9. Dealloying and Dezincification

Dealloying occurs when one or more components of an alloy are more susceptible to corrosion than the rest and as a result, are preferentially dissolved.

- Dezincification
: the selective removal of Zn from brass.
- Graphitic corrosion
: the selective leaching of iron or steel leaving the graphite network in cast iron. The graphite is cathodic to iron and an excellent galvanic cell exists.

TABLE 9.4 Environments Causing Dealloying for Various Alloys

Alloy	Environment	Element Removed
Brasses	Many waters, especially under stagnant conditions	Zinc (dezincification)
Gray Cast Iron	Soils, many waters	Iron (graphitic corrosion)
Aluminum Bronzes	Hydrofluoric acid, acid chloride solutions	Aluminum (dealuminification)
Silicon Bronzes	High-temperature steam, acidic species	Silicon (desiliconification)
Tin Bronzes	Hot brine or steam	Tin (destannification)
Copper-Nickels	High heat flux and low water velocity (in refinery condenser tubes)	Nickel (denickelification)
Monels (Ni-Cu)	Hydrofluoric and other acids	Copper in some acids, nickel in others
Gold Alloys	Sulfide solutions, human saliva	Copper, Silver
High-Nickel Alloys	Molten salts	Chromium, Iron, Molybdenum, Tungsten
Medium, High-Carbon Steels	Oxidizing atmospheres, hydrogen at high temperatures	Carbon (decarburization)
Iron-Chromium Alloys	High-temperature oxidizing atmospheres	Chromium which forms a protective film
Nickel-Molybdenum Alloys	Oxygen at high temperature	Molybdenum

Compiled from Polan.[45]

9.1 Dezincification

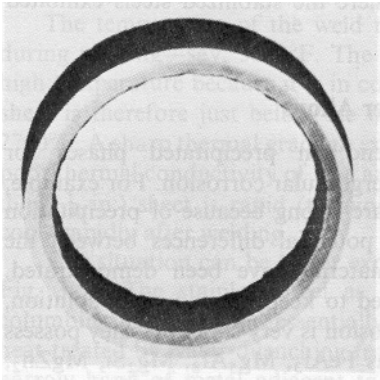
Dezincification occurs in brasses containing more than 15% zinc.
o. Uniform (layer type) dezincification : favor the high brasses(high zinc content) and acid environments.
o. Localized(plug type) dezincification : favor the low brasses and neutral, alkaline solutions.

9.2 Dezincification Mechanism

1) Zn selectively dissolves, leaving behind a porous, weak copper structure.
2) Both zinc and copper dissolve and the more noble copper then redeposits as a porous layer

9.3 Prevention

1) Remove the aggressiveness of the environment (ex. Oxygen removal)
2) Apply cathodic protection.
3) Alloy design : Addition of 1% Sn to 70-30 brass → Cu-28Zn-1Sn. Add small amount of As, P, and Sb as inhibitors to brass for further improvement in corrosion resistance. →Cu-29Zn-1Sn-0.04As : These inhibiting elements are redeposited on the alloy as a film thereby hinder deposition of copper.



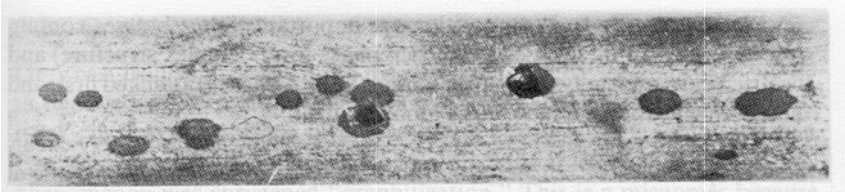


Figure 3-36 Plug-type dezincification.