Bringing Innovative and Affordable Solutions to a Costly and Complex Problem

AMS deploys technology to treat Cr(VI) to non-detect levels at a fraction of the cost of traditional systems

Chromium is a naturally occurring element found in rocks and soil; however, a form of it called hexavalent chromium [Cr(VI)] is typically produced by industrial processes, such as stainless-steel production and electroplating. According to the NIH-HHS, exposure to Cr(VI) can cause an increase in likelihood of nasal and sinus cancers and kidney and liver damage, among other things.

While the U.S. Environmental Protection Agency has set a maximum contaminant level (MCL) of 100 parts per billion (ppb) for total Cr(VI) in drinking water, numerous states have established limits of 50 ppb of total Cr(VI) in drinking water.

There had been a regulatory limit of 10 ppb at the presence of Cr(VI) in drinking water in the state of California, the lowest limit set yet among states. However, it quickly became apparent that the cost of achieving that regulatory limit, which was designed to improve human health and reduce exposure of the consumer to Cr(VI), was going to become very expensive — both for big cities and smaller communities. In 2017, the Superior Court of Sacramento County issued a judgment staying the Cr(VI) MCL for drinking water because, it said, the California Department of Public Health "failed to properly consider the economic feasibility of complying with the MCL." As a consequence, California returned to an MCL of 50 ppb that is in force today. Yet, Cr(VI) remains present in the water supply of many public water systems and continues to pose a threat to public health.

AMS Responds to California State Water Board White Paper

The California State Water Board (SWB) has more recently engaged in a process of consultation to determine at what level the regulatory limit for Cr(VI) should be set. The state published a white paper entitled "Economic Feasibility Analysis in Consideration of a Hexavalent Chromium MCL" and invited public comment and debate on it.

The leaders of Aqua Metrology Systems (AMS), a Sunnyvale, Calif.-based water quality monitoring and treatment solutions company, offered an official response to the white paper in the form of a few main comments and recommendations, which are summarized here:

An MCL for Cr(VI) of 0.002 mg/L should be put into place, given the medical evidence of the adverse consequences for the health of consumers exposed to this contaminant of concern.

"Technological advances in Cr(VI) treatment over the past two years have been demonstrated to remove Cr(VI) to 0.001 mg/L, a level that can be determined by both laboratories and AMS' Cr(VI) online analyzer," said Rick Bacon, CEO of AMS. "This supports our argument that the new regulatory limit for Cr(VI) should be set closer to the public health goal of 0.00002 mg/L, significantly below the previous 0.01 mg/L limit and in line with the health protective function of 0.002 mg/L."

All Cr(VI) treatment systems should be continuously monitored. Online remote monitoring can support the compliance of small public water systems.

Bacon said AMS recommends that the state sets a requirement that all Cr(VI) treatment systems be continuously monitored so that plant operators are immediately alerted to intermittent system failures. He also suggests that the state considers setting a

requirement that a treatment system should comply on a far more consistent basis than once every 90 days, which is the current regulatory compliance sampling period.

The analyses of different treatment solutions should be on a fully comparable basis to include all capital and lifetime costs, treatment system efficiency and the value of treatment waste.

Since 2017 when the Superior Court made its decision, new treatment technologies have been developed and proven in the field. These new treatment technologies are highly cost-competitive with the best available techniques that were analyzed at the time.

It is essential that the cost analysis of the different treatment systems be based on a like-for-like basis and fully inclusive of the lifetime costs of the entire system. This should include the costs of: engineering and design, permitting for waste disposal facilities and environmental impact studies, chemical and waste storage and associated facilities, energy and the option to use solar power in small remote water systems, civil works that will be dictated by the footprint of the treatment system and access for chemical transportation and storage, appropriately qualified labor for treatment system control and supervision, servicing and maintenance, treatment and disposal of treatment system waste, the loss of produced water during back flushing of filters and inertia loss during the start-up of a well post shut-down, losses from degradation in the effectiveness of treatment chemicals that are stored prior to their use, and continuous system performance monitoring to ensure that the treatment system remains continuously in compliance.

"We were closely involved in monitoring those early validations of technologies designed to treat for Cr(VI), so it was apparent to us how expensive and inefficient those systems were going to be," Bacon said. "We've developed in the meantime an alternative technology that can treat Cr(VI) down to levels of non-detect, and more importantly, at a fraction of the cost of those traditional technologies. As a result, the opportunity to reintroduce a regulatory limit, even much lower than what was originally in place, is now possible.

The Technology

How is this possible? AMS' SafeGuard™ H2O Cr(VI) remediation system uses an in-situ stannous generator with tin, a proven chemical reagent that is non-toxic and has great reductive power, to treat water for Cr(VI). The system generates on demand a stannous ion reagent in-situ via an electrolytic process, posing no environmental or health risks (Figure 1). Generating a stannous reagent on site is a far more cost-effective treatment solution compared to traditional alternatives because tin and electricity are the only consumables with this approach.

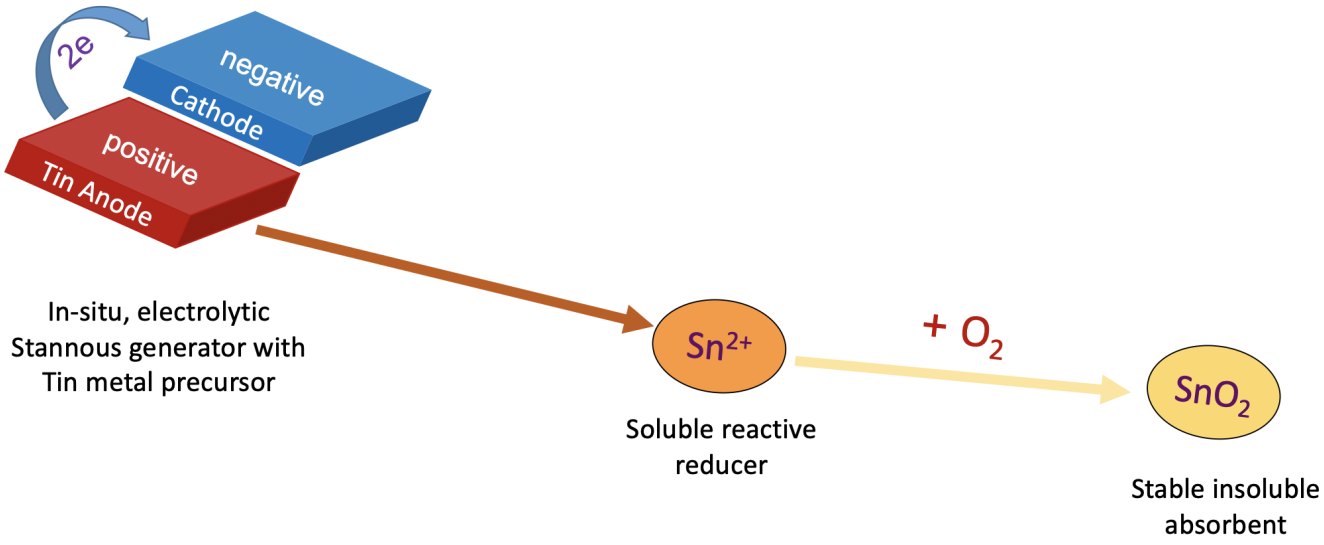
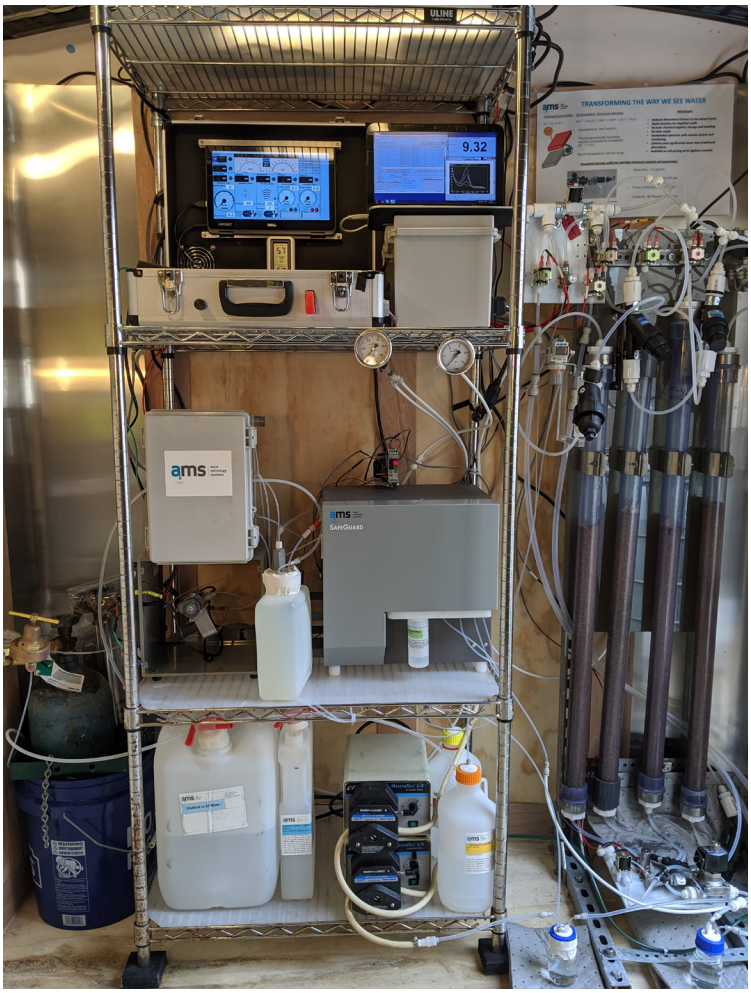


Figure 1. Electrogeneration of Soluble Stannous Ion and Its Conversion into Tin Dioxide Adsorbent

This technology can reduce Cr(VI) down to less than 2 ppb, is half the cost of traditional treatment systems and can be run autonomously for up to 90 days at a time. The byproduct, stannic oxide, is itself a valuable reagent that can be recycled and used for the removal of arsenic and mercury in drinking and wastewater applications, thereby reducing the net cost of the Cr(VI) treatment system.

AMS' MetalGuard™ analyzer for Cr(VI) uses real-time sensing, which ensures performance is optimized to prevent over- and under-treatment and will signal any flags in system performance for timely intervention. This online analyzer helps control operational and treatment costs by quickly detecting changing contaminant levels, optimizing reagent usage and reducing associated labor costs, maximizing blend efficiencies and quickly detecting the effectiveness of the remediation process.



AMS' SafeGuard™ H2O

Micro-Piloting Program

In 2019, AMS debuted a micro-piloting program for its SafeGuard™ H2O remediation systems, whereby municipalities and utilities can assess and deploy demonstrations of the SafeGuard™ H2O technology quickly and for a cost that is a fraction of traditional technology demonstration pilots.

Because the system can be fully controlled, monitored and optimized remotely, the presence of personnel on site for supervision is not required. A SafeGuard™ H2O pilot demonstrates, at scale, using a fraction of the eventual volume/flow to be treated. This results in a pilot with a small footprint that can be set up and operational in hours rather than days. An AMS on-site pilot will use 100 liters per day compared to other technologies that use thousands per day. This ensures that a larger proportion of funding is available for final projects instead of demonstration pilots.

"There is a significant financial burden tied to the design, permitting and installation of demonstration pilot systems that has to be paid by someone — the client, the treatment system vendor or taxpayer through grants. These costs drain financial and environmental resources and are a barrier to innovation that the water treatment sector so badly needs," Bacon said. "Understandably, clients expect to see a technology demonstrated before it can be deployed. The time and costs to deploy such pilot systems is one of the reasons why the industry is so slow to adopt new innovations and is one of the reasons why start-up companies die before their innovations gain acceptance. Now, with our Micro-Piloting program, we've reduced the time to market, providing clients more rapid access to the benefits of the SafeGuard™ technology."

Case Studies

One such piloting program took place in Los Banos, Calif., where a SafeGuard™ H2O demonstration system was deployed in one of the wells that had Cr(VI) levels of more than 40 ppb. The pilot successfully demonstrated the system's ability to effectively and affordably treat Cr(VI) to non-detect levels (under 1 ppb) in unchlorinated well water. Real-time data of the system's performance were streamed live, demonstrating the treatment efficacy of the technology.

Another California utility, California American Water, which services 675,000 people, was experiencing elevated Cr(VI) levels at

two of its well sites. Cr(VI) levels were in the 25-ppb range after well water was filtered with granular activated carbon and before being stored at a 5,000-gallon hydro tank.

As a result, the utility turned to AMS' MetalGuard™ analyzer, which provides high-frequency real-time data on Cr(VI) contaminant levels in 30 minutes with sensitivity down to 1 ppb. The Cr(VI) analyzers were installed and connected to the motor starter of the wells — one was installed in February 2017 and the other in February 2018. To date, the analyzers at the two sites have collected 39,254 samples and 20,493 samples, respectively. If the analyzers detect Cr(VI) at 10 ppb or above, the well is automatically shut off. An operator would then take a sample which is sent to a lab, and if the lab values correlate with the Cr(VI) analyzer values, the system is flushed and retested before being put back online.

According to Lacy Carothers, P.E., project manager for California American Water, "The MetalGuard™ Cr(VI) analyzer enabled California American Water to have higher visibility of contaminant levels in real-time. The fast and reliable online data allowed us to maintain the wells operational while continuing to deliver safe drinking water to our customers."

Bringing Intelligence and Affordability to the Market

AMS is committed to bringing intelligent water remediation solutions that can be fully controlled, monitored and optimized remotely, while ensuring that these systems are more accessible to a wider sector of the population through affordable financial models.

With AMS' municipalities and utilities can take advantage of a unique and less burdensome funding model that accompanies its technology.

"The typical pricing model has always been that the commercial vendor sells the capital equipment and then enjoys an ongoing revenue stream of the chemicals and replacement parts and everything that goes with it for the length of the contract," Bacon said. "That's very burdensome, particularly in this current environment, where there isn't going to be a lot of capital around, not to mention the ongoing costs."

AMS has developed a commercial model where the utility can pay per gallon of water treated, or per thousands of gallons of water treated, or by amount of chrome removed, according to Bacon.

"Because we have all the real-time data around the operation of our system, we can guarantee great water quality on a continuous basis for the volume treated. So, it becomes a variable cost model, as opposed to a very substantial capital upfront payment, and then ongoing operating costs," he said. "People deserve safe, clean drinking water and there are hundreds of communities in California that can now have access to Cr(VI) safe water, and at a reasonable price."

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