ZINC & LEAD – ANCIENT METALS WITH MODERN & LESSER KNOWN BENEFITS

A.C. WADHAWAN
Past-President, The Indian Institute of Metals
Former CMD, Hindustan Zinc Ltd

The different periods in history have been divided into Iron age, Bronze age etc., thus implying that metals are indeed pre-historic commodities used by mankind. Lead & Zinc are also two such ancient metals used by Romans, Indians etc., The society at large is unaware that these two metals have some very unique properties and applications in modern life and this article presents a gist of the story.

ZINC

Centuries before Zinc was discovered in the metallic form, its ores were used for making brass and zinc compounds were used for healing wounds and eye sores. Brass was used by the Romans at the time of Augustus (20 BC – 14 AD). By 1374 Zinc was recognized in India as a new metal and at Zawar mines in Rajasthan, both Zinc metal and Zinc oxide were produced from the 12th to the 16th Century; the old, crude retorts can be seen even today in those locations.

Zinc is everywhere

Zinc is a gift of nature for the benefit of mankind. It exists naturally in air, water and soil. Zinc is present everywhere in the environment and is continuously mobilized and transported by natural processes such as erosion, forest fires, volcanic eruptions etc.,

Life on earth has evolved in the presence of zinc, which is used by nature for many biological processes. All living organisms – including man, animals, fish, plants and micro-organisms – need zinc for growth and development. Zinc intake is regulated by each organism's natural processes.

Zinc contributes to society's wellbeing

Zinc is an important pharmaceutical ingredient, providing daily skin care and protection against the harmful rays of the sun. Zinc is needed in fertilizers that boost crop yields and so help feed the world's growing population. Year after year, India uses significant quantities of Zinc Sulphate, an agricultural micronutrient, to make up for the Zinc deficiency levels in the soils; this chemical product is manufactured from process residues containing Zinc, truly in the spirit of Sustainable Development. Recyclable zinc-air batteries successfully power electric vehicles, offering another solution to the problem of urban air quality. And zinc is present all around us in our household appliances, door fittings, domestic hardware, zippers, sliders, razors, tools, toys, computers, cars, trains etc.,

Zinc protects human health

The adult body contains 2 – 3 grams of Zinc, other metals being Calcium, Sodium, Pottasium, Magnesium etc., The beneficial properties of zinc have been appreciated for many years, generations of mothers have applied zinc cream to cure nappy rash and it is common knowledge that zinc helps heal wounds. The importance of dietary zinc supplements in the recovery from severe malnutrition has been well documented and more than 35 years ago it was recognized that severe zinc deficiency was responsible for dwarfism. Recent advances in medical sciences are revealing the importance of zinc for the proper functioning of the immune system, the transfer of nervous signals, the expression of genes and many other vital functions. Zinc supplementation is proving successful in the fight against major causes of child mortality such as diarrhea, pneumonia and malaria. Zinc is known to be vital to the functioning of more than 300 enzymes in the human body. Research is also showing, however, that as much as half the world's population is at risk from zinc deficiency, with even greater numbers at risk in developing countries and among poor populations. Zinc supplementation is proving to be an effective and cheap intervention that can greatly improve the health status of groups at risk. The US Recommended Dietary Allowance (RDA) of Zinc in milligrams/day are as follows:

Infants	(0 – 1 year)	5
Children	(1 – 10 years)	10
Men	(11 – 51 years)	15
Women :	Pregnant	15
	Lactating	19

Zinc protects steel

One of the most remarkable characteristics of Zinc is its ability to protect steel against corrosion. Corrosion of iron and steel is a drain on the economy, estimated to cost at least 4% of GDP in industrialised countries. The life and durability of steel is greatly improved when coated with zinc. No other material known to man can provide such durable and cost-effective protection for steel. About 70% of the Zinc consumed in the world is used for protection of steel products.

By protecting steel against corrosion and prolonging its useful life, zinc helps save the energy that would otherwise be needed to frequently replace corroded steel structures and manufactured goods. It has been estimated, for example, that the use of zinc coated steel in Sweden saves the country the energy equivalent of one nuclear power plant each year! Life-cycle costing of public infrastructure using galvanized steel shows how significant the savings are: longer service life, lower maintenance costs, longer payback on investments and no interruptions in service or utility.

Zinc is recyclable

Today, over 30% of the global zinc supply comes from recycled zinc, recovered from both new and old scrap. Approximately 80% of all the zinc used today will be recycled sooner or later. End of life cycle products as well as industrial wastes containing Zinc have literally become a "mine above the ground" and these are traded globally. For countries short of Zinc reserves, the scraps containing Zinc are key input materials. India is known to be a major importer of Zinc dross, Zinc ash/skimmings etc., Dry cell batteries which are discarded indiscriminately contain significant quantities of Zinc. Due to the long life span of many zinc products – over 100 years in some cases – much of the zinc used in the past is still in service. Zinc recycling technology is advancing and the supply of zinc available for recycling is growing too. Zinc can be recycled indefinitely, without loss of its physical or chemical properties, thus constituting a valuable and sustainable resource for future generations.

LEAD

Lead is an essential commodity in the modern industrial world, ranking fifth in tonnage consumed after iron, copper, aluminum, and zinc. Lead has been mined and smelted for at least 8000 years. Lead beads found in Turkey have been dated to around 6500 B.C. The Egyptians used lead as early as 5000 B.C. A lead mine in Rio Tinto in Spain operated in 2300 B.C and the Chinese used lead coins around 2000 B.C. Lead was also widely used by the Greeks and Romans. Lead water pipes in 3-m lengths and in 15 different standard diameters have been found in the ruins of Rome and Pompeii, confirming the use of lead during that period. Some pipes still in excellent condition have been found in modern-day Rome and Britain. The toxicity of Lead was identified by Marcus Vitruvius Pollio, a first-century Roman architect and engineer, from the poor color of the lead workers of those times.

The estimated economic reserves of lead in the world are 71 million tonnes and are scattered around the world. Australia, United States, Canada, Mexico, former Soviet Union and China account for over two-thirds of these reserves. The total world reserve base (which includes marginal deposits) is estimated at 124 million tonnes. If lead scrap, now a major source of lead, and less economic lead ore deposits are considered, the entire reserve base for the world is estimated at 140 million tonnes. The concentration of Lead in ore bodies of commercial interest generally ranges from 2% to 6%, with an average of 2.5%. Improvements in ore-dressing techniques have made possible the exploitation of deposits having lead contents even less than 2%.

Some of the modern applications of Lead are : Lead acid batteries, UPS for computers, domestic and office power backups/inverters, solders used in PCBs, nuclear radiation shielding, radiation shields in CAT scanners and medical X-ray applications, keels in yachts, balancing weights in computer hard disk drives, lead-lined storage vessels in chemical industry, vacuum seals in light bulbs, explosive detonation chords in Space Shuttle, acoustic barrier panels, crystal glasses, fibre optic cables, infrared detectors in pollution monitoring, Lead in earthquake protection, lead sheets in architecture, lead alloys in printing type metals etc., The list seems to be endless !

Despite their known toxicity, lead and its alloys can be handled safely and continue to be critical in many areas for the modern society. This continued dependence on lead arises from several of its unique properties. The low melting point, ease of casting, high density, softness and high malleability at room temperature, low strength, ease of fabrication, excellent resistance to corrosion in acidic environments, attractive electrochemical behavior in many chemical environments, chemical stability in

Contd... page 18