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Effects of Sodium Nitrite, Sodium Dichromate and Benzoic Acid as Inhibitors in the Protection of Mild Steel in Water

J. W. J. Silva*, E. N. Codaro and L. R. O. Hein

Campus de Guaratinguetá, Universidade Estadual Paulista, email:jwjsilva@yahoo.com.br

* Corresponding author.

Abstract – In Petrobras SA refineries there are thousands of heat exchangers in which cooling water is treated for recycling, often by outsourced companies. In all of these refineries there happen shutdown for corrective maintenance of the exchangers by problems related to corrosion caused by the cooling water, requiring about four days to repair a unit. The shutdown of a production line results in loss of revenue between U$ 200,000.00 and U$ 300,000.00 per day. To control the cooling water quality, it is used coupons for corrosion analysis. Tests are limited to visual inspection and by mass loss analysis.

The samples were subjected to corrosion tests by immersion in saline solution, saline fog and immersion in acid solution, in order to value the coupons corrosion degree. At the end of immersion there was a pH increase in Sodium Nitrite and Sodium Dichromate solutions, however there was a pH reduction in one of the Benzoic Acid solutions. In relation to benzoic acid, between the immersion and the first removal, there was an abrupt diminish in the pH value; this value has been increasing to each partial removal, being the final value bigger than the initial. As for the weight, there was an increase for the cdp immersed in Nitrite and Dichromate, but there was a reduction for the cdp immersed in Benzoic Acid.

Through atomic absorption the values of total Fe quantity were determined. Sodium dichromate, in such conditions, appeared to be the most efficient as corrosion inhibitor of the studied samples, whereas the benzoic acid, instead of acting as an inhibitor, virtually became a corrosion accelerator.

In table 1 nitrite and dichromate efficiency, as inhibitors, is displayed, since even at a temperature above 36ºC the corrosion was found to be virtually zero. That appears not to be true when the images obtained after immersion are observed; nevertheless, even the images seeming to indicate the opposite, the corrosion suffered by samples was not sufficient so that it could contaminate the mean.

Table 1 shows that, while dichromate and nitrite had a relevant role in corrosion resistance, benzoic acid, at a high temperature, acted in an opposite way, in other words, by increasing the corrosion process. This can be seen both by the images (Fig. 1 and Fig. 2) and for the atomic absorption analysis (table 1).

Table 1 – Immersion with aeration, using inhibitor as mean

Mean	W_i (g)	W_f (g)	Mass loss (g/cm^2)	Average temp/ºC	pH_i	pH_f	Total Fe ($mgFe^{2+}/L$)
Sodium Nitrite	14.635	14.642	-8.7×10^{-4}	36.44	6.73	7.65	0.0
Sodium Dichromate	13.233	13.239	-8.2×10^{-4}	36.51	3.98	4.27	0.0
Benzoic Acid	13.362	12.315	1.4×10^{-1}	36.51	8.45	8.55	174.0

Figure 1:–Optic micrograph displaying surface before immersion.

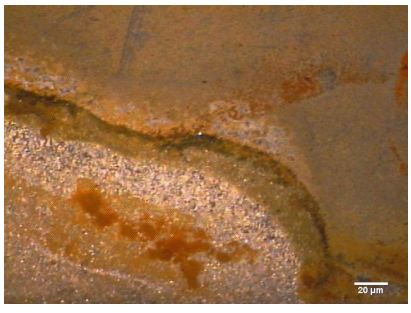

Figure 2: – Surface optic micrograph displaying corrosiong after immersion.

References

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