= Manganese =

Manganese is a chemical element with symbol Mn and atomic number 25 . It is not found as a free element in nature ; it is often found in minerals in combination with iron . Manganese is a metal with important industrial metal alloy uses , particularly in stainless steels .

Historically , manganese is named for various black minerals (such as pyrolusite) from the same region of Magnesia in Greece which gave names to similar @-@ sounding magnesium , Mg , and magnetite , an ore of the element iron , Fe . By the mid @-@ 18th century , Swedish chemist Carl Wilhelm Scheele had used pyrolusite to produce chlorine . Scheele and others were aware that pyrolusite (now known to be manganese dioxide) contained a new element , but they were unable to isolate it . Johan Gottlieb Gahn was the first to isolate an impure sample of manganese metal in 1774 , which he did by reducing the dioxide with carbon .

Manganese phosphating is used for rust and corrosion prevention on steel . Ionized manganese is used industrially as pigments of various colors , which depend on the oxidation state of the ions . The permanganates of alkali and alkaline earth metals are powerful oxidizers . Manganese dioxide is used as the cathode (electron acceptor) material in zinc @-@ carbon and alkaline batteries .

In biology , manganese (II) ions function as cofactors for a large variety of enzymes with many functions . Manganese enzymes are particularly essential in detoxification of superoxide free radicals in organisms that must deal with elemental oxygen . Manganese also functions in the oxygen @-@ evolving complex of photosynthetic plants . The element is a required trace mineral for all known living organisms but is a neurotoxin . In larger amounts , and apparently with far greater effectiveness through inhalation , it can cause a poisoning in mammals with neurological damage that is sometimes irreversible .

= = Characteristics = =

= = = Physical properties = = =

Manganese is a silvery @-@ gray metal that resembles iron . It is hard and very brittle , difficult to fuse , but easy to oxidize . Manganese metal and its common ions are paramagnetic . Manganese tarnishes slowly in air and oxidizes (" rusts ") like iron in water containing dissolved oxygen .

= = = Isotopes = = =

Naturally occurring manganese is composed of one stable isotope , 55Mn . Eighteen radioisotopes have been isolated and described , the most stable being 53Mn with a half @-@ life of 3 @.@ 7 million years , 54Mn with a half @-@ life of 312 @.@ 3 days , and 52Mn with a half @-@ life of 5 @.@ 591 days . All of the remaining radioactive isotopes have half @-@ lives of less than three hours , and the majority of less than one minute .

Manganese also has three meta states . Manganese is part of the iron group of elements , which are thought to be synthesized in large stars shortly before the supernova explosion . 53Mn decays to 53Cr with a half @-@ life of 3 @.@ 7 million years . Because of its relatively short half @-@ life , 53Mn is relatively rare , produced by cosmic rays impact on iron . Manganese isotopic contents are typically combined with chromium isotopic contents and have found application in isotope geology and radiometric dating . Mn ? Cr isotopic ratios reinforce the evidence from 26Al and 107Pd for the early history of the solar system . Variations in 53Cr / 52Cr and Mn / Cr ratios from several meteorites suggest an initial 53Mn / 55Mn ratio , which indicates that Mn ? Cr isotopic composition must result from in situ decay of 53Mn in differentiated planetary bodies . Hence , 53Mn provides additional evidence for nucleosynthetic processes immediately before coalescence of the solar system . The isotopes of manganese range in atomic weight from 46 u (46Mn) to 65 u (65Mn) . The primary decay mode before the most abundant stable isotope , 55Mn , is electron capture and the primary mode after is beta decay .

= = = Chemical properties = = =

The most common oxidation states of manganese are + 2 , + 3 , + 4 , + 6 , and + 7 , though all oxidation states from ? 3 to + 7 have been observed . Mn2 + often competes with Mg2 + in biological systems . Manganese compounds where manganese is in oxidation state + 7 , which are restricted to the unstable oxide Mn2O7 and compounds of the intensely purple permanganate anion MnO4 ? , are powerful oxidizing agents . Compounds with oxidation states + 5 (blue) and + 6 (green) are strong oxidizing agents and are vulnerable to disproportionation .