Chapter 1

Heavy Metal Pollution: A Global Pollutant of Rising Concern

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ABSTRACT

The chapter covers various issues related to heavy metals. Here we attempt to document the possible definitions for heavy metals. Heavy metals, the elements having density higher than 3.5 g/cm² are being added at a high rate to our close vicinity. These metals lead to serious problems related to ecology and mankind. Toxic effects of heavy metals are dependent on the concentration of metals, reactivity of metal species and duration of exposure. There is a need to address the toxicological and remedial aspects of heavy metals.

INTRODUCTION

Human civilization is constantly developing and progressing and in the course of development and progression, natural resources play a significant role. Biotic (living organisms and their products) and abiotic resources (air, water and soil) are used to meet the requirements or demands of civilization. In the age of rapid development, we have been exploiting resources without considering the recovery time for the resources. Injudicious use of resources not only causes the dearth for future use, but also leads to the addition of certain substances to our surroundings, which were not a part of biosphere or if they were present earlier the quantity was negligible. The phenomenon of this unwanted addition of substances to environment is referred as “Pollution” and the substances added as “pollutants”. These pollutants added to the environment due to various developmental activities, pose a threat to ecosystem in general and to human lives in particular. Various historical incidents including, Bhopal gas tragedy, Minamata Bay catastrophe, London smog and many more have showcased the threat pollutants cause.

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to mankind. Pollutants occur in gaseous, liquid or solid forms. They can be created and released due to some human activity or they appear in biosphere due to over-exploitation of resources which leads to unveiling of pollutants from deeper crusts of soil. Amongst different kinds of pollutants, heavy metals have attracted attention of scientific community because of serious health hazards associated with them. Metals were always the part of nature, but over exploitation of resources or other anthropogenic activities have added to the background concentration of these metals in the biosphere. Like, higher level of arsenic in groundwater of many regions is result of over exploitation of underground water resources, leading to dissolution of minerals (Nagajyoti, Lee, & Sreekanth, 2010; Hashim, Mukhopadhyay, Sahu, & Sengupta, 2011; Bernhoft, 2012; Thomas-Mkude, 2015).

Heavy metals released from various industries and agrochemicals have proven to be a serious concern for all types of living organisms. International bodies, like, WHO, US Environmental Protection agency (EPA) have extensively studied and reviewed health effects related to various metals mainly cadmium, mercury, arsenic and lead. Although the use of heavy metals have been known since more than 5000 years and their severe health effects are also known from centuries but since the middle of 19th century, there is a steep rise in use of heavy metals leading to their emissions in neighboring environment and thus triggering the cause-effect phenomenon at a faster pace. Heavy metals released through any activity remain in environment for a long time as they cannot be destroyed. Although, many of these heavy metals are also required in traces for the physiological metabolism of both plants and animals but they are toxic at higher concentrations (Järup, 2003; Inoue, 2013).

Extensive research is being carried out in context of heavy metals. There is need to archive basics of heavy metals to aid in future research. This chapter aims to document most of the available definitions of heavy metals, the sources, distribution and toxicity.

DEFINITIONS

In periodic table, metals are classified as alkali metals, transition metals, alkaline earth metals and rare metals. The term heavy metals, which is commonly used in scientific literature does not belong to any well-defined section in periodic table. According to Oxford dictionary, the oldest documentation of this term was found in a book on inorganic chemistry written by Bjerrum in 1936 (Duffus, 2002; Hodson, 2004). Broadly, heavy metals can be defined on the basis of physical properties, chemical reactivity and toxicity to living organisms.

On the Basis of Physical Properties

The term “heavy metals” is being widely used to refer toxic metals. But there is still a controversy regarding the definition of these metals. In 2002, a technical report published by IUPAC (International Union of Pure and Applied Chemistry) questions the reliability of this term and considered it to be “most loosely defined term”. The word “heavy” signifies higher density which is usually attributed to the toxicity of metals. The challenge here for the scientific community was to determine the threshold level of density, above which a metal should be considered heavy metals. In past, various levels of densities were proposed and metals above that limit were considered to be heavy metals. IUPAC has summarized various studies mentioning the range of density to be considered as high. Earlier, heavy metals having density above 7 g/cm³ were considered toxic but this definition phased out many toxic metals like arsenic from
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