Chlorine Dioxide versus Chlorine

Is Chlorine Dioxide the same as Chlorine?

While chlorine dioxide (ClO_2) has chlorine in its name, chlorine dioxide's chemistry is radically different than that of chlorine. One atom can make all the difference in the world. The difference between chlorine and ClO_2 stems from their dissimilar chemical structure--and this is what accounts for their distinct chemical behaviors. Similarly, hydrogen is an explosive gas. But when combined with oxygen, it becomes dihydrogen oxide--commonly known as water.

How is Chlorine Dioxide used in water treatment applications? How does it work?

At present in North America, ClO_2 is used principally as a primary disinfectant for surface waters with odor and taste problems. It is an effective biocide at concentrations as low as 0.1 ppm and over a wide pH range. ClO_2 penetrates the bacteria cell wall and reacts with vital amino acids in the cytoplasm of the cell to kill the organism. The by-product of this reaction is chlorite. Of importance is that toxicological studies have shown that ClO_2's disinfection by-product, chlorite, poses no significant adverse risk to human health.

Does Chlorine Dioxide have any uses other than municipal water treatment?

Chlorine dioxide is used extensively as a bleaching agent in the pulp and paper industry. In fact, in order to minimize the environmental effects of the bleaching process, ClO_2 is rapidly becoming the chemical of choice. Chlorine dioxide is also being used as a disinfectant agent in the food industry for fruit and vegetable washing, flume water disinfection, meat and poultry disinfection, food process equipment sanitizing water and for odor control. In industrial processes, ClO_2 is used in industrial water treatment (cooling systems/towers), ammonia plants, pulp mills (slime control, paper machines), oil fields, scrubbing systems/odor control, textile bleaching and the electronic industry. Chlorine dioxide is also being applied to medical wastes.

How does the use of Chlorine Dioxide affect the environment?

Chlorine dioxide is environmentally friendly and in fact is a pollution protection technology that protects the environment and human health from bacteria and by-products formed from other disinfection methods. For example, in the pulp and paper industry the use of ClO_2 has virtually eliminated dioxin in mill waste water and has led to a significant improvement in the aquatic eco-system.

Why should I use Chlorine Dioxide rather than Chlorine for water treatment?

It should first be noted that both chlorine and chlorine dioxide are powerful and effective disinfectant agents. Chlorine has been and continues to be a very effective disinfectant which is responsible for making and keeping drinking water safe for people around the world. In the instances in which the drinking water source is surface water, which contains organic materials, ClO_2 offers the following benefits. First, ClO_2 functions via an oxidative rather than chlorinating reaction. This virtually eliminates the formation of chlorinated organic compounds which are suspected to increase cancer risk. Second, ClO_2 is generated on site, thereby eliminating the need for site storage of chlorine and/or transportation thereof.

Is Chlorine Dioxide toxic?

Fifty years of worker experience has demonstrated that ClO_2 is a safe compound when handled properly. World-wide, nearly 4.5 million pounds per day of chlorine dioxide are used in the production of pulp and paper. However, as with any and all disinfectant chemicals, if handled improperly, or consumed internally or absorbed or subjected to prolonged exposure, ClO_2 can be toxic. However, it is also this toxicity that makes ClO_2 a good water disinfectant agent.

Is Chlorine Dioxide a commodity chemical (i.e. can I purchase it directly from a chemical supplier)?

Pure chlorine dioxide cannot be purchased in solid, liquid or gaseous form. In fact, because ClO_2 is such a highly effective and reactive chemical, transportation of ClO_2 is not permitted. Chlorine dioxide must be produced and used at the point of application. Chlorine dioxide generators are automated and user friendly.

How is Chlorine Dioxide made?

Chlorine dioxide may be prepared chemically from either sodium chlorite or sodium chlorate or generated electrochemically.

Is Chlorine Dioxide expensive?

The cost of chlorine dioxide is dependent on the cost of the precursor chemicals-sodium chlorite or sodium chlorate- and the chemicals required to convert these chemicals into ClO_2. The cost of ClO_2 will also depend on the generation method employed. When compared to the cost of chlorine, the cost of ClO_2 is higher. However in those instances in which chlorine is not the preferred regulatory or environmental alternative, ClO_2 is a very attractive alternative. The capital equipment costs of generating ClO_2 are also far less than that of other alternatives like ozone which can also be used for water treatment.

Can Chlorine Dioxide be stored safely?

Solutions of approximately 1% ClO_2 (10 g/L) may safely be stored at 5°C for several months, with little change in concentration, provided that the solution has no gas space and is protected from light.