ENVIROTECH

REFLEX

PRODUCT TESTING

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Corrosivity of Peroxyacetic/Nitric Acid Solution from Reflex on Chrome

Background

Peroxyacetic acid (PAA) has been used to sanitize various types of manufacturing equipment and machinery in the food industry for many years. PAA is a known corrosive agent to common transition metals and should only be used on stainless steel or stainless steel systems. Machinery containing chrome parts are used in ice cream manufacturing because it has better heat transfer properties compared to stainless steel. Therefore, the purpose of this study is to determine whether the use of PAA containing nitric acid (Reflex®), diluted to 100 ppm PAA, causes corrosion to chrome.

Methods

Two chrome plated sockets were provided for use in this study. One socket was "high grade" (better quality, slightly heavier, thicker chrome plating and more expensive) and the other was "low grade" (lower quality, lighter, thinner chrome plating and less expensive). Oil and grease may create a barrier against the PAA, protecting the chrome sockets from corrosion. Therefore, IPA was used to remove all ink, grease, dirt and oil from the surfaces of the two chrome-plated sockets. The weights of the two sockets were recorded at the start of the experiment.

Reflex® was diluted with city water to a nominal 100 ppm PAA solution. Two clean, clear, labeled sample cups each containing one of the chrome-plated sockets, were filled with approximately 100 ml PAA solution. The two sample cups, containing the chrome sockets and the PAA solution were stored at room temperature out of UV light throughout the experiment. Reflex® dilutions in 150 ppm hard water at 750-1 dilutions with water typically result in pH values of 3.0-3.2.

Visual observations of the PAA solution for corrosion of the sockets were documented at Day 0, Day 1, Day 4 and Day 7. The chrome sockets were also removed from the sample cups, weighed and microscopically observed for signs of corrosion at the same time intervals. Freshly prepared PAA solutions were made upon returning the chrome sockets to the sample cups for the duration of the experiment. Each time a freshly prepared PAA solution was made it was tested for PAA using a HACH DR/700 Colorimeter and 10 mL Total Chlorine Pillow Packs. The procedure is available from Enviro Tech on request.

Results and Discussion

Throughout the seven-day experimental period, the solutions in both sample cups containing the two sockets were visually observed for signs of corrosion. Image 1 was taken on Day 1 and it shows that there was certainly corrosion occurring but upon microscopic examination of the chrome sockets themselves, it appeared that only the inside unplated mild steel metal of both chrome sockets had been attacked. The orangebrown coloration and debris was a result from corrosion of the underlying metal, which could be an indication of mild steel or other reactive metals present. It is known that PAA and nitric acid are a corrosive agent to these types of metals. These observations can be seen in Tables 1 and 2.

IMAGE 1

Although the solution of both the low grade chrome socket and high grade chrome socket turned to an orange-brown color throughout the seven day experimental period, only the low grade chrome socket showed signs of corrosion on the chrome plating itself, after the first day and continued to worsen throughout the seven day period.. The chrome plating covering the outside of the high grade chrome socket remained intact for the first part of the experiment but by Day 7, one small corrosion spot appeared. The corrosion areas present on the chrome of both sockets were located only where there were engraved grooves exposing the underlying mild steel and subsequently allowing contact with PAA solution. Image 2 shows both the low grade and high grade chrome sockets after being exposed to the 100 ppm PAA solution for seven days. These observations can be seen in Tables 1 and 2.

IMAGE 2

The actual PAA concentration was measured at the start of the experiment and after a fresh 100 ppm solution was made on Days 1 and 4. There was 101.65 ppm PAA present in the solution at the start of the experiment. Actual PAA concentrations made at Days 1 and 4 were 93.09 ppm and 94.16 ppm, respectively.

Although there was substantial corrosion of the inside of both sockets and mild corrosion of the chrome plating, there was no loss of weight of both chrome sockets.

TABLE 1 Low Grade Chrome Socket

Time *(day)*	Weight of Socket *(g)*	Condition of Nominal 100ppm PAA Solution	Condition of Chrome Socket	Actual ppm PAA After Refreshing Solution
0	8.64	N/A- Fresh	New	101.65
1	8.64	soln- orange, brown/orange debris present	No change in chrome, exposed underlying metal corroding	93.09
4	8.64	soln- orange, brown/orange debris present	One corrosion spot on chrome, underlying metal corroding	94.16
7	8.64	soln- orange, brown/orange debris present	Corrosion on chrome worsening on chrome, exposed underlying metal	N/A

TABLE 2 High Grade Chrome Socket

Time *(day)*	Weight of Socket *(g)*	Condition of Nominal 100ppm PAA Solution	Condition of Chrome Socket	Actual ppm PAA After Refreshing Solution
0	8.64	N/A- Fresh	New	101.65
1	8.64	soln- orange, brown/orange debris present	No change in chrome, exposed underlying metal corroding	93.09
4	8.64	soln- orange, brown/orange debris present	No change in chrome, exposed underlying metal corroding	94.16
7	8.64	soln- orange, brown/orange debris present	One corrosion spot on chrome, exposed underlying metal corroding	N/A

Conclusion

- Peroxyacetic acid (PAA) is commonly used to sanitize various types of manufacturing equipment and machinery in the food industry, some of which contain chrome parts, but it is a known corrosive agent to reactive metals. The purpose of this study is to determine whether the use of PAA containing nitric acid (Reflex®), diluted to 100 ppm PAA, causes corrosion to chrome.
- Two chrome plated sockets were exposed to 100 ppm PAA containing nitric acid (Reflex®) for one week to determine the corrosivity of the solution to chrome.
- Both sockets showed interior signs of corrosion throughout the seven day experimental period. However, microscopic examination indicated that corrosion only occurred where the underlying mild steel was exposed, including engraved areas on the chrome plating where the PAA solution came into contact with that reactive metal unprotected by the chrome.
- Based on this study, Reflex® used at 100 ppm is safe to use on chrome plated equipment in the production of food products. However, any exposed underlying mild steel or "soft metals" will be vulnerable to corrosion by the PAA/nitric