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## **Chemical Elements Used in Engineering**

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Engineering uses a large number of different chemical elements, but we will look at the main ones that are used in every field of engineering. Nickel is a chemical element with Ni symbol and atomic number of 28. It is a silvery-white shiny metal with a slight golden tinge. Nickel belongs to the transition metals and it is hard and ductile. Nickel usage has been traced as far back as 3500 BC. Nickel was first taken and classified as a chemical element in 1751 by Axel Fredrik Cronstedt. Major production sites are the Sudbury region in Canada, New Caledonia in the Pacific, and Norilsk in Russia [1]. Brass is a metallic alloy that is made of copper and zinc. The proportions of zinc and copper can vary to create different types of brass alloys with different mechanical and electrical properties. Both bronze and brass may include small amount of other different elements including arsenic, lead, phosphorus, aluminium, manganese, and silicon. Brass has higher malleability than bronze or zinc. Brass is used for decoration due to its bright gold-like appearance and also for applications where low friction is required, for instance: locks, gears, bearings, doorknobs, ammo and valves; for plumbing and electrical applications; and extensively in musical instruments such as horns and bells where a combination of high workability and durability is needed. It is also used in zippers. Brass is often used in issues where it is important that sparks are not struck, such as in tools used near flammable or explosive materials [2].

Copper is a chemical element with symbol Cu and atomic number 29. It is a soft, malleable, and ductile. A freshly exposed surface of pure copper has a reddish-orange color. Historically, copper was the first metal to be worked by people. The discovery that it could be hardened with a little tin to form the alloy bronze gave the name to the Bronze Age. Traditionally it has been one of the metals used to make coins, along with silver and gold. However, it is the most common of the three and therefore the least valued. All US coins are now copper alloys, and gun metals also contain copper. Most copper is used in electrical equipment such as wiring and motors. This is because it conducts both heat and electricity very well, and can be drawn into wires. It also has uses in construction (for example roofing and plumbing), and industrial machinery (such as heat exchangers). Copper is one of few metals that could be found in nature in directly usable metallic form (native metals) [3].

Aluminium or aluminum is a chemical element with symbol Al and atomic number 13. It is a silvery-white, soft, nonmagnetic and ductile metal in the boron group. By mass, aluminium makes up about 8% of the Earth's crust; it is the third most abundant element after oxygen and silicon and the most abundant metal in the crust, though it is less common in the mantle below. Aluminium is remarkable for its low density and its ability to resist corrosion through the phenomenon of passivation. Aluminium and its alloys are vital to the aerospace industry and important in transportation and building industries, such as building facades and window frames. The oxides and sulfates are the most useful compounds of aluminium [4]. Silicon is a chemical element with symbol Si and atomic number 14. A hard and brittle crystalline solid with a blue-grey metallic lustre, it is a tetravalent metalloid and semiconductor. It is a member of group 14 in the periodic table, along with carbon above it and germanium, tin, and lead

below. It is rather unreactive, though less so than germanium, and has a very large chemical affinity for oxygen; as such, it was first prepared and characterized in pure form only in 1823 by Jöns Jakob Berzelius. Silicon is the eighth most common element in the universe by mass, but very rarely occurs as the pure element in the Earth's crust. It is most widely distributed in dusts, sands, planetoids, and planets as various forms of silicon dioxide (silica) or silicates. Over 90% of the Earth's crust is composed of silicate minerals, making silicon the second most abundant element in the Earth's crust (about 28% by mass) after oxygen [5].

Lead is a chemical element with symbol Pb and atomic number 82. It is a heavy metal that is denser than most common materials. Lead is soft and malleable, and has a relatively low melting point. When freshly cut, lead is bluish-white; it tarnishes to a dull grey colour when exposed to air. Lead has the highest atomic number of any stable element. metallic lead beads dating back to 7000–6500 BC have been found in Asia Minor and may represent the first example of metal smelting. At that time lead had few applications due to its softness and dull appearance [1].

#### References:

1. Scerri, E.R. The periodic table: its story and its significance / E.R. Scerri. – Oxford University Press. – 2007. – pp. 239–240.
2. Joseph, R.D. Copper and Zinc Alloys / R.D. Joseph. – ASM International. – 1 January 2001. – p.7.
3. Scott, D.A. Copper and Bronze in Art: Corrosion, Colorants, Conservation / D.A. Scott. – Getty Publications. – 2002.
4. Aluminum. – Encyclopedia Britannica. – 12 March 2012.
5. Voronkov, M.G. Silicon era / M.G. Voronkov. – Russian Journal of Applied Chemistry. – No. 80. – 2007.