SECTION 43 31 13.13 10

ACTIVATED CARBON-GAS AND LIQUID PURIFICATION FILTERS

PART 1. GENERAL

1.1 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required to install Gas and Liquid Phase Granular Activated Carbon (LGAC) units for the removal of organic compounds. The Contractor shall provide materials and equipment which are new and unused.

B. This section specifies the performance requirements for the design, fabrication, installation, and operation of the Liquid Phase Granular Activated Carbon (LGAC) system as shown on the Contract Drawings and as specified. The Contractor shall provide three (3) LGAC filters (LGAC-410, LGAC-420 and LGAC-430). The three units will be used to remove any organics that remains after Multimedia Filters and Advanced Oxidation Process (AOP). The contractor shall also provide and install one (1) carbon cannister vessel (C-100) as specified and shown on the contract drawings.

C. All piping shall be provided and installed in accordance with Section 41 10 02.

1.2 RELATED SECTIONS

A.	Section 01 01 00	Scope of Work
B.	Section 01 33 00	Submittals Procedures
C.	Section 01 78 00	Closeout Submittals
D.	Section 01 78 23	Operation and Maintenance (O&M) Data
E.	Section 41 10 02	Process Piping

1.3 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

<u>AMERICAN SOCIETY OF MECHANICAL ENGINEERS INTERNATIONAL</u>

ASME Section VIII, Division 1 - American Society of Mechanical Engineers Boiler and Pressure Vessel Code.

ASME/ANSI B16.5 - American Society of Mechanical Engineers/American National Standard Institute.

ASME Section II, American Society of Mechanical Engineers - Materials, Parts A, B & C.

ASME B40.100(2005) Pressure Gauges and Gauge Attachments.

AMERICAN SOCIETY OF TESTING MATERIALS INTERNATIONAL (ASTM)

ASTM D 1784(2011) Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 1785(2006) Standard Specification for Poly(Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2241(2009) Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D 2564(2004; R 2009e1) Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D 3139(1998; R 2005) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM F 477(2010) Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
American Water Works Association (AWWA) - B604, Standard for Granular Activated Carbon

1.4 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00

Submittals:

A. Pre-Construction Submittals:

1. Manufacturer's technical and engineering data sheets for the LGAC system including system features, materials of construction of the adsorber vessel, LGAC media, general dimensions, and operational parameters. Product data shall include selected model number, rated flow capacity, dimensions, weights (dry and operating), accessories, instrumentation list, and warranty coverage. List of all instrumentation shall include descriptive information for each component including, but not limited to, instrument number, manufacturer, and ranges measured.

2. Shop Drawings, including:

   a. General arrangement drawings with dimensions of adsorber vessel, skid, valve packs, clearance requirements, and Manufacturer's data covering installation instructions, weight, detailed specifications, materials of construction, parts, devices, and other information required to verify compliance with these specifications.

   b. Show on the Drawings proposed layout, location of valves and interface points, and anchorage requirements. Show location of piping, valves, pressure/vacuum relief devices, lifting lugs, anchor bolt locations. Indicate all sizes, capacities, and dimensions.

   c. Process flow diagrams and instrumentation diagrams(s) showing all major pieces of process equipment with valves. Show on the drawings complete piping, wiring and schematic diagrams and any other details required to demonstrate that the system has been coordinated and shall properly function as a unit.

   d. Clearances for maintenance and operation.

   e. Details on vessel internals including underdrain and top distributor.

3. Empty bed contact time for each vessel, and pressure drop information across each carbon vessel for all plant flow conditions (min: 600 gpm, Average:1600 gpm, and Maximum: 1800 gpm).

4. Backwash requirements – flow and pressure drop.

5. Specification of each type of granular activated carbon to be utilized including iodine number, moisture content, effective size, uniformity coefficient, abrasion number, apparent density, and screen size. Projected granular activated carbon usage rates. Reports of testing granular activated carbon in accordance with AWWA B604. Material safety data sheets in conformance with 29 CFR 1910 Section 1200(g) for activated carbon.

6. Calculations:

a. Structural and anchorage calculations. Contractor shall submit detailed calculations illustrating the seismic characteristics and anchorage of the proposed skid. Calculations shall be signed and sealed by a professional engineer licensed to practice in the State of New York.

7. Manufacturer's certificates, including the name and address of the production facility, attesting that the activated carbon furnished meets the specified requirements.

8. Material specifications for pipe, valves, fittings and instrumentation, and specifications for vessel lining and painting (interior and exterior).

9. A comprehensive instrument, valve, and actuator list and associated datasheets. Contractor shall supply drawings detailing wiring between field instruments/valve actuators to Manufacturer supplied junction box. Manufacturer shall provide instrumentation per Contract Documents.

B. Informational Submittal, including:

1. Equipment delivery schedule.

2. Manufacturer’s hydrostatic test report at manufacturing facility.

3. Coating manufacturer certification of internal coating application.

4. Recommended spare parts list.

C. Contractor shall submit a Test Report describing the findings of the field inspection of the installed equipment and the results of the functional testing, hydrostatic testing, and performance testing – see paragraph 3.4 for details.

D. Operation and Maintenance Manual

1. Submit the operation and maintenance (O&M) manual and required number of copies in accordance with Section 01 78 23.

1.5 SEISMIC LOADS

The structural aspects of the LGAC shall be sufficient to meet the 2021 International Building Code requirements for Seismic Design Category = B. See structural sheet S-001 for additional Design Criteria information.

1.6 DELIVERY AND STORAGE

Protect all equipment, delivered and designated for storage, from the weather, humidity and temperature variations, dirt and dust, or other contaminants.

1.7 EQUAL PRODUCTS

The Contract Drawings and Technical Specifications are based on a

conceptual arrangement of the three LGAC vessels and piping (TIGG Model CP-20K-10-GA system with 3 units). Should the Contractor propose to furnish an equivalent system of a different configuration, the Contractor shall be responsible for all revisions necessary to incorporate the proposed LGAC into the design and submit the necessary revised Contract Drawings and Technical Specifications for review and

approval.

1.8 QUALIFICATION AND WARRANTY

A. Manufacturer Qualification

1. The LGAC System shall be supplied by reputable Manufacturers having at least ten (10) years' experience in the design and fabrication of such systems for the treatment of groundwater and water.

B. Warranty

1. Manufacturer shall provide warranty in accordance with Section 01 77 00 of the specifications.

PART 2. PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Provide materials and equipment which are the standard products of a manufacturer regularly engaged in the manufacture of LGAC systems and components, and that essentially duplicates items that have been in satisfactory use at other locations for at least 10 years.

B. GAC system shall be skid mounted, assembled, piped, and tested in the shop prior to shipment. Field assembly shall be minimized to the maximum extent possible. The Owner's Representative may desire to witness a factory acceptance test at the manufacturer's shop.

C. This equipment shall be manufactured/ supplied by: TIGG, Calgon, Carbonair, Evoqua, or approved equal.

2.2 GAC SYSTEM REQUIREMENTS

A. Service: The LGAC system (LGAC-410, LGAC-420 and LGAC-430) shall be designed to remove any residual hydrogen peroxide and organics.

B. Anticipated Influent Characteristics

Flow : 1800 gpm (max) and 1600 gpm (average)

Compound	Units	LGAC Influent Value (maximum)
Hydrogen Peroxide	ppm	3 maximum
Trichloroethene	ppb	5
Tetrachloroethene	ppb	1
Freon 113	ppb	1
1,1-Dichloroethene	ppb	1
cis-1,2-Dichloroethene	ppb	1
1,4-Dioxane	ppb	1.5

C. Performance Requirements

The LGAC System shall be designed to meet the discharge limits given below for
1800 gpm (max) and 1600 gpm (average) flow:

Compound	Units	Discharge Requirement
Hydrogen peroxide	ppm	ND*
Trichloroethene	ppb	ND
Tetrachloroethene	ppb	ND
Freon 113	ppb	ND
1,1-Dichloroethene	ppb	ND
cis-1,2-Dichloroethene	ppb	ND
1,4-Dioxane	ppb	<0.1

* ND – Non-Detect

D. Design Criteria

1. Number of LGAC Units: 3 (LGAC-410, LGAC-420 and LGAC-430) for Hydrogen Peroxide and Organics Removal

2. Headloss:8 psi during normal operation and maximum 15 psi

3. Maximum flow Rating: 785 gpm per unit

4. Flow direction: Three (3) units operating in parallel

5. Empty bed contact time: 12 minutes per vessel flow of 700 gpm per unit

6. Hydraulic loading rate: 8.9 gpm/ft^2 at flow of 700 gpm per unit

7. Backwash loading rate & water source: Atleast 12 gpm/ft^2

2.3 EQUIPMENT DESCRIPTION

A. GAC Vessel: The vessel shall have a diameter of 10 feet, a total height of 18 feet, and shall be oriented vertically. The vessels shall be of welded carbon steel construction and shall be tested to withstand a maximum allowable working pressure of 125 psi. Lifting lugs, supports, connections and appurtenances shall be provided as detailed on the drawings including pressure relief and vacuum relief valves for each vessel. The vessel shall be designed and fabricated in accordance with the ASME BPVC SEC VIII D1 and does not have to be stamped and certified.

B. Underdrain System: The underdrain shall be of the standard manufacturer's design particular to the supplied LGAC unit and furnished with the constructed package unit except that it shall not be of plastic material. The LGAC underdrain/ backwash distributor shall be slotted septa constructed of 316L stainless steel. The underdrain system shall be designed to withstand all loads due to design pressures, design loading rates, forces from backwash flows, and loads from the media to be installed in the tank. The slot size or perforations in the underdrain shall not permit media to pass through it.

C. Activated Carbon: Material shall be free from impurities that affect the serviceability and appearance of the finished product.

a. Twenty thousand (20,000) pounds of virgin LGAC shall be provided and installed within each vessel.

b. The activated carbon shall be virgin liquid phase coal- or coconut-based activated carbon specifically designed to removal low concentration of weakly adsorbed organics from water. The media shall be produced in the United States. Granules shall be clean and hard. The LGAC shall conform to AWWA B604 (Potable Water Service) standard for LGAC and comply with ANSI/NSF Standard 61. The activated carbon which is manufactured to the following specification:

1. Manufacturer & Commercial Name: TIGG-5DC 0830

2. TIGG-5DC 0830 or Approved Equal

3. Iodine Number, mg/g (minimum) (ASTM D 4607): 1100

c. US Sieve, 90 wt% min: 8 x 30

d. Abrasion Number (minimum):85

e. Apparent Density, g/cc (ASTM D 2854): 0.42 - 0.47

2. An analysis sheet certifying compliance with the specifications and indicating point of manufacture shall accompany the delivered activated carbon.

D. Appurtenances and Instrumentation:

1. Pressure relief at each vessel shall be provided by a pressure/vacuum relief valve to relieve pressure at the Maximum Allowable Working Pressure (125 psi) of the vessel. One shall be provided for each liquid-phase LGAC vessel. Each of the vessels shall also be provided with a pressure relief/vacuum relief valve. The pressure/vacuum relief valve shall be mounted on the lines shown on the P&IDs.

2. Provide all skid-mounted interconnecting piping and valves between LGAC-410, LGAC-420 and LGAC-430. The process piping at each vessel shall be equipped with a differential pressure gauge to indicate the pressure drop across each adsorber and the system. The differential pressure gauge shall have a 4" face diameter with an encapsulated sensing element in a brass case housing (0 to 20 psig range). The differential pressure gauge shall have the ability to provide a field configurable, 120 VAC discrete input indicating a differential pressure of up to 10 psid.

3. The carbon fill and discharge shall be fitted with hose connections, such that carbon transfer to and from the adsorbers can be facilitated using carbon transfer hoses. These connectors shall be 3" Quick Disconnect Adaptors constructed of corrosion resistant materials (nylon) as manufactured by Dover Corp. as Kamlock connectors or approved equal.

4. Two (2) flush connections shall be provided on each LGAC fill line, one upstream and one downstream of the fill isolation valve. One (1) flush connection shall be provided on each LGAC discharge line, downstream of the fill isolation valve. The connections shall be welded into the steel or stainless steel pipe. Flush connections shall consist of a short section of ¾" pipe, a ¾" full port ball valve and a ¾" quick disconnect adaptor to match with water hose fittings.

E. Equipment Control: The LGAC system shall be provided with manual butterfly valves. The appropriate valves will be opened or closed to place LGAC in normal operation model or to initiate backwash.

1. Valves: Transfer of water to and from the LGAC unit shall be accomplished by a manual butterfly valve.

2. Control System Junction Box: Manufacturer shall provide a local, prewired, NEMA 4X junction box to terminate all skid mounted instrumentation and equipment wiring. Signals from the junction box shall be transmitted to the plant PLC to alarm, and notify when to initiate backwash due to high differential pressure, or place specific LGAC vessels back in service. Backwash initiation shall be by manual initiation. The valves shall be completely assembled, tested at the factory prior to shipment.

F. Carbon Cannister (vessel):

1. Furnish and install one (1) carbon cannister (vessel) from TIGG (Model: N-1200 PDB), Carbonair, Evoqua or approved equal.

2. The carbon cannister shall be rated for upto flow rate 1200 CFM with 1000 pounds of carbon capacity. Carbon media shall be 4mm pellet virgin carbon media.

   Bed Depth 36 inch
   Carbon Tetrachloride Number 60% (minimum)
   Apparent density (dense packing) 30 lbs/ft3
   Hardness Number 95 (minimum)
   Moisture Content (as packed) 2% (maximum)

2.4 PAINT

A. The interior and exterior of fabricated ferrous metal components shall be treated after fabrication to prevent corrosion. The surfaces of the vessels shall be sandblasted and completely factory finish painted prior to shipment. Insulating components such as gaskets, couplings, or bushing or dielectric-type which will prevent corrosion of bimetallic-type contacts, shall be used at connections between dissimilar metals.

B. Exterior Surfaces: All ferrous surfaces shall be coated or painted. Ferrous metal surfaces shall be prepared with two coats of epoxy paint.

C. Interior Surfaces: All interior surfaces shall be coated with Plasite 4110 applied at 40 mil dry film thickness (DFT).

2.5 ACCESSORIES

A. Supporting Skid: The LGAC system and all appurtenances shall be supported on a steel skid and legs.

B. Lifting Lugs: Individual equipment and or each field-assembled part over 100 pounds in weight shall be provided with lifting lugs for ease of handling.

C. Anchor Bolts: Contractor shall size and provide 316 SS anchor bolts, and shall provide installation template for positioning the bolts. The support system shall be designed to resist seismic forces. The seismic forces shall be based on the vessels and all appurtenances full of water.

D. Equipment Identification Plate: A stainless steel identification plate shall be securely mounted on the equipment (each LGAC vessel) in a location that is visible at eye level. The plate shall bear the Manufacturer’s name, address, phone number, equipment model number, serial number, and equipment ID number that matches the P&IDs.

2.6 SPARE PARTS & TOOLS

A. Contractor shall provide one set of recommended spare parts for LGAC and related accessories supplied.

B. Contractor shall supply one set of any special tools required for assembly, disassembly, or adjustment of the equipment supplied.

PART 3. EXECUTION

3.1 GENERAL

A. The LGAC System shall be manufactured in accordance with the best trade practices and in accordance with all applicable codes and regulations.

3.2 FABRICATION & SHIPMENT

A. The Contractor shall allow the Owner’s Representative access to the manufacturing facility should the Owner’s Representative decide to inspect the equipment during the manufacturing of the system or any part of the equipment. The Owner’s Representative may desire to witness a factory acceptance test at the manufacturer’s shop prior to shipping to demonstrate maximum processing flow rate and full functionality of all service/backwash modes of operation.

B. LGAC units shall be shipped dry without any media.

C. All open piping shall be fitted with blank flanges prior to shipment.

D. Work not required to be performed in the field shall be performed in the factory under controlled conditions. Field assembly of the equipment will be performed by the Contractor under the supervision of the Manufacturer.

E. The Contractor shall provide all installation documents and O&M Manuals in accordance with the Contract Documents.

3.3 INSTALLATION

A. Verify all dimensions in the field and advise the Owner’s Representative of any discrepancy before performing the work.

B. The LGAC system shall be installed in accordance with the Manufacturer's Instructions, as shown on the Contract Drawings, and in the presence of the Manufacturer’s representative.

C. The installed LGAC system shall be visually inspected for plumb and nozzle alignment, smoothness, and evenness.

D. Factory painted items shall be touched up as needed. Factory painted items requiring touching up in the field shall be thoroughly cleaned of all foreign material, wire brushed, sanded, primed and top-coated with the manufacturer's standard factory finish to match the desired color.

E. All valves and piping shown on the P&ID within the skid limits shall be factory installed.

F. After installation of the LGAC vessels, the Contractor shall load (fill/ transfer) each LGAC vessel with virgin LGAC. The Contractor shall provide all related equipment for the carbon fill to each LGAC unit including utilities such as air and potable water. Contractor shall assume that approximately 24,000 gallons of potable water will be required for two LGAC units for initially backwashing the carbon units for LGAC segregation prior to placing the units in service. Use care in loading carbon media and clean up all spills after they occur. Wear dust masks and/or other protective equipment to avoid breathing carbon dust.

G. Dispose of waste generated during the startup and placement of the units in service, including backwash waste generated during backwash of the units to segregate the carbon prior to startup, and all other related wastes.

3.4 TESTING

A. Functional Testing: Prior to startup, all equipment components shall be inspected by the Contractor for proper alignment, proper connections, and satisfactory installation. All products shall be carefully inspected for defects in workmanship and material; debris and foreign matter shall be cleaned out of valve openings and seats; all operating mechanisms shall be operated to check their proper functioning; and all nuts and bolts shall be checked for tightness. Valves and other equipment which do not operate easily or are otherwise defective shall be repaired or replaced. Proper installation and tightness of all underdrains and inlet distributors shall be checked. Photographs of each vessel internals shall be taken prior to loading LGAC.

B. Hydrostatic Tests: After installation, all LGAC pressure vessels/tanks shall be tested for water tightness. Testing shall be performed with potable water provided by the Contractor. Testing plugs or caps, all necessary pressure pumps, pipe connections, gauges, other equipment, potable water, and all labor required shall be included. The Contractor shall ensure all the air is removed from the system prior to pressure testing. Test pressures shall be 100 psi for 2 hours. No leaks are allowed; and a decrease in pressure of 0.5 psi is permissible. System shall be checked for leaks after one hour. Piping systems shall be isolated from the tanks for pressure testing at the specified test pressure.

C. Performance Tests: An Operating Performance Test shall be performed to demonstrate that the LGAC System conforms to the requirements of this specification. The performance test shall be performed for 3 days. Field tests shall not be conducted until such time that the entire treatment plant has been installed, and after startup and shakedown is complete, and the plant is ready for testing.

D. For the purpose of performance testing, system throughput will be continuously monitored on the plant flow meters. LGAC Influent and Effluent samples from all units will be collected, marked, preserved, and analyzed for any VOCs, SVOCs organics and residual hydrogen peroxide. The samples will be collected and analyzed once a day for three (3) days at the maximum design flow rate. The data will be compared to the influent characteristics and effluent requirements specified to verify that they are within the specified ranges. The system performance will be considered acceptable if the influent and effluent concentrations are per the concentrations specified in Paragraph 2.2 of this section.

E. Test Report: Contractor shall provide a test report that shall include as a minimum a description of the test, methodology used, data and time when test was performed, and the results of the testing. All testing results shall be reported, including test results that failed to meet the requirements. Should test runs fail to meet the requirements, an explanation shall be provided with the rational for failure of the test.

3.5 REMEDY

A. If the Installation, Inspection or Operating Performance Test reveals deficiencies, corrective measures shall be taken until the system satisfies all of the specified requirements. Remedies shall be at no additional cost to the Owner.

3.6 MANUFACTURER SERVICES

A. The Contractor shall provide the following personnel:

1. One (1) representatives of the Manufacturer who is experienced in the installation and adjustment of the equipment specified. The representative shall supervise the installation and adjustment of equipment - for up to 10 days (8 hours a day).

2. A representative of the Manufacturer for 15 days (3 trips) during Testing described in Paragraph 3.4.

B. Conduct a video recorded training course for designated operating, maintenance and support staff members. The training period shall be a total of 16 hours of normal working time. Field training shall cover each item contained in the operating and maintenance manual.

C. Application of the internal vessel coating shall be witnessed and certified by the coating manufacturer.

3.7 FIELD PAINTING

A. Do not paint stainless steel, galvanized steel, and nonferrous surfaces.

B. Touch-Up Painting

1. Factory painted items requiring touching up in the field shall be thoroughly cleaned, and wire brushed of all foreign material, and shall be sanded, primed and top coated with the Manufacturer's standard factory finish.

3.8 SAFETY MESSAGE

A. Wet activated carbon preferentially removes oxygen from air. In closed or partially closed containers and vessels, oxygen depletion may reach hazardous levels. If workers are to enter a vessel containing carbon, appropriate sampling and work procedures for potentially low oxygen spaces should be followed, including all applicable Federal and State requirements.

B. Contractor shall take all necessary health and safety precautions including the use of appropriate personal protective equipment (PPE) when unloading activated carbon.

END OF SECTION