

Innovation in Fluoridation Technology Promises Improvements in Oral Health

KC Industries (KCI) has developed a fluoridation tablet and feeder system for water systems unable to use traditional fluoridation equipment due to cost or operation limitations, typically small water systems serving rural communities. This innovative technology will offer tens of thousands of smaller public water systems the ability to provide the benefits of water fluoridation to communities in need.

Community water fluoridation is the process of adjusting the amount of fluoride found in water to achieve the optimal level for prevention of tooth decay. Drinking fluoridated water keeps teeth strong, reducing cavities by about 25% in children and adults. By preventing cavities, community water fluoridation has been shown to save money for families and for the US health care system. It is an equitable and effective way to deliver fluoride to all community members, regardless of age, education, or income.

Today, more than 34,000 community water systems in the United States do not provide fluoridated drinking water to their customers. About 35% of Americans do not have access to properly fluoridated water, either because they live in a home not served by a public water system or because their public water system potentially lacks the resources or size to make installing and maintaining robust fluoridation systems feasible. These systems were designed for larger communities and are not cost-efficient for small water systems, such as those that serve rural, disadvantaged populations with decreased access to health care providers. It is uncommon for conventional fluoridation technology to serve systems with fewer than 1,000 people, and economies of scale make fluoridation increasingly expensive as service populations fall below 5,000.

The Centers for Disease Control and Prevention (CDC) has long recognized the need for a method that allows these smaller systems to optimally fluoridate water. CDC's National Fluoridation Engineer Kip Duchon (retired) theorized that fluoridation systems could use tablets similar to those already widely used in other low-volume water treatment applications, such as swimming pool chlorination.

To test the feasibility of this idea, CDC in 2013 announced a Small Business Innovation Research (SBIR) funding opportunity to develop a pill or tablet that small water systems could use to provide fluoridated water to their customers. Through a competitive, objective process, KC Industries (KCI) of Mulberry, Florida, received a CDC Phase I SBIR award in 2014 to study whether smaller public water systems could use compressed tablets of sodium fluorosilicate with commercially available equipment currently used to add fluoride additive products to water. Sodium fluorosilicate additive was selected because of its reliability, low cost of feeding equipment, and convenience as a fluoridation agent. Phase I testing revealed that while fluoride tablets were technologically feasible, the product would require the development of a new fluoride delivery method that would allow the tablet to slowly erode over time in a tablet contactor.

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Having established through the CDC SBIR Phase I award that a practical fluorosilicate tablet could be produced, KCI competed for a CDC SBIR Phase II award in 2015 to develop a turnkey tablet-based fluoridation system while refining their newly developed tablets for commercial use through laboratory and field testing.

While Phase II was underway, KCI president Paul Maasen passed away, and a major partner—the firm working to develop a feeder system for KCI’s tablets—withdrawed from the project. The prospects of bringing the new technology to market looked grim, as did the future of the company itself; however, convinced of the project’s intrinsic merit and its commercial appeal, Steve McCarter took the helm at KCI and resolved to develop the tablet contactor in house.

Meanwhile, KCI also had to grapple with packaging, a new concern for a bulk chemical supplier. “Transportation and how this product travels were major uncertainties,” said McCarter, “but SBIR funding enabled KCI to bring in experts in logistics and supply chain to give us ideas on how to address packaging and shipping.” In fact, SBIR support and guidance helped KCI to assemble a broadly interdisciplinary team of specialists in water science, engineering, and marketing as well as in logistics and supply chain management.

By the end of Phase II, KCI’s tablet system had gained NSF 60 approval for the tablet systems from NSF International and the American National Standards Institute for use in public water systems, and the tablets themselves were ready for commercial manufacture. KCI performed pilot testing at several water facilities, proving that the technology would work effectively under normal operating conditions with a target water systems size of 10,000 people or less.

This SBIR funding has resulted in technology that will finally allow small water systems to provide underserved rural communities, which often experience the greatest challenges in scaling traditional fluoridation technologies, the same potential for oral health benefits enjoyed by other populations receiving optimally fluoridated water.

The KCI tablet system is economical for systems that serve between 50 and 10,000 people, filling a large gap— of the more than 34,000 community water systems that do not currently provide optimally fluoridated water, an estimated 32,000 are small systems, serving about 19 million people. The new tablet system could allow these small public utilities to contribute to the Healthy People 2030 goal of reaching 77.1% of the US population with access to fluoridated water.

The Future of KC Industries

With the development of the sodium fluorosilicate tablet complete, KCI’s focus has shifted to product promotion and corporate reorganization. “We’re actually restructuring our whole company around this product,” explains McCarter. “Because of our belief not only in the importance of this product but also in its appeal, we’re taking on partners, and restructuring

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our resources. Everything is going to be based around making sure that this product is available for the market.”

Before it can be used in drinking water facilities, a fluoride additive must be certified to meet NSF and American National Standards Institute Standards 60, which addresses product quality during production and product integrity during transport. After achieving NSF Standard 60 certification for the tablet product, KCI piloted the new technology at water systems in 3 states in 2019 and refined their feeder equipment design for more accurate delivery of the tablet. They received NSF 61 approval for the feeder equipment in late 2020 and are now ready for market. Once state drinking water programs review the operational data from these installations and provide final approval, KCI expects that the system will be ready for widespread use and installation in March 2021.

In keeping with a broader industry shift to using liquid water treatment additives, many water systems have increasingly switched to the fluorosilicic acid additive. After decades of the resulting decline in dry additive sales, KCI has a new lease on life thanks to SBIR support. “When the product hits the market there’s a good chance for an immediate return on investment,” said McCarter.

So, it’s no surprise that word-of-mouth interest is building: “We have had literally dozens of phone calls from health departments across the United States, as well as from Australia and Canada,” marvels McCarter, who predicts, “It will be a success because there’s a need. There’s obviously a very large gap in the segment that we have targeted. The response and consistent inquiries from people around the world asking, ‘When is this product coming to market?’ and ‘Can we be the first?’ has been overwhelmingly positive.”

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[Sidebar quote: “CDC SBIR funding and support from technical experts ensured that we had a road map for how to get from the beginning concept to the culmination of having a viable, marketable fluoride tablet. We were able to assemble the right plan and the right people to give us the right advice so that the end product has commercial appeal as well as scientific validity.” —Steve McCarter, KC Industries President]

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