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Makers of OilSorb™ and Other State-of-the-Art Filtration Media

Technical Advisory #27

Oxidative Systems

The primary function of oxidative systems used in water treatment is to inactivate (kill) microorganisms. A secondary function is to break down long-chain organic molecules.

These oxidative systems are either chemical:

- Chlorine family compounds
  Chlorine, chlorine dioxide, chloramines, bromine
- Hydrogen peroxide
- Ozone or non-chemical: Ultraviolet irradiation.

Microorganism Inactivation
The chlorine family compounds are most effective on water borne pathogens, particularly bacteria, and to lesser extent, viruses. They are much less effective with protozoan cysts such as Cryptosporidium and Giardia. Within the family, the specific chemicals exhibit varying degrees of efficacy.

Hydrogen peroxide (H2O2) is expensive compared to the chlorine compounds, but is very effective on microorganisms. It disintegrates into oxygen and water leaving no residual.

Ozone (03) is the second most powerful oxidant known (behind fluorine) and is extremely effective with virtually all microorganisms. A disadvantage of ozone is that it leaves no residual, whereas the chlorine family compounds do.

Ultraviolet (UV) irradiation is much less powerful than ozone, and also leaves no residual. Although slightly less effective than chlorine with regard to bacteria and virus inactivation, it does inactivate the pr! otozoan cysts.

Organic Destruction
In general, these technologies break down organics only after they have inactivated microorganisms. The efficacy is a function of both concentration and time, and is represented by a "CT" value. Obviously, different organic molecules will require different CT values for destruction.

The chlorine family compounds are relatively ineffective in organic destruction properties. Hydrogen peroxide, particularly when combined with ozone or UV, is very effective in breaking down organic compounds. Ozone, by itself, is also effective in organic breakdown. Ultraviolet irradiation, at a wavelength of 185 nm, i relatively effective in organic break down.

Pretreatment
If interfering contaminants, such as suspended solids, can be removed with economical pretreatment, they should. Likewise, if economical technologies can be utilized to remove the bulk of the contaminants (microorganisms or larg! e organics), the above technologies are very effective in a polishing mode.

Oily Wastes
A troublesome class of contaminants is that of oily wastes. Free oils are particularly difficult to treat in that they are insoluble in water, and tend to form coatings on everything into which they come into contact.

The chemical oxidants (chlorine family, hydrogen peroxide and ozone) tend to react with oily wastes and are quickly consumed.

Ultraviolet lamps are very susceptible to coating from free oils.

Adsorbents such as organoclay are very effective and economical at removing free oils prior to downstream polishing operations, such as microorganism inactivation.

Organoclay
Organoclays are bentonites that have been chemically modified with quaternary amines, rendering the bentonite hydrophobic or organophylic. Bentonites consist primarily of montmorillonite-type clay. They ! are a natural cation exchange resin, the exchangeable ions being primarily sodium, calcium and magnesium. These ions are exchanged with the nitrogen end of the quaternary amine.

Since the 1950s, organoclays have been used as thickeners and antisettling agents in grease, lubricants, putties and paints.

In the granular form, organoclays are placed into the same filter vessels as activated carbon.

Once immersed in water, the quaternary amine chains will stand up, perpendicular to the clay platelets. As an oil droplet passes by and encounters the amine, the amine will partition (i.e. dissolve) into that droplet and fixate it by coulomnic forces, permanently removing the oil.

In this fashion, and by ion exchange, they also remove humic acids, PCBs and other chlorinated hydrocarbons, and any organic associated with oil. Only anionic and non-ionic surfactants can remove the oil once it is attached to the organoclay.

Organoclay has! the ability to remove 50% of its weight in oil, seven times the capacity of activated carbon.

Depending on the solubility of the oil, organoclay may be used in the stand-alone mode, or followed by activated carbon, to reduce the oil content to a nondetectable level.

A **tutorial** on Biomin Column Treatment Design is provided at Biomininc.com

George Alther, president of Biomin Inc. will provide workshops on organoclays at the 2007 International Activated Carbon Conferences: Sydney, Australia July 1-7, 2007 and Pittsburgh, PA October 14-21, 2007.

Please visit http://biomininc.com for additional technical information.

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