IMCHLO

Essential expertise for improving chlorine biocontrol performance.

Uleashing the Power of bleach with DMH.

When considering the various options to replace bleach as a biocontrol in industrial applications it is worthwhile considering halogenated hydantoin products currently available in the market, and important to fully understand the different chemical forms and intermediates that these unique products provide.

A general perception about these products is that they're simply a delivery form or a stabilizer for hypohalous acids; however, they also afford a modified form of hypohalous acid that provides the customer with additional benefits in terms of physical removal of biofilm and ultimately, improved heat transferefficiency.

One such example is a 15% 5,5-Dimethylhydantoin (DMH) solution, which whencombined with a molar equivalent of Hypochlorous acid (HOCl), forms a stabilized, 1:1 DMH: chlorine complex. In the case of IMCHLO-Stab , this stabilized form of HOCl has been shown to dramatically improve the biocidal efficacy of HOCl in high organic demand papermaking systems.[1,2]

In order to better understand the possible reasons behind this improved efficacy, one can use a model forthe DMH stabilized HOCl in the form of monochloro- 5,5-dimethylhydantoin (MCDMH). Since MCDMH dissociates in water to form DMH and HOCl, this model appears well-suited to match with the performance features of the DMH stabilized HOCl. MCDMH was included in a study[3] where it was shown to provide superior performance in terms of sessile bacterial removal.

Interestingly, this performance shows marked improvements over bromine, even at the more typical alkaline pH levels usually found in most water treatment programs. Herein, is presented a summary of this study and how these results may correlate with the observed improved performance of the DMH stabilized HOCl.

Sessile Efficacy:

In the aforementioned study,[3] the effect of various oxidizing biocides on the removal of established *Sphaerotilus natans* biofilm was measured using both Heat Transfer Resistance (HTR) and Dissolved Oxygen (DO) during the treatment program. The more effective treatment protocol was determined tobe a slug plus continuous mode, where the biocide was added initially on a slug basis to overcome halogen demand, followed by a continuous, three-hour treatment at a concentration based on the makeup water rate.

Figure 1 from the study summarizes testing using doses of 10, 15 and 20 ppm as active chlorine for MCDMH added at the time points shown. Both HTR and DO were measured over a 200-hour time period. For DO, there was a measured increase in the amountof dissolved oxygen soon after biocide addition, which correlates with a decrease in microbial activity. Dissolved oxygen then decreases as bacterial populations regrow, up and until the point of the next biocide dose when the process is repeated. For HTR, there is a marked decrease after the last 20 ppm addition, which is indicative of biofilm sloughing and removal.[3]

In this study, Sodium Hypochlorite (NaOCl), Sodium Hypobromite (NaOBr) and 1-bromo-3-chloro-5,5-dimethylhydantoin/5-methyl-5-ethylhydantoin (BCDMH/MEH), along with dichloro-5,5-dimethylhydantoin (DCDMH), were also tested under the same conditions. In the case of NaOCl, NaOBr and BCDMH/MEH, there was not a dramatic decreasein HTR (i.e., biofilm removal) as observed with the MCDMH compound. Figures 2 through 4 from the study shows these results for BCDMH/MEH, NaOCl and NaOBr respectively. In the case of the DCDMH, there was also a dramatic decrease in HTR due to biofilm removal.[3]

Figure 1. Testing biocidal efficacy of MCDMH

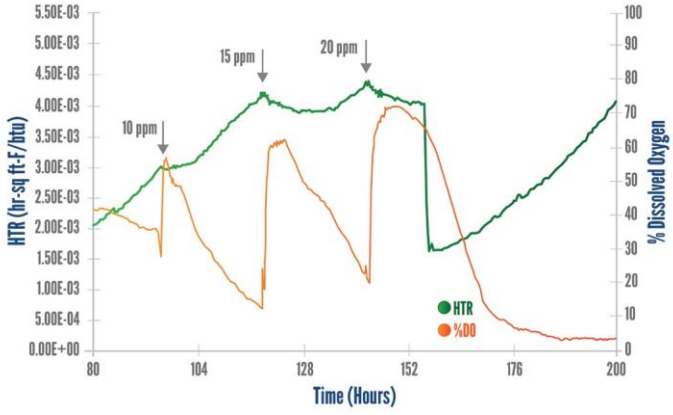


Figure 2. Testing biocidal efficacy of BCDMH/MEH

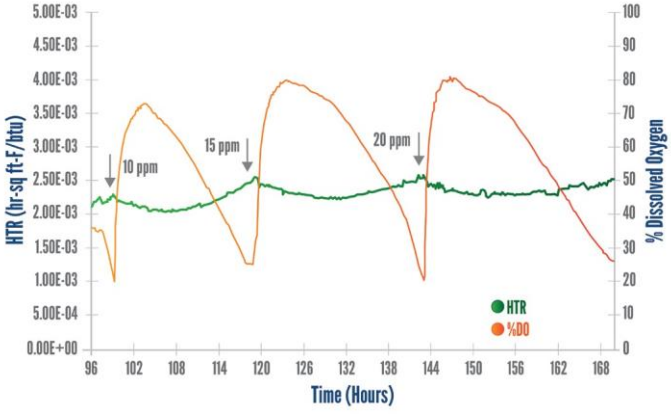


Figure 3. Testing biocidal efficacy of NaOCl

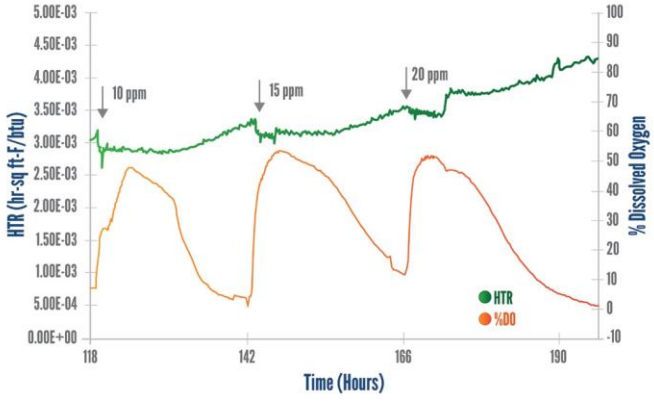
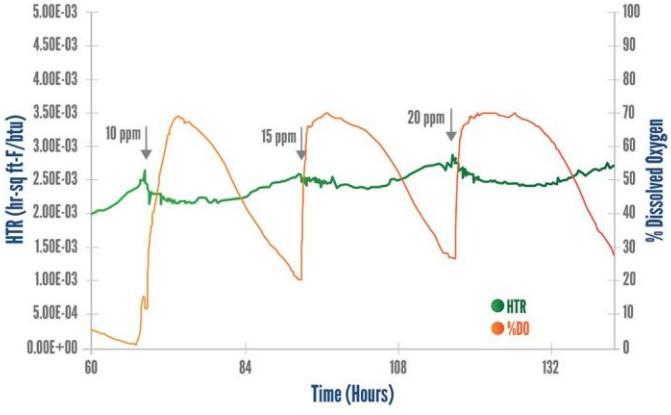


Figure 4. Testing biocidal efficacy of NaOBr



SUMMARY & CONCLUSIONS:

The results from the HTR and DO study with MCDMH offers some interesting insights into the associated behavior of the improved efficacy when using DMH in conjunction with bleach. The stabilizing effect of DMH on HOCl makes it less available for consumption via organic demand, and more available to last longer and further penetrate and help remove biofilm. The added value of DMH is therefore to help common bleach become a more effective biocide by enhancing the power of bleach.

References

» [1]Sweeny, P.G., 1995. Hydantoins-enhanced halogen efficacy in pulp and paper applications, US Patent 5,565,109.

» [2]Sweeny, P.G., 1996. Hydantoin effects on hypochlorite and hypobromite biocidal efficacy in alkaline papermaking applications", Proc. TAPPI Conference, 529-532.

» [3]Ludensky, M.L. and Sweeney, P.G., inventors; Lonza, Inc., assignee. Method for Removal of Biofilm. US patent 7,407,590 B2. August 5, 2008.

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