CHAPTER 7.5
CARBON ADSORPTION

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7.5-1. GENERAL.

a. Liquid Phase Carbon Adsorption. Liquid phase carbon adsorption is a technology in which water is pumped through a vessel containing granular activated carbon (GAC) to which dissolved contaminants adsorb (are removed from the water). Carbon is "activated" for this purpose by processing the carbon to create porous particles with a large internal surface area that attracts and adsorbs organic molecules as well as certain metals and some inorganic molecules. Carbon adsorption is effective at removing contaminants to low concentrations. Commercial grades of granular activated carbon (GAC) are available specifically for use in liquid applications. These carbons differ from the activated carbon used in vapor-phase applications. When the concentration of contaminants adsorbed reaches a certain level, the contaminants begin to leave (breakthrough) the bed. At that time the carbon must be regenerated or replaced.

b. Vapor Phase Carbon Adsorption. Vapor phase carbon adsorption is a remedial technology in which pollutants are removed from an air stream by physical adsorption onto activated carbon grains. Commercial grades of activated carbon are available for specific use in vapor phase applications. These carbons have a finer pore structure and are more expensive than those used in liquid phase carbon adsorption applications.

7.5-2. PRODUCTS.

a. Carbon Units. Carbon units are typically fabricated off site and delivered ready for installation. Carbon vendors are required to provide the proper piping configuration for the systems. Carbon adsorption units normally consist of one or more vessels filled with carbon and connected in series or parallel. The vessels range in size from large steel vessels that hold up to 20,000 pounds of activated carbon to "55-gallon" drums. The large vessels are often cylindrical tanks mounted horizontally or vertically. Some are similar in shape to large garbage roll-off dumpsters. The large units come as either skid mounted units which are ready to use or as separate tanks that must be installed, piped, and filled with carbon. Small drums come filled with carbon but all piping and connections to the contaminated air stream must be made on site.

b. Carbon.

(1) Check to ensure that the carbon type delivered to the project is in conformance with the specification.

(2) Check to see if regenerated carbon or virgin carbon is specified for use.

7.5-3. EXECUTION.

a. Piping. Some carbon vessels have the influent line at the top and some at the bottom. Verify that the unit is piped correctly. The piping and valving are complex and can easily be installed incorrectly. A detailed inspection is needed to assure the

installation is correct.

b. Liners. Ensure that the GAC vessel lining is as specified.

c. Air Release Valves. Ensure that air release valves in liquid phase units are provided on the high points of the piping, normally on the carbon piping skid.

d. Vessel Finish. Verify that all scratches on the vessel surface are repainted in accordance with the manufacturer's recommendation.

e. Safety Features. Ensure that vapor phase carbon vessels are equipped with pressure relief and internal fire suppression (sprinklers) systems as shown on the plans and specifications.

7.5-4. OPERATION AND MAINTENANCE.

a. Plugged Media. Plugged media can be unplugged by back washing. Recurring media plugging problems should be referred to the supplier or the design district.

b. Carbon Disposal.

(1) A plan for off-site disposal or regeneration of carbon should be established well before the carbon is spent.

(a) A written disposal agreement with an EPA/state approved disposal facility may be required.

(b) Manifesting may also be required if the contaminants adsorbed make the carbon a hazardous waste. Refer to EP 200-1-2 for additional information on manifesting.

(2) Adsorption of some organic materials can cause the carbon to ignite when exposed to air as it is removed for regeneration or disposal. Determine whether the organic chemicals being adsorbed present this problem before removing carbon from the vessel. If the specifications do not address the potential for fires, contact the design district or the carbon vendor before removing carbon from the vessel.

c. Regeneration.

(1) Regeneration can be accomplished on or off site. It is regenerated on site by steam desorption. It is regenerated off site by thermal desorption. Regeneration is often carried out off site due to economic constraints.

(2) Following breakthrough of a primary carbon column, a secondary column is normally placed on line as the primary column while the exhausted column is replaced.

d. Biofouling. A potential operational problem associated with granular activated carbon involves the growth of microorganisms on the carbon bed. In some cases, this growth may become so prolific that the differential pressure through the carbon bed becomes too great to allow for efficient operation. The contractor, or operator, can correct this problem through periodic "back-flushing" of the carbon bed, or through pretreatment activities to destroy the microorganisms in the influent.

e. Breakthrough. The contractor should supply the design district with the predicted breakthrough time. The design district will compare the predicted to the actual breakthrough time. If the actual time of breakthrough is much less than the design, require the contractor to determine the cause.