ClO_2Sure: Reduced Chlorite and Chlorate Formation

ClO_2Sure represents a significant advancement in Chlorine Dioxide (ClO_2) technology, offering enhanced efficiency and reduced chlorite and chlorate by-product formation compared to conventional ClO_2 treatments. The equilibrium dynamics and chemistry that contribute to ClO_2Sure's superior performance are explained in more detail.

Chlorite and Chlorate – Raw Materials

Chlorite and chlorate are present in the raw materials, and their presence is an unavoidable consequence of their manufacturing method and chemistry. ClO_2Sure samples have been tested under laboratory conditions, and the results show that chlorite and chlorate levels are within acceptable limits for potable water applications in the UK and EU.

Product Dose Rate & By-Products

Product	Dose Rate	Chlorites	Chlorates	Free Chlorine
ClO_2Sure Standard	6 ml/m^3	<0.1 ppm	0.2 ppm	0.73 ppm
ClO_2Sure Plus	3 ml/m^3	<0.1 ppm	0.14 ppm	0.37 ppm

Equilibrium Regeneration - Chlorite to ClO_2

In conventional ClO_2 systems, the reaction of ClO_2 typically results in the formation of chlorite (ClO_2^-) as a major by-product. However, ClO_2Sure's equilibrium-based formulation allows for the continuous regeneration of ClO_2 from chlorite until full conversion is achieved.

The key to this process lies in establishing a dynamic equilibrium between ClO_2 and its related compounds. As ClO_2 reacts and forms chlorite, the system's equilibrium is disturbed. To maintain balance, the equilibrium shifts, promoting the reconversion of chlorite back into ClO_2. This process continues until the chlorite is exhausted, maximising the utilisation of the active ingredient.

The equilibrium can be represented as:

$ClO_2 \rightleftharpoons ClO_2^-$ + other compounds

As ClO_2 is consumed, the equilibrium shifts to the left, regenerating ClO_2 from chlorite.

Suppression of Chlorate Generation

Chlorate (ClO_3^-) formation is a common concern in conventional ClO_2 treatments, especially at higher pH levels. ClO_2Sure's equilibrium-based system effectively suppresses chlorate generation through two primary mechanisms:

1. **Equilibrium Maintenance** – The system constantly seeks to maintain its equilibrium state. Chlorate formation disrupts this stability, prompting the system to resist its formation.
2. **Rapid Chlorite Reconversion** – By efficiently reconverting chlorite back to ClO_2, ClO_2Sure reduces the availability of chlorite for further oxidation to chlorate.

The net result is a significant reduction in chlorate formation compared to conventional ClO_2 systems.

Reduced Chlorinated By-Products

ClO_2Sure's efficiency in regenerating ClO_2 from chlorite leads to a marked reduction in chlorinated by-products. As the chlorite is continuously reconverted to ClO_2 until exhaustion, the final concentration of chlorite in the treated water is minimised. This process effectively lowers the levels of harmful by-products typically associated with ClO_2 treatments.

Moreover, the suppression of chlorate formation further contributes to the reduction of chlorinated by-products. The result is a treatment system that maintains high efficacy while minimising the formation of potentially harmful chlorinated compounds.

Enhanced Efficiency Compared to Standard ClO_2

ClO_2Sure demonstrates superior efficiency over standard ClO_2 treatments due to several factors:

- **Maximised Active Ingredient Utilisation** – The continuous regeneration of ClO_2 from chlorite ensures that a higher percentage of the initial dose remains active for disinfection.
- **Reduced Loss to By-Product Formation** – By suppressing chlorate formation and minimising chlorite levels, more of the initial ClO_2 dose is available as a biocide.
- **Stability in Challenging Conditions** – ClO_2Sure's liquid-phase stability allows it to remain effective in turbulent and hot water systems where conventional ClO_2 fails.
- **Broader pH Tolerance** – While conventional ClO_2 tends to form more chlorate at higher pH levels, ClO_2Sure maintains its stability and efficiency across a wider and particularly higher pH range.

Conclusion

ClO_2Sure's equilibrium-based formulation addresses many of the limitations associated with conventional ClO_2 treatments. By regenerating ClO_2 from chlorite, suppressing chlorate formation, and minimising chlorinated by-products, ClO_2Sure offers a more efficient and environmentally friendly alternative for multiple water treatment applications. Its enhanced stability and performance across various conditions make ClO_2Sure the solution of choice for a wide range of potable and industrial water treatment applications.