The Removal of PCBs From Aqueous Waste Streams

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Process Descriptions

In addition to its solubility in oils, PCBs tend to accumulate on and in particulate matter as its maximum solubility in water is in the 200 to 300 ppb range. Removal of PCBs from an aqueous waste stream requires a two-step approach. **The first step** is the effective removal of suspended solids.

Removal of suspended solids for small flow (0-50 GPM) applications can be accomplished by successive filtration of particles down to one micron. By successive is meant:

1. Primary removal of settleable solids through gravity settling or centrifugal separation.

2. Secondary removal of suspended particles down to 5 microns in size through cartridge filtration.

3. Tertiary removal of suspended particles down to one micron in size.

Since PCBs are invariably associated with oils, the concurrent presence of dispersed and/or mechanically emulsified oils is commonplace. The use, therefore, of an oleophilic (oil loving) material of construction for the 5 micron and/or one micron cartridge filter will help separate out those PCBs which are associated with the oily constituent.

Removal of suspended solids for larger (greater than 50 GPM) flow applications can be accomplished by chemical addition, coagulation, flocculation, and filtration. With proper chemistry this process effectively removes particulate matter as well as dispersed and mechanically emulsified oils.

The smaller flow approach utilizing cartridges costs more per gallon than the larger flow chemical addition approach. The cartridge approach, however, is slightly easier to operate.

The second step utilizes adsorption technologies. Common practice is to use granular activated carbon (GAC) adsorption. PCBs readily adsorb onto GAC because of their large molecular weights. An empty bed contact time (EBCT) of 22 minutes @ 45°F minimum temperature will reduce PCBs to the 50 ppt level. Currently, the practical limit of detection of PCB is in the 30 to 50 ppt range.

Other adsorbents are more cost effective than GAC. One such adsorbent utilizes clays which are impregnated with quaternary ammonium amines. Another adsorbent is a naturally occurring mineral with ion exchange properties called clinoptilolite (clino). Yet another adsorbent is a man-made product similar to ion exchange resins (AmberSorb® manufactured by Rohm and Haas). The impregnated clays and clino adsorbents are used on a one time only basis whereas the Ambersorb product may be steam regenerated in-situ and reused again and again--a significant advantage. Many of the adsorbed organics, including PCBs, may actually be recovered as a condensate and thereafter disposed of on a highly reduced volume basis. All three adsorbents are more process effective than GAC as PCB removals to less than its detection limit is easily accomplished.

On larger flow applications, it is also possible, although not necessarily economically feasible, to combine the suspended solids and adsorption removal steps. This is accomplished by replacing diatomaceous earth filter aid with powdered activated carbon (PAC) or clinoptilolite. The process must allow sufficient time for adsorption to occur before initiating the coagulation reaction.

If the application is short term, the economics favor the combination removal approach. If longer term, the use of the regenerable Ambersorb™ is the more cost effective. Also, smaller flows favor the combination approach whereas higher flows favor the two step approach.