# Technical Information Bulletin

## GAS-PHASE FILTRATION

Gas-phase filtration is utilized in areas where toxic fumes and/or odors are present and need to be removed from an air stream or general breathing space.

There are a few different types of gas-phase media available today. The most common is activated carbon.

**ACTIVATED CARBON:**
Activated carbon is any form of the element carbon which has the ability to collect and hold gases, liquids or dissolved substances. To understand how these filters work, it is necessary to know how activated carbon adsorbs undesirable odors and other gaseous contaminates.

**Large Surface Area:**
Odors are caused by gases or vapors which will condense on any surface. The film which continually forms on everything around a home or manufacturing facility is a mixture of vapors or gases and particulate matter. The building may present a million square feet of surface for this mixture to condense on; a single pound of activated carbon has approximately six million square feet of surface space. Since other factors enter into adsorption, this is an over-simplification, but it does indicate the amount of surface area present in a small quantity of activated carbon. Activated carbon contains millions of microscopic pores. These pores provide the tremendous surface area which take up and hold the substances that condense on the activated carbon.

**Activity:**
The ability of activated carbon to adsorb a gas or vapor is called its activity. The carbon used in our filters has a minimum carbon tetrachloride ($CCl_4$) activity of 60%. This means it will adsorb at least 60% of its own weight of $CCl_4$ vapor under a standard set of test conditions. Indicating a good or better rating of activated carbon that is used in any other system.

**Gas Molecules:**
Gas molecules do not travel in line with the air flow, but in many different directions. As the gas molecules travel through the ilter, they collide with many of the spheres. This is called Brownian Molecular Movement. The gas molecules ultimately attach themselves to the carbon spheres. Once attached to the outer surface of the carbon granule, the gas molecules work their way into the pores. They are drawn into the pores by Van der Waals forces. The distribution of pore sizes is critical to the adsorptive effectiveness of the activated carbon granule. Like dust particles, gas molecules are of different sizes. The smaller molecules are drawn into the micropores allowing room in the mesopores and macropores for larger particles.

**Adsorption Capacity:**
The ability of an activated carbon filter to adsorb is not unlimited, and all gases and vapors are not adsorbed in the same amounts. The physical chemist's explanation for this is quite involved and includes molecular weights, molecule sizes and a large number of other technical terms.

**Media Testing / Retentivity:**
The easiest test to determine if a carbon filter is loaded to capacity is to smell its outlet. If any odor comes through, it is saturated, and the activated carbon should be changed. Activated carbon can also be rated in terms of retentivity. This is a direct measure of how much gas or vapor the activated carbon will desorb after it is saturated, all at specified test conditions.

Another rating applied to activated carbon is its break-through time. In other words, how much time it takes a gas or vapor to penetrate an activated carbon bed under specified test conditions. Most suppliers rate activated carbon in terms of carbon tetrachloride break-through time at 25 minutes.

**Life Cycles:**
All gas-phase media life cycles will depend on a variety of variables. Concentration of the contaminate, type of contaminate, number of contaminates, temperature and humidity of ambient air, and the process air.

**Adsorption Ability for Carbon:**
A separate *TECHNICAL INFORMATION BULLETIN* lists the adsorption ability of activated carbon for various materials.