Charcoal Reduction Of Copper Oxide Experiment

Blast furnace

Blast furnaces operate on the principle of chemical reduction whereby carbon monoxide converts iron oxides to elemental iron. Blast furnaces differ from bloomeries - A blast furnace is a type of metallurgical furnace used for smelting to produce industrial metals, generally pig iron, but also others such as lead or copper. Blast refers to the combustion air being supplied above atmospheric pressure.

In a blast furnace, fuel (coke), ores, and flux (limestone) are continuously supplied through the top of the furnace, while a hot blast of (sometimes oxygen-enriched) air is blown into the lower section of the furnace through a series of pipes called tuyeres, so that the chemical reactions take place throughout the furnace as the material falls downward. The end products are usually molten metal and slag phases tapped from the bottom, and flue gases exiting from the top. The downward flow of the ore along with the flux in contact with an upflow of hot, carbon monoxide-rich combustion gases is a countercurrent exchange and chemical reaction process.

In contrast, air furnaces (such as reverberatory furnaces) are naturally aspirated, usually by the convection of hot gases in a chimney flue. According to this broad definition, bloomeries for iron, blowing houses for tin, and smelt mills for lead would be classified as blast furnaces. However, the term has usually been limited to those used for smelting iron ore to produce pig iron, an intermediate material used in the production of commercial iron and steel, and the shaft furnaces used in combination with sinter plants in base metals smelting.

Blast furnaces are estimated to have been responsible for over 4% of global greenhouse gas emissions between 1900 and 2015, and are difficult to decarbonize.

Antoine Lavoisier

decomposes) and the reduction of calces by inflammable air (a combination of gas from calx with oxygen to form water). Despite these experiments, Lavoisier's - Antoine-Laurent de Lavoisier (l?-VWAH-zee-ay; French: [??twan l???? d? lavwazje]; 26 August 1743 – 8 May 1794), also Antoine Lavoisier after the French Revolution, was a French nobleman and chemist who was central to the 18th-century chemical revolution and who had a large influence on both the history of chemistry and the history of biology.

It is generally accepted that Lavoisier's great accomplishments in chemistry stem largely from his changing the science from a qualitative to a quantitative one.

Lavoisier is noted for his discovery of the role oxygen plays in combustion, opposing the prior phlogiston theory of combustion. He named oxygen (1778), recognizing it as an element, and also recognized hydrogen as an element (1783). By using more precise measurements than previous experimenters, he confirmed the developing theory that, although matter in a closed system may change its form or shape, its mass always remains the same (now known as the law of conservation of mass), which led to the development of the balanced physical and chemical reaction equations that we still use today.

Lavoisier helped construct the metric system, wrote the first extensive list of elements, in which he predicted the existence of silicon, and helped to reform chemical nomenclature. (1787)

His wife and laboratory assistant, Marie-Anne Paulze Lavoisier, became a renowned chemist in her own right, and worked with him to develop the metric system of measurements.

Lavoisier was a powerful member of a number of aristocratic councils, and an administrator of the Ferme générale. The Ferme générale was one of the most hated components of the Ancien Régime because of the profits it took at the expense of the state, the secrecy of the terms of its contracts, and the violence of its armed agents. All of these political and economic activities enabled him to fund his scientific research. At the height of the French Revolution, he was charged with tax fraud and selling adulterated tobacco, and was guillotined despite appeals to spare his life in recognition of his contributions to science. A year and a half later, he was exonerated by the French government.

Chromium

the oxide in a charcoal oven, for which he is credited as the one who truly discovered the element. Vauquelin was also able to detect traces of chromium - Chromium is a chemical element; it has symbol Cr and atomic number 24. It is the first element in group 6. It is a steely-grey, lustrous, hard, and brittle transition metal.

Chromium is valued for its high corrosion resistance and hardness. A major development in steel production was the discovery that steel could be made highly resistant to corrosion and discoloration by adding metallic chromium to form stainless steel. Stainless steel and chrome plating (electroplating with chromium) together comprise 85% of the commercial use. Chromium is also greatly valued as a metal that is able to be highly polished while resisting tarnishing. Polished chromium reflects almost 70% of the visible spectrum, and almost 90% of infrared light. The name of the element is derived from the Greek word ?????, chr?ma, meaning color, because many chromium compounds are intensely colored.

Industrial production of chromium proceeds from chromite ore (mostly FeCr2O4) to produce ferrochromium, an iron-chromium alloy, by means of aluminothermic or silicothermic reactions. Ferrochromium is then used to produce alloys such as stainless steel. Pure chromium metal is produced by a different process: roasting and leaching of chromite to separate it from iron, followed by reduction with carbon and then aluminium.

Trivalent chromium (Cr(III)) occurs naturally in many foods and is sold as a dietary supplement, although there is insufficient evidence that dietary chromium provides nutritional benefit to people. In 2014, the European Food Safety Authority concluded that research on dietary chromium did not justify it to be recognized as an essential nutrient.

While chromium metal and Cr(III) ions are considered non-toxic, chromate and its derivatives, often called "hexavalent chromium", is toxic and carcinogenic. According to the European Chemicals Agency (ECHA), chromium trioxide that is used in industrial electroplating processes is a "substance of very high concern" (SVHC).

Tungsten

of Bergara, Spain, the brothers succeeded in isolating tungsten by reduction of this acid with charcoal, and they are credited with the discovery of the - Tungsten (also called wolfram) is a chemical element; it has symbol W (from Latin: Wolframium). Its atomic number is 74. It is a metal found naturally on Earth almost exclusively in compounds with other elements. It was identified as a distinct element in 1781 and first isolated as a metal in 1783. Its important ores include scheelite and wolframite, the latter lending the element its alternative name.

The free element is remarkable for its robustness, especially the fact that it has the highest melting point of all known elements, melting at 3,422 °C (6,192 °F; 3,695 K). It also has the highest boiling point, at 5,930 °C (10,706 °F; 6,203 K). Its density is 19.254 g/cm3, comparable with that of uranium and gold, and much higher (about 1.7 times) than that of lead. Polycrystalline tungsten is an intrinsically brittle and hard material (under standard conditions, when uncombined), making it difficult to work into metal. However, pure single-crystalline tungsten is more ductile and can be cut with a hard-steel hacksaw.

Tungsten occurs in many alloys, which have numerous applications, including incandescent light bulb filaments, X-ray tubes, electrodes in gas tungsten arc welding, superalloys, and radiation shielding. Tungsten's hardness and high density make it suitable for military applications in penetrating projectiles. Tungsten compounds are often used as industrial catalysts. Its largest use is in tungsten carbide, a wear-resistant material used in metalworking, mining, and construction. About 50% of tungsten is used in tungsten carbide, with the remaining major use being alloys and steels: less than 10% is used in other compounds.

Tungsten is the only metal in the third transition series that is known to occur in biomolecules, being found in a few species of bacteria and archaea. However, tungsten interferes with molybdenum and copper metabolism and is somewhat toxic to most forms of animal life.

Iron

an acidic medium is used in the Bechamp reduction, the conversion of nitrobenzene to aniline. Iron(III) oxide mixed with aluminium powder can be ignited - Iron is a chemical element; it has symbol Fe (from Latin ferrum 'iron') and atomic number 26. It is a metal that belongs to the first transition series and group 8 of the periodic table. It is, by mass, the most common element on Earth, forming much of Earth's outer and inner core. It is the fourth most abundant element in the Earth's crust. In its metallic state it was mainly deposited by meteorites.

Extracting usable metal from iron ores requires kilns or furnaces capable of reaching 1,500 °C (2,730 °F), about 500 °C (900 °F) higher than that required to smelt copper. Humans started to master that process in Eurasia during the 2nd millennium BC and the use of iron tools and weapons began to displace copper alloys – in some regions, only around 1200 BC. That event is considered the transition from the Bronze Age to the Iron Age. In the modern world, iron alloys, such as steel, stainless steel, cast iron and special steels, are by far the most common industrial metals, due to their mechanical properties and low cost. The iron and steel industry is thus very important economically, and iron is the cheapest metal, with a price of a few dollars per kilogram or pound.

Pristine and smooth pure iron surfaces are a mirror-like silvery-gray. Iron reacts readily with oxygen and water to produce brown-to-black hydrated iron oxides, commonly known as rust. Unlike the oxides of some other metals that form passivating layers, rust occupies more volume than the metal and thus flakes off, exposing more fresh surfaces for corrosion. Chemically, the most common oxidation states of iron are iron(II) and iron(III). Iron shares many properties of other transition metals, including the other group 8 elements, ruthenium and osmium. Iron forms compounds in a wide range of oxidation states, ?4 to +7. Iron also forms many coordination complexes; some of them, such as ferrocene, ferrioxalate, and Prussian blue have substantial industrial, medical, or research applications.

The body of an adult human contains about 4 grams (0.005% body weight) of iron, mostly in hemoglobin and myoglobin. These two proteins play essential roles in oxygen transport by blood and oxygen storage in muscles. To maintain the necessary levels, human iron metabolism requires a minimum of iron in the diet. Iron is also the metal at the active site of many important redox enzymes dealing with cellular respiration and oxidation and reduction in plants and animals.

Acetic acid

white lead (lead carbonate) and verdigris, a green mixture of copper salts including copper(II) acetate. Hippocrates used vinegar as an antiseptic and - Acetic acid , systematically named ethanoic acid , is an acidic, colourless liquid and organic compound with the chemical formula CH_3COOH (also written as CH_3CO_2H, $C_2H_4O_2$, or $HC_2H_3O_2$). Acetic acid is the active component of vinegar. Historically, vinegar was produced from the third century BC making acetic acid likely the first acid to be produced in large quantities.

Acetic acid is the second simplest carboxylic acid (after formic acid). It is an important chemical reagent and industrial chemical across various fields, used primarily in the production of cellulose acetate for photographic film, polyvinyl acetate for wood glue, and synthetic fibres and fabrics. In households, diluted acetic acid is often used in descaling agents. In the food industry, acetic acid is controlled by the food additive code E260 as an acidity regulator and as a condiment. In biochemistry, the acetyl group, derived from acetic acid, is fundamental to all forms of life. When bound to coenzyme A, it is central to the metabolism of carbohydrates and fats.

The global demand for acetic acid as of 2023 is about 17.88 million metric tonnes per year (t/a). Most of the world's acetic acid is produced via the carbonylation of methanol. Its production and subsequent industrial use poses health hazards to workers, including incidental skin damage and chronic respiratory injuries from inhalation.

Gunpowder

explosive. It consists of a mixture of sulfur, charcoal (which is mostly carbon), and potassium nitrate (saltpeter). The sulfur and charcoal act as fuels, while - Gunpowder, also commonly known as black powder to distinguish it from modern smokeless powder, is the earliest known chemical explosive. It consists of a mixture of sulfur, charcoal (which is mostly carbon), and potassium nitrate (saltpeter). The sulfur and charcoal act as fuels, while the saltpeter is an oxidizer. Gunpowder has been widely used as a propellant in firearms, artillery, rocketry, and pyrotechnics, including use as a blasting agent for explosives in quarrying, mining, building pipelines, tunnels, and roads.

Gunpowder is classified as a low explosive because of its relatively slow decomposition rate, low ignition temperature and consequently low brisance (breaking/shattering). Low explosives deflagrate (i.e., burn at subsonic speeds), whereas high explosives detonate, producing a supersonic shockwave. Ignition of gunpowder packed behind a projectile generates enough pressure to force the shot from the muzzle at high speed, but usually not enough force to rupture the gun barrel. It thus makes a good propellant but is less suitable for shattering rock or fortifications with its low-yield explosive power. Nonetheless, it was widely used to fill fused artillery shells (and used in mining and civil engineering projects) until the second half of the 19th century, when the first high explosives were put into use.

Gunpowder is one of the Four Great Inventions of China. Originally developed by Taoists for medicinal purposes, it was first used for warfare around AD 904. Its use in weapons has declined due to smokeless powder replacing it, whilst its relative inefficiency led to newer alternatives such as dynamite and ammonium nitrate/fuel oil replacing it in industrial applications.

Chlorine

Scheele wrote a description of chlorine gas in 1774, supposing it to be an oxide of a new element. In 1809, chemists suggested that the gas might be a pure - Chlorine is a chemical element; it has symbol Cl and atomic number 17. The second-lightest of the halogens, it appears between fluorine and bromine in the periodic table and its properties are mostly intermediate between them. Chlorine is a yellow-green gas at room temperature. It is an extremely reactive element and a strong oxidising agent: among the elements, it has the highest electron affinity and the third-highest electronegativity on the revised Pauling scale, behind only oxygen and fluorine.

Chlorine played an important role in the experiments conducted by medieval alchemists, which commonly involved the heating of chloride salts like ammonium chloride (sal ammoniac) and sodium chloride (common salt), producing various chemical substances containing chlorine such as hydrogen chloride, mercury(II) chloride (corrosive sublimate), and aqua regia. However, the nature of free chlorine gas as a separate substance was only recognised around 1630 by Jan Baptist van Helmont. Carl Wilhelm Scheele wrote a description of chlorine gas in 1774, supposing it to be an oxide of a new element. In 1809, chemists suggested that the gas might be a pure element, and this was confirmed by Sir Humphry Davy in 1810, who named it after the Ancient Greek ?????? (khl?rós, "pale green") because of its colour.

Because of its great reactivity, all chlorine in the Earth's crust is in the form of ionic chloride compounds, which includes table salt. It is the second-most abundant halogen (after fluorine) and 20th most abundant element in Earth's crust. These crystal deposits are nevertheless dwarfed by the huge reserves of chloride in seawater.

Elemental chlorine is commercially produced from brine by electrolysis, predominantly in the chloralkali process. The high oxidising potential of elemental chlorine led to the development of commercial bleaches and disinfectants, and a reagent for many processes in the chemical industry. Chlorine is used in the manufacture of a wide range of consumer products, about two-thirds of them organic chemicals such as polyvinyl chloride (PVC), many intermediates for the production of plastics, and other end products which do not contain the element. As a common disinfectant, elemental chlorine and chlorine-generating compounds are used more directly in swimming pools to keep them sanitary. Elemental chlorine at high concentration is extremely dangerous, and poisonous to most living organisms. As a chemical warfare agent, chlorine was first used in World War I as a poison gas weapon.

In the form of chloride ions, chlorine is necessary to all known species of life. Other types of chlorine compounds are rare in living organisms, and artificially produced chlorinated organics range from inert to toxic. In the upper atmosphere, chlorine-containing organic molecules such as chlorofluorocarbons have been implicated in ozone depletion. Small quantities of elemental chlorine are generated by oxidation of chloride ions in neutrophils as part of an immune system response against bacteria.

Flux (metallurgy)

smelting of copper. These agents served various functions, the simplest being a reducing agent, which prevented oxides from forming on the surface of the molten - In metallurgy, a flux is a chemical reducing agent, flowing agent, or purifying agent. Fluxes may have more than one function at a time. They are used in both extractive metallurgy and metal joining.

Some of the earliest known fluxes were sodium carbonate, potash, charcoal, coke, borax, lime, lead sulfide and certain minerals containing phosphorus. Iron ore was also used as a flux in the smelting of copper. These agents served various functions, the simplest being a reducing agent, which prevented oxides from forming on the surface of the molten metal, while others absorbed impurities into slag, which could be scraped off molten metal.

Fluxes are also used in foundries for removing impurities from molten nonferrous metals such as aluminium, or for adding desirable trace elements such as titanium.

As reducing agents, fluxes facilitate soldering, brazing, and welding by removing oxidation from the metals to be joined. In some applications molten flux also serves as a heat-transfer medium, facilitating heating of the joint by the soldering tool.

Phosphorus

main oxidation states +5, +3 and ?3. The isolation of white phosphorus in 1669 by Hennig Brand marked the scientific community's first discovery of an element - Phosphorus is a chemical element; it has symbol P and atomic number 15. All elemental forms of phosphorus are highly reactive and are therefore never found in nature. They can nevertheless be prepared artificially, the two most common allotropes being white phosphorus and red phosphorus. With 31P as its only stable isotope, phosphorus has an occurrence in Earth's crust of about 0.1%, generally as phosphate rock. A member of the pnictogen family, phosphorus readily forms a wide variety of organic and inorganic compounds, with as its main oxidation states +5, +3 and ?3.

The isolation of white phosphorus in 1669 by Hennig Brand marked the scientific community's first discovery of an element since Antiquity. The name phosphorus is a reference to the god of the Morning star in Greek mythology, inspired by the faint glow of white phosphorus when exposed to oxygen. This property is also at the origin of the term phosphorescence, meaning glow after illumination, although white phosphorus itself does not exhibit phosphorescence, but chemiluminescence caused by its oxidation. Its high toxicity makes exposure to white phosphorus very dangerous, while its flammability and pyrophoricity can be weaponised in the form of incendiaries. Red phosphorus is less dangerous and is used in matches and fire retardants.

Most industrial production of phosphorus is focused on the mining and transformation of phosphate rock into phosphoric acid for phosphate-based fertilisers. Phosphorus is an essential and often limiting nutrient for plants, and while natural levels are normally maintained over time by the phosphorus cycle, it is too slow for the regeneration of soil that undergoes intensive cultivation. As a consequence, these fertilisers are vital to modern agriculture. The leading producers of phosphate ore in 2024 were China, Morocco, the United States and Russia, with two-thirds of the estimated exploitable phosphate reserves worldwide in Morocco alone. Other applications of phosphorus compounds include pesticides, food additives, and detergents.

Phosphorus is essential to all known forms of life, largely through organophosphates, organic compounds containing the phosphate ion PO3?4 as a functional group. These include DNA, RNA, ATP, and phospholipids, complex compounds fundamental to the functioning of all cells. The main component of bones and teeth, bone mineral, is a modified form of hydroxyapatite, itself a phosphorus mineral.

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