

AN INTRODUCTION TO VIGOROX® WWT II FOR WASTEWATER DISINFECTION

VigorOX® WWT II
Wastewater Disinfection Technology

Disinfection Forum
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Welcome to the first edition of *Disinfection Digest*, a forum to share experiences using Evonik's VIGOROX® WWT II wastewater disinfection technology. If you have any questions about the content in *Disinfection Digest* or suggestions for future topics, please contact philip.block@evonik.com.

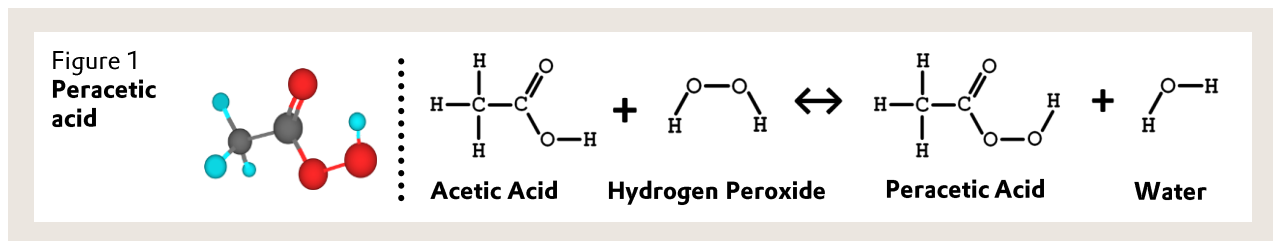
VIGOROX® WWT II is a peracetic acid (PAA)-based formulation. Peracetic acid is a low temperature disinfectant and sterilant that has been marketed by Evonik (formerly PeroxyChem) since the mid 1980's for a variety of different end-use applications:

- replacement for highly toxic glutaraldehyde as a biocide for medical devices such as endoscopes and surgical tools
- alternative for chlorine and quaternary ammonium compounds for hard, non-porous surfaces in medical facilities and food processing plants for the control of micro-organisms such as Listeria, Salmonella and E. coli
- Control of citrus canker (*Xanthomonas axonopodis*) on citrus fruit bearing trees under the name VIGOROX® Citrus XA
- application directly to poultry carcasses for the control of Listeria and Salmonella under the Spectrum® trade name and to beef under the Blitz® trade name for the control of E. coli
- a replacement for glutaraldehyde in the oil and gas market, for the down-hole control of sulfate reducing bacteria which can reduce well production through the generation of iron sulfides.

Today, peracetic acid is an ideal choice for the control of pathogenic microbes for municipal wastewater treatment. Due to its low oxidant demand in wastewater, lack of harmful disinfection by-product formation, low environmental impact and its efficacy, VIGOROX® WWT II offers a cost effective alternative to chlorine, UV and ozone.

FORMULATION

VIGOROX® WWT II peracetic acid is produced by combining water, hydrogen peroxide (H₂O₂) and acetic acid (vinegar). It exists as an equilibrium solution containing all four compounds:

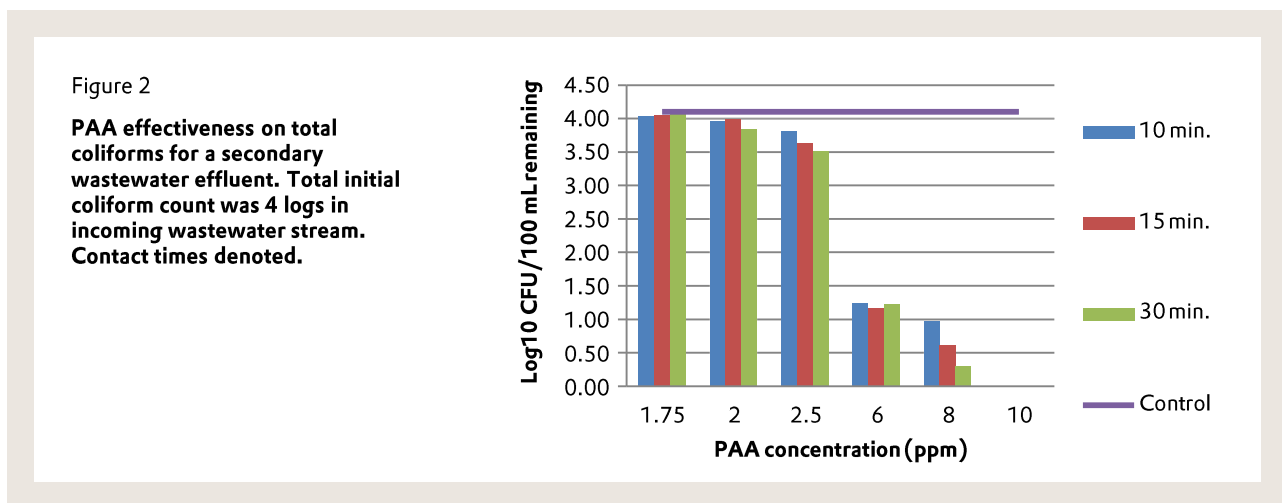


Different equilibrium concentrations of peracetic acid, hydrogen peroxide and acetic acid are achievable depending upon the manufacturing process and the safety inherent in certain combinations.

VIGOROX® WWT II is commonly referred to as a 15 / 23 formulation, meaning 15% peracetic acid and 23% hydrogen peroxide, and also contains 16% acetic acid with the remainder being water. VIGOROX® WWT II is formulated with this mixture combination to provide the maximum efficacy with the maximum safety. The specific gravity of VIGOROX® WWT II is 1.15 and is completely soluble in water. It has a freezing point at -56 °F (-49 °C), and as a result, can be used in cold weather conditions without concern about freezing issues, as compared to bleach and bisulfite solutions. Due to PeroxyChem's stringent manufacturing process, VIGOROX® WWT II is very stable, and under typical operation conditions has a guaranteed shelf life in excess of one year. This is an important factor when considering on-site storage for wastewater treatment facilities and wet weather flow operations (such as combined sewer overflow and sanitary sewer overflow) and to insure proper and adequate dosing of the disinfectant into the waste stream.

MODE OF ACTION

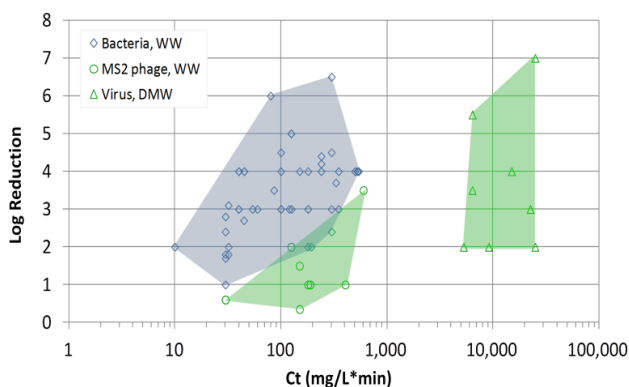
Peracetic acid has widespread efficacy on a variety of bacterial and viral micro-organisms, even in the presence of organic matter and ammonia. Two different disinfection mechanisms have been proposed¹. The first suggests the peracetic acid releases active oxygen, which in turn disrupts the sulfhydryl (-SH) and sulfur (S-S) bonds within enzymes contained within the cell membrane, thereby affecting transport across the cell membrane. The second mechanism is the release of hydroxyl radicals, which have a very high oxidation potential, leading to rapid oxidation and destruction of the organism. In either case, there is no build up of resistance to peracetic acid disinfection within the micro-organism, and as a result there is no accumulated tolerance.



It has been suggested that the disinfection efficacy of peracetic acid is more dependent upon dosage and peracetic acid demand than on contact time². Figure 2 shows that once the initial demand for the peracetic acid is overcome (at 2.5 ppm for this particular wastewater), rapid disinfection occurs. In general, VIGOROX® WWT II is extremely effective and dosing for most wastewater treatment plants will lie in the range of 1 – 5 ppm with a contact time between 15 and 30 minutes to achieve a 4 to 5 log reduction in bacteria. This will be site specific and dependent on water quality and target organism. In general, this leads to an average of around 100 mg*min / L Ct (concentration time) units for bacterial control, with higher Ct's for viral control. This can be seen in figure 3. Peracetic acid also is known to have a very low dependence upon pH, especially in the range of 5 to 8.7.

Figure 3

Log vs Ct for peracetic acid. Bacteria and MS2 phage data measured in wastewater, viral data in distilled water. Data gathered from references 3 – 6, and others. For a full reference list, please contact Evonik.



THE VALUE PROPOSITION FOR VIGOROX® WWT II

VIGOROX® WWT II is an effective alternative for wastewater disinfection. But why choose this as the disinfection solution for a wastewater treatment plant? The following are some of the key drivers in choosing VIGOROX® WWT II:

1. EASE OF USE

VIGOROX® WWT II is a highly soluble, low freezing point, stabilized concentrated solution that can easily be retrofitted into existing chlorine infrastructure. Easy to install tankage, pumps, piping and probe technology require low investment costs to the incorporation of peracetic acid at a given facility.

2. LOW TOXIC IMPACT ON THE ENVIRONMENT

VIGOROX® WWT II generates no chlorinated disinfection by-products, such as trihalomethanes (THMs) or cyanides. Coupled with its rapid breakdown to the benign products of vinegar and water, VIGOROX® WWT II has a very low impact on the environment with low aquatic toxicity.

3. LOW DEMAND

Compared to other oxidative disinfectants, VIGOROX® WWT II has a relatively low oxidant demand from organics and suspended solids within the wastewater stream. This often leads to lower effective dosages needed. Furthermore, the dosing of peracetic acid needed will not depend on the amount of ammonia present, making it a perfect fit for wastewaters with varying ammonia levels, which may affect the performance of chlorination processes.

4. INCREASE DISINFECTION CAPACITY.

VIGOROX® WWT II can be coupled with UV systems to increase disinfection capacity for UV systems that are currently constrained and cannot meet disinfection requirements. The combination of peracetic acid and UV leads to a synergistic increase in inactivation of target bacteria, thereby reducing the power consumption of the UV system.

CONCLUSION

VIGOROX® WWT II has been demonstrated to provide cost effective disinfection as compared to chlorination systems, often requiring lower dosages and shorter contact times. Peracetic acid does not generate toxic disinfection by-products, resulting in a lower impact profile on the environment. It can be implemented with on-line probe monitoring and can be controlled at the plant level for several factors, including residual, flow pacing and incoming water quality.

Future Disinfection Digests will take a look at these attributes of VIGOROX® WWT II and the factors governing its effective use to disinfect target micro-organisms.

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