Chloramine Removal

Activated carbons are produced from selected raw materials such as bituminous coal, lignite, wood and coconut shell. These raw materials contain large amounts of oxygen. During the carbon activation process, oxides are formed on the surface of the raw material. Complete carbonization of the raw material would result in graphite, not activated carbon. To maximize the raw material porosity, the carbon activation process uses steam. Steam also contributes oxygen to the surface of the raw material increasing the formation of surface oxides.

The surface oxides are divided into acidic and basic groups. The acidic surface oxides, coupled with attractive forces, enable steam activated carbons to remove chlorine and chloramines. The acidic surface oxides include carbonyl, carboxyl, phenol and quinine groups.

These surface oxides degrade chloramines by the following reactions:

$$NH_2Cl + H_2O + GAC \rightarrow NH_3 + HCl$$

$$2NH_2Cl + GAC \rightarrow N_2 + 2HCl + H_2O$$

The degradation of chloramines by activated carbon is slow. Increasing the reaction rate requires a greater external surface area such as a powdered carbon or a slightly macroporous granular carbon. There is much confusion about activated carbons and their pore structure. For example, iodine number is used to determine carbon activity. This is only true if the contaminant to be adsorbed is iodine. In the case of chlorine, iodine number has no meaning.

Chlorine degradation is a chemical reaction with the oxides on the surface of the carbon. Chloramine degradation is also a chemical reaction with the carbon surface oxides. However, the reaction is slow and the chloramines compound must be held on the carbon for a longer period of time. Chloramine is a relatively large molecule. It is more strongly held by the carbon's mezzo-pores instead of micro-pores. Therefore, selecting the proper carbon for chloramines degradation requires evaluating its pore volume distribution. Correlating iodine, phenol, tannin and molasses values is the only true method of comparing carbon performance.

Modifying the activated carbon surface can increase chloramines selectivity, capacity and reaction rate. Products like catalytic carbons are surface modified carbons. The surface modifications involve reacting (some called it impregnating) a chemical with the activated carbon's oxide groups. This creates a more reactive carbon surface giving it a greater selectivity, capacity and rate of reaction.

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INNOVATIONS IN ION EXCHANGE

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