

= water , argyros =

silver ) ? since it is liquid like water and shiny like silver . The element was named after the Roman god Mercury , known for speed and mobility . It is associated with the planet Mercury ; the astrological symbol for the planet is also one of the alchemical symbols for the metal . Mercury is the only metal for which the alchemical planetary name became the common name .

= = = Copernicium = = =

The heaviest known group 12 element , copernicium , was first created on February 9 , 1996 , at the Gesellschaft für Schwerionenforschung ( GSI ) located in Darmstadt , Germany by Sigurd Hofmann , Victor Ninov et al . It was then officially named by the International Union of Pure and Applied Chemistry after Nicolaus Copernicus on February 19 , 2010 , the 537th anniversary of Copernicus ' birth .

= = Occurrence = =

Like in most other d @-@ block groups , the abundance in Earth 's crust of group 12 elements decreases with higher atomic number . Zinc is with 65 parts per million ( ppm ) the most abundant in the group while cadmium with 0 @.@ 1 ppm and mercury with 0 @.@ 08 ppm are orders of magnitude less abundant . Copernicium , as a synthetic element with a half @-@ life of a few minutes , may only be present in the laboratories where it was produced .

Group 12 metals are chalcophiles , meaning the elements have low affinities for oxides and prefer to bond with sulfides . Chalcophiles formed as the crust solidified under the reducing conditions of the early Earth 's atmosphere . The commercially most important minerals of group 12 elements are sulfide minerals . Sphalerite , which is a form of zinc sulfide , is the most heavily mined zinc @-@ containing ore because its concentrate contains 60 ? 62 % zinc . No significant deposits of cadmium @-@ containing ores are known . Greenockite ( CdS ) , the only cadmium mineral of importance , is nearly always associated with sphalerite ( ZnS ) . This association is caused by the geochemical similarity between zinc and cadmium which makes geological separation unlikely . As a consequence , cadmium is produced mainly as a byproduct from mining , smelting , and refining sulfidic ores of zinc , and , to a lesser degree , lead and copper . One place where metallic cadmium can be found is the Vilyuy River basin in Siberia . Although mercury is an extremely rare element in the Earth 's crust , because it does not blend geochemically with those elements that constitute the majority of the crustal mass , mercury ores can be highly concentrated considering the element 's abundance in ordinary rock . The richest mercury ores contain up to 2 @.@ 5 % mercury by mass , and even the leanest concentrated deposits are at least 0 @.@ 1 % mercury ( 12 @,@ 000 times average crustal abundance ) . It is found either as a native metal ( rare ) or in cinnabar ( HgS ) , corderoite , livingstonite and other minerals , with cinnabar being the most common ore .

While mercury and zinc minerals are found in large enough quantities to be mined , cadmium is too similar to zinc and therefore is always present in small quantities in zinc ores from where it is recovered . Identified world zinc resources total about 1 @.@ 9 billion tonnes . Large deposits are in Australia , Canada and the United States with the largest reserves in Iran . At the current rate of consumption , these reserves are estimated to be depleted sometime between 2027 and 2055 . About 346 million tonnes have been extracted throughout history to 2002 , and one estimate found that about 109 million tonnes of that remains in use . In 2005 , China was the top producer of mercury with almost two @-@ thirds global share followed by Kyrgyzstan . Several other countries are believed to have unrecorded production of mercury from copper electrowinning processes and by recovery from effluents . Because of the high toxicity of mercury , both the mining of cinnabar and refining for mercury are hazardous and historic causes of mercury poisoning .

= = Production = =

Zinc is the fourth most common metal in use , trailing only iron , aluminium , and copper with an

annual production of about 10 million tonnes . Worldwide , 95 % of the zinc is mined from sulfidic ore deposits , in which sphalerite (  $\text{ZnS}$  ) is nearly always mixed with the sulfides of copper , lead and iron . Zinc metal is produced using extractive metallurgy . Roasting converts the zinc sulfide concentrate produced during processing to zinc oxide : For further processing two basic methods are used : pyrometallurgy or electrowinning . Pyrometallurgy processing reduces zinc oxide with carbon or carbon monoxide at  $950^\circ\text{C}$  (  $1740^\circ\text{F}$  ) into the metal , which is distilled as zinc vapor . The zinc vapor is collected in a condenser . Electrowinning processing leaches zinc from the ore concentrate by sulfuric acid : After this step electrolysis is used to produce zinc metal .

Cadmium is a common impurity in zinc ores , and it is most isolated during the production of zinc . Some zinc ores concentrates from sulfidic zinc ores contain up to 1 % of cadmium . Cadmium is isolated from the zinc produced from the flue dust by vacuum distillation if the zinc is smelted , or cadmium sulfate is precipitated out of the electrolysis solution .

The richest mercury ores contain up to 5 % mercury by mass , and even the leanest concentrated deposits are at least 1 % mercury , with cinnabar (  $\text{HgS}$  ) being the most common ore in the deposits . Mercury is extracted by heating cinnabar in a current of air and condensing the vapor .

Super heavy elements such as copernicium are produced by bombarding lighter elements in particle accelerators that induces fusion reactions . Whereas most of the isotopes of copernicium can be synthesized directly this way , some heavier ones have only been observed as decay products of elements with higher atomic numbers . The first fusion reaction to produce copernicium was performed by GSI in 1996 , who reported the detection of two decay chains of copernicium

208

$82\text{Pb} + 70$

$30\text{Zn} \rightarrow 277$

$112\text{Cn} + n$

In total , approximately 75 atoms of copernicium have been prepared using various nuclear reactions .

= Applications =

Due to the physical similarities which they share , the group 12 elements can be found in many common situations . Zinc and cadmium are commonly used as anti corrosion ( galvanization ) agents as they will attract all local oxidation until they completely corrode . These protective coatings can be applied to other metals through by hot dip galvanizing a substance into the molten form of the metal , or through the process of electroplating which may be passivated by the use of chromate salts . Group 12 elements are also used in electrochemistry as they may act as an alternative to the standard hydrogen electrode in addition to being a secondary reference electrode .

In the US , zinc is used predominantly for galvanizing ( 55 % ) and for brass , bronze and other alloys ( 37 % ) . The relative reactivity of zinc and its ability to attract oxidation to itself makes it an efficient sacrificial anode in cathodic protection ( CP ) . For example , cathodic protection of a buried pipeline can be achieved by connecting anodes made from zinc to the pipe . Zinc acts as the anode ( negative terminus ) by slowly corroding away as it passes electric current to the steel pipeline . Zinc is also used to cathodically protect metals that are exposed to sea water from corrosion . Zinc is also used as an anode material for batteries such as in zinc carbon batteries or zinc air battery / fuel cells . A widely used alloy which contains zinc is brass , in which copper is alloyed with anywhere from 3 % to 45 % zinc , depending upon the type of brass . Brass is generally more ductile and stronger than copper and has superior corrosion resistance . These properties make it useful in communication equipment , hardware , musical instruments , and water valves . Other widely used alloys that contain zinc include nickel silver , typewriter metal , soft and aluminium solder , and commercial bronze . Alloys of primarily zinc with small amounts of copper , aluminium , and magnesium are useful in die casting as well as spin casting , especially in the automotive ,

electrical , and hardware industries . These alloys are marketed under the name Zamak . Roughly one quarter of all zinc output , in the United States ( 2009 ) , is consumed in the form of zinc compounds , a variety of which are used industrially .

Cadmium has many common industrial uses as it is a key component in battery production , is present in cadmium pigments , coatings , and is commonly used in electroplating . In 2009 , 86 % of cadmium was used in batteries , predominantly in rechargeable nickel @-@ cadmium batteries . The European Union banned the use of cadmium in electronics in 2004 with several exceptions but reduced the allowed content of cadmium in electronics to 0 @.@ 002 % . Cadmium electroplating , consuming 6 % of the global production , can be found in the aircraft industry due to the ability to resist corrosion when applied to steel components .

Mercury is used primarily for the manufacture of industrial chemicals or for electrical and electronic applications . It is used in some thermometers , especially ones which are used to measure high temperatures . A still increasing amount is used as gaseous mercury in fluorescent lamps , while most of the other applications are slowly phased out due to health and safety regulations , and is in some applications replaced with less toxic but considerably more expensive Galinstan alloy . Mercury and its compounds have been used in medicine , although they are much less common today than they once were , now that the toxic effects of mercury and its compounds are more widely understood . It is still used as an ingredient in dental amalgams . In the late 20th century the largest use of mercury was in the mercury cell process ( also called the Castner @-@ Kellner process ) in the production of chlorine and caustic soda .

= = Biological role and toxicity = =

The group 12 elements have multiple effects on biological organisms as cadmium and mercury are toxic while zinc is required by most plants and animals in trace amounts .

Zinc is an essential trace element , necessary for plants , animals , and microorganisms . It is " typically the second most abundant transition metal in organisms " after iron and it is the only metal which appears in all enzyme classes . There are 2 ? 4 grams of zinc distributed throughout the human body , and it plays " ubiquitous biological roles " . A 2006 study estimated that about 10 % of human proteins ( 2800 ) potentially bind zinc , in addition to hundreds which transport and traffic zinc . In the U.S. , the Recommended Dietary Allowance ( RDA ) is 8 mg / day for women and 11 mg / day for men . Harmful excessive supplementation may be a problem and should probably not exceed 20 mg / day in healthy people , although the U.S. National Research Council set a Tolerable Upper Intake of 40 mg / day .

Mercury and cadmium are toxic and may cause environmental damage if they enter rivers or rain water . This may result in contaminated crops as well as the bioaccumulation of mercury in a food chain leading to an increase in illnesses caused by mercury and cadmium poisoning .