Covering of Bleach Washers for Material Friendly Environment

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Summary

Bleach section of a pulp mill is very corrosive. At the same time the working environment is also not healthy due to emanation of chlorine from washers. To avoid the later problem, mills are now having covered washers, which is expected to also affect corrosivity of gaseous environment near the washers. To study this aspect of process practice on material performance, corrosion tests have been performed in the gaseous phase of such bleach plant washers. The corroded coupons were analysed and the results have been correlated with process conditions. It is observed that though corrosion near chlorination washer increased, it has reduced substantially in other two washers. The practice of covering the washers is expected to provide not only a better working atmosphere but also reduced corrosion of materials including those involved in bleach plant structures.

Introduction

Corrosion is a serious problem, particularly in bleach plant of paper industry, where it costs roughly half the entire corrosion expenditure in paper industry (1,2). During last few years tests have been performed in Indian mills, which also indicate quite severe corrosion on steels in bleach plant (3-5). The aggressivity of environment is expected to increase further with increasing recycling of wash water (6-8).

The tests done so far, included mills which were having open washer in bleach plant. However, recently the trend, particularly in local mills, has been to cover these washers with hood to avoid emanation of chlorine. The purpose is to provide healthier environment to mill personnel of bleach section. This covering of washer may give rise to a different aggressive environment to materials particularly those exposed to gaseous phase e.g. shower pipe, upper part of vat, bleach plant structure etc. To investigate this aspect, corrosion tests were performed in bleach plant of a mill having covered washers. The corroded coupons have been analysed for localised and general corrosion, correlated with process parameter and the results have been compared with earlier reported results (3-5), which pertains to tests in case of uncovered washers.

Experimental Procedure

The test coupons of five commercial stainless steels have been exposed in bleach plant of a nearby paper mill. Chemical composition of these alloys analysed with optical emission spectroscopy method, are given in Table 1. For surface preparation, the test coupons of specific size (1 inch x 1.5 inch) were ground with no. 120 to 600 silicon carbide paper followed by emery papers of grade 1/0 to 4/0. Finally, coupons were polished on selvyt cloth with fine alumina powder. The surface finished specimens were then degreased by washing with acetone. The dried coupons were weighed before exposure for test.

Table -1

CHEMICAL COMPOSITION

Material	C	S	Si	P	Mn	Ni	Cr	Mo	Ti
304	0.046	0.008	0.64	0.034	0.97	8.88	17.60	0.12	-
304L	0.035	0.009	0.60	0.036	0.97	9.33	18.05	-	-
316	0.053	0.004	0.52	0.041	1.79	11.42	17.20	2.65	-
316L	0.026	0.002	0.44	0.031	1.62	13.85	17.27	2.58	-
321	0.061	0.007	0.70	0.034	1.31	9.39	17.64	-	0.34

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The bleach plant, where coupons were exposed, consists of chlorination(C), alkali extraction (E) and hypochlorination (H) stages. The mill uses mixture of eucalyptus, bamboo and pine as raw material. Test coupons were mounted on racks with each rack consisting of five specimens insulated from each other by polyvinylchloride spacers. These racks were fitted on the shower pipes of respective washers so that coupons are exposed to gaseous phase. Process parameters of vat liquor were monitored every week till the removal of test racks. Table 2 gives the value of these parameters.

Residual chlorine and chloride ions were determined by method described elsewhere (3). Duration of test was planned for six months, but due to failure of shower pipe in chlorination washer, test rack of this washer had to be removed after three months. However, in the other two stages racks continued to be exposed for six months. After exposure, the coupons were cleaned and weighed for corrosion rate determination, which was done by the weight-loss method (9). These cleaned coupons were analysed for localised corrosion also.

Table -2

PROCESS PARAMETERS

Bleaching stage	pH	Temperature °C	Residual Cl_2 (ppm)	Cl (ppm)
C	1.97	38	17	2163
E	8.24	49	-	1944
H	7.60	41	116	2539

Results

Corrosion rate for the different specimens in different washers are given in Table 3. In case of the coupons exposed in C-washer, the corrosion rate for all the steels is highest and the values are higher than that recommended for a suitable material of construction for a given environment. For coupons exposed in E-and H-washers, the rates are low enough to categories the tested steels as acceptable on the basis of uniform corrosion criterion.

The assessment of pitting and crevice corrosion, determined on the basis of localised corrosion analysis, are illustrated in Table 4 and 5 respectively for different steels.

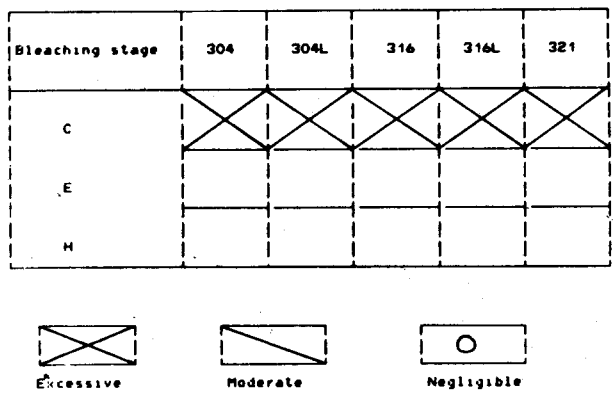
Table -3

CORROSION RATE (IN MPY)

Bleaching Stage	304	304L	316	316L	321
C	14.06	17.43	19.16	18.83	16.06
E	0.005	0.005	0.001	0.002	0.005
H	0.02	0.004	0.004	0.002	0.006

Three categories have been considered for the degree of attack namely negligible, moderate and excessive. All the tested steels experience excessive pitting and crevice corrosion in C-washer. It may be noted here that coupons in this washer were exposed for only three months. Though exposure duration of the coupons in E-and H-washers was six months, yet no significant pitting was observed on these coupons, whereas, barring 304, steels did not show any noticeable crevice corrosion too. Even 304 was only negligibly affected.

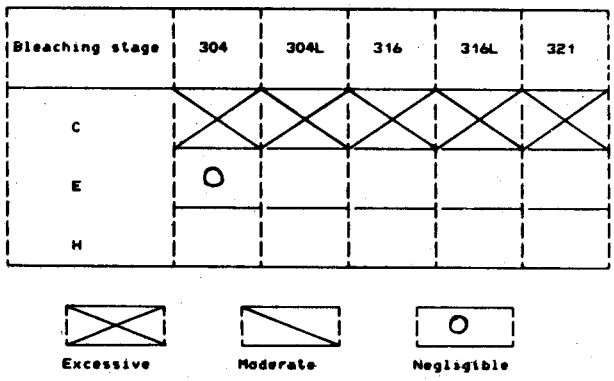
Table 4 Degree of pitting



Discussion

It is evident from the results on uniform corrosion and

Table 5 Degree of Crevice Corrosion



pitting and crevice corrosion (Tables 3-5) that the gaseous phase of C- washer is highly corrosive as compared to those of E - and H - washers. The finding is in accordance with the earlier reported results (1-5). It has been attributed the presence of chlorine (Cl_2) in the gaseous phase of chlorination washer which is emanated from the residual chlorine of chlorinated pulp. Chlorine condenses in the form of aqueous media having very low pH (≤ 2) and chloride ions. Such a solution is extremely corrosive in nature (4). This type of condition is not feasible in E- and H - washers (refer to process conditions in these washers) hence negligible or no noticeable corrosion is observed on coupons exposed in these washers.

Comparison of the present results with those obtained in the tests conducted in open washers (4), one observes some significant differences. The process parameters of present mill are similar to one of the mills (mill B in ref.4) showing higher degree of corrosion. Corrosion rates of steels, in C- washers of present tests, are slightly less than those observed in mill B (of ref.4) and higher than those observed in mill A (of ref.4). Whereas corrosion rates observed in E - and H - washers of present tests are 10 to 100 times lower than those observed in respective washers, but open, of mills A and B (see Table 3 and compare with Table 2 and 3 of ref. 4). Pitting and crevice corrosion experienced by steel coupons in present tests is excessive in C- washer (Tables 4 and 5). The extent of attack is same as that observed on similar steel coupons in mill B and more than that observed in mill A (ref. 4). However, practically nil pitting or crevice corrosion is observed on coupons exposed in E - and H - washers of present tests, which are covered. This observation is completely different from the results of localised attack in similar washers of mills A and B where coupons of same steels experience excessive to moderate to negligible localised corrosion.

Thus although the process conditions in the closed washers are either more or equally corrosive to those of open washers involved in the earlier tests, the coupons experience practically no uniform or localised corrosion when exposed to gaseous phase of former type of washers of E - and H - stages. Whereas in open washers, of similar stages, coupons experience both uniform and localised corrosion to greater extent. On the other hand, in C - washers of either open or closed type, the degree of attack is in accordance with the process parameters. It appears that corrosion in gaseous phase or those of open structures/ equipment, to a large extent, is governed by the presence of chlorine gas emanated from chlorinated pulp. This gas also travels from C-washers to surrounding area and hence corrode the coupons exposed in E-and H-washer's gaseous phase as well as other open structures. However, this spreading and hence the corrosive effect of chlorine gas is avoided if the washers are covered. There is then practically no chance of chlorine escaping from C-washer and it at all a little of this gas escapes it does not interact with material of construction of other washer since they are also covered.

From the results of the present tests, one thus observes that machinery part of weashers which are exposed to gaseous phase of E-and H-washers can be fabricated even of stainless steel 304L, if the washers are covered. Becasue of covering, the structure of bleach plant will also not be affected much as there will be non-significant amount of chlorine in atmosphere. Thus in addition to providing a healthier working environment to mill personnel, the covering of washers will also provide a better material friendly environment.

Conclusion

It is concluded from present study that covering of washers by hood, a practice suggested for providing less polluting environment in bleach plant, also protects the material of construction of E-andH-washers. Hence such machinery parts as are likely to be exposed to the gaseous phases of these washers can be fabricated of 304L. In addition the same practice will also reduce, to a significant extent, the corrosion of structures of bleach plant in paper mills.

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