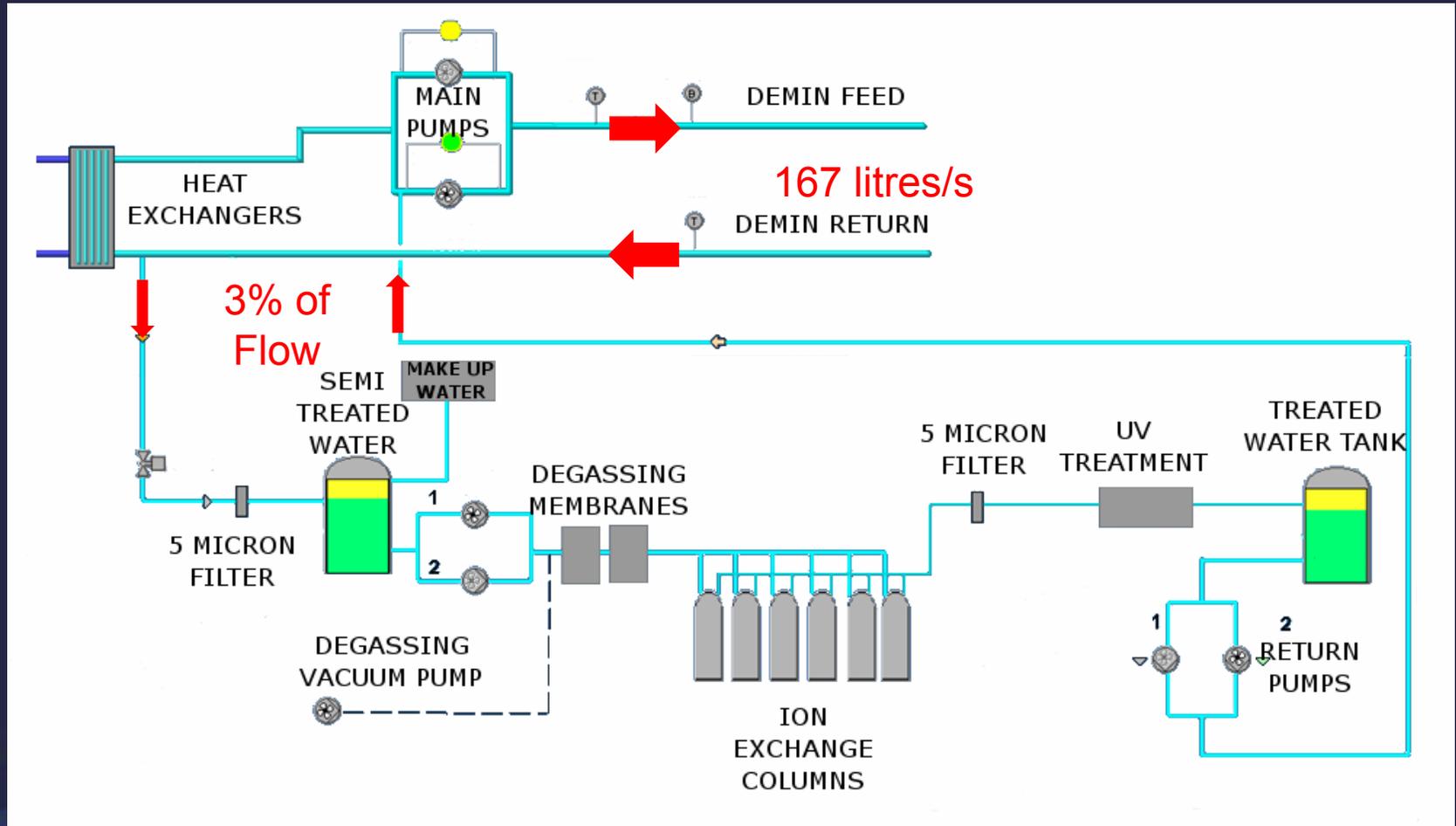


Cooling Water Chemistry, Corrosion Products and their effect on Accelerator Operation at the Diamond Light Source

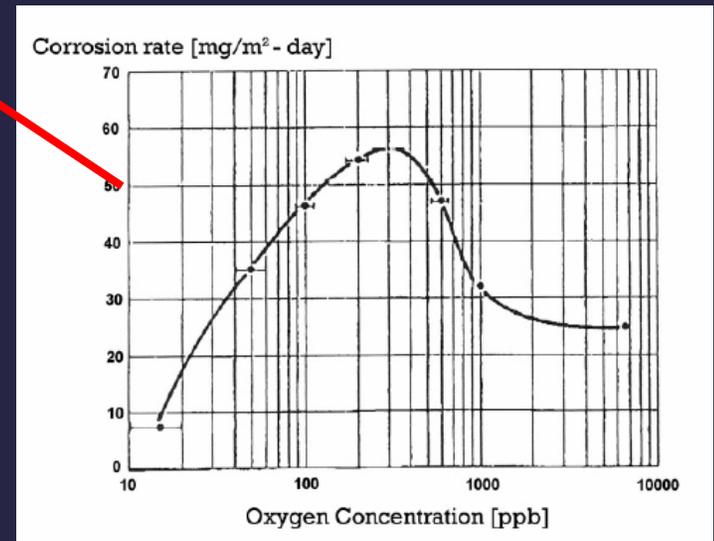
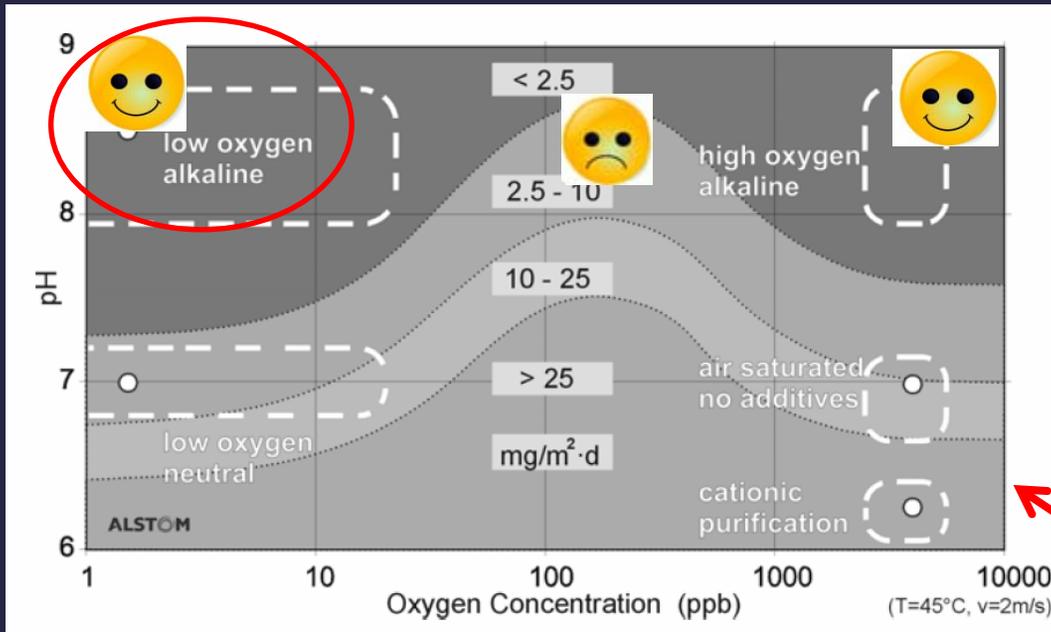
By Nigel Hammond



Water Treatment Plant Schematic



Operating Regions for Demineralised Water used to Cool Copper Components



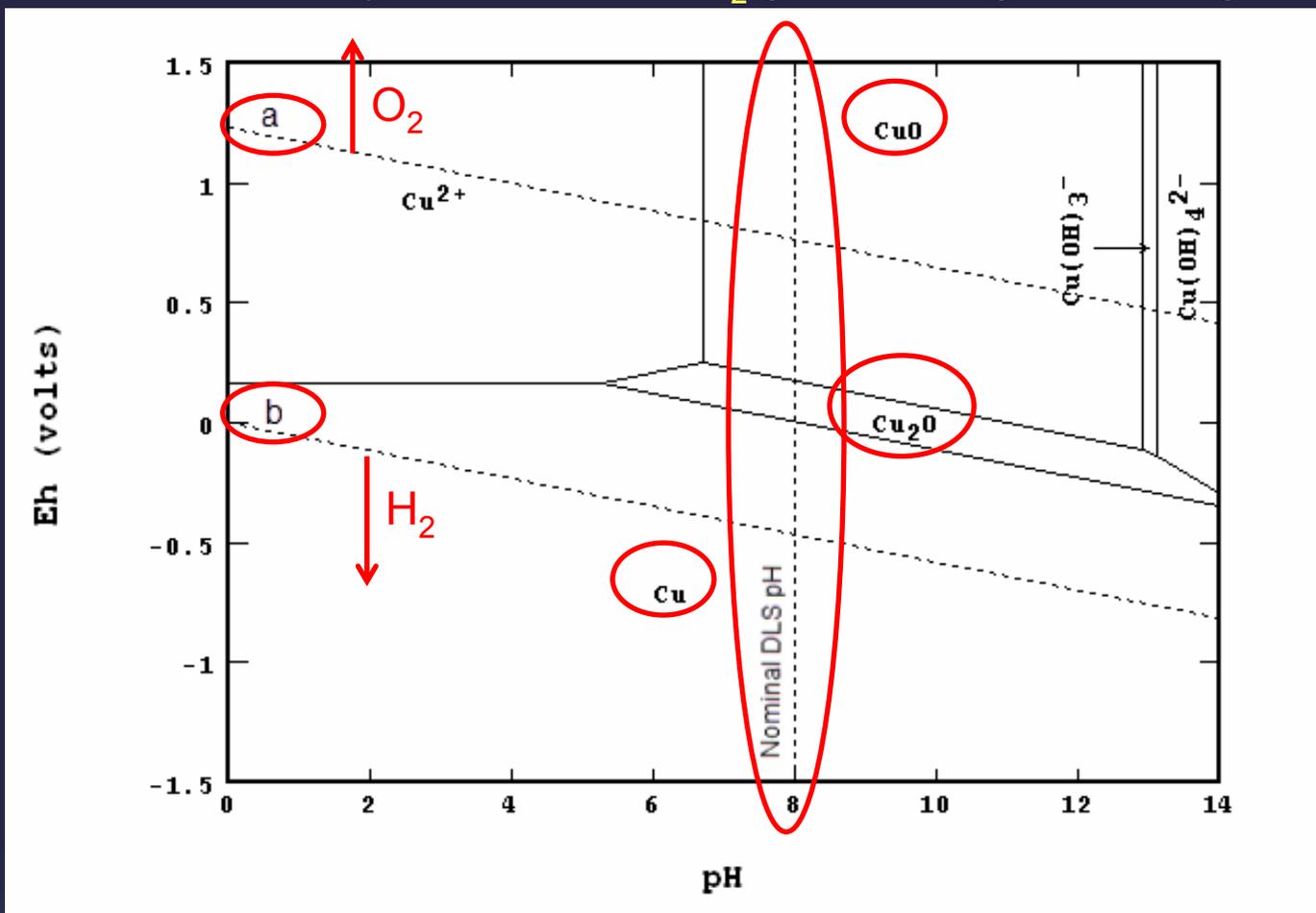
Pourbaix Diagram for Copper in an Aqueous Solution

Increases in conductivity could result in O_2 gas evolving in the magnets

Sextupole and
Quadrupole Magnets
operate at +12V to
+14V

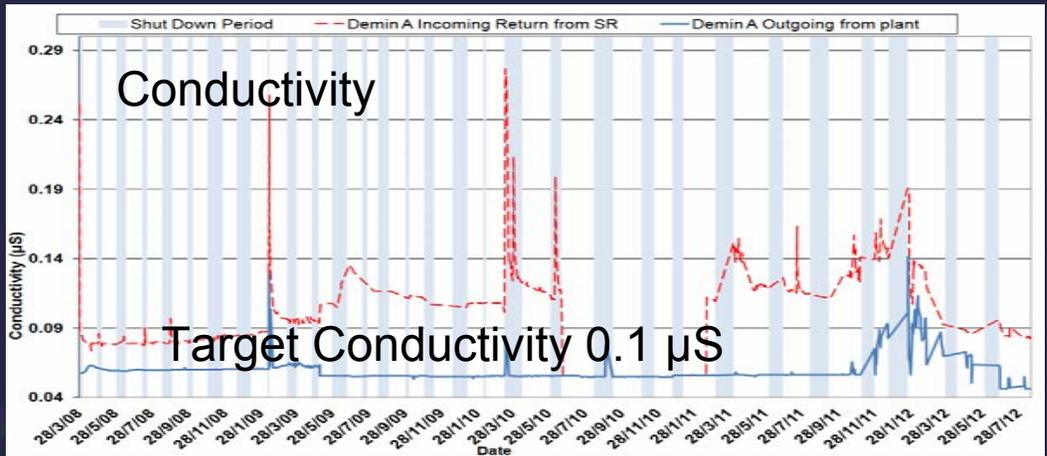
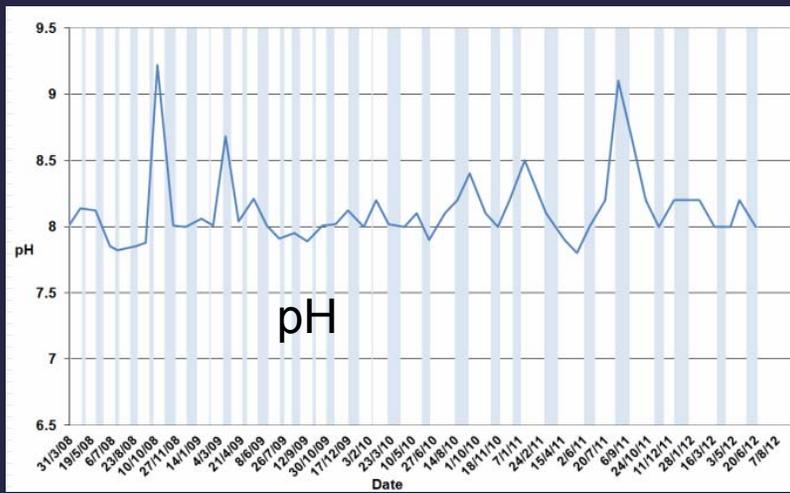
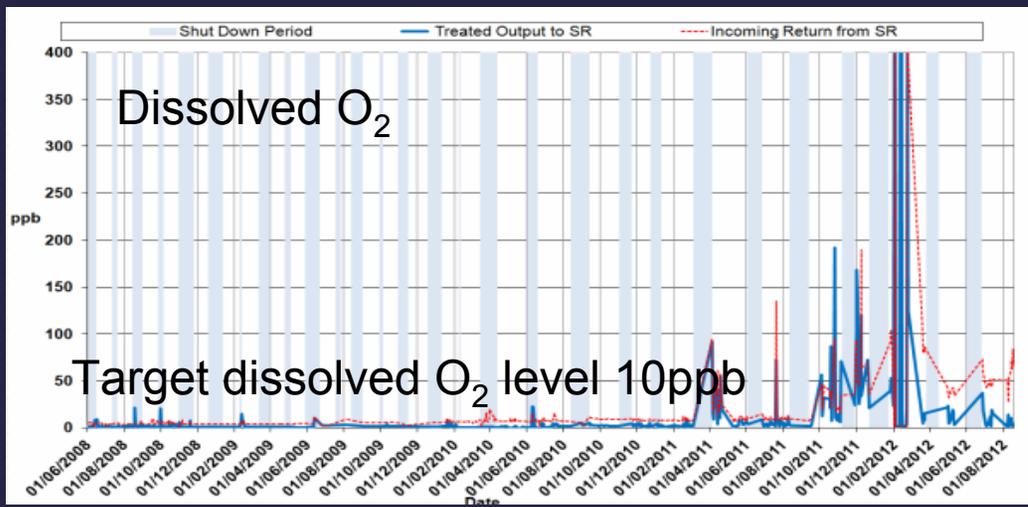
Dipole Magnets
operate at +200V to
-200V around the
storage ring

Absorbers and
pipework at 0V



Modify polarity of cooled magnets to
ensure -ve potential?

Dissolved Oxygen and Conductivity Variation over time



O₂ and CO₂ take up during installation periods?

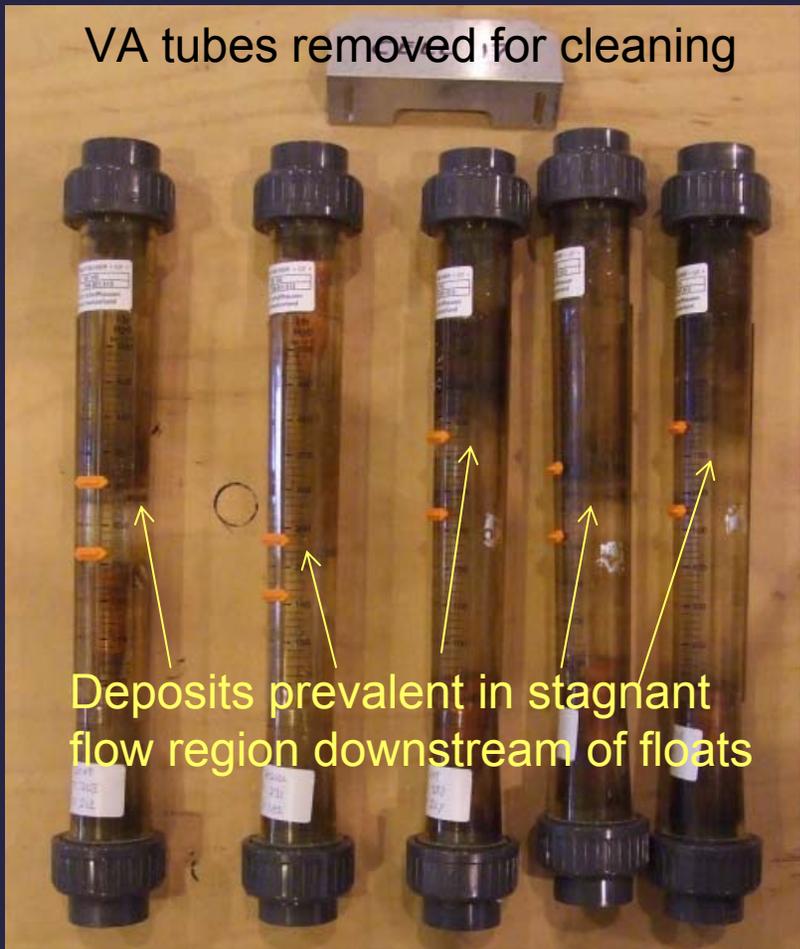


Deposits Visible in Variable Area Flow Meters

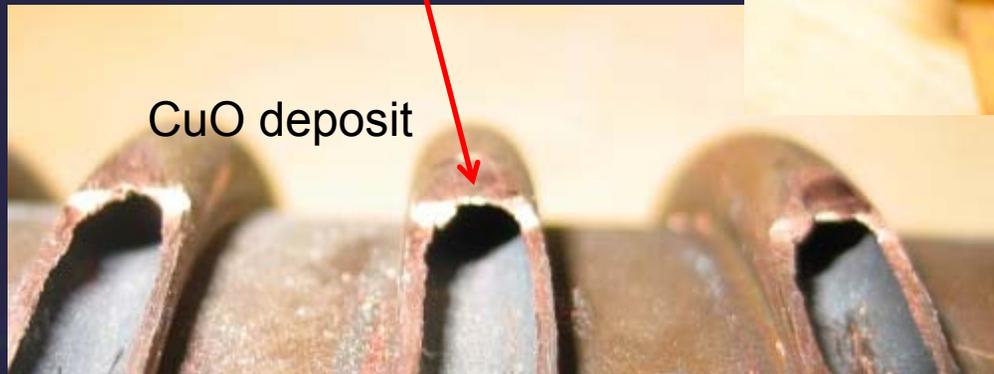
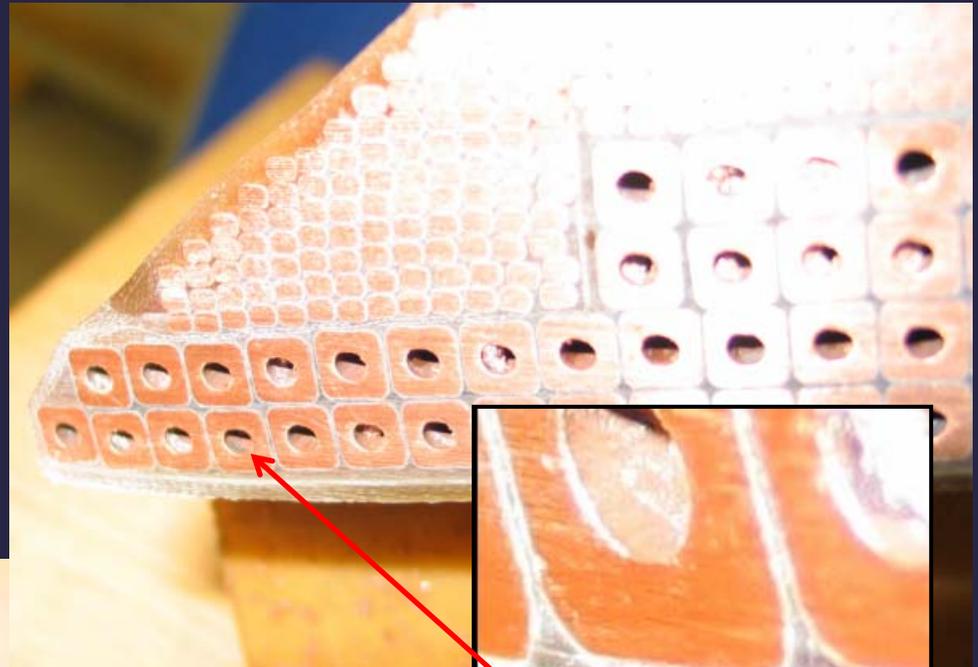
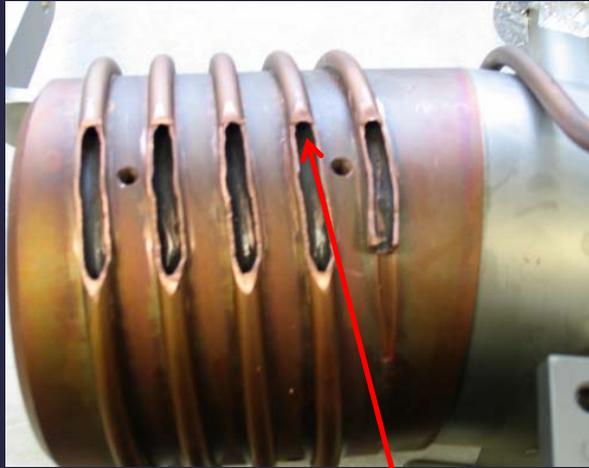


Sextupol
e

Crotch Vessel
X-Ray leg
Absorber



Sections through Cooling Channels of Sextupole Magnet, and Crotch Vessel X-Ray Leg Absorber

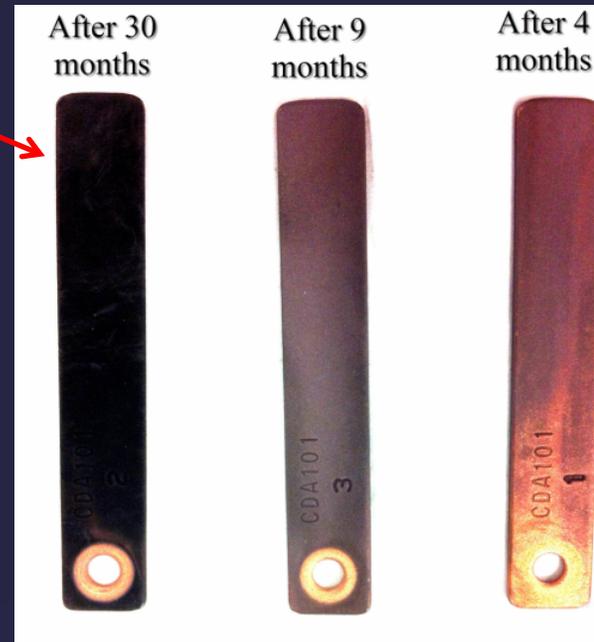
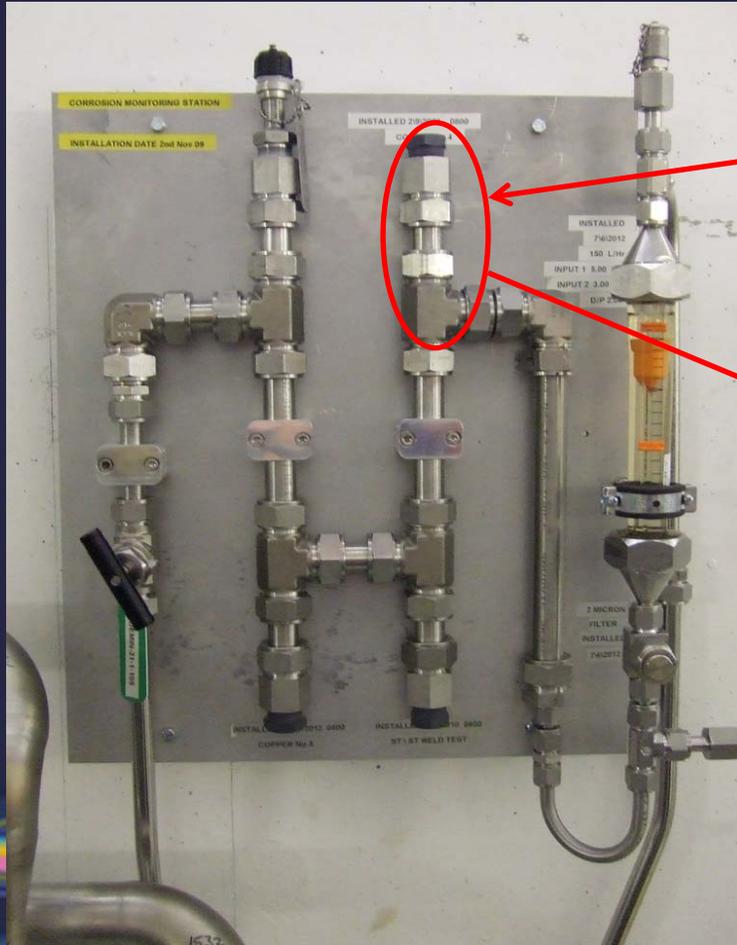


CuO deposit

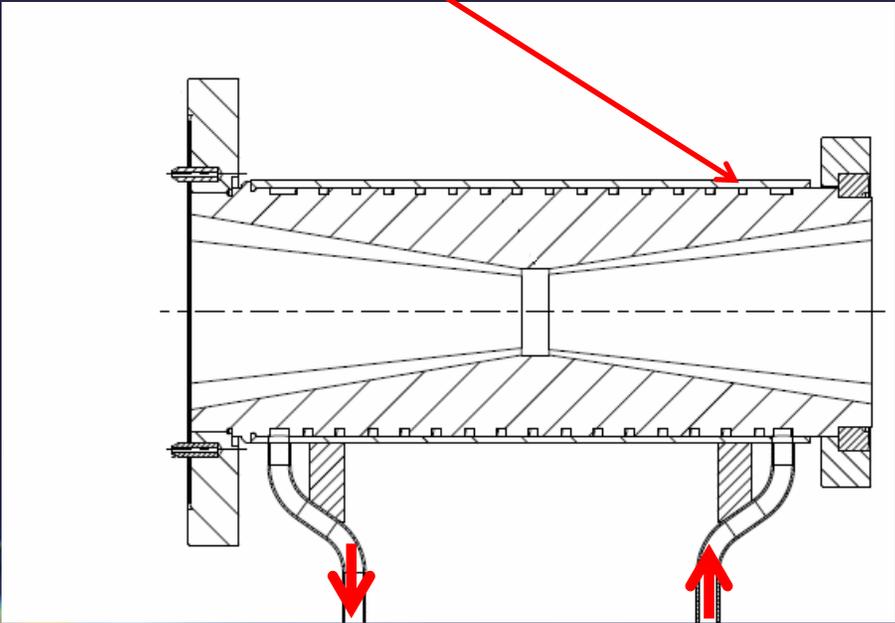
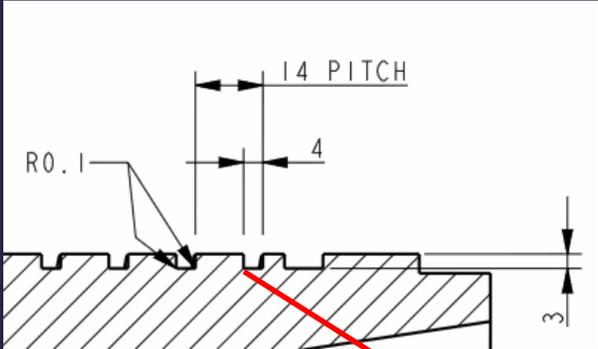


Clear

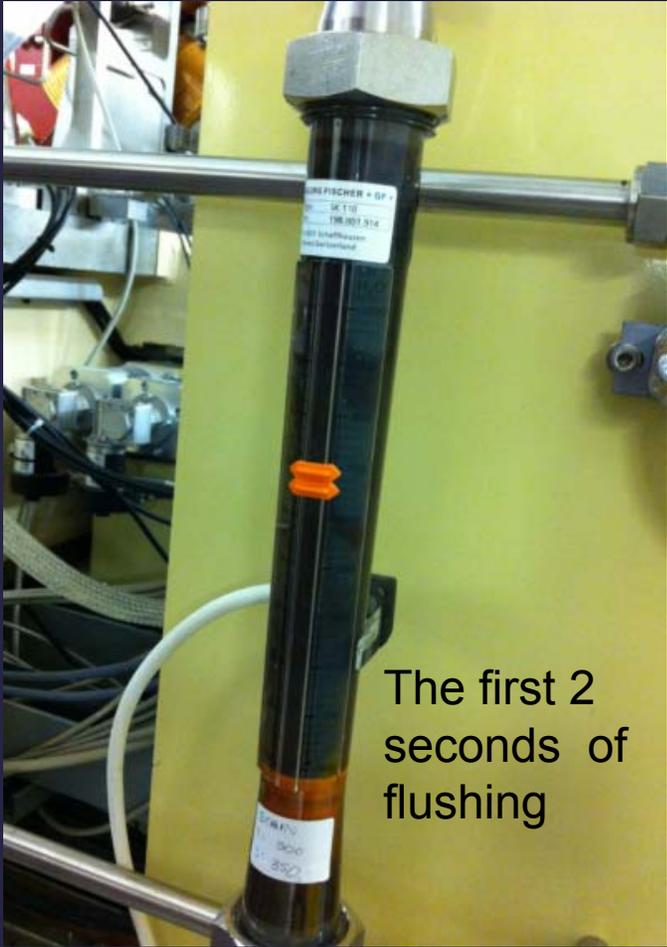
Is copper oxide presence in the water due erosion of oxide in some supplied components or is it being created by water chemistry?



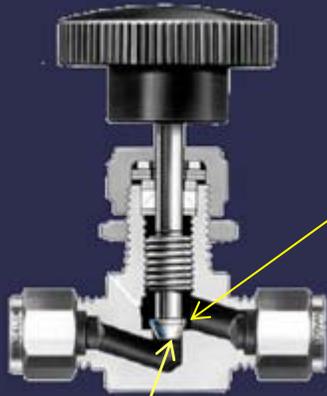
Components with Small and Tortuous Cooling Channels are Prone to Blocking



Temporarily reverse flow to flush out blockage

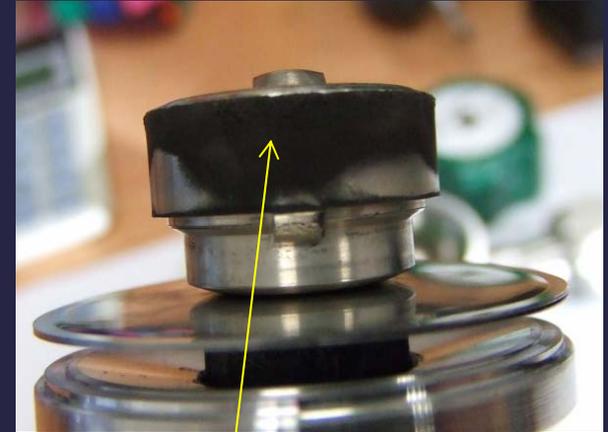
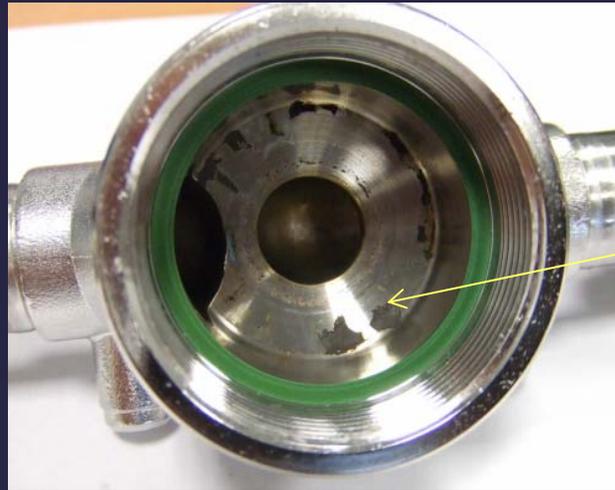


Some valves are oversized and need replacing with a more appropriate size or with fixed diameter orifice plates



Annular opening can be as small as 0.3-0.4mm on heavily throttled flow

Blockage occurs here



Build up of copper oxide on valve spindle and seat for diaphragm and needle valves which are less than 1 turn open .

Conclusion:

No matter how carefully the cooling water chemistry is controlled the ingress of oxygen and carbon dioxide into the system over time cannot be prevented and a method of removing the resulting copper oxides must be included in plant design.

The reason why the 5 μ m filters in the water treatment plant are free of copper oxide remains a mystery.

Thank you for your attention

