Removing Dissolved Copper in Wastewater Treatment Plant

How do you meet your dissolved copper discharge limit if it is 1.6 ppb, 3.1 ppb or 6.1 ppb? What is the cost, to achieve these limits? Which treatment is cost effective? Is deionization, Reverse Osmosis or chemical precipitation the best alternative to achieve the low levels of dissolved copper for your wastewater system? Is it cost effective to run a Water Effect Ratio (WER) Study?

Reverse Osmosis System (R.O.)

RO systems are very effective in removing dissolved copper ions from wastewater. The main advantage of RO is that the effluent from this type of treatment will generate a 90% removal rate of everything. However, the disadvantages of RO System are: 1) it removes all ionic components up to 90% depending the rejection rate, 2) installation cost-expensive high-pressure pumps, 3) high rejection rate up to 20% depending on membrane, 3) maintenance cost and replacement cost, 5) average treatment cost can vary from $0.03/gal to $0.05/gal over the operational life of the system, 6) energy cost, 7) disposal of spent cleaning solutions and 8) high tech. There are specific operational parameters that must be taken into consideration when evaluating using RO (ie. NTU, TSS, solid loading, silt density index (SDI), disposal of spent cleaning solutions and energy cost).

Deionization Systems (DI)

DI systems are very effective in removing dissolved copper ions from a wastewater system as low as 0.1 ppb. DI system work on the principle of ionic exchange. DI systems have a resin chamber that contains both cationic enhanced resin and anionic enhanced resin. The copper laden wastewater passes through the resin bed and copper ions are exchanged for hydrogen ions until the unit is exhausted. Once the resin bed is exhausted, sulfuric acid is used to regenerate. The spent solution of copper ion and sulfuric acid is sent to another system for disposal. The advantage of DI is that it removes all cationic ions and replaces them with a hydrogen ion. The disadvantages of DI are: 1) high capital investment, 2) disposal problem with spent cleaning solutions, 3) frequent regeneration of system, and 3) replacement cost for resin is high.

Chemical Precipitants

Dissolved metal removal is driven by pH of the solution or metal precipitants. In the case of dissolved copper ions, the traditional method for removal is to raise the pH of the wastewater with caustic soda or lime or soda ash. This creates an insoluble metal hydroxide. The metal hydroxide is water –loving ion that creates excessive and sometimes difficult to dewater sludge. The metal hydroxide is amphoteric, ie they are increasingly soluble at both low and high pH. The optimum pH to remove copper is 8.1.

Using a metal precipitant like JC 9830, we have created a copper sulfide ion that precipitate over a broad pH range. Metal sulfides are not amphoteric and they form a dense easy to dewater sludge. In full scale plant trials, JC 9830 operate over a broad pH range for optimal removal. Metal sulfides have a lower solubility than metal hydroxides. That means we can achieve higher removal of dissolved copper ion than traditional found using a metal hydroxide. In some wastewater system, there are natural occurring chelating agents that prevent normal precipitation of a metal hydroxide. Using JC 9830 with JC 1687, we have generated a wastewater effluent having less than 0.5 ppb in full scale plant trials-economically. JC 1687 is a cationic organic/inorganic coagulant that is very effective in creating a dense particle that improves the settling rate of the metal precipitate (metal sulfide).

In a full-scale plant trial for one year, we fed JC 9830 at 10 mg/l and JC 1687 at 10 mg/l. We fed JC 9830 into the aeration basin discharge and chemically bonded the dissolved copper to form a copper sulfide. In the inlet of the Secondary Clarifier, we fed JC 1687. The results of our study indicated that we could remove 94% of the dissolved copper and 70% of the dissolved zinc from the effluent. Please note that the effluent data collect was from the Secondary clarifier's effluent prior to filtering.

Date	Inf-Cu	Eff-Cu	% Removal	Inf-Zn	Eff-Zn	%Removal
3-11	35 ppb	2.0 ppb	94.3	87 ppb	27 ppb	68.9
3-15	28 ppb	1.6 ppb	94.3	109 ppb	22 ppb	79.8
3-30	58 ppb	1.4 ppb	97.6	100 ppb	24 ppb	76.0
8-16	46 ppb	3.8 ppb	91.7	96 ppb	42 ppb	56.3

(Note: The information above is expressed in ppb-parts per billion)

If you would like a copy of the aquatic toxicity reports, please contact us at (sales@jenfitch.com) or 925-289-3559.

In other studies, we have been able to achieve non detect levels for dissolved copper using the same treatment program.

If you are looking for alternatives to remove dissolved copper or zinc, give us a call 925-289-3559 ext 102 or send us an email (sales@jenfitch.com)