Activated Carbon Solutions and Services For the Petroleum Refining Industry

Water Technologies
Activated Carbon Solutions and Services
For the Petroleum Refining Industry

With over 25 years of experience in the activated carbon business, Siemens Water Technologies is uniquely equipped to supply a full range of Westates® activated carbon products and related services for a variety of applications in petroleum refineries. We currently supply these products and services to dozens of refineries, offering prompt, expert service.

Regulatory compliance and the desire to improve product quality are key drivers for the use of activated carbon in refineries. The following discussion highlights these common applications and the solutions that Siemens Water Technologies can supply.

Vapor Phase Applications

VOC Treatment & Control
Compliance with either the Benzene National Emission Standard for Hazardous Air Pollutants (NESHAP) regulation or local air emission regulations drives the need for VOC control at several emission points within the refinery, including:
- Sewer pumps / junction boxes
- Covered API separators and DAF units (level changes and diurnal breathing losses)
- Vacuum truck exhaust
- Wastewater and storm water storage tanks (level changes and diurnal breathing losses)

Typical carbon system design for these applications is two carbon adsorption units in series at design velocities of 25-80 ft/min. Either an upflow or downflow configuration may be used.

Vapor / Solvent Recovery
Activated carbon is often used in systems designed for the recovery of economically valuable products (gasoline vapors, benzene, and solvents) at refineries and terminals. Both pressure swing (for gasoline vapors) and temperature swing (for benzene and solvents) designs are commonly used.

In this application, activated carbons with high working capacities (allowing for effective adsorption and desorption through numerous cycles) are preferred. Carbon system designs are provided from various system manufacturers and vary by application.

Hydrogen Sulfide Removal
The processing of sour crude oil often results in the formation of hydrogen sulfide (H₂S) at various points in the refinery. Activated carbon is a common technology to control the nuisance odors and corrosion issues that often result from H₂S.

Specialty grades of carbon are often used to enhance the H₂S capacity. System designs are similar to VOC abatement applications (25-80 ft/min design velocity, upflow or downflow configuration).

Liquid Phase Applications

Wastewater Treatment
Local wastewater discharge permits often regulate organic contaminants (often measured as COD, BOD, TOC, or biotoxicity) that adsorb well onto activated carbon. Treatment may occur via collection of the various wastewaters to a central treatment system, or by treating at point sources.
Due to the nature of the contaminants involved in wastewater treatment, onsite pilot studies are often required to properly design the adsorption system. Recommended empty bed contact times of 15 minutes per bed are typical for this application. Series operation of the adsorbers is recommended to optimize the utilization of the carbon.

**Groundwater Remediation**

Organic compounds such as BTEX and MTBE often migrate into groundwater supplies from a variety of sources, including:
- Leaking storage tanks
- Process upsets or spills
- Unlined wastewater holding ponds

Local discharge permits often require that activated carbon be used to treat these groundwater sources. Recommended empty bed contact times are typically 5-8 minutes for BTEX, and 10-15 minutes for MTBE. Series operation of the adsorbers is recommended to optimize the utilization of the carbon.

**Boiler Feedwater Treatment**

Impurities in boiler feed water used to produce steam in the refinery can lead to various problems including:
- Scaling
- Corrosion
- Foaming
- VOC carry over into the steam

In this application, a low silica carbon is often desired to prevent silica from leaching into the feed water. Recommended empty bed contact times of 5-10 minutes per bed are common.

**Process Applications**

**Amine Purification**

Various alkanolamines are used by refineries to purify gas streams by removing acid gases such as CO₂, H₂S, and COS. During this process, the amine solution picks up hydrocarbons and organic acids. Activated carbon is utilized to treat a slipstream of the amine solution to prevent buildup of these hydrocarbons, and provides several benefits to the refinery:
- Improved amine scrubbing efficiency
- Reduced corrosion rate
- Reduced operating costs

In this application single-stage adsorbers with 20 minutes of empty bed contact time are required, with pre- and post-filtration (5-10 micron) used to remove solids and prevent carbon fines from entering the amine solution.

**Decolorization**

Activated carbon is the perfect choice to remove unwanted color or other organic impurities from desired end products such as jet fuel, kerosene, gasoline, lube oil, and other products.

**Warning**

The adsorption of organic compounds onto activated carbon generates heat. In rare instances, adsorbed compounds may also react on the carbon surface to generate additional heat. If these heat sources are not properly dissipated, the carbon bed temperature may rise to the point where the carbon can ignite, leading to a fire or other hazardous condition. A description of industry-accepted engineering practices to assure the dissipation of heat and safe operation of the carbon bed can be provided upon request. In certain applications where the risk of ignition is significant, activated carbon may not be a recommended treatment technology. Please contact your Technical Sales Representative for more details.