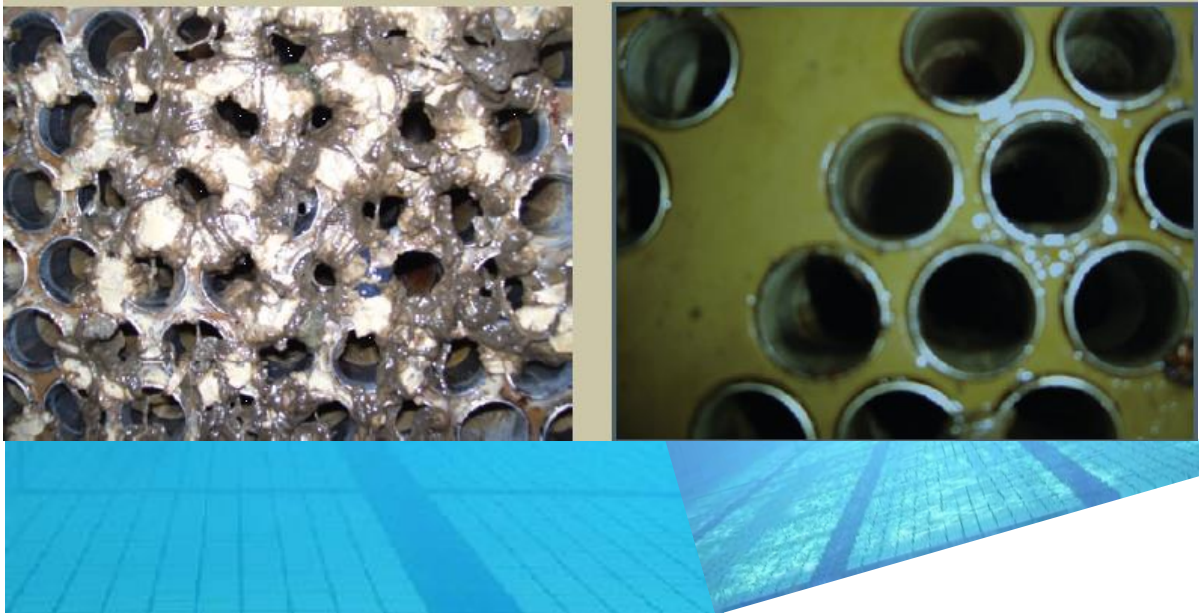


Biofilm Removal Using BACO On-Site Generation Mixed Oxidants



A Novel Solution to Remove the Biofilms

Many biocide treatment regimes exist, including a multitude of combinations of cleaning (hot caustic such as sodium hydroxide) and disinfection chemicals (quats, chlorine or proprietary biocides). An alternative to these variable regimes is BACO Mixed Oxidant Solution (BACO). The BACO solution is a simple, cost-effective cleaning and disinfection solution that has the potential to provide enhancements to biofilm control strategies.

Biofilms can be formed and sustained in any aqueous environment including water distribution lines, water storage tanks, open channels and pipe pyramid based on the environmental situation. The biofilm is indeed a complex of different microorganisms and also their disposals when they begin to excrete substances which are slimy and sticky and allow them to be a microscale layer adhered to the surfaces. A stratum of biofilm may consist of different types of bacteria, fungi, algae, protozoa and even viruses, dead or alive. That combination inside a biofilm layer makes it resistant to chlorine since it is changed to the slightly impenetrable layer for the chlorine molecules. Therefore, it will be hard to affect the microorganisms once initial adhesion takes place. Moreover, that layer of chlorine resistant microorganisms can be pathogenic and host disease-causing microorganisms such as Legionella, Listeria and temperature-resistant bacterial spores. In addition, biofilm increases the demand for chlorine and so consumes more chlorine components in the networks since it requires higher doses.

The BACO solution has clearly proved the ability of removing biofilms much more reliable than any other disinfectants or regular chlorination technologies. There are lots of evidences reported by



the interested researchers, also experimental documentations from municipal and industrial operators and a local experience about improvements as the results of removing biofilms.

Through this technical overview of electrochemical generation, also known as on-site generation (OSG), the applications and scientific mechanisms of this revolutionary technology is outlined. The overall advantages of the BACO solution include:

- Operation cost reduction
- Accessibility
- Operation and generation safety and security
- Cost reduction of hazardous chemicals transportation and storage and increasing their safeties
- Disinfectant quality
- Technological user-friendly operation
- Application of more ecological solution

Electrochemical Generation of Mixed Oxidant Solution

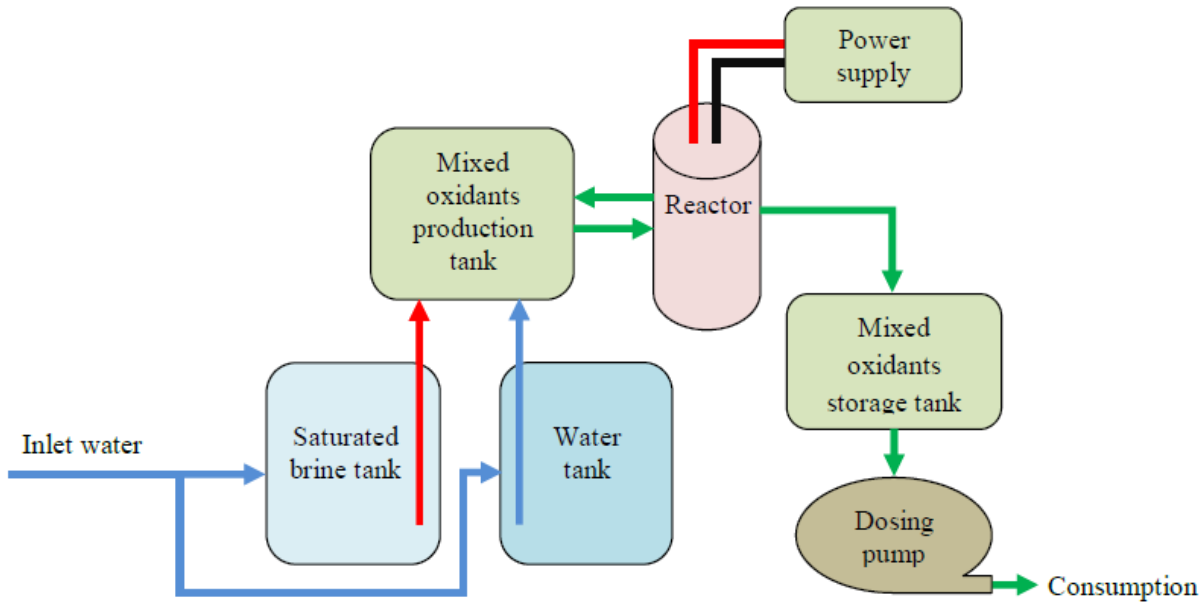
In general, mixed oxidants solution (MOS) is a salt water based solution containing different disinfectant oxidants produced through a complicated electrochemical processes of salt brine. The BACO technology of OSG producing MOS is optimized for the highest level of bacteria inactivation efficacy through its exclusive reactor design, electrical controlling system and cell geometry. MOS is absolutely efficient for removing and deactivating microbial species represented at biofouling and biofilm formation in water and wastewater treatment applications. Its effectiveness is a result of the synergistic antimicrobial action of the multiple oxidants mainly free available chlorine species containing chlorites and also including chlorine gas, chlorine dioxide with traces of ozone, oxygen and hydrogen peroxide.

Benefits of the BACO Solution in Biofilm Removal

- Rapid reaction because of ozone and other oxygen components
- More effective in microorganism inactivation, usually few times greater than same level of FAC chlorine dose and pH
- Reduction of chloramine side effects
- Reduction of befouling and so improving filtration
- Elimination of Legionella
- Reduction of micro flocculation and coagulant demand
- Effective iron and manganese oxidation, enabling removal by flocculation and filtration
- Increasing long term residual chlorine species in distribution systems with longer detention time
- Reduction in disinfection byproduct formation
- Turbidity reduction
- Promotion of water taste and odors in potable water networks
- Rapidly oxidizes hydrogen sulfide
- In addition, the OSG process starts when a signal from the switch located in the downstream oxidant tank conducted with a Programmable Logic Controller (PLC) and some other electrical



instruments such as sensors. This means very minimal operator attention is required during normal operation.



Application and Prove

According to previous researches and observations like the following images reported by MIOX, biofilm removal in different cases including swimming pools, hot spring sites, industrial plants and cooling towers, RO membranes, municipal installations and sanitary distribution systems has been proved properly. It is indicated that the biofilm does not start to regrow, even when disinfection is temporarily interrupted. The recommended remedy for the cases with high risk of biofilm is to flush the water lines for the first several weeks of operation. The distribution system typically stabilizes after a few weeks, and after the biofilm is removed and water quality will be improved.



Feed water pipe with sodium hypochlorite



After 6 days with mixed oxidants

Although few peer-reviewed publications have been produced on removal of biofilms using mixed oxidants, according to the result of reports for performance assessment of BACO by organizations and commercial plants which BACO has been installed, the mixed oxidant is capable of well biofilm removal through the system.



For instance, based on the report of Water & Waste Water Company of Esfahan Province, Iran, the performance of BACO mixed oxidant in terms of biofilm and coliform removal could meet environmental standards and no slimy biofilm is apparent.



***After 22 days with
mixed oxidants***

