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SENSIBLE SCIENCE:

Materials Compatibility Benefit Of MB-10 Tablet Solution Over Acid Activated Sodium Chlorite And 5000 Ppm Chlorine On 304 Stainless Steel

Objective: To compare the room temperature materials compatibility of type 304 stainless steel with the following 3 chemicals: 200 PPM of free chlorine dioxide from Quip MB-10TM tablets, 600 PPM of sodium chlorite solution acid activated to 2.5 pH (equivalent to OXINE, CLIDOX, EXPORE, etc.) , and a 0.525% (5250 ppm) solution of sodium hypochlorite (i.e. chlorine bleach diluted 1 part by weight bleach in 9 parts by weight water).

Discussion of Results: Details of the experimental methods are given at the end of this report. Briefly, six 304 stainless steel test coupons were weighed and measured. For each test solution, two test coupons were immersed vertically to about 30% of their height in the test solution in a capped glass jar at room temperature. The test solution was changed daily for 14 days of the test. At the conclusion of the test the coupons were rinsed with water, dried, weighed, and measured.

The four 304 stainless steel coupons that were subjected to the two chlorine dioxide solutions experienced superficial surface staining at the air-liquid interface. Otherwise, the dimensions of these coupons were unaffected. The diluted bleach solution, on the other hand, caused significant corrosion which resulted in a decrease in weight and an increase in coupon thickness (due to scale formation). Test data are presented in Table I and figure 1 below. A photo comparing the MB-10 tablet and chlorine treated samples is shown at the end of this section.

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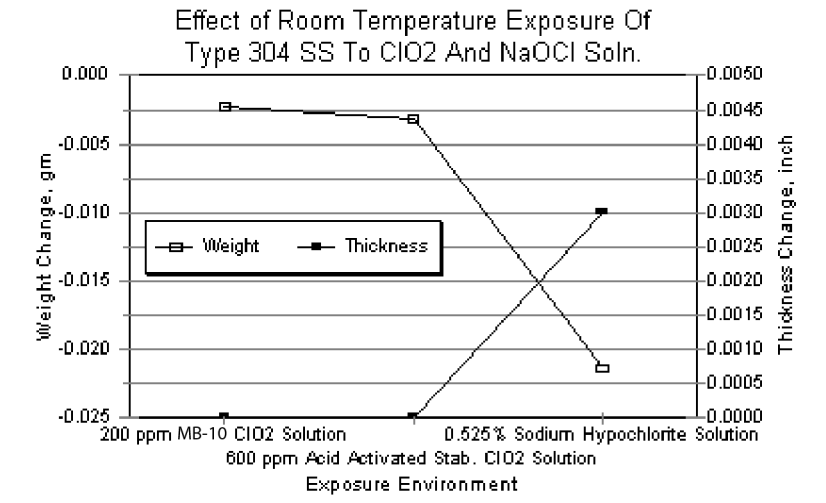
Coupon Weight Change Due to Chemical Corrosion, gm								
200 ppm MB-Tab ClO_2 Solution			600 ppm Acid Activated Stab. ClO_2 Solution			0.525% Sodium Hypochlorite Solution		
Initial	Final	Change	Initial	Final	Change	Initial	Final	Change
10.3511	10.3489	-0.0022	10.3804	10.3772	-0.0032	10.4161	10.3883	-0.0278
10.4650	10.4627	-0.0023	10.4130	10.4099	-0.0031	10.3502	10.3352	-0.0150
Average:		-0.00225			-0.00315			-0.0214

Coupon Thickness Change Due to Chemical Corrosion, inch								
200 ppm MB-Tab ClO_2 Solution			600 ppm Acid Activated Stab. ClO_2 Solution			0.525% Sodium Hypochlorite Solution		
Initial	Final	Change	Initial	Final	Change	Initial	Final	Change
0.055	0.055	0	0.0550	0.055	0	0.055	0.059	0.004
0.0550	0.055	0	0.0550	0.055	0	0.055	0.057	0.0020
Average:		0			0			0.003



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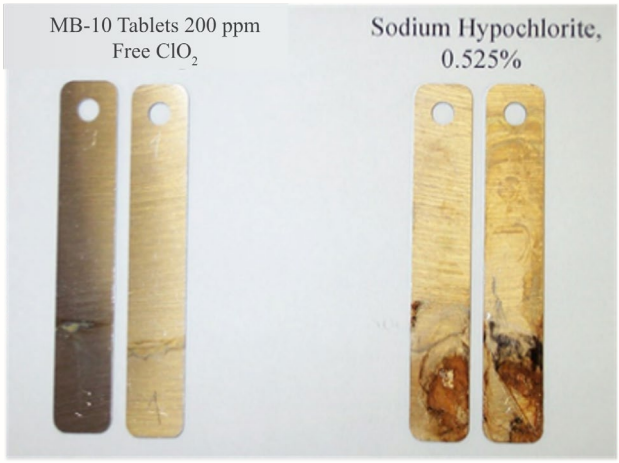

Corrosion due to acid activated sodium chlorite was more subtle, but acid activation caused a statistically significant weight loss compared to the more neutral pH of MB-10 solution. The analysis of variance table below shows that the increased weight loss caused by the acid activation was significant at the 99% confidence level [i.e., P(T<=t) two-tail=0.0061 is < 0.01].

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t-Test Two Sample Assuming Equal Variance		.
	MB-10	***Acid Act.***
Mean	-0.00225	-0.00315
Variance	5E-09	5E-09
Observations	2	2
Pooled Variance	5E-09	
Hypothesized Mean Difference	0	
df	2	
t	12.72792	
P(T<=t) two-tail	0.006116	
t Critical two-tail	4.302653	

Conclusion:

1. Sterilizing solutions of chlorine dioxide made from either Quip MB-10 tablets or acid activated sodium chlorite solution are substantially more compatible with 304 stainless steel compared to a 5250 ppm solution of sodium hypochlorite (household chlorine bleach diluted 1/9 with water). Depending upon the measure of corrosion (weight vs. dimensional change), the reduction ranges from 85%-90% (weight) to 100% (thickness, i.e. no thickness corrosion for chlorine dioxide).
2. Solution made from MB-10 tablets resulted in a slightly, but statistically significantly, lower level of weight loss than solution made by acid activating sodium chlorite solution.

Preparation of the Test Solutions and Test Procedure:

1. Prepare one liter of a 200 PPM solution of chlorine dioxide by adding two Quip MB-10 tablets to one liter of tap water. Store in a tightly capped amber glass jar in the refrigerator (at about 40oF).

2. Prepare one liter of a 600 PPM solution of acid activated sodium chlorite solution using an activation and dilution procedure supplied by Dr. Joe Kelley of IDI. One liter of 4000 PPM acid

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activated stabilized chlorine dioxide was prepared by mixing 920 cc of tap water with 80 cc of 5% Anthium AGP. This mixture was activated by adding 3.4 cc of 36% hydrochloric acid and allowing it to react for at least one hour. One liter of 600 PPM chlorine dioxide was prepared by mixing 150 cc of 4000 PPM solution with 850 cc of tap water. Store in a tightly capped amber glass jar in the refrigerator.

3. Prepare one liter of 0.525% by weight sodium hypochlorite solution by adding 100 grams of 5.25% sodium hypochlorite solution (laundry bleach) to 900 grams of tap water. Store in a tightly capped amber glass jar in the refrigerator.

4. Clean, weigh, and measure six corrosion test coupons of 304 stainless steel.

5. Place two coupons in each of three labeled standard flint glass corrosion test jars.

6. Add 30 ml of MB-10 tablet chlorine dioxide solution to one jar, 30 ml of activated stabilized chlorine dioxide test solution to a second jar, and 30 ml of diluted bleach test solution to the third jar.

7. Cap tightly and place the three jars on the bench at room temperature (70o-75oF). Record the temperature.

8. After 23-25 hours, gently remove the spent test solution from each jar and repeat steps 6 & 7 above. Do not rinse the jars or test coupons.

9. After fourteen cycles of 6-8 above, remove the test coupons from the jars, gently rinse with DI water, and clean any loosely adherent debris. Air dry, reweigh, remeasure, and photograph.