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CALGON CARBON CORPORATION

GRANULAR ACTIVATED CARBONS USED AS CATALYST AND CATALYST SUPPORT

Because of its extensive pore area, relative inertness, and ability to withstand great pressure and high temperature, activated carbon has proved to be highly effective as a catalyst and a catalyst support in liquid and vapor phase processes. Recent developments in technology make a number of grades of hard activated carbons, tailored for specific applications, available for process industries. These carbons may be used in fluidized beds as well as in fixed beds, and have pore sizes and distributions and other properties optimized for the processes in which they are used.

PROPERTIES AND BENEFITS IN CATALYSIS

The properties of activated carbon make it advantageous for use as a catalyst or a catalyst support. Among the properties and benefits are the following:

- **Large Surface Area** — Typical activated carbons used for precious metal catalyst support have surface areas of 1200 m^2/g. The metals are dispersed over a large area and, therefore, are utilized very effectively.
- **Virtually Inert** — Skeletal carbon is virtually inert and does not interfere with the main reaction conducted on activated carbon. Low ash levels which are present in some grades of activated carbons have been found to enhance the catalytic properties of the product.
- **Operates at High Pressure** — Activated carbon may be used for high pressure reactions without structural deterioration.
- **Operates at High Temperature** — High temperature reactions may be conducted on activated carbon without sintering. Loss of surface properties does not occur if oxygen and water vapor are excluded at high temperatures. In the presence of oxygen reactions may be conducted at temperatures up to approximately 400°C. In the presence of water vapor, reactions may be conducted at temperatures up to 700°C.

  The highest temperature for catalyst integrity depends on process conditions, and in some cases can be determined only through experiment.
- **Customized Activated Carbon with Controlled Pore Range and Better Raw Materials** — Current technology extends the range of pore sizes available from 5 Å to 1000 Å. This selection, combined with availability of better raw materials, has considerably extended the potential range of application of activated carbon for catalyst processes.
- **Hardness** — Technology makes available hard activated carbons able to withstand the harsh conditions found in fluidized bed reactors.
- **Synergistic Effect on Easy Recovery** — Carbon-supported catalysts benefit from carbon's large surface area and, in some cases, from traces of metal complexes found on carbon's surface. The resulting catalysts are more effective than supports based on other materials.

  If precious metals are the impregnants, their recovery is facilitated by simply oxidizing the carbon matrix. Activated carbons are, therefore, cost/effective for precious metal support.
- **Stereospecificity** — Traditional activated carbons and newer molecular sieve carbons have unique stereospecific properties which make them valuable for a wide range of reactions.
- **Versatile** — Activated carbon is used in a wide variety of applications throughout the chemical industry.

APPLICATIONS

The known applications of activated carbons for catalyst and catalyst support are varied, and in many cases, the use of carbon is proprietary. Therefore, only a partial listing is presented here of major applications where activated carbon has been widely used in industrial processes.

Mercaptan Conversion

In liquid phase, the widely used Merox and Mercapfining processes convert mercaptans present in heavy petroleum fractions to disulfides. The oxidation catalyst is supported on activated carbon. In the gas phase, mercaptans are also converted to disulfides in the presence of air by non-impregnated carbons and in the absence of air by metal oxide-impregnated carbons.

Oxidation of Sulfur Dioxide

In air, sulfur dioxide is converted to sulfur trioxide in the presence of activated carbon. The Sulfacid® Process is particularly well suited for cases in which sulfuric acid can be reused or economically concentrated. There are five Sulfacid® systems presently in operation.

Hydrogen Sulfide

In streams containing air or oxygen along with moisture, activated carbon converts hydrogen sulfide to sulfur. The elemental sulfur remains on the carbon. The reaction takes place in varying proportions of hydrogen sulfide and air. One application of this reaction has been in the control of odor-causing sulfur gases from sewage treatment plants.

Dechlorination

The removal of chlorine from water involves both adsorption and catalysis. Chlorine is initially adsorbed, reacts, and is bound on the carbon surface. The process is widely used by bottlers who desire to eliminate chlorine from their water supply.

Reactions with Halogens

Chlorination and bromination reactions are often catalyzed with activated carbon. Synthesis and decomposition of phosgene, for instance, are both catalyzed with activated carbon.

Ozone and Hydrogen Peroxide Decomposition

Ozone and hydrogen peroxide are decomposed by activated carbon. In liquid phase applications, European potable water producers ozonate and decompose excess ozone on the carbon. In the gas phase, low levels of ozone may be removed from air.

Hydrogenation Catalysts

Activated carbon is widely used for many different and significant industrial proprietary processes involving hydrogenation. It is suitable for these applications because of its desirable surface properties and its ability to operate in a reducing environment.

NEW APPLICATIONS

Recent advances in product technology have broadened the field of applications in which activated carbon can be used as a catalyst and catalyst support medium.

At your request, a Calgon Carbon specialist can assist you in determining the feasibility of using activated carbon in your process operation and help you obtain design parameters and cost estimates for the carbon portion of your process system.

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