OZONE AND TOC

The requirement for the reduction of TOC from purified water often brings our attention to the use of ozone. Ozone, known to be a very powerful oxidizing agent, is often indicated for reduction of TOC, and very often it does not satisfy the end user and as more often ozone is expected to do magic.

Predicting the amount of organic matter that can be removed by ozone is very difficult to predict. Organic compounds like Ketones, aldehydes do not react with ozone. Some organics are broken into smaller compounds that do not react with ozone. To effectively know how ozone will react to organics, we need to study the organic contents in the water.

Relationship Between TOC and COD

TOC is always a function of COD. As a thumb rule if the COD is say 100 ppm, we can expect the TOC to be around 30. Hence, while opting for ozone for organic removal, you will always have to consider the COD. COD determines the amount of oxygen to convert all of the organic carbon to CO2. There is definitely a correlation between ozone applied and the COD removed from water. From experience for every gram of COD to be reduced, we may need 1–3 grams of ozone. The removal of COD is also not directly proportional to the ozone applied. That is to say that when the COD is low, more ozone is required for its removal than when the COD is high.

TOC

Total Organic Carbon (TOC) measures the total carbon (TC) in water less all Inorganic carbons such as carbonates. Though ozone can oxidize organic compounds, many of the compounds will remain in the water in an oxidized state, so the change in TOC might not obvious. Removal of TOC is usually a function of removal of COD by ozone.

For removal of smaller quantities of TOC from water, usually UV 185 can be effectively used for removal of smaller amounts of TOC (ppb levels) .We can also use AOP which involves the use of ozone and other technologies to generate OH free radicals A combination of various technologies are usually a better way to address removal reduction of TOC.

UV/O2

UV at 180 has been used successfully to remove small amounts of organics. But using UV 250 nM with ozone is another method to reduce the amount of ozone required and reduction of the reaction time. It has been noted that the ozone dose is halved when UV is combined with ozone. However the disadvantages of this method are due to the fact that the formation of OH radicals is slow and the water must be pre–treated to ensure high UV penetration. UV is also power intensive and using ozone and UV could mean high operation costs. The commercially available UV lamp sizes available in the market also restrict its use only in small flow capacities.

Determination of Ozone Contact Time

This is a very vital aspect for the design of ozone for COD/TOC reduction. Though Experience and thumb rules can be a method of determination of ozone dose and contact time, it could be prudent to determine the same using a lab scale method or even by a pilot trial. Ozone /UV have capital costs and are power intensive. Correct determination of ozone and contact time can reduce the capital and operation costs of the system.

Contacts Time for Ozone and Ozone/ UV Process Differ

The contact times are determined to allow the reactions of ozone and organics to proceed to completion (mineralization). Not all reactions complete to mineralization. Under designed contact times can render ozone in effective way. The reactions of ozone during dissolution in water are to form both O3 molecules and OH free radicals, the proportion dependant on the pH. At alkaline pH, the proportion of OH is high. Using UV will convert all O3 to OH free radicals. Since OH free radicals have greater EOP than ozone, it is imperative that actions with OH free radicals are faster and complete. This is why using ozone/UV combinations reduce the requirement of ozone and also brings about reduction in contact time.

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