

Mercury- Environmental Implications and Toxicity

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Smt. Kalpana Palkhiwala* Mercury is the only liquid state metal, which finds very wide commercial application in industries, electrical appliances, mercurial catalysts, healthcare sector for extensive , seed treatment, laboratory reagents etc. Because of extensive use in thermometers, sphygmomanometers, dental amalgams, agriculture for seed treatment, as laboratory reagents etc. Because of extensive commercial use, the mercury consumption in the country is quite high. The Mercury Cell process based Chlor-alkali industries are one of the major users and thus prime source of mercury release to the environment along with the coal-fired thermal power plants, plastic industries, pulp and paper industries, discarded medical instruments, used electrical appliance, electronic waste, certain pharmaceuticals and agricultural products. The mercury is highly toxic in both forms elemental and compounds; irrespective of whether inhaled, ingested or absorbed through the skin. The microbes convert inorganic mercury of aquatic environment into methyl mercury and various organic mercury compounds. These compounds may be bio-accumulated and bio-magnified in food chain, particularly in the body tissue of fresh water and marine organisms and consequently get transferred to human beings. The Environmental issues of elemental mercury and its various forms, their toxico-kinetics and human health impacts have been widely documented. The mercury compounds are recognized as cumulative poison and are potent neuro and nephro toxic substances. Alkyl mercury has been known to cause permanent mental retardation. **Nature, Occurrence, Distribution** Mercury is the only element, which is liquid at ambient temperature and sometimes called Quicksilver because of its silvery white appearance. It rarely occurs free in nature and is mainly found as bright red crystalline solid Cinnabar ore (HgS). Mercury is a heavy, odourless, lustrous liquid metal that sinks in water. It is mobile, ductile and converts into malleable mass on being solidified at -39°C , which may be cut with a knife. Mercury has very wide commercial and industrial applications. It is an excellent conductor of electricity, therefore it is widely used in electrical apparatuses i.e. meters, switches, batteries etc. Being highly mobile, it cannot be disintegrated into harmless components. In the industrial processes, mercury is actually not consumed, therefore whatever mercury is used comes back with wastes, effluents, air emissions or in the products. The mercury hazards have been recognized since last few decades due to environmental awareness. It is estimated that more than 90 percent of the mercury used in the industrial processes literally vanishes into various environmental components. Chlor-alkali industries had been the major source of mercury release to the environment till sometimes back, because of obsolete technology. However, now all of the Chlor alkali industries except few are based on upgraded advanced and cleaner Technology viz. Membrane Technology which does not use mercury in the process. The average concentration of mercury in the earth's crust is about 0.07 mg/kg. More than 90% of the world's supply of mercury is provided by seven countries: USA, Spain, Yugoslavia, Italy, former Soviet Union, China and Mexico. **Existence of Various Forms of Mercury In Environment** Mercury and its compounds exist in the environment in two forms, inorganic mercury and its compounds and organic mercury and its compounds. The inorganic mercury is available either in mercurous (Hg°) or mercuric (Hg^{2+}) form, while organic mercury is covalently bonded with alkyl or aryl groups. The metallic mercury when enters in the aquatic environment, the bacterial action converts it slowly to methyl mercury, both the methyl mercury ions (CH_3HG^+) and Dimethyl mercury ($\text{CH}_3)_2\text{Hg}$ are formed. Mercury is particularly dangerous in organomercury compounds. The inorganic mercury directly accumulates in body tissues, while organic mercury in form of aryl salts of mercury, breaks down into organic mercury in the body tissue. The alkyl salts of mercury, particularly methyl mercury is able to diffuse easily through the membranes and spread throughout the body. **Mercury Trade in India** Mercury is not geologically extracted in the country, but imported for commercial uses. Mercury and mercury containing wastes are included in the waste streams of the Basel Convention on trans-boundary movements of hazardous waste and their disposal. In order to control the movement of Basel wastes, the export and import of mercury

bearing wastes has been banned under Schedule 8 of the Hazardous Waste (Management and Handling) Amendment Rules, 2003. But elemental mercury and mercury containing equipments are continued to be freely imported. **Global Production of Mercury** Mercury is Natural component of the Earth, with an average abundance of approximately 0.05 mg/kg in the Earth's crust, with significant local variations. The ores of mercury, which are mined generally, contain about one percent mercury. **Natural Sources of Mercury** Mercury can be found virtually in all geological media in small, but varying concentrations. The major sources of mercury are the natural degassing of the earth's crust i.e. evaporation from soil and water surfaces, degradation of minerals and forest fires. Elemental and oxidized forms of mercury are being continuously added to the environment due to their volatile nature. Several cycles are involved in the transport and distribution of mercury in the environment. The global cycle involves the atmospheric circulation of elemental mercury vapours from sources on that also transport the mercury to streams and lakes through surface. **Anthropogenic Sources of Mercury** Industrial use and commercial products containing mercury are recognized as significant sources of mercury release in the environment. Air emissions from coal burning power plants, incinerators, and hazardous waste combustions are the major contributors of mercury. Mercury is also contributed directly from municipal and industrial sites, hospitals, dental clinics, and wastewater and from breakage or disposal of mercury contains products such as fluorescent lights, thermostats and thermometers. There are three major sources of anthropogenic release of mercury which include mobilization of mercury impurities, intentional extraction and use of mercury and waste treatment and cremation, etc. Coal-fired power generation and heat production, energy production from other fossil carbon fuels, cement production (mercury in lime), mining and other metallurgical activities, and petroleum production are sources of mobilization of mercury impurities. Chlor-alkali production, products such as thermometers, manometers and other instruments viz. electrical and electronic switches containing mercury, use of fluorescent lamps, instruments and dental amalgam fillings, etc., and use of batteries, fireworks and laboratory chemicals form the source from intentional extraction and use of mercury. Waste treatment and cremation, etc. activities include municipal, medical and hazardous wastes incineration, landfills and recycling and storage. **Mercury in Atmosphere and Aquatic Environment** The atmospheric chemistry of mercury involves several interactions such as gas phase reactions; aqueous phase reactions (in cloud and fog droplets); partitioning of elements and oxidized mercury species between the gas and solid phases and partitioning between gas and aqueous phase. Methyl mercury can be formed in the environment by microbial metabolism. The efficiency of microbial mercury methylation generally depends on factors such as microbial activity and the concentration of bio available mercury, which in turn are influenced by temperature, pH, redox potential and the presence of inorganic and organic agent. **Mercury in Soil/Sludge and Food Chain** Soil contamination could be caused either by direct dumping or land filling of mercury contaminated wastes. Mercury in water body sediments may indicate the history of contamination. The concentration of mercury in Municipal Solid Waste (MSW) composts is usually very low and thus there is little likelihood of significant transfer of mercury to other environmental components. Mercury enters into the terrestrial food chain by way of seed eating animal species, resulting in increased level of mercury in tissues and eggs of predatory birds, singing birds and rodents. Some parts of mercury also enters via plant in Ionic, complexes and gaseous form through leaves and roots. Human beings can be affected on consumption of contaminated plants and animals on setting the mercury poisoning. ***Deputy Director(M & C), Press Information Bureau, New Delhi. [caption id="attachment_18944" align="alignleft" width="267" caption="Mercury- Environmental Implications and Toxicity "]**

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