

# Information Bulletin

## GLOSSARY OF TERMS - ADSORPTION

### ***Abrasion Number***

The abrasion number of granular carbon defines the resistance of the particles to degrade on handling. It is calculated by contacting a carbon sample with steel balls on a Ro-Tap machine and determining the percent ratio of the final mean particle diameter to the original mean particle diameter.

### ***Activated Carbon***

Activated carbon is a crude form of graphite, with a random or amorphous structure, which is highly porous over a broad range of pore sizes, from visible cracks and crevices to cracks and crevices of molecular dimensions.

### ***Acid-Washed Activated Carbon***

Carbon which has been contacted with an acid solution with the purpose of dissolving ash in the activated carbon.

### ***Adsorbate***

That which is adsorbed on the adsorbent.

### ***Adsorbent***

Any solid having the ability to concentrate significant quantities of other substances on its surface. Activated carbon is an adsorbent.

### ***Adsorber***

A vessel designed to hold granular carbon.

### ***Adsorption***

The phenomenon whereby molecules adhere to a surface with which they come in contact.

### ***Adsorption Isotherms***

A measurement of adsorption determined at a constant temperature by varying the amount of carbon used or the concentration of impurity in contact with the carbon.

### ***Adsorption Pores***

The finest pores in the carbon structure. Pores which have adsorption capabilities.

### ***Apparent Density***

The weight per unit volume of activated carbon.

### ***Ash***

The mineral oxide constituents of activated carbon. It is normally defined as a weight percent basis after a given amount of sample is oxidized.

### ***Backwash***

An operating method used to remove suspended solids from the carbon bed. Water is pumped into the bottom of the adsorber, flows upward through the carbon bed, and exits through the backwash outlet. The upward flow expands the bed and removes the suspended solids, carbon fines, and entrained air. The percent bed expansion and time required for backwashing is a function of the backwash rate and water temperature.



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**Bed Depth**

The amount of carbon expressed in length units, which is parallel to the flow of the stream and through which the stream must pass.

**Butane Number**

The volume of butane adsorbed per unit weight of activated carbon after air saturated with butane is passed through a carbon bed at a given temperature and pressure.

**Carbon Column**

A column filled with granular activated carbon whose primary function is the preferential adsorption of a particular type or types of molecules.

**Carbon Tetrachloride Activity**

The maximum percentage increase in weight of a bed of activated carbon after air saturated with carbon tetrachloride is passed through it at a given temperature.

**Chemi-Sorption**

Adsorption where the forces holding the adsorbate to the adsorbent are chemical (valence) instead of physical (London's).

**Color Bodies**

Those complex molecules which impart color (usually undesirable) to a solution.

**Counter Current Efficiency**

The unique advantage of a carbon column that permits partially spent activated carbon to adsorb impurities before the semi-processed stream comes in contact with fresh carbon. This allows the maximum capacity of the activated carbon to be utilized.

**Critical Bed Depth**

In a carbon column the critical bed depth is the depth of granular carbon which is partially spent. It lies between the fresh carbon and the spent carbon and is the zone where adsorption takes place. In a single column system, this is the amount of carbon that is not completely utilized. See MASS TRANSFER ZONE.

**Cross Sectional Bed Area**

The area of activated carbon through which the stream flow is perpendicular.

**Deaeration**

The process of removing air (gases) from a bed of carbon particles. In a volume of 1 m<sup>3</sup> of activated carbon, there are approximately 40% of void space, 40% of pore volume and 20% of carbon skeleton.

**Desorption**

The opposite of adsorption. A phenomenon where an adsorbed molecule leaves the surface of the adsorbent.

**Eductor**

A device with no moving parts used to force an activated carbon water slurry through pipes to the desired location.

**Heat of Adsorption**

The heat given off when molecules are adsorbed.



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### **Hardness Number**

The hardness number is the resistance of a granular carbon to the degradation action of steel balls in a Ro-Tap machine. It is calculated by using the weight of granular carbon retained on a particular sieve after the carbon has been in contact with steel balls.

### **Iodine Number**

The iodine number is the milligrams of iodine adsorbed by one gram of carbon at a filtrate concentration of 0.02N iodine.

### **Make Up Carbon**

Fresh granular activated carbon which must be added to a column system after a regeneration cycle or when deemed necessary to bring the total amount of carbon to specification.

### **Macropore**

See TRANSPORT PORES

### **Mass Transfer Zone**

The adsorption gradient that exists in the carbon bed. It corresponds to the gradual transition of the carbon from “fresh” (or “virgin”) to “spent” (or “exhausted”). Also referred to as the MTZ.

### **Mesh Size**

The particle size of granular activated carbon as determined by the U.S. Sieve Series. Particle size distribution within a mesh series is given in the specifications of the particular Calgon carbon.

### **Micropore**

See ADSORPTION PORES

### **Molasses Number**

The molasses number is calculated from the ratio of the optical densities of the filtrate of a molasses solution treated with a standard activated carbon and the activated carbon in question.

### **Methylene Blue Number**

The methylene blue number is the milligrams of methylene blue adsorbed by one gram of carbon in equilibrium with a solution of methylene blue having a concentration of 1.0 mg per lit

### **Moisture**

The percent by weight of water adsorbed on activated carbon.

### **Moving Bed**

A unique application with granular carbons in which a single carbon column offers the efficiency of several columns in series. This is accomplished by the removal of spent carbon from one end of the carbon bed and the addition of fresh carbon at the other end with little or no interruption in the process.



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### **Particle Density**

The weight per unit volume of granular activated carbon not including the voids between the particles and cracks larger than 0.1 mm. It is determined by the displacement of mercury.

### **Pore Volume**

The volume of the internal void spaces in a granule, smaller than 0.1 mm and large enough to allow access to helium. It is measured as the difference in the volumetric displacement by granular activated carbon in mercury and in helium at standard conditions.

### **Pulse Bed**

See MOVING BED

### **Real Density**

The density of the skeleton of a carbon granule. This is determined by helium displacement.

### **Reactivation**

The removal of adsorbates from spent granular activated carbon which will allow the carbon to be reused and recycled.

### **Specific Heat**

The quantity of heat required to raise the temperature of a unit weight of granular activated carbon through a particular interval of temperature divided by the corresponding quantity for water. For Calgon Granular Activated Carbon this value is 0.25. It should be noted that the thermal conductivity of granular activated carbon is extremely low.

### **Surface Area**

The surface area of granular activated carbon is empirically determined by the Brunauer, Emmett and Teller Method (BET Method), which utilizes the adsorption of nitrogen at liquid nitrogen temperature in the calculation. Surface area is usually expressed in square meters per gram of carbon. Calgon carbons range from 700 to 1,200 square meters per gram.

### **Transport Pores**

Pores larger than the largest adsorption pores. They function as a diffusion path to transport adsorbates. Adsorption does not occur in these locations even at near saturated conditions.

### **Voids**

The percent by volume of the interstices to total bed volume.

### **Wave Front**

The carbon loading gradient that exists in the critical bed depth. It corresponds the gradual transition of the carbon from "fresh" (or "virgin") to "spent" (or "exhausted"). See MASS TRANSFER ZONE.

## **Safety Message**

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. For additional details, see Calgon Carbon Bulletin AB-006-08/94: Safety Considerations with Activated Carbon.

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The logo for Chemviron Carbon, with "Chemviron" in a bold, sans-serif font above "Carbon" in a similar font.