A
Metallic materials

A 1 Silver and silver alloys

Even in the presence of oxygen only trace amounts of silver are dissolved in aqueous carbon dioxide solutions (carbonated water). The behavior of silver-rich silver solders is similar. Only little has been reported in the literature about the corrosion rates of silver in carbonated water. One of these publications refers to a very low corrosion of 0 to 0.08 mm/a (0 to 3.15 mpy) [43].

A 2 Aluminium

Due to their passivated layer aluminium materials have a good corrosion resistance in almost neutral or low-chloride aqueous media. As can be seen in Figure 8, the passivated area of aluminium ranges from about pH 4 to pH 8.5 [44].

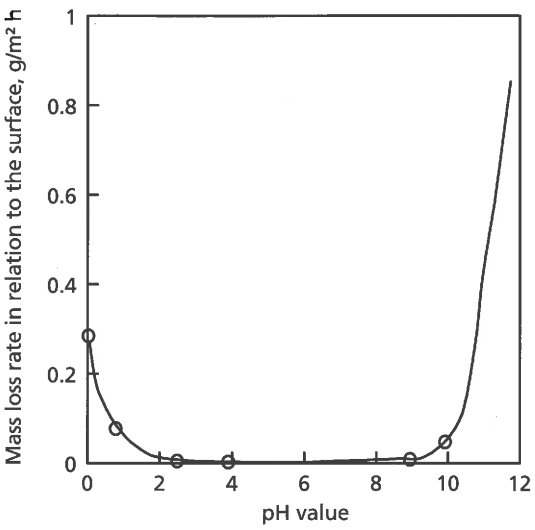

Figure 8: Influence of the pH value to the corrosion resistance of aluminium [44]

Since pH values below 4 in CO_2 containing waters can be reached only at high partial CO_2 pressures, a sufficient resistance of aluminium materials can be expected under normal conditions in such waters.

The studies described in [45] investigated the influence of carbon dioxide on the behavior of pure aluminium Al99,5 in a 3.5% sodium chloride solution, involving a pitting corrosion risk for aluminium as in all chloride ion-containing solutions. The test solutions were either flushed with high-purity carbon dioxide, nitrogen, a mixture of nitrogen with 1% CO_2 or with air, partially contained sodium hydrogen carbonate as a buffering substance. Solutions flushed with pure nitrogen were adjusted to various pH values by adding low amounts of hydrochloric acid or NaOH solution. The tests were performed at 303 and 353 K (30°C and 80°C). After an exposure duration of one month, the material consumption as well as the number and the depth of the pitting corrosion sites were determined.

Table 7 contains the test conditions and the results obtained at a test temperature of 303 K (30°C). The results for a test temperature of 353 K (80°C) are indicated in Table 8.

The results obtained at a test temperature of 303 K (30°C) show that, although the ratio of both components CO_2 or $(HCO_3)^-$ and their buffer capacity exert an influence on the pH value of the solution, a significant effect on the corrosion rates or pitting corrosion of aluminium cannot be found. At rising temperatures both the corrosion rates and the sensitivity to pitting corrosion clearly increase and also the influence of the pH value becomes more apparent.

Gas phase	*$(HCO_3)^-$ ppm*	*pH*	*Corrosion rate µm/a*	*Number of pit holes per 40 cm²*	*Depth of the pit holes µm*
100% CO_2	0	4.5	3.4 ± 0.3	0	
	5	4.6	5.8 ± 0.5	0	
	300	5.4	0.5 ± 0.3	0	
Nitrogen with 1% CO_2	0	5.9	1.3 ± 0.3	0	
	5	6.1	0.8 ± 0.1	0	
	300	7.4	1.4 ± 0.2	0	
Nitrogen with 330 ppm CO_2	0	6.3	0.8 ± 0.1	2	80
	5	6.4	1.1 ± 0.1	0	
	300	8.5	3.6 ± 0.3	0	
Air	0	6.3	7 ± 1	5	160
	5	6.4	2 ± 1	1	140
	300	8.5	67 ± 4	3	120

Table 7: Results of the test of pure aluminium (Al99,5) exposed to 3% NaCl solution at 303 K (30°C), test duration: 30 days [45]