March 22, 2012

Department of Chemical Engineering

Indian Institute of Technology Delhi, Hauz Khas, New Delhi-110016

Notice Inviting Quotations (NIQ) for the purchase of a pilot plant Ozonation / Advanced Oxidation system for effluent treatment

Quotations (separate sealed envelopes of technical and commercial bids kept together in a single sealed outer envelope) are invited for the purchase of *a **"pilot plant Ozonation / Advanced oxidation system for effluent treatment"*** as per the specifications given below. The sealed quotations should reach the address given below latest by 5 p.m. (IST) on 10-04-2012 with the superscription "***Quotation for a pilot plant Ozonation / Advanced oxidation system for effluent treatment due on 10-04-2012***":

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Technical specifications for the pilot plant Ozonation / Advanced oxidation system for effluent treatment

It is proposed to install pilot plant for treating different types of effluents. The pilot plant should provide Ozone treatment, UV treatment and H_2O_2 dosing system.

1. PLANT CAPACITY

The capacity of the plant should be 15 L/h (maximum) in continuous mode. However, the plant should be capable of working up to 5 L/h minimum.

2. PROCESS DESCRIPTION

The effluent to be treated should be collected in effluent collection tank. The tank should be equipped with an agitator. The tank should also have a drain outlet. From effluent tank, the effluent should be transferred through a metering pump to the reactor vessel with a provision for varying the flow rate. A suitable filter should be used after the metering pump along with a flow meter.

The provision should be there for the dosing of alkali or acid for pH correction of the effluent, if required and on-line addition of hydrogen peroxide. A Static Mixer should be provided after dosing of H_2O_2.

The effluent after addition of H_2O_2 should be sent to the reactor chamber. The reactor should be a vertical cylindrical vessel having UV radiation for photo oxidation process.

An ozonation unit should also be provided in the reactor, which should mix ozone into the effluent. The ozone mixing system should consist of a re-circulation loop. The effluent from the reactor should be drawn and passed through a venturi injector for the injection of ozone. A static mixer should be installed after ventury. After passing through the static mixer the effluent should be returned back into the reactor tank. Ozone mixing efficiency should be more than 90%.

The ozonation system should have a sampling port at ozone generator's and reactor's output line for monitoring the ozone concentration as and when required. The provision should be there to collect the treated effluent sample from different stages of treatment.

This plant should be a skid mounted unit on casters and capable of using in the Lab.

3. TECHNICAL SPECIFICATION OF DIFFERENT EQUIPMENT

3.1. EFFLUENT BUFFER STORAGE

A cylindrical storage tank with a conical bottom should be provided. There should be a provision for draining the leftover effluent. The tank should be equipped with an agitator and should have a provision for draining the leftover effluent. .

- **<u>STORAGE TANK</u>**
  - Capacity : 40 L (Approx)
  - Shape : Cylindrical with conical bottom
  - MOC : Stainless Steel SS-316

- **AGITATOR**

  The Agitator should be mounted on the storage tank with a provision of removal, for ease of cleaning the tank.

  - Shaft Diameter : 20 mm
  - M.O.C. Shaft/Blades : SS-316
  - Powered by : Helical Geared Motor
  - R.P.M. : 35 R.P.M.
  - Voltage : 220 V A.C

- **LEVEL INDICATOR**

  A level indicator should be provided in the storage tank.

- **LEVEL CONTROLLER**

  A level controller should be provided in the storage tank.

  - Output : Potential Free Contact
  - Signal : Warning hooter
  - Interlock :Low level, Stop transfer pump

3.2. EFFLUENT TRANSFER METERING PUMP

The transfer metering pump should be utilized for feeding effluent at a desired flow rate. The pump should be acid and alkali resistant. The pump should provide consistent flow & necessary pressure to pass through the static mixer and other components of the system.

- Type : Metering pump
- MOC : SS / PP
- Capacity : 15 L/h
- Head ~ 8 m

3.3. FLOW REGULATOR & INDICATOR

The flow rate is required to be adjusted as per the needed. The flow should be indicated on the flow meter, which should be mounted at a suitable location.

3.4. PROVISION OF pH ADJUSTMENT

There should be an appropriate location where pH probe should be installed. The preferred location is at the effluent coming out from the

storage tank. Depending upon the initial pH of the effluent, either acid or alkali is to be added.

3.5. pH CORRECTION DOSING SYSTEM

- **ACID & ALKALI TANKS**
  - Quantity : 2 Nos.
  - Capacity : 5L
  - MOC : PP

3.6. OXIDANT (H_2O_2) DOSING SYSTEM

A dosing system for H_2O_2 should be provided. The rate of dosing should be adjusted manually; however the flow rate of H_2O_2 should be monitored. The operation of hydrogen peroxide dozing pump should be synchronized with the metering pump.

3.7. ON-LINE STATIC MIXER (AFTER H_2O_2 DOSING)

An on-line static mixer should be provided after dosing of hydrogen peroxide.

- MOC : SS-316

4. REACTOR

The reactor should be made of SS-316, and should have arrangement for UV radiations. There should be provision for changing the intensity of UV radiation. A UV intensity monitor should be provided.

The Technical Specifications of different components are as follows:

- **SHAPE & DIMENSION**
  - Reactor type : Cylindrical with conical bottom
  - Rated Flow Rate : 10 LPH
  - Total Reactor Volume: 28 L
  - Liquid Volume in Reactor : 25 L (Max)
  - Total Reactor Height : min 800 mm
  - MOC : SS-316

- **THE REACTOR SHOULD HAVE FOLLOWING FACILITIES:**
  - Effluent Inlet
  - Effluent Outlet

- Exhaust Gas Outlet
- Drain at bottom with valve
- Sampling port at suitable location
- Level indicator

4.1. U.V. RADIATION UNIT

- **QUARTZ TUBES**

  The tubes should be compatible for medium pressure mercury lamp.

  - Quantity : 2 Nos.
  - MOC : Quartz (High Purity)
  - OD of tube : 24 mm
  - Thickness : 2 mm

- **UV LAMPS**

  The emission spectrum of the proposed U.V. lamp

  - Lamp Type :Low/ Medium Pressure
  - Maximum Emission :253.7 nm
  - End Connection :4 Pin
  - Supply Voltage :220 Volts AC
  - Wattage :36 W
  - Quantity : 2 Nos.
  -

- **POWER SUPPLY FOR LAMPS**
  - Power Supply unit : For 2 UV Lamps
  - Lamps : 36 W each
  - Supply Voltage : 220 Volts AC

5. OZONATION SYSTEM

The ozonation system should consist of ozone generator of 20 g/h, oxygen generation unit and ozone absorption system and ozone destruction.

5.1. OZONE GENERATOR (20 g/h)

An ozone generator of 20 g/h (high concentration) of ozone using oxygen as a feed gas should be provided. The provision should be there to alter the output of the ozone generator from 10% to 100% continuously. The technical specifications are as follows:

Technical Specification

- Ozone Output 20 g/h on Oxygen Feed Gas
- Type Corona Discharge
- Feed Gas Oxygen
- Ozone Flow 1-5 LPM
- Cell Cooling Forced Air Cooling
- Control System Digital
- Indicators
  - Operational Indicators
    - % Output indicator
    - Control Supply On
    - Inverter On
    - Blown Fuse (Control)
  - Fault Indicators
    - Trip PSU
    - High Current
    - Hi-Low Voltage
- Utilities
  - Electrical Requirement
    - Voltage (Volts) 220 ± 15%
    - Phase Single
- Feed Gas Requirement
  - Oxygen
    - Oxygen Purity 93 % ± 1%
    - Dew Point $-60^{o}C$
- Controls
  - Input Voltage to HT Transformer 150-230 V
  - Input Frequency 50 Hz
  - Oxygen Feed Flow 1-5 LPM

5.2. OXYGEN CONCENTRATOR

Ozone generator should be fed with an oxygen source for the generation of ozone. Oxygen concentrator should produce oxygen from environmental air. The oxygen concentrator should produce 5 LPM of Oxygen.

Technical Specifications

- Quantity 1 No
- Feed Atmospheric Air
- Type PSA Based
- Oxygen Flow 1-5 LPM.
- Purity 93% ± 1%
- Electrical Supply 220 – 240 V AC, 50 Hz,
  Alarms Power Failure, Battery Test

5.3. OZONE MIXING SYSTEM

The ozone mixing system should consist of a re-circulation loop in the Reactor itself. The loop should consist of a pump, venturi injector, static mixer and central diffuser along with pipeline. The Ozone should be injected through the ventury injector installed at the outlet of the pump. A static mixer should be located after injector. The mixture of effluent and ozone should be diffused back into the reactor using a venturi diffuser. The injection of ozone quantity should be controlled by ozone generator's output. The specifications of the main components are as follows:

- RECIRCULATION PUMP
  - Flow 50 LPH (Max)
  - MOC SS-316

- VENTURI INJECTOR
  - MOC SS-316/PTFE
  - Size ½"
  - N.R.V. One
- STATIC MIXER
  - MOC SS-316
- CENTRAL VENTURY DIFFUSER
  - MOC SS-316
  - Ozone Mixing Efficiency 93%
- DEGASSING UNIT

  The degassing unit will be utilized for removal of absorbed gases from the treated effluent.

- Effluent outlet 300 mm from bottom
- MOC SS-316

5.4. OZONE DESTRUCTION UNIT

A destructor of ozone from the outgoing gasses should be provided. The specifications are as follows:

- Type Catalytic
- Max O_3 Flow 20 g/h
- Flow Rate 8 LPM
- Efficiency more than 99.9%

Arrangement should be made to measure O_3 gas concentration before Ozone destruction unit.

6. CONTROL PANEL

The control panel should be located on the front side of the pilot plant skid. The control panel should include power distribution, monitoring and control. All the instruments, circuits and other components required for indicating, monitoring, signaling and interlocking should be housed in the control Panel.

Following equipment should be controlled from the control panel. Their status should be indicated and necessary inter-locks should be provided.

- Storage tank stirrer
- Feed metering pump
- Microprocessor based pH indicator
- H_2O_2 Doser
- UV Lamps selection
- UV Intensity Control & Monitoring
- Ozone Generator – 20 g/h
- Oxygen Generator – 5 LPM
- Re-Circulation pump
- Degassing unit
- Ozone Destructor

7. EQUIPMENT FOR MONITORING OZONE

7.1. OZONE CONCENTRATION MONITOR (U.V. BASED)

Ozone Concentration Monitor is required for checking the output of the ozone generator and leftover ozone coming out after the process in

terms of g/h. The instrument should indicate ozone concentration in terms of g/m^3.

There should be a provision for taking a sample from the output of ozone generator or the left over gases after the reactor. The ozone concentration monitor unit should be detachable type, so that if the monitor is required to be used at other location, the monitoring unit should have been removed and located at other location with ease.

Model : BMT 964/ Equivalent

- Specifications
  - Ranges proposed 0 – 200 g/Nm^3
  - Facilities should be switched to % wt / wt Or PPM
  - Accuracy 0.1% of Range (Based on Beer-Lambert Law)
  - Zero Drift 0% (Automatic Zero)
  - Span Drift 0 % (Microprocessor Controlled)
  - Noise <1% of full scale Range
  - UV lamp life more than 10,0000 hrs
  - Pressure Compensation Automatic
  - Temperature Compensation Automatic
  - Rate of measurement Every 2 seconds (without switching valve)
  - Digital Outputs Ozone level, RS 232,
  - Analog Outputs 0-10 v DC / 4-20 m Amps
  - Calibration Not required (Pre-set at Factory)
  - Confirm to the following Standards EPA, ISO, IOA, DIN, NFT.

8. GENERAL ARRANGEMENT FOR PILOT PLANT

All the components / equipment of the pilot plant should be assembled on a skid with a provision of four wheels for its transportation from one location to other. The control panel should be located on the front side of the plant including all indicators, switches and the flow meters to check the flow rate of different fluids the operating conditions.

9. SCOPE OF SUPPLY

- Design, engineering, fabrication, installation and commissioning of the pilot plant as per technical specifications of the tender.
- Electrical fittings and instrumentation.

- For electrical connection to the plant, a 5 m. cable with industrial plug should be provided at the control panel.
- List of drawings & documents to be submitted along with the offer.
  a) Emission spectra of UV Lamps for photo-oxidation
  b) Process Flow Scheme
  c) General Arrangement Drawing & Layout Plant
  d) Electrical & Instruments connections,
  e) Electrical Load List
  f) List of Commissioning Spares
  g) List of Two Years Operational & Maintenance Spares

- List of Drawings & Documents to be submitted after award of the contract.
  a. Basic Design & Manufacturing Drawings for approval of IIT Delhi
  b. As built Drawings of the plant
  c. Specification for all items like pumps/compressor, microprocessor based pH indicator, UV lamps, quartz tubes etc.
  d. Test Certificate of major equipment
  e. Operation and maintenance Manual – Two copies

10. Process Guarantee

- The offered pilot plant should be guaranteed for 2 years for any manufacturing defect. The defective components should be repaired or replaced during this period free of cost.
- Free servicing tune up and adjustment of the Plant equipment once in four months

Terms and Conditions:

1. Quotations must be made in sealed envelopes. Technical and commercial bids must be sent separately in two sealed envelopes and then put together in one envelope. The quotes must reach the following address by 10th April, 2012 by latest by 5 p.m.

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1. Price must be quoted FOB New Delhi.
2. Indian agency certificate must be enclosed.
3. Proprietary certificate might be enclosed if applicable.
4. Payment after installation.
5. Validity of quotation should be at least 3 months.
6. Period of delivery should be mentioned.

Remarks:
The Institute reserves the right to accept or reject any all the quotations without assigning any reason thereof.

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