resin, etc.<br>b) Phenolic nameplate<br>c) Stainless steel sampling system accessories<br>d) Portable test kit |