Corrosion-resistant brass for harsh environments

The so-called dezincification resistant (DZR or DR) brasses are used where there is a large corrosion risk and where normal brasses do not meet the standards. Applications with high water temperatures, chlorides present or deviating water qualities (soft water) play a role. DZR-brass is excellent in water boiler systems. This brass alloy must be produced with great care, with special attention placed on a balanced composition and proper production temperatures and parameters to avoid long-term failures

DZR BRASS

Dezincification of brass is a critical aspect of the fitness for purpose (quality) of plumbers fitting that is
in contact with water. The risk and rate of dezincification increases with water hardness and the
acidity or alkalinity of water away from a PH of 7.
Dezincification is the name given to the corrosion of brass. Dezincification resistant brass, or DZR brass, (something designed CR or DR) is the name given to brass that has exceptional resistance to this corrosion. The resistance is imparted by the adherence to SABS specifications for chemical composition and careful process controls.
In order to be called DZR brass each batch must pass an ISO 6509

dezincification resistance laboratory test.

Dezincification

Dezincification of brass is an example of 'de-alloying' in which one of the constituents of an alloy is
preferentially removed by corrosion. In the case of brass this constituent is zinc, hence the name
dezincification.
Copper and zinc are not found as separate constituents in brass, the two elements go into solid
solution, that is, they completely mix together at every atomic level. However, as part of the
solidification process of an alloy of copper and zinc at around the 60% 40% mixture, areas of the
body of brass become slightly higher in copper concentration, this is called an 'alpha phase'.
Other areas become slightly higher in zinc concentration, these areas are called 'beta phase'. See
attached a thermal equilibrium diagram showing the alpha and beta phase distribution in relationship
to regard to copper/zinc/temperature co-ordinates.
The process by which dezincification occurs is that instead of the zinc being selectively leached out in
corrosive conditions, the whole body of the brass passes into solution. The difference in electrical
potential between alpha and beta phases in the brass bring about a galvanic action which

electroplates only the lost copper ions back into the brass fitting at the site of the corrosion attack.
Due to this electroplating of the copper ions dezincified brass will retain the original shape and dimensions of the metal component before corrosion but the copper residue is porous and has very little strength. If the dezincified brass fitting is a tap, the tap will fail and water will leak to the extent of the failure.
Dezincification was first recognized as a serious problem in brass tubes used in ships condensers before about 1920. It was stated that "condenseritis" i.e. dezincification of condenser tubes had more effect than the German navy in putting HM ships out of action in the first world war. Research on the problem by G D Bengough and R May established incorporating dezincification-inhibiting elements could prevent that dezincification. This work resulted in the formulation of dezincification resistant Admiralty brasses, which in turn have been written into British Standards and are used by Cobra in all brass components that are in contact with water.
Dezincification of brass plumber's fittings in some districts was first recognized in England in the late 1950's and in South Africa in the 1960's. The recognition in South Africa was brought about by the fact that the dead of night water flow into the major residential areas of Johannesburg was some 70% of the peak usage flow. This was later found to have been caused by leakage of underground water pipes due to the failure of dezincified brass fittings.
This was a type of dezincification now called 'meringue dezincification', in which the zinc passing into solution from the brass forms very bulky hollow mounds of corrosion product, which block the fitting. It

attacks the beta phase preferentially but will eventually spread.

Recognition

Dezincification may show itself as dull red spots developing on the surface of brass after periods of exposure to urban or industrial atmospheres. These do not usually represent any significant loss of strength in the component concerned but since they are more than simply superficial they cannot be removed by the cleaning and polishing procedures that would normally the brass to its original appearance.
Dezincification in water fittings, taps and valves etc. can show itself in a variety of ways depending on the water composition and service conditions. Water may be seen seeping through the walls of fittings with an accompanying whitish deposit of zinc and lime scale on and around the leak site. In exposed

fittings this would probably be the time when the corrosion and resultant water leak is noticed and attended to. On under wall or underground fittings dezincification takes on worse proportions as the dezincification could be occurring from both inside and outside of the fitting. The first small loss of water will probably be noticed until the time that flooding occurs due to gross breakage.

Conditions for dezincification

There are a number of factors that will predispose brass to dezincify.

- Water hardness and the acidity or alkalinity of water away from a PH of 7.
- Temperature. The higher the temperature the greater the risk
- Water flow. Less flow equals greater risk
- Polluted atmosphere
- Large brass grain size
- Sea or brackish water
- Corrosive soils such as acid peat, salt marsh, waterlogged clay, or ‘made up’ ground