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FA-18

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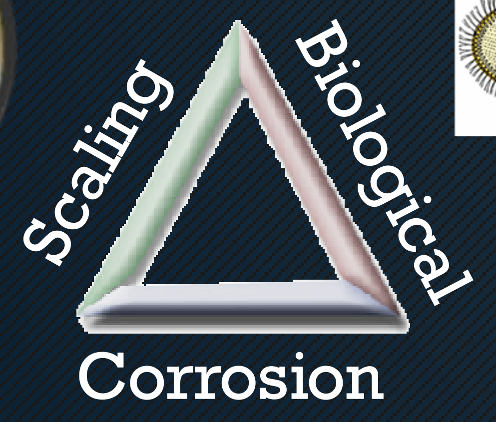
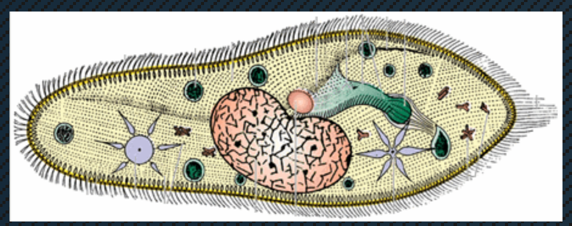
Disinfection Alternatives to Control Corrosion on Water Systems

Abstract

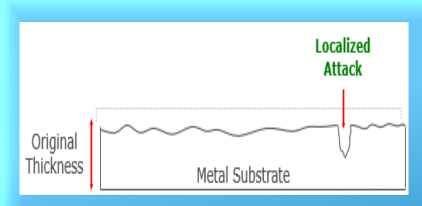
Disinfection is one of the most common processes in the world since the human understood that the water contained pathogens that can be lethal. Since this, new methods and techniques of disinfection had been developed and studied. An effective disinfection method should be one that besides eliminating the pathogens present in water, does not affect the water system or human health in other manners. The most common disinfectant for water is hypochlorite, since is an economic solution for most pathogens that may be present in potable water, but it presents a problem since it is a very corrosive solution and most water systems are built from mild steel and copper. Oxidation of metals can become a problem for water systems. The deterioration of metals can cause iron and copper molecules to be added to water, which are known to have a direct impact on human health. Chlorine dioxide may be a solution for this common problem since it is a selective biocide with less impact on the metals and health.

Corrosivity and Chlorine Dioxide

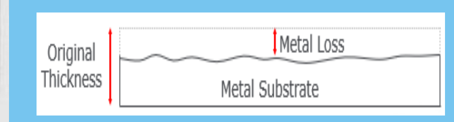




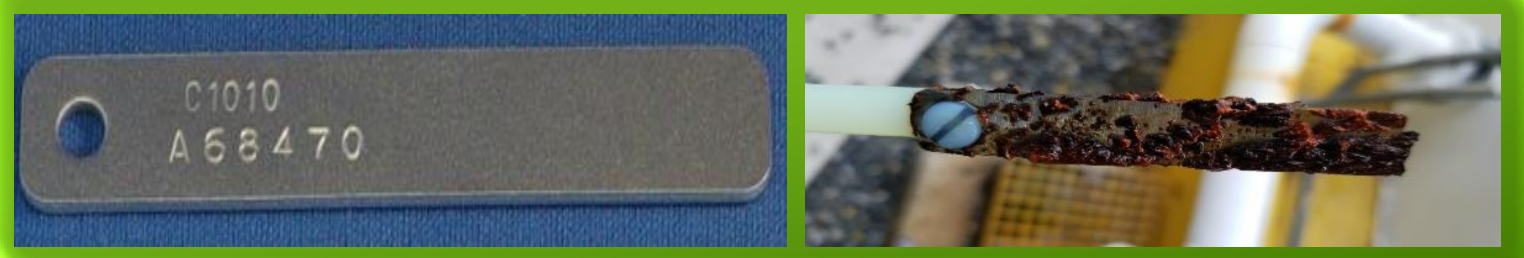
Corrosion Rate (mm/y) = (K×W)/(A×T×D)



Localized corrosion tends to occur on high stress areas of the system like welds, ruptures of coating and uneven surfaces. Also, dissimilar metals on conductive water will result on localized (galvanic type). This type of corrosion affects a metal surface that is confined to a small area and take the form of a cavity.



General corrosion is the most common type of corrosion in water systems treated with oxidant biocides. For a coupon to have generalized corrosion equal deterioration of the material surface area. This type of corrosion is a result of alternations between anodic and cathodic conditions



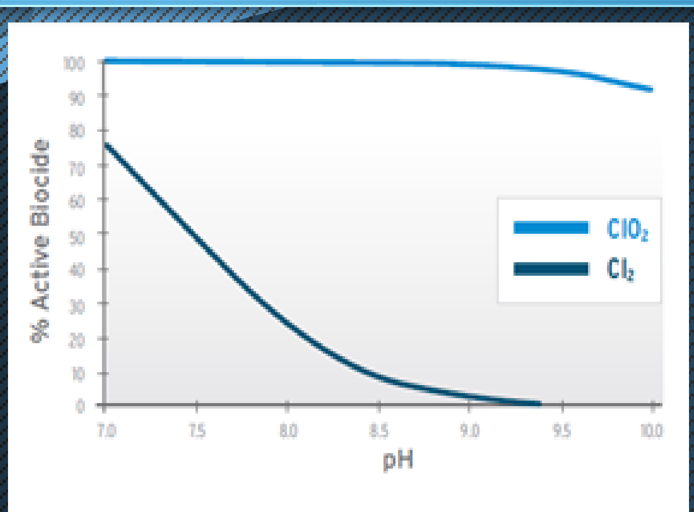
Cl_2 vs ClO_2

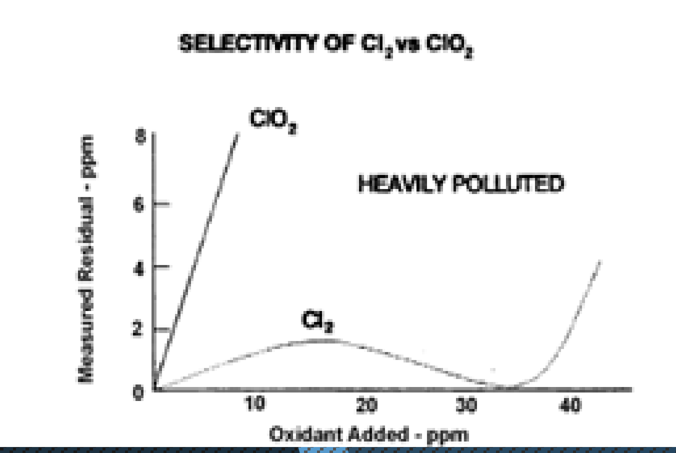
Date	Total Iron (ppm)	Date	Total Iron (ppm)
6/6/2016	0.44	8/10/2016	0.55
6/8/2016	0.44	8/23/2016	0.52
6/10/2016	0.46	8/31/2016	0.50
6/14/2016	0.40	9/9/2016	0.49
6/15/2016	0.39	9/14/2016	0.48
6/20/2016	0.46	9/23/2016	0.45
6/28/2016	0.48	9/30/2016	0.48
7/11/2016	0.55	10/5/2016	0.48
7/18/2016	0.54	10/11/2016	0.49
8/5/2016	0.52	10/25/2016	0.51
Average		0.48	

Date	Total Iron (ppm)	Date	Total Iron (ppm)
11/16/2016	0.00	1/30/2017	0.00
11/21/2016	0.02	2/6/2017	0.02
11/30/2016	0.03	2/13/2017	0.03
12/6/2016	0.01	2/21/2017	0.02
12/13/2016	0.00	2/27/2017	0.00
12/23/2016	0.00	3/6/2017	0.01
12/24/2016	0.01	3/13/2017	0.01
12/27/2016	0.01	3/20/2017	0.02
1/3/2017	0.02	3/29/2017	0.01
1/24/2017	0.02	4/3/2017	0.01
Average		0.02	

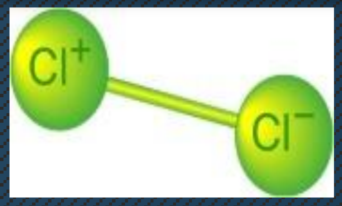
Corrosion coupons were analyzed by a certified lab following ASTM G1-03:2011 and ASTM G4-01:2014 procedures. In addition to corrosion coupon monitoring and testing in this system, total iron tests were performed regularly to monitor residual iron on the system. HACH method 8635 with a DR900 equipment were used to conduct the mentioned tests. Results with a median of 0.4815 ppm were received when the water distribution system was disinfected with chlorine, with results as high as 0.55 ppm.

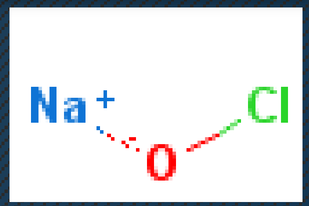
Results





A comparison between a water system treated with chlorine, and then changed to chlorine dioxide was performed to understand the impact and potential risks involved. Corrosion coupons with localized and crevice corrosion were obtained with chlorine treatment, no more than 2.0 mg/L were used to maintain bacterial control .At this level of corrosion of the system can get more than 10 mills per year of corrosion (mpy). Because of these observations, chlorine dioxide treatment can be used to replace the current treatment, components .





The residual of chlorine dioxide on the system was changed to a setpoint of 0.40 ppm, validated with microbiological samples to maintain proper control. After the disinfectant treatment was replaced with chlorine dioxide a system flush was performed to lower the concentrations of iron on the system that were caused by the chlorine corrosiveness. The consequent tests for total iron received decreased values of an average of 0.02 ppm on the system, with results as high as 0.03 ppm, these results are presented on the tables. With these results we can conclude that the corrosion rate on the system is negligible. The high total iron concentrations of iron prior to the change to chlorine residual was one of the reason that help to make the decision of changing the disinfectant. With a corrosion rate this high, serious problems can be predicted on the system, that will lead to high replacements cost for system components. The higher costs of chlorine dioxide disinfection are one of the main reasons people still use chlorine as the preferred disinfectant for water systems, but this can be contradictive because of the high corrosiveness of the chlorine, that can lead to higher replacement costs.

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