Technical note

Assessment of a chlorine dioxide proprietary product for water and wastewater disinfection

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Abstract

Chlorine on its own is adequate for many, if not most, potable water pre-oxidation and disinfection systems at plants where the application is straightforward. Similarly, most wastewater plants can be disinfected by chlorine in one of its commercially available forms. However, when more intense pre-oxidation is required or significant iron or manganese is present in a potable supply, the use of alternative disinfectants is often preferable. Similarly, when secondary problems are present in wastewater effluent, such as high ammonia, a stronger oxidant may be preferable. Hitherto, the use of stronger oxidants has been limited to large works due to the complexity of the operational processes required. Recently, the use of ozone has spread to smaller works as new developments in equipment have become available. However, chlorine dioxide has not been used in small works until now. This paper provides details regarding a product which is simply dissolved in water in tablet or granular form and generates chlorine dioxide on solution in water. The solution is stable over weeks or even months and can be used for disinfection and or pre-oxidation purposes. The chemical was assessed in a series of tests. The performance of the chlorine dioxide product was compared against sodium hypochlorite, for different water types. The reduction in microbial counts was monitored in a secondary effluent sample and a high-ammonia secondary effluent sample. The oxidation ability in a high iron and manganese water was also assessed. A cost assessment was carried out and compared to the use of sodium hypochlorite. Other factors such as safety ease of use, and storage requirements are discussed.

Keywords: chlorine, chlorine dioxide, oxidant, iron, manganese

INTRODUCTION

The treatment of water and wastewater is physical, chemical and biological in nature. The object of the process is to remove contaminants and produce water which is suitable for potable use, or an effluent of a quality that can be discharged into the environment. As part of the process, pre-oxidation may be necessary when treating potable water to oxidise organic compounds as well as iron or manganese which may exist in a reduced form in many borehole waters and impounded supplies. The oxidant used is invariably also a strong disinfectant and can also render the water bacteriologically safe. Disinfection of a wastewater effluent is an important final stage of wastewater treatment. It plays a vital role in the reduction of waterborne diseases and the destruction/sterilisation of pathogens. In summary, disinfection reduces the number of microorganisms in the water to be discharged back into the environment in order to provide for the later uses of the water for drinking, bathing, or irrigation.

Disinfection may be obtained by chemical, physical or biological methods. The chemical method of chlorination is the most common form of disinfection used. Historically, small wastewater works may use calcium hypochlorite tablets or the more familiar liquid sodium hypochlorite (NaOCl) (usually approximately 13% chlorine) as a chemical disinfectant. Chlorine, whether by gas or hypochlorite addition, is by far the most common method of disinfection and has saved millions of people from waterborne disease over the past 100 years.

However, chlorine has a number of shortcomings under certain circumstances. When used for pre-oxidation in potable water treatment, it can give rise to trihalomethanes which are carcinogenic. It is also slow to oxidise manganese which can then pass through the works and contaminate the distribution system (Freese, 2008). Also, when chlorine is applied to wastewater effluent which has high ammonia concentrations, it is relatively ineffective within the time frame between dosage and discharge into the environment (Freese, 2008). Chlorine dioxide (ClO_2) is an alternative chemical which may also be used in the treatment of water and wastewater as an oxidant and disinfectant.

Iron (Fe) and manganese (Mn) in a wastewater effluent are considered as microelements. However, if they are in sufficient concentrations, they do have a toxic impact on the receiving environment. To reduce the impact, soluble Fe^{2+} and Mn^{2+} are oxidised to their insoluble forms of Fe^{3+} and Mn^{4+}, which may be filtered prior to discharge.

This paper reports on an investigation carried out on a patented chlorine dioxide product. This product is produced as a tablet or granular product which, when added to an appropriate volume of water, generates a solution which contains approximately 0.2% chlorine dioxide. It is not readily possible to assess the effect of a disinfectant on potable supplies when the bacterial counts may be too low to draw conclusions. Tests were therefore carried out to assess the effect on microbial counts, on a wastewater effluent and a high-ammonia wastewater effluent,

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