Evaluation Of Electrolyzed Water For Clean-in-place Of Dairy Processing Equipment

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Author:
Yu, Yun
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Food Science
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- Robert F Roberts, Thesis Advisor

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Abstract:

Good cleaning and sanitation practices in the dairy industry are essential to maintaining public health and increasing profitability for producers. Dairy processing equipment is commonly cleaned using a four-step clean-in-place (CIP) procedure: rinse with water, wash with an alkaline solution, rinse with water again to remove alkaline residue, and then rinse with an acid sanitizer. The chemicals used in CIP procedures of dairy processing equipment are usually handled and stored in concentrated forms, and may have adverse effects on the environment, and can cause skin or eye burns on contact.

Electrolyzed water is produced via electrolysis of a dilute sodium chloride solution, which results in a sodium hydroxide solution, called electrolyzed reducing (ER) water (pH ca. 11.0 and ORP ca. -850 mV), and an acidic solution, called electrolyzed oxidizing (EO) water (pH ca. 2.5, ORP ca. 1168 mV and 80-100 ppm of chlorine). Thus, electrolyzed water has the potential to serve as an alternative to CIP chemicals. The antimicrobial efficacy of acid EO water has been demonstrated. The efficacy of electrolyzed water used as cleaning and disinfecting agent for on-farm milking systems

also has been demonstrated. The use of acid EO water in CIP applications for dairy processing systems, especially those involving heat treatment of milk has not been evaluated.

The purpose of this research was to investigate the efficacy of electrolyzed water for CIP procedure of dairy processing equipment, specifically a refrigerated milk storage tank and a tank used for thermal processing of milk. In this work, a pilot scale test system composed of a 15 liter (4 gallon) stainless steel test vessel was constructed and characterized to allow evaluation and optimization of electrolyzed water as CIP agent for dairy processing equipment. Use of the test system was validated by pilot trials of CIP cleaning with conventional CIP detergent and sanitizer.

Using the same CIP procedure, electrolyzed water was successfully employed to clean the test vessel after soiling with milk at refrigerated temperatures (2-4°C). The effectiveness of cleaning was assessed using a microbiological enrichment method, as well as ATP bioluminescence and residual protein detection assays.

Finally, use electrolyzed water for CIP procedures of the test vessel soiled by heating milk was evaluated using a response surface model to optimize temperatures and times for both alkaline ER water and acid EO water treatments. Parameters for 4-step CIP procedures using electrolyzed water were: wash with alkaline ER water at 54.6°C for 20.5 min and sanitize with acid EO water at 25°C for 10 min.

The validation study demonstrated that a complete CIP procedure using electrolyzed water with optimal operational temperatures and time was capable of returning the surface of the test vessel to a satisfactory clean condition with non-detectable residual ATP and protein.

The study demonstrated the cleaning efficacy and potential application of using electrolyzed water for CIP procedures in dairy plant. In contrast to conventional CIP chemicals that are usually prepared by diluting of concentrated chemicals, electrolyzed water has the advantage of on-site generation, dairy processing plants, especially small dairy foods manufactures, could benefit by reducing the risk and cost of storing and handling of concentrated CIP chemicals.