

DIOXIN: GENERATION, TOXICITY, IMPACT ON PUBLIC HEALTH, ABATEMENT

Eilene Basu^{1*}, Projjal Basu², Munmun Datta³

¹ Ramaiah Medical College, MS Ramaiah Nagar, P.O. MSRIT, Bengaluru - 560054, India.

² SNAM Alloys R&D Centre, Hosur - 635126.

³ Annamalai University, Annamalainagar, Tamil Nadu – 608002

* Corresponding Author

ABSTRACT

Dioxin is a group of chlorinated compounds consisting over 400 types of compositions, of which, polychlorinated dibenzo-p-dioxins (PCDD) and polychlorinated dibenzofurans (PCDF) are, in particular, extremely toxic. One of the most toxic chemicals ever discovered, it was originally developed as a defoliating agent and later used in chemical warfare, but no longer synthesized commercially. However, dioxin is environmentally persistent and added constantly to the ecosystem as it is formed as an unintentional by-product of many socio-industrial processes. Organic materials containing chlorine release these compounds during heating at relatively low temperature. Municipal incinerators, cement kilns, metallurgical plants, chemical and pesticide manufacturing, pulp and paper bleaching employing different industrial heating processes, large scale bonfires, etc. are held responsible as the major contributors. As the compounds possess different toxicity levels, an equivalent toxicity is calculated for the entire gas mixture and even an extremely low dosage can be fatal. They severely affect the living organisms including human being. Once ingested, it mostly remains in the body and with continuous exposure, keeps on accumulating. Dioxin-exposed poultry/meat/fish brings toxicity to human body. EPA (USA) recommends a safe exposure limit of 6.4 femtograms (6.4×10^{-15} grams) per kilogram of body weight per day, meaning a total lifetime exposure of 0.01 micrograms for a 70kg adult for 70 years. Its exposure beyond limit leads to severe Gastrointestinal, Neurological, Endocrine, Maternal and Child health, Congenital Anomalies, Reproductive, and Psychiatric disorders, as well as abnormalities in gene expression. PCBs can pass along the food chain and bioaccumulate in aquatic animals which ultimately report to the human system through consumption. Brain asymmetry has been reported in many species exposed to *in ovo* 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD). These endocrine-disrupting chemicals (EDCs) are known for their adverse effects on the neurobehavioral, neurodevelopment and cognitive performance aspects. Chronic inhalation of PCBs causes deprivation of attention and emotional well-being. PCBs cause modulation of the endocrine system, including disrupting effects on sexual dimorphic neurobehavior and sex steroid hormones (estrogens and androgens) and maternal exposure of the same causes disruption of the neuroendocrine system development of the fetus during the perinatal period. There too exists a relationship between dioxin exposure and endometriosis. Among the dioxin xenobiotics, TCDD is the most toxic and causes numerous biological responses such as cancer. TCDD induces changes to rat testicular mitochondria even though this has not been reported in human sperm. Its control primarily relates to increase the processing / burning temperature. However, global awareness about its impact is still poor and even emission standards have not been formulated and set for many industries in most of the countries. Consequently, its abatement procedures are rarely followed. Considering its impact even in minute quantities, this imminent and deadly evil must be managed and controlled before it takes its toll. This paper presents an overview of the characteristics, generation, impact on environment and health, abatement, and legislation regarding dioxins.

Keywords: Dioxin, Furan, PCDD, PCDF, I-TEQ, Toxic Emissions, Neurotoxicity, Endocrinedisrupting chemicals (EDC), Maternal exposure, Congenital Anomalies

