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PERASAN® STABILITY IN BRINE SOLUTIONS

Background: Meat, poultry, seafood and dairy industries often utilize brine chilling operations to cool or prepare the end product for final packaging. Brine (salt) solutions are preferred in many cases to preserve the osmotic balance between the finished product and the cooling water medium. The products subject to brine chilling may include ready-to-eat or further processed products of all kinds, shapes and ingredients. In an effort to prevent the spread of harmful organisms such as E.coli, Pseudomonas, Listeria, Salmonella, etc, most processing companies employ some kind of antimicrobial treatment. Usually this antimicrobial treatment is chlorine-based. Other antimicrobial treatments consist of adding food grade acids to the recirculating brine, such as citric or phosphoric acid, with the objective of lowering the pH below 3. At this low pH pathogenic or spoilage-causing microorganisms do not proliferate. Both approaches have a significant negative impact on the life span of the equipment employed in these brine chilling operations.

The chlorine molecule is an oxidizer by nature, and inactivates microorganisms quite readily in water-based exposures. However, in brine chilling operations chlorine has a devastating effect on the integrity of stainless steel that is used in these operations. Salt brine solutions by themselves are quite corrosive to all normal stainless steels, including 304 and 316, by a process known as chloride stress corrosion cracking and pitting. As the processing day progresses the pH of the recirculating water changes and organic matter, fats, proteins and the like increase in amounts which further consumes chlorine at an accelerated rate. As more chlorine is added the chloride content rises continually, which in turn accelerates the metallic corrosion rates.

Some processors choose to use the increased acidity method using citric acid or other pH lowering techniques. Although this method is *inhibitory* to microbial growth, it is not an antimicrobial treatment. Lowering pH increases the effects of chloride stress corrosion, but at a reduced rate compared to the chlorine-brine method. In addition, this approach often requires pre-treatment with a strong alkali to affect a rise in pH prior to final discharge. This methodology results in substantial TDS, salt, and conductivity increases in the wastewater which are problematic for most locations.

Thus, there remains a need to find a system or product that is antimicrobial in nature, is food contact approved, is benign to wastewater discharge concerns, and does not contribute to the corrosion rates of the brine chilling operation. Enviro Tech's PERASAN® peracetic acid products meet all these requirements. Perasan® is non-corrosive to stainless steels and aluminum, does not contribute to the TDS or conductivity of a solution, is resistant to depletion due to organic matter, and is quite antimicrobial at concentrations as low as 2 ppm in cooling water applications.

Evaluation and Considerations: Peracetic acid (PAA) is quite unique in its broad spectrum use. It is also known that PAA solutions are degraded very rapidly by seawater, typically expressing a half-life of less than 5 minutes. The pH of seawater is about 8.2, which is not excessively high for peracetic acid. Thus, it is the brine (salt) content that is attributed to the very short lifespan of PAA in these situations. Enviro Tech has shown Perasan® to be a very good antimicrobial product at low concentrations (<30 ppm) and it was determined to test these peracetic acid based products in a brine solution to establish a half-life curve, which would determine the potential use of Perasan® in brine solutions.
Elsewhere in Enviro Tech's literature we evaluated the efficacy of Perasan® in cooling water uses. Under recirculating cooling water conditions Perasan® products perform very well as an antimicrobial agent at concentrations as low as 5-9 ppm. Relatively long contact times at these low activities are necessary in order to express good efficacy (15-90 minutes). Therefore, contact time of the sanitizer at a specific concentration is important to establish whether Perasan® may be efficacious to microorganisms. Thus, the decay rate of Perasan® in salt-based solutions is of prime importance.

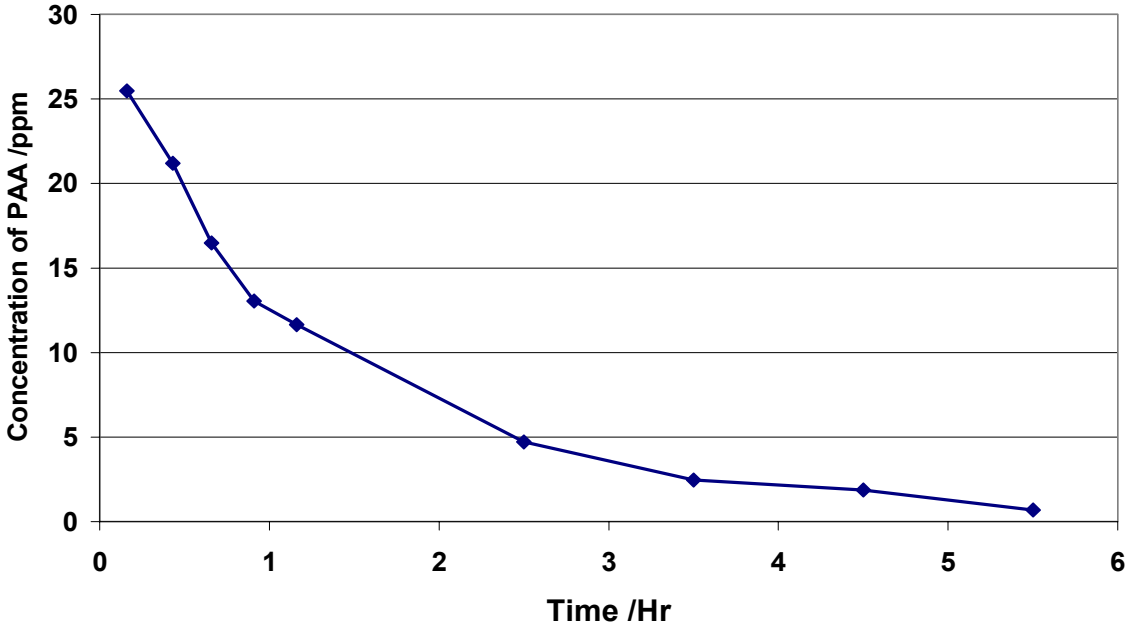
Methods: 150 grams of non-iodized salt was added to 850 gms of tap water to yield a 15% w/w salt brine solution. To this solution was added a serial dilution of Perasan® 'A' (5.6% active PAA) and Perasan® 15 (15% active PAA) to yield end product solutions of approximately 25 ppm active peracetic acid. All challenges were performed at 70ºF. Residual testing was done at the initial time zero to establish initial levels. Tests were continued on the residuals of PAA every 15 minutes to establish a definitive decay curve profile. The results were plotted using Linear Regression Analysis which confirmed the first order decay kinetics of the 5.6% and 15% Perasan® products. The slope of the linear regression plot was used to calculate the half-life of the PAA in the respective products. Decay curves for the two products are also displayed below.

Testing: Normal drop-count testing on the brine/PAA solutions proved to be very inaccurate and unreliable. "Bleed-through" of the hydrogen peroxide is suspected of being the probable cause. Thus, normal drop-count titration test kits can not be used for brine/salt solution testing. The results give a false high reading with very little decay over time, although the PAA solution had indeed decayed substantially. Subsequent test-strip analysis was performed with Enviro Tech's Perasan® Test Strips (0-160 ppm) and were confirmed to be quite accurate, as confirmed by a parallel colorimetric analysis procedure also developed by Enviro Tech.

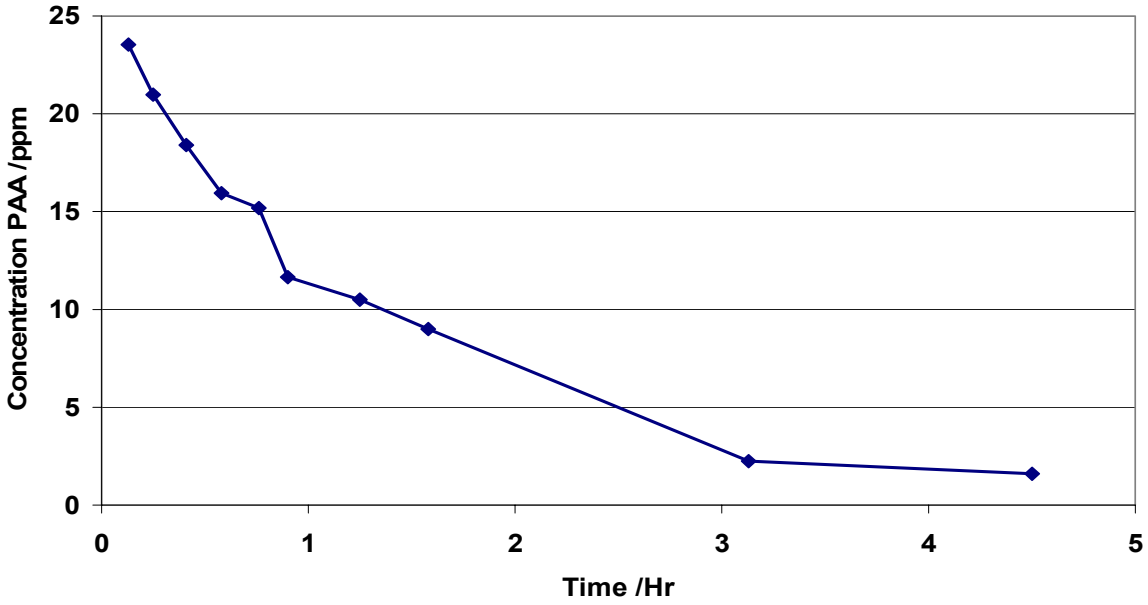
Results: Both 6% and 15% Perasan® products result in a half-life of about 1-1¼ hrs. (from 25 ppm to about 12 ppm activity). The linear regression coefficients for both products are greater than 97%, which indicates accurate linearity and a straight line first order decay rate is predominant. These regression coefficients indicate that varying concentrations of the PAA in salt/brine solutions will exhibit similar if not identical decay dynamics, and that these products are amenable for antimicrobial treatment in brine chiller systems where the brine/salt concentration is approximately 15%. Similar testing at 40° F has shown much better half-life decay kinetics of Perasan® and will be reported in February 2005.

It was also established that conventional drop-count titration methods for determining peracetic acid concentrations do not yield accurate results in brine/salt chilled water. Test strips should be used to determine the concentration of PAA in these situations for field analysis.

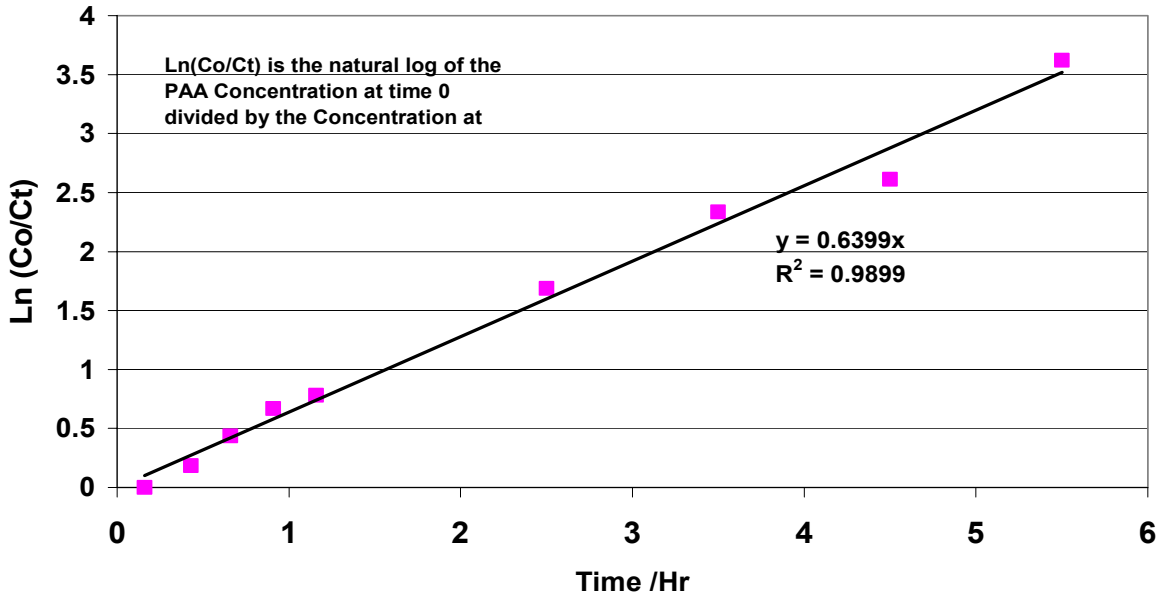
Decay of PAA (15%) in Brine



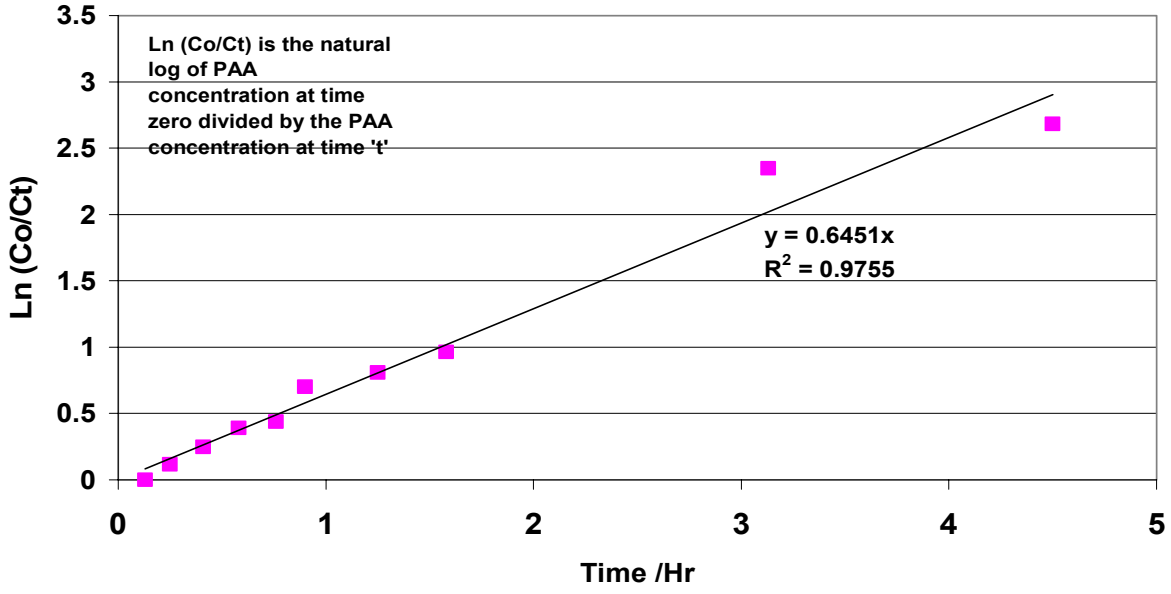
Decay of PAA (6%) in Brine



First Order Decay Kinetics of 15% PAA in Brine
Linear Regression Plot



First Order Decay Kinetics of PAA (5%) in Brine
Linear Regression Plot



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