Dezincification (selective corrosion)

It is a form of corrosion in which Zinc is selectively attacked in zinc containing alloys, like brass. De-alloying and selective leaching are broader terms which refers to the corrosion of one or more constituent of a solid solution alloy.

Dezincification is a form of de-alloying as phenomenon was first absorbed in brass in which zinc separated by dissolution from copper and can be observed by naked eyes because the alloy changes in color from yellow to red, the term dezincification was still used. It is generally takes place in water under stagnant conditions.

Two types of dezincification are commonly absorbed:

1. Uniform, the active area is leached out over, a broad are of surface and it is not localized to certain point of surface (see the below) for example dezincification occurs in tooth of gear wheel.

2. Plug type, attack is localized at a certain point on surface. It is found particularly in α–brass heat exchanger pipes.

Mechanism

There is a disagreement between workers on the mechanism of dezincification, the first group suggest that the entire alloy is dissolved and later one of its constituent is re-plated from solution, copper is deposited as a fine copper dust which zinc is leached out of brass leaving behind a highly porous mass (zinc has a high tendency to dissolution while copper has a high tendency to plate $E^\circ_{\text{Zinc}} = -0.76 \text{ volt}, E^\circ_{\text{Copper}} = 0.33 \text{ volt}$)

Dezincification cause only a slight change in appearance and does not affect the dimensions.
The other group believe that one species is dissolved selectively from alloy and a porous residue of more noble is left.

On the basis of the information generated by electrochemical methods, pH-potential diagrams have been constructed.
From these diagrams, the domains of selective leaching of zinc, and domains of dissolution of both zinc and copper can be observed. The regions where copper deposition takes place are also shown in the figure. From the diagram it is observed that at potentials between 0.000 and +0.200 V_{SHE}, both zinc and copper dissolve, but in stagnant conditions copper may deposit on the specimen without any evidence of selective leaching. Above +0.200 V_{SHE}, both alloys dissolve but there is no re-deposition of copper. If the potential is held above +0.200 V_{SHE} for a long period of time and then lowered below +0.200 V_{SHE}, deposition of copper would take place.

In spite of the development and evolution of new techniques, such as microprobe analysis and advances in the electrochemical methods, it is not clearly known which mechanism is operative. It, however, appears on the basis of the literature published that both mechanisms may operate, i.e. selective leaching or dissolution of both components and re-plating of one of the component, or selective dissolution of one species only leaving a porous residue of the more noble species.

De-alloying
Dezincification is a special case of de-alloying, the phenomenon of de-alloying by selective leaching can occur in various materials. Selective leaching of some important materials is summarized below:

a) Graphitic corrosion: gray cast iron show the effect of selective leaching out of iron in mild corrosive environments. The surface layer of the iron becomes like graphite and it can be easily cut with a knife. Iron is dissolved and an interlocking nobler graphite network is left. Iron is dissolved and a porous mass of voids and complex iron oxides is left behind. This graphitized cast iron loses its strength and other metallic properties, but unchanged in shape and this lead to dangerous situations.

b) De-aluminification: Copper alloys containing more than 8% Al may be subjected to the preferential dissolution of aluminum component of the alloy. The α-phase of aluminum – bronze is attacked and residue of copper is left behind.

c) De-nickelification: Although, not common the de-alloying of nickel in 70-30 Cu-Ni alloy has been observed under low flow conditions.

Prevention
1- Use copper alloys with copper content above 85%.
2- Use brass alloys with tin, arsenic or antimony addition.
3- Avoid environment where the solution becomes stagnant and deposits accumulate on the metal surface.