Evaluation of Chlorine Disinfection Processes in a Water Treatment and Distribution System in Rural Haiti

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In July of 2010, the United Nations General Assembly recognized access to water and sanitation as a human right essential for leading a life of dignity (UN Resolution A/RES/64/292). Despite this declaration, today only 71% of the global population have access to a safely-managed drinking water service and over 150 million people are still reliant on surface water for their daily water needs (World Health Organization, 2018). Contaminated drinking water is known to cause diseases such as cholera, diarrhea, dysentery, typhoid, and polio and leads to around 502,000 diarrheal deaths each year mostly in the context of developing countries (World Health Organization, 2018).

In the developing world, many barriers exist that prevent access to safely-managed drinking water sources. In response to this, Clemson Engineers for Developing Countries (CEDC) has been working in the Central Plateau of Haiti since 2009 to find creative solutions to some of the biggest challenges facing communities in resource constrained environments. In the village of Cange, about two hours northeast of Haiti's capital Port-au-Prince, CEDC has been testing alternative methods for drinking water disinfection using chlorine tablets in a water system first built in the 1980s and expanded in 2013. So far, three different chlorinators with unique sets of benefits and drawbacks have been used within the water treatment system. Some of the benchmarks CEDC has set for the chlorinators include ease of operations and maintenance, capability to operate without electricity, ability to deliver consistent levels of chlorine, cost effectiveness, and a robust design that can be used in a wide range of applications.

Most recently, in March of 2018 a fiberglass reinforced plastic (FRP) tablet feeder erosion chlorinator designed by CEDC and Fluidtrol Process Technologies, Inc. was installed in the system. The chlorinator lid opens to allow for the addition of 3" calcium hypochlorite tablets that the water erodes as it flows through the system effectively chlorinating the water. The tablet feeder is proving to be a viable option for the addition of chlorine in the Cange Municipal Water Treatment System as water quality data over the last several months have shown that residual chlorine levels at the point-of-use are much closer to an acceptable range than with past chlorinators used in the system. This method has met many of the other benchmarks deemed important as well as it does not rely on electricity, is simple to operate, and can withstand the high pressures of the system. However, further refinement is needed to ensure a consistent dosage of chlorine.

Over the coming months, water testing data will continue to be collected and analyzed with the intent of developing a model that will be able to accurately predict the correct dosage of chlorine needed daily in the system considering the inflow water quantity and quality parameters such as turbidity, total dissolved solids, and pH. Computational fluid dynamic (CFD) modeling will also be conducted to gain a detailed understanding of how the chlorine tablets are behaving within the chlorinator and how it could be better designed to control dissolution of the tablets and deliver more consistent levels of chlorine.

References:

"Drinking Water Fact Sheet." World Health Organization, World Health Organization, 7 Feb. 2018, www.who.int/en/news-room/fact-sheets/detail/drinking-water.

Resolution A/RES/64/292. United Nations General Assembly, July 2010