2.1.3 Carbon and Catalyst Regeneration Units

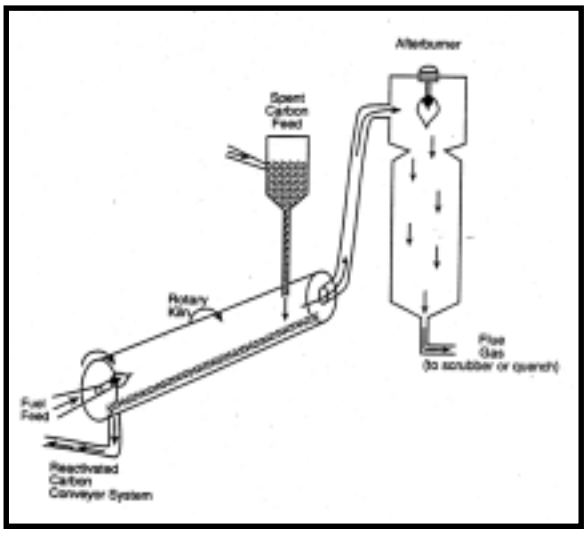
Carbon and catalyst regeneration units include both controlled-flame and non-flame devices. Since 1991, EPA has considered the regeneration or reactivation of spent carbon from a carbon absorption system, used in the treatment of a listed hazardous waste or used to capture emissions from a listed hazardous waste, to be thermal treatment under the interim status provisions of RCRA. The carbon, which contains absorbed organics, is classified as a hazardous waste under the "derived – from rule" (40 CFR §261.3 (c)(2)(i)). In that process, organic contaminants are desorbed from activated carbon at temperatures as high as 1,800 degrees (°) Fahrenheit (F). Carbon regeneration units that use thermal treatment include rotary kilns, fluidized-bed regenerators, infrared furnaces or multiple-hearth furnaces, all of which transfer heat to the contaminated carbon. The most prevalent furnace type is the multiple hearth furnace, followed closely by rotary kilns. As an alternative, steam may be used to desorb contaminants from the media in devices similar to tanks.

Refer to August 8, 1991 Policy Memo and January 5, 1998 Policy Memo regarding the regulatory status of Carbon Regeneration Units.

Catalyst regeneration processes can be similar to those used for carbon regeneration. However, the types of catalyst to be regenerated, the types and concentrations of contaminants to be desorbed, and the conditions under which the desorption takes place may alter the combustion chemistry significantly from that which is seen in carbon regeneration units.

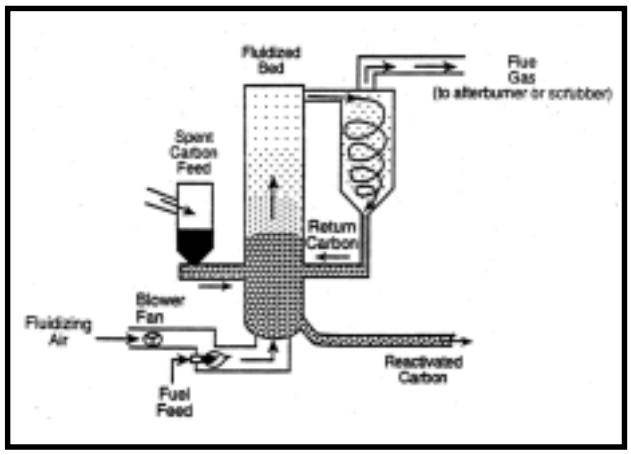
Controlled-flame devices used for carbon regeneration are similar to those used for incineration or for boilers and industrial furnaces (BIF). However, strict compliance with incinerator or BIF regulations may not be appropriate. Use of EPA's incinerator and BIF destruction and removal efficiency (DRE) standard and carbon monoxide and total hydrocarbon monitoring in the off gases may be appropriate for such units. Following are brief descriptions of some of the more common types of regeneration units.

A rotary kiln is an inclined rotating cylinder, lined with refractory brick and internally fired. The spent carbon is fed at the higher end of the kiln and moves, driven by gravity, down the length of the kiln as the kiln rotates. A heated air stream passes countercurrent with the waste, volatilizing the contaminants in the carbon. The exiting air stream contains desorbed contaminants and any combustion products that may have formed within the kiln. The rotational speed of the kiln can be varied. Peripheral speeds of 0.5 meters/minute (m/min) to 2 m/min are typical.



Schematic of Rotary Kiln.

A fluidized-bed furnace is a cylindrical vertical vessel with an air feed at the bottom of the unit. In fluidized-bed units, the granular material (the bed) is fluidized by directing air upward through the bed. Fuel is charged directly into the fluidized-bed or into the window box beneath the bed. The temperature in the freeboard area above the bed can be higher than that within the bed. Because of the airflow required to fluidize the carbon particles, fluidized-bed furnaces have a larger exhaust volume than other types of regeneration furnaces with the same carbon throughput rate.



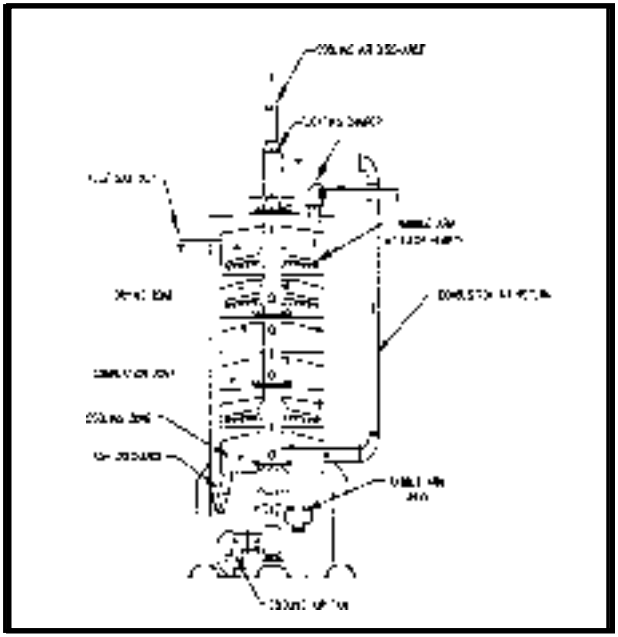
Schematic of Fluidized-bed Furnace.

A multiple hearth furnace typically consists of a refractory-lined vertical steel shell. Inside is a series of flat hearths that are supported by the walls of the shell. A rotating shaft runs vertically through the center of the hearth. Rabble arms attached to the rotating shaft move the waste across each hearth. The hearths have holes, either in the center near the

shaft or near the outside edge through which the waste drops to the hearth below. Combustion air travels countercurrent to the waste flow.

In an infrared furnace spent carbon is transported through the horizontal furnace via a metal grate. A series of heating elements above the metal grate are electrically heated to incandescence. The infrared radiation heats the carbon and a draft fan is used to draw air through the furnace and remove desorbed gases as they are released from the carbon.

These types of units may use a backflush of steam to desorb contaminants. The contaminated steam then is condensed and transferred to a decanter. In the decanter, a concentrated organic solvent phase is separated from the water phase. The water phase contains measurable concentrations of organic contaminants and must be treated as hazardous wastes.

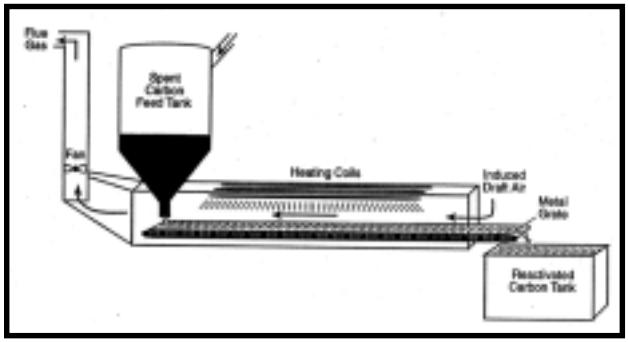


Schematic of Multiple Hearth Carbon Regeneration Unit.

Some carbon regeneration tanks also may meet the definition of wastewater treatment unit under 40 CFR §260.10. Such units are used to adsorb contaminants from wastewaters. These units are exempt from permitting standards under RCRA when they are used to treat wastewater for discharge under National Pollutant Discharge Elimination System (NPDES) or publicly owned treatment works (POTW) standards.

2.1.4 Thermal Desorption Units

As outlined in a June 12, 1998 Policy Memo, the EPA regulations do not define "thermal desorber", but the term generally applies to a unit which treats wastes thermally to extract contaminants (i.e., volatile organics) from a matrix. A thermal desorber



Schematic of Infrared furnace.