Filtration:
Advantages of Water Treatment with Coconut Shell Carbons

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Summary: *Several naturally occurring materials are used to produce activated carbon for use in drinking water filter cartridges. Each raw material offers unique advantages in specific applications, and is selected based on performance requirements and economic factors. In certain cases, coconut offers several benefits over coal. Following is an outline of these benefits, comparing inherent characteristics of coconut with other materials that ultimately affect the performance and, in some cases, the cost of a drinking water cartridge.*

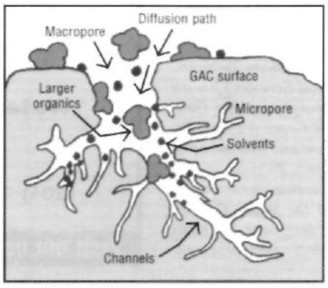
Activated carbons are amorphous charcoals obtained from heating or burning carbonaceous materials under controlled conditions. This process drives off volatiles and forms the basic char residue from which the activated carbon product is made. The usual carbonaceous starting materials are coal, lignite, peat, wood and certain types of nutshells, the most common being coconut shells. After the charring process, further treatment—activation—is needed to give the final product its unique functional characteristics and properties. Activation is the process by which the internal pores are formed within the charred carbon particles. These narrow channels provide adsorption sites.

Pore structure

Activated carbon manufacturers utilize two primary activation processes—steam and chemical. Most of the carbon used today is processed by steam activation. In this process, the pores are opened and enlarged, forming intricate narrow channels of varying sized pores.

Each starting carbonaceous material possesses inherent properties for forming different size ranges of internal pores. In general, peat and lignite tend to form relatively large pores. Coal-based carbons tend to form a wide range of pore sizes (depending on the type and degree of activation). Coconut shell carbons tend to have much higher pore volume in the microporous region (<40 Angstroms, see Figure 1) and a slightly lower pore volume in the macroporous region. This is because coconut char is less amorphous (harder, more crystalline-like) than coal. The result is that coconut-based carbons adsorb smaller organic molecules, such as chloroform (see Figure 2) and other trihalomethanes (THMs), trichloroethylene (TCE), carbon tetrachloride and MTBE (methyl tertiary-butyl ether), while coal-based carbons more effectively remove larger molecules, such as color-producing compounds (tannins and humics).

Figure 1. Pore volume structure of coconut shell carbons.



In addition, because of the tenacity (high energy of adsorption) of the coconut-based carbon's micropores, once the smaller organic molecules are adsorbed, they're very tightly retained. Therefore, coconut shell carbons in general have a higher retentivity (see Figure 3) for these types of contaminants than do other types of carbons. For these reasons, coconut shell carbons are often selected for drinking water treatment where contamination is attributed to organic solvents or disinfection by-products (DBPs) such as THMs.

Hardness

Another advantage of coconut shell carbon is that it's typically harder than coal, lignite and peat-based carbons. This can be important in the initial shipping of the bulk material, and in the manufacturing/handling process and final shipping of the finished product.

Softer carbon granules may break down during bulk shipment and create dust and fines. During handling and assembly of cartridges, these fine particles may cause dust problems that in turn requires installation of venting and dust handling equipment, not to mention disposal of the waste dust. During shipping of the finished product (e.g., cartridge or system), constant vibration may