

CopperCEEF S.a.r.l.

3, rue du 8 mai 1945
F-60590 Sérifontaine

The electrochemical behaviour of brass alloy in NaCl solution

1. Potential measurements

	E (mV) vs. SCE
Al	-640 ± 5
CuZn42 (CW 510L)	-292 ± 21
CuZn28As (CW 511L)	-260 ± 12
CuZn21Si (CW 714R)	-243 ± 15
CuZn39Pb3 (CW 614N)	-237 ± 7

Table 1: Potentials of aluminum and four uncoupled brass alloy in a 3.5% NaCl solution at $T=18 \pm 1$ °C, measured versus a saturated calomel electrode (SCE)

Table 1 shows that the potential of aluminum is the most negative one in comparison to CuZn42 (CW510L), CuZn38As (CW511L), CuZn21Si (CW724R) and CuZn39Pb3 (CW614N). It easily forms galvanic coupling corrosion with these alloys.

The order of potentials in NaCl solution has been found to be:



2. Galvanic current measurements

Measurement of galvanic currents between galvanic coupled metals is based on the zero resistance ammeter technique.

2.1. Testing conditions

- Specimens have the same anodic and cathodic surface area with a diameter of 9 mm.
- Test duration: 24H

Prior to the electrochemical measurements, the samples were sequentially ground with silicon carbide emery paper up to 2000 grit, then rinsed with de-ionized water and dried by cool air.

2.2. Result

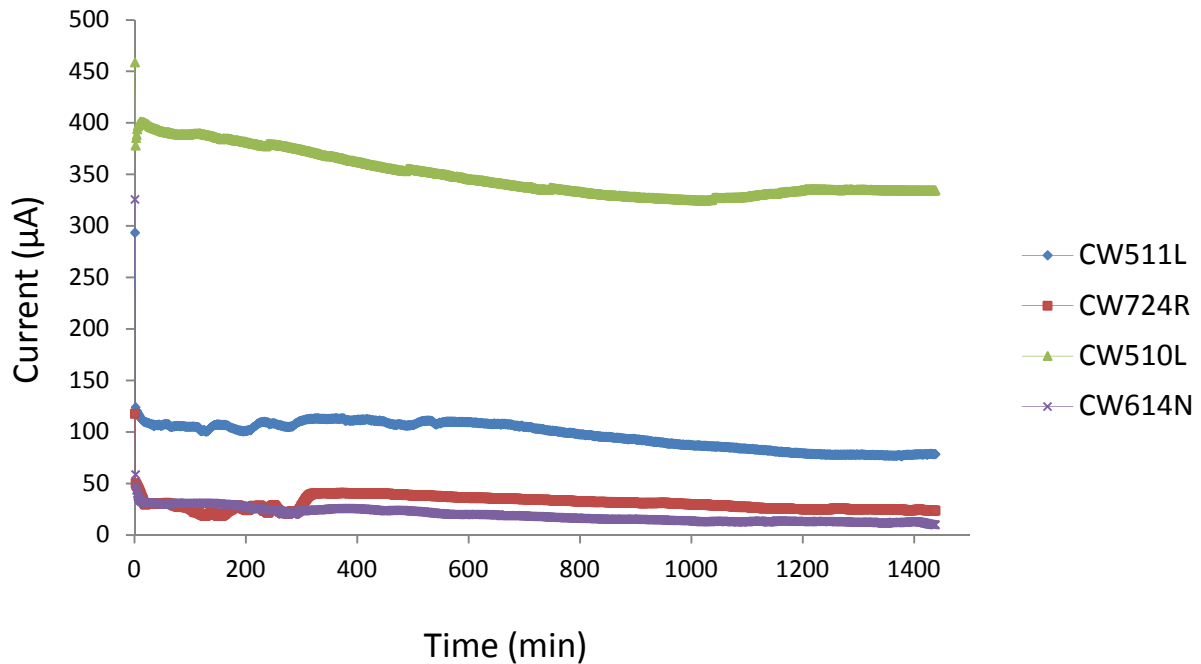


Figure 1: Galvanic current I for Aluminum coupled to brass alloys in 3.5 % NaCl

Figure 1 shows that the galvanic current is much higher when aluminum is coupled to unleaded CuZn42 brass (CW510L) than when it is coupled to CuZn38As (CW511L), CuZn21Si (CW724R) and CuZn39Pb3 (CW614N).

The galvanic current created by coupling aluminum and brass alloy decreases as follows:

CuZn42 (CW510L) > CuZn38As (CW511L) > CuZn21Si (CW724R) ≥ CuZn39Pb3 (CW614N).

Thus aluminum is more attacked when in contact with CuZn42 (CW510L), CuZn21Si (CW724R) than with CuZn39Pb3 (CW614N).

3. Polarization measurements

A conventional three-electrode cell arrangement was used for the electrochemical measurements, with a saturated calomel electrode (SCE) as the reference electrode and a platinum plate as the counter electrode. Electrochemical measurements were carried out with the potentiostat, model PGP 201, Radiometer Copenhagen.

Polarization measurements were carried out in a 0.1 M NaCl solution by scanning the potential from -0.85 V to +0.0 V vs. the SCE with a rate of 500 mV/min.

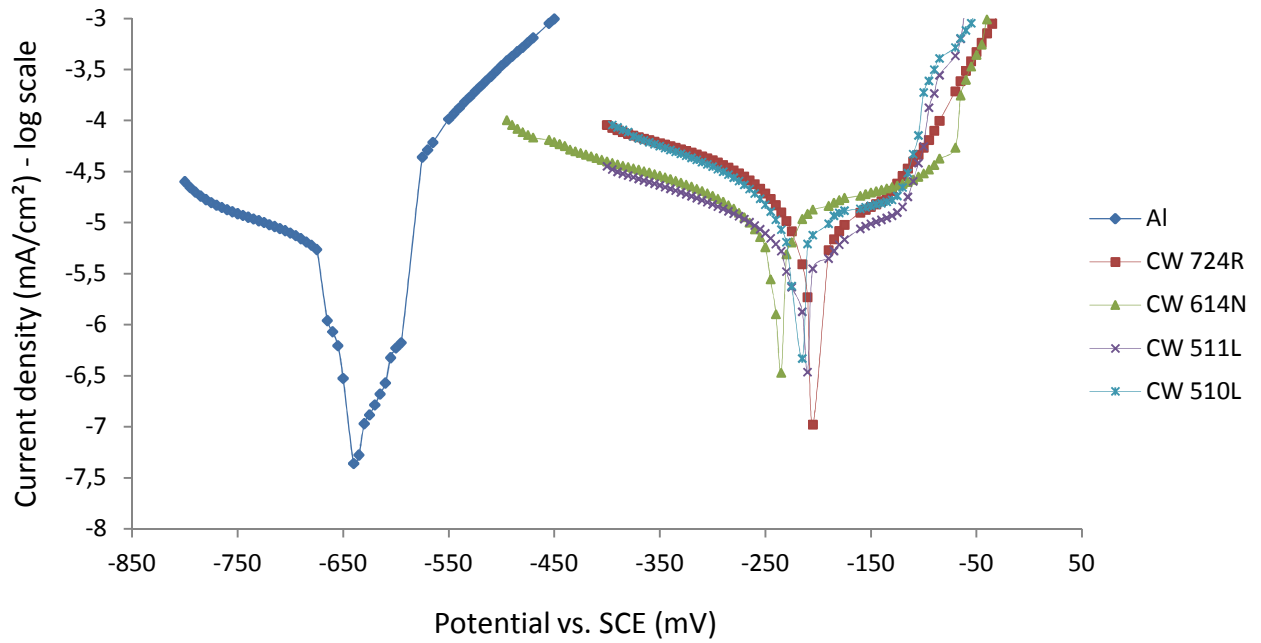


Figure 2: Polarization curves of aluminum and brass alloys in 0.1 M NaCl solution, scan rate 500 mV/min.

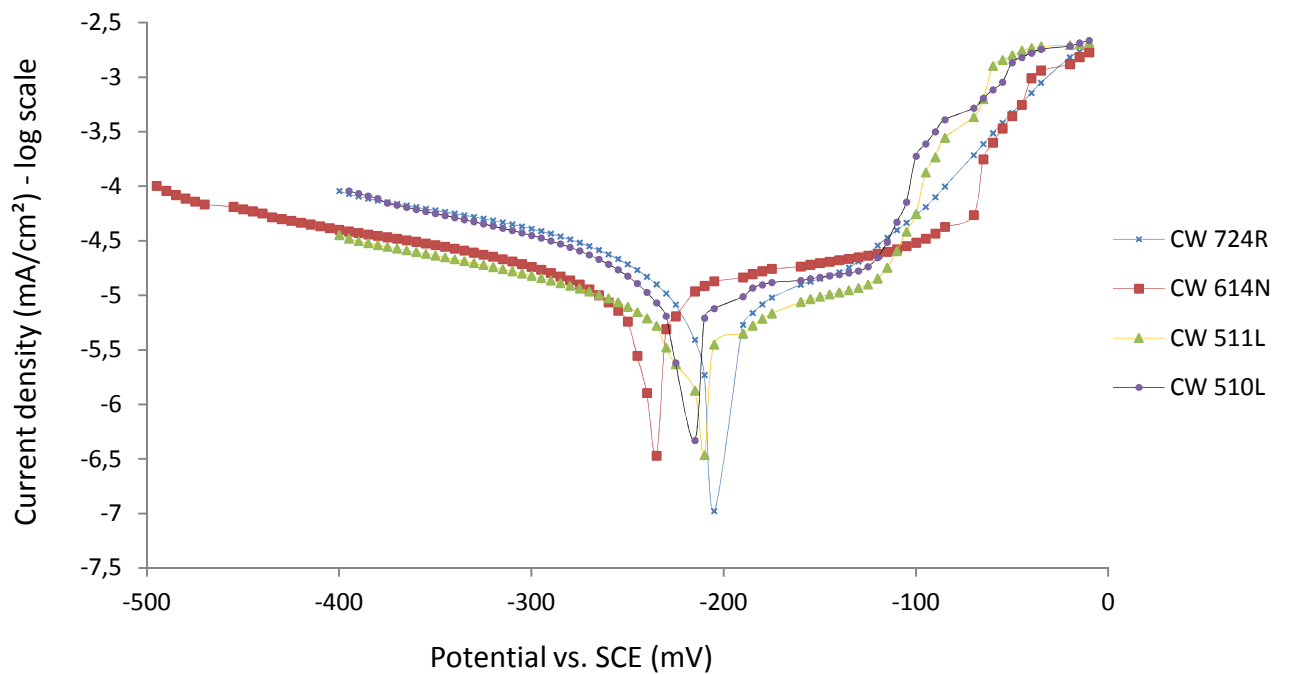
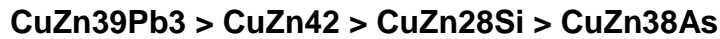


Figure 3: Polarization curves of brass alloys in 0.1 M NaCl solution, scan rate 500 mV/min.

In the anodic part of the polarization curves one observes the following features:

- The current density of the brass alloys increases slightly as the potential of the alloys grows from -200 to -100 mV / SCE. It may correspond to the dezincification or/and passivation of the alloys

The corrosion current density of brass alloy is in the following order:



Although the current density of CuZn39Pb3 (CW 614N) is slightly higher in this potential range than the ones of the other alloys, it is almost stable over a larger domain (see Figure 3).

- At higher potential (higher than -100 mV / SCE), the dissolution rate (current density) increases more rapidly. The corrosion rate increases in the following order:



The corrosion or “mixed” potentials E_{corr} of the four brass alloys are very close.

	E_{corr} (mV) vs. SCE
Al	-640
CuZn39Pb3 (CW 614N)	-267
CuZn28As (CW 511L)	-233
CuZn42 (CW 510L)	-225
CuZn21Si (CW 714R)	-223

Table 2: Potentials of aluminum and four uncoupled brass alloys in a 3.5% NaCl solution at $T = 18 \pm 1^\circ\text{C}$

4. Conclusions

- CuZn42 alloy is less resistant in the environment of 0.1 M NaCl. It causes a higher galvanic current when it is in contact with aluminum.
- CuZn39Pb3 alloy has a broader potential range of 160 mV where the corrosion current density increases only slightly.
- The alloy CuZn28As (CW 511L) resists best in an environment of 0.1 M NaCl where the potential is not high (-200 mV to -100 mV).
- For high potential (> -100 mV / ECS), it appears that the alloy CuZn21Si (CW 714R) would be more resistant.