= Copper (I) chloride =

Copper (I) chloride , commonly called cuprous chloride , is the lower chloride of copper , with the formula CuCl . The substance is a white solid sparingly soluble in water , but very soluble in concentrated hydrochloric acid . Impure samples appear green due to the presence of copper (II) chloride .

= = History = =

Copper (I) chloride was first prepared by Robert Boyle in the mid @-@ seventeenth century from mercury (II) chloride (" Venetian sublimate ") and copper metal :
HgCl2 + 2 Cu ? 2 CuCl + Hg
In 1799 , J.L. Proust characterized the two different chlorides of copper . He prepared CuCl by heating CuCl2 at red heat in the absence of air , causing it to lose half of its combined chlorine followed by removing residual CuCl2 by washing with water .
An acidic solution of CuCl was formerly used for analysis of carbon monoxide content in gases , for example in Hempel 's gas apparatus . This application was significant during the time that coal gas was widely used for heating and lighting , during the nineteenth and early twentieth centuries .

= = Synthesis = =

Copper (I) chloride is synthesed by reducing copper (II) chloride , e.g. with sulfur dioxide :
2 CuCl2 + SO2 + 2 H2O ? 2 CuCl + H2SO4 + 2 HCl
Many other reducing agents can be used .

= = Chemical properties = =

Copper (I) chloride is a Lewis acid , which is classified as soft according to the Hard @-@ Soft Acid @-@ Base concept . Thus , it tends to form stable complexes with soft Lewis bases such as triphenylphosphine :
CuCl + P (C6H5) 3 ? [CuCl (P (C6H5) 3)] 4
Although CuCl is insoluble in water , it dissolves in aqueous solutions containing suitable donor molecules . It forms complexes with halide ions , for example forming H3O + CuCl2 ? with concentrated hydrochloric acid . It is attacked by CN ? , S2O32 ? , and NH3 to give the corresponding complexes .
Solutions of CuCl in HCl or NH3 absorb carbon monoxide to form colourless complexes such as the chloride @-@ bridged dimer [CuCl (CO)] 2 . The same hydrochloric acid solutions also react with acetylene gas to form [CuCl (C2H2)] . Ammoniacal solutions of CuCl react with acetylenes to form the explosive copper (I) acetylide , Cu2C2 . Complexes of CuCl with alkenes can be prepared by reduction of CuCl2 by sulfur dioxide in the presence of the alkene in alcohol solution . Complexes with dienes such as 1 @,@ 5 @-@ cyclooctadiene are particularly stable :
In absence of other ligands , its aqueous solutions are unstable with respect to disproportionation into Cu and CuCl2 . In part for this reason samples in air assume a green coloration (see photograph in upper right) .

= = Uses = =

The main use of copper (I) chloride is as a precursor to the fungicide copper oxychloride . For this purpose aqueous copper (I) chloride is generated by comproportionation and then air @-@ oxidized :
Cu + CuCl2 ? 2 CuCl
6 CuCl + 3 / 2 O2 + 3 H2O ? 2 Cu3Cl2 (OH) 4 + CuCl2
Copper (I) chloride catalyzes a variety of organic reactions , as discussed above . Its affinity for

carbon monoxide in the presence of aluminium chloride is exploited in the COPureSM process .

= = = In organic synthesis = = =

CuCl is used with carbon monoxide , aluminium chloride , and hydrogen chloride in the Gatterman @-@ Koch reaction to form benzaldehydes .

In the Sandmeyer reaction . Treatment of an arenediazonium salt with CuCl leads to an aryl chloride , for example :

The reaction has wide scope and usually gives good yields .

Early investigators observed that copper (I) halides catalyse 1 @,@ 4 @-@ addition of Grignard reagents to alpha , beta @-@ unsaturated ketones led to the development of organocuprate reagents that are widely used today in organic synthesis :

This finding led to the development of organocopper chemistry . For example , CuCl reacts with methyllithium (CH3Li) to form " Gilman reagents " such as (CH3) 2CuLi , which find extensive use in organic synthesis . Grignard reagents form similar organocopper compounds . Although other copper (I) compounds such as copper (I) iodide are now more often used for these types of reactions , copper (I) chloride is still recommended in some cases :

Here , Bu indicates an n @-@ butyl group . Without CuCl , the Grignard reagent alone gives a mixture of 1,2- and 1 @,@ 4 @-@ addition products (i.e. , the butyl adds at the C closer to the C = O) .

Copper (I) chloride is also an intermediate formed from copper (II) chloride in the Wacker process .

= = = In polymer chemistry = = =

CuCl is used as a catalyst in Atom Transfer Radical Polymerization (ATRP) .