

ENVIRONMENTAL IMPACT OF MERCURY ON SUSTAINABLE ENVIRONMENT

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ABSTRACT

Heavy metals are the elements that are mostly found as toxic at a very low concentration. Mercury has a high tendency to aggregate in life forms, the most destructive are natural mixes of Hg, particularly in water, which easily accumulate in organisms. Inorganic types of mercury are extremely versatile yet natural and synthetic procedures can change it into toxic MeHg. Plants and animals, in general, are sensitive to the presence of this component. The main goal of this study is to assess the environmental sustainability and to compare the environmental profiles of the current and emerging technologies. A further goal is to identify the main stages contributing to environmental performance. This will provide the proper framework to evaluate the

opportunities for success for emerging technologies integration in this sector. However, By using these types of toxic metal, we may disperse and pollute our surrounding which may threaten our future generation with an unsafe environment. This review article highlights the impact of mercury on the environment as well as a solution to enhance environmental sustainability.

KEYWORDS: Environment, Heavy metal, Impact, Mercury, Reproductive system, Soil, Water.

INTRODUCTION

The concept of sustainable development was introduced in Burtland's famous report "Our Common Future" which generally says that sustainable development is that which meets the needs of the present without threatening the abilities of future generations to meet their needs.

Initially, heavy metals are used as new materials for the production of goods. Since they are non-renewable resources and their amounts are limited on our planet, sooner or later they may be exhausted, and thus future generations may not be able to meet their needs for heavy metals. This is one side of the problem. The use of heavy metals by our civilization is another problem where they do not disappear from the planet but are dispersed throughout Earth's surface, polluting it, and thus threatening a safe environment for future generations.

Mercury has received particular attention of its potential to harm human and surrounding. Mercury is widely spread and obdurate heavy metal that occurs in three forms in the earth. Conversion of mercury into other forms depends upon two types of reactions

- a) Oxidation-reduction(redox) reaction
- b) Methylation-demethylation reaction

In oxidation-reduction reactions, mercury is either oxidized to a higher valence state (e.g., from the relatively inert Hg^0 to the more reactive Hg^{2+} or through the loss of electrons reduced, the reverse of being oxidized, to a lower valence state.

1. Hg metallic form which is found as a whitish shiny, odorless liquid at room temperature or vapor at high temperature due to evaporation.
2. Hg^{2+} mercurous form found as an inorganic salt of mercury combined with sulfur, chlorine, and oxygen.
3. Hg^+ mercuric form found as an organic compound in combination with carbon.

Hydrargyrum (hydra means liquid and gyrum means water) is the historical name for mercury, so the 'Hg' used. The vast percentage of mercury in the atmosphere is vapor form which remains throughout the year. So mercury gets widely spread over long distances quickly from sources of emission in water, soil, plants, and animals. Organic mercury compound has a long list example are: methylmercury, dimethylmercury, phenylmercury, ethyl mercury, etc. but most common is methylmercury.

Mercury can cause hearing and eyesight issues. The amount of damage depends on the scale of exposure to mercury. In infants, severe brain damage due to mercury is seen. This heavy metal concentration continually increasing in the forest, topsoil, and lakes bed. Since the level of heavy metals is increasing, there is an immediate need to reduce the deposition. (J. S. Adiansyah, 2017).

As mentioned above, the implementation of sustainable development requires a reduction in energy consumption because natural reserves are limited and their combustion increases the concentration of CO₂ in the atmosphere, which seems to lead to climate change. (Pawlowski A., 2019)

Ezio Ranieri *et al.* 2019 reported that Mercury is a highly toxic element as well as global environmental pollutants which may affect the sustainability of the environment.

Sunderland *et al.* 2009 described mercury concentration in seawater by using a combination of different observation data & modeling simulation. He reported that it will rise by about 50% in 2050.

Bellanger *et al.* 2013 reported methyl mercury toxicity in European countries. He described the association between long term IQ deficits with Hg exposure. Therefore, He suggested decreasing the emission of mercury to support regulatory efforts.

Elaine Fabre *et al.* 2019 reported about the prevention of mercury exposure by using banana peels as biosorbent.

Impact of Mercury in the Soil

The effect of heavy metal on solid is tedious work to relate with accuracy to the concentration limits of a different metal. The impact of toxicity due to heavy metal is first shown in soil respiration on decomposition and nitrogen mineralization. The enzyme is highly sensitive to metal toxicity.

Mercury has the property to dissolve metals. They help in the making of amalgams. Dental amalgams have old latex cones also emits mercury. (Adiansyah, 2015) Skin lightening creams and soap also have a portion of mercury. Due to occupational exposure in factories, industries that manufacture thermometer, barometer, battery, dental amalgams, paints, disinfectants, Dimethyl mercury is mainly needed in magnetic resonance spectroscopy. These ways lead to hazardous exposure to mercury. One major survey of Sweden shows that 80 tons of batteries contain 900 ppm of mercury excluding mercury cells. This is dangerous and needs attention a few years before Sweden is declared mercury-free, which means the max. the limit should not be more than 250 ppm. (Rathore, 1997)

Impact of Mercury in the Reproduction system

Due to small size, these metal cross the placenta and got collected in fetal tissue. Females, due to the effect of heavy metals become infertile and have disbalance in hormonal level. However, the toxic effect of mercury occurs in both the male and female reproductive systems. It leads to congenital disability, sperm motility reduction, impotence, infertility, etc. (Boger, 2013)

Higher rates of abortion also reported when spouses exposed to occupational mercury vapor. Chronic exposure to toxic mercury drastically affects fertility, fetus development, and pregnancy. There is a direct relation between methyl mercury levels and several malformation and abortion.

Inorganic mercury is also released through breast milk to infants. In the last ten years, cases of autism increased ten times. These increased cases are a topic of severe debate and immediate action. One theory claims due to vaccines containing mercury preservatives, mothers' milk lead to mercury toxicity in infants and fetuses.

Impact of Mercury in water

Since the oceans are a sink for most heavy metals, there is a danger that growing heavy metal concentrations in the marine environment will disturb plankton growth. These may affect not only the food chain in the marine environment, but also decrease CO₂ assimilation by plankton, one of the very important global sinks of CO₂. This would accelerate climate change and may affect the aquatic food chain.

Prevention of mercury exposure

We should also seek to develop sources of energy and materials which are replaceable or self-regenerating, and as non-polluting as practically possible.

One proposed method of reducing energy consumption is to use fluorescent bulbs. However, the solution to one global problem creates another fluorescent bulb contain small amounts of mercury vapor and larger amounts of mercury in a powder or dust form, both of which can become airborne if the bulb breaks. If the breakage is not cleaned up properly, the mercury may continue to circulate. Disposing of these bulbs in the trash can cause also serious harm to health and the environment.

The other best way to decrease Hg exposure is to reduce its sources. To treat soil, water bodies at a vast level, newer technology is in high demand. A genetically engineered plant having mercury resistant bacterial genes merA and merB are developed. Herbal drugs like speman are used against HgCl toxicity.

The use of biosorbent such as banana peel also studied in a different solvent. (Elaine Fabre *et al.* 2019). The capacity to absorb Hg should be examined under seawater, wastewater, which leads to promising reports. Hence a counter-current two-stage unit is designed for the application of banana peel as biosorbent.

Researchers must develop a vaccine without the use of Hg. In the Health sector, Hg free mercury equipment for measuring and treatment should be used. The main target should be on reducing man based sources of mercury.

CONCLUSION

We all are knowing the toxic effect of mercury on environment animals and humans. The especially fish-eating population is more vulnerable to mercury poisoning due to biomagnification. Occupational health hazard for gold miners, dental personnel is on a dangerous level. Safety must be increased on an individual level.

World organization, national governing bodies must focus on mercury-free process developments, use of mercury-free equipment in medical fields, industries, etc. proper disposal guidelines must be strictly followed. Excellent training, secure storage, and less usage are keynotes to be developed to reduce mercury-like heavy metal toxicity.

Researchers should try to build on existing knowledge by employing previously studied biomarkers in new situations or species, or replicating previous studies with lower levels of mercury exposure while the role of methylated heavy metals (monomethyl, dimethyl, trimethyl, and tetramethyl mercury) in the migration of heavy metals in the global environment needs to be better understood.

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