Hexavalent Chromium Removal: Future-Proof Your Technology Investment

In California, the State Water Resources Control Board (SWRCB) recently adopted a lower Maximum Contaminant Level (MCL) of 10 parts-per-billion (ppb) for hexavalent chromium (Cr6). This regulation will take effect in October 2024. As a result, approximately 500 sites throughout the state will need to assess their Cr6 treatment plans, determine an appropriate remediation solution, and implement a compliance plan to meet the standard. This has generated considerable concern about the cost to ratepayers and taxpayers in terms of achieving compliance today and in the future should the State determine to lower the MCL.

Within the regulation, the SWRCB has identified three best available treatment (BAT) technology solutions for Cr6 removal that cities can review and evaluate. These include ion exchange (IX), reverse osmosis (RO), and reduction/coagulation/filtration (RCF) with either an on-site generated stannous, or bulk ferrous- or stannous-based reagents. Additionally, the SWRCB noted that it will periodically review the proposed 10 ppb MCL to bring it as close to the Public Health Goal (PHG) limit of 0.02 ppb. As with the setting of the current MCL, that decision will be based on the availability, cost and performance of treatment technologies.

Therefore, as cities set out to meet today's MCL, they must consider the MCL of the future and adopt the right Cr6 treatment approach that can cost-effectively comply with a more stringent regulatory limit.

BAT Technologies: The Need to be Fit-for-Purpose

To find the most suitable Cr6 treatment approach, cities must take a set of criteria into account. These criteria include economic, environmental, and operational parameters, which are outlined in Table 1. To compare, three technologies have been evaluated against these parameters, including bulk ferrous reagent RCF, IX, and on-site generated stannous reagent RCF. Although all three solutions meet the 10 ppb MCL, some may not be suitable if the MCL is lowered in the future.

Table 1: Comparison of Hexavalent Chromium (Cr6) Removal Treatment Processes

	Ferrous Reagent RCF	Ion Exchange (IX)	On-Site Generated Stannous Reagent RCF*
GHG Emissions	Medium	High	Low
Interferences	Medium-High	High	None
Reagent Dose	High	None	Low
Sludge Generation	High	None	Low
Toxic Residuals	None	Yes	None
System Footprint	Large	Medium-Large	Low
Latency	High	Medium-High	Low
Process Controllability	Low-Medium	Low-Medium	High
Overall Complexity	High	High	Low
Cost	$$$	$$$$	$

- GHG Emissions: Amount of GHG emissions emitted by using the technology.
- Interferences: Effect of water quality parameters and interferences on treatment process performance.
- Reagent Dose: Amount of reagents needed to treat a unit of water volume (mg/L, ppm, etc.)
- Sludge Generation: Amount of sludge generated by the treatment process per volume of treated water.
- Toxic Residuals: Identifies if the process generates a toxic residual.
- System Footprint: Footprint and space required by the treatment process equipment.
- Latency: Time period between when a treatment system process change is (re)initiated and water quality complies.
- Process Controllability: Ability to control the treatment process without requiring multiple and difficult approaches with a high risk of failure.
- Overall Complexity: Level of complexity the treatment process requires from the water system and treatment/operational staff.
- Cost: Cost to treat a unit of water volume (Eg., per thousand gallons).

*SafeGuard™ H2O is an on-site stannous reagent generation technology manufactured by AMS.

On-Site Generated Stannous Reagent RCF: Cr6 Treatment Solution for the Present and Future

The innovative RCF technology, SafeGuard™ H20, is based on the on-site generation of a stannous reagent. This technology has been proven to remove Cr6 down to sub-ppb residual levels, which is close to PHG of 0.02 ppb. The SafeGuard™ H20 system is highly efficient and has been used successfully in multiple field demonstrations. As a result, this technology provides cities with two unique ways to protect their Cr6 technology investment.

Cities that use SafeGuard™ H20 can reduce costs associated with treating multiple wells and implement a water blending strategy because of the technology's ability to consistently achieve non-detect (<1 ppb) effluent levels of Cr6. Additionally, by using the SafeGuard™ H20 technology, cities can future-proof their investment and lower the presence of Cr6 as close to the PHG as possible in a cost-effective and efficient manner.

The SafeGuard™ H20 technology is highly accurate and reliable, delivering a tightly controlled dose of a stannous reagent generated onsite through an electrolytic process. The electrolytic process design consists of an electrolyzer that causes food-grade tin plates to dissolve, producing a reagent at a concentration required to meet the treatment goals of the city. Thus, meeting a treatment goal of less than 10 ppb or less than 1 ppb with SafeGuard™ H20 is merely a question of dissolving tin at a faster rate (+20%) in order toto increase the reagent dose. This means that scaling the SafeGuard ™ H20 solution to meet future MCL levels will not require more capital investment, simply an increase in tin consumption. Scaling the process would represent a minimal incremental operating cost, a testament to the investment security SafeGuard™ H20 offers cities.

In the context of the other technologies outlined in Table 1, the economic impact of lowering the MCL may vary significantly. For example, IX treatment technology may sometimes achieve less than 5 ppb. However, it will come at the expense of much more frequent media regeneration cycles needed. Also, due to multiple potential interferences, which may reduce IX media capacity and stability, costly monitoring equipment must be implemented to ensure tight treatment process control. As a result, both system capital and operational costs will increase significantly, along with a dramatic increase in toxic waste generation. The ability of a ferrous-based reagent RCF treatment system to maintain less than 5 ppb Cr6 effluent levels has been reported. However, to achieve 5 ppb, higher reagent demand is required, along with an expensive ultra-filtration polishing step. Such treatment process upgrades and modifications will result in higher treatment lifetime costs, a larger system footprint, and higher sludge generation and disposal costs.

In conclusion, cities must prioritize the implementation of Cr6 treatment solutions while protecting their investment. SafeGuard™ H20 provides a solution that ensures safety and confidence for cities. With SafeGuard™ H20, cities can pursue a water blending strategy where appropriate and be assured of sustainable compliance if the State decides to lower the MCL.

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