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Manganese Exposure and Toxicity

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Abstract

One of the main essential elements for human is Manganese (Mn). Furthermore Mn is a row material for many king of ferrous foundry and there is a working exposure to Mn for workers in the workplaces. High exposure to Mn can result in increase in human tissues levels and neurological effects. Though, there should be some threshold limit value for Mn exposure related to adverse effects may occur and increase with higher exposures further than threshold limit. Conclusions from scientific literatures related to Mn toxicity revealed that this pollutant can effect on brain system and create some neurological disorders or neurological endpoints which measured in many of the occupational health assessments. Many researches have tried to show a relationship regards to biomarkers with neurological effects, such as neurological changes or magnetic resonance imaging (MRI) changes have not been founded for Mn. More precise study need for Mn risk assessment for industrial pollution exposure and it will be used to recognize situations that may guide to understand Mn accumulation on brain and Mn metabolism in different exposed workers. Workplace evaluations for Mn will prepare valuable scientific information for the development of more scientifically sophisticated guidelines, regulations and recommendations for future study and for Mn occupational toxicity control and exposure prevention in the related workplaces.

Keywords: Manganese; Working exposure; Biomarker; Occupational health

Introduction

There are many chemical materials which can affect on human health as air pollutant, one of them is manganese exists as airborne particulate matter in ferrous foundries is manganese particle. Furnacemen are exposed to manganese (Mn) in the workplaces from both naturally occurring processes and processing activities. There are variety of pollution sources in such factories include furnaces, melting process, cars, lift trucks, sanding and combustion. Because of their small size particles, tend to remain and suspending in the air for long periods of time (weeks or months). Usually, the health effects of Manganese (Mn) airborne particles for human are likely to depend on several parameters, including the ingredient of melting materials, duration of and level of exposure, size of the particles, and individual characterization of the exposed subject. High exposure to airborne manganese may tend to accumulation of the compound in the basal ganglia of the brain [1,2], where it may toxic condition for subjects [3]. Researchers illustrated that the neurological disorder of manganese (`manganism') that bears many similarities to Parkinson's disease for exposed workers [4-6]. To prevent of work-related disease early indicators of the clinical effects and sensitive parameters of manganese exposure are needed. The major parameter to control the exposure is time weighted average exposure for manganese airborne particulate concentration is about 1 mg/m^3 in workplaces. The manganese preclinical adverse effects have been observed to cause in the central nervous systems in workers exposed for less than 20 years [7]. A few studies have revealed basis subclinical intoxication which has been observed in manganese exposed workers with moderate (1 ± 4 lg/l) increases in B-Mn [8,9]. The foundry furnacemen are potentially exposed to manganese pollution during melting, weighting, transportation of recycled manganese-alloyed iron scrap from storehouse to furnace as well as manganese fumes exposure from the furnaces, especially during smelting in the foundry workplace. The non-furnace workers may be potentially exposed to manganese during the handling of manganese-alloyed iron and preparing of the production and maintenance. There is a need to find personal exposure with manganese particles in foundry factory based on local psychrometric condition such as relative humidity, dry bulb temperature, wind speed and altitude; it may improve our understanding of what humans are actually exposed to and how to reduce this exposure. Assessment of indoor air quality may carry out by variety study models such as regression model or multiple linear models aimed for pollution estimation with emphasis on particle matter distribution of effectiveness by psychrometric parameters in the workplaces. Similarly, regression model was used before by other researchers in terms of pollution predictive model [10-12].

Manganese Exposures

The ferrous foundry iron and steel industry is especially different in materials and processes, resulting in occupational exposures to a wide variety of substances. The introduction of organic binder materials in the late 1950s has resulted in exposures of foundry workers to other chemicals, including phenol, formaldehyde, isocyanates and various amines. Earlier exposure studies have been reviewed previously (IARC, 1984). Furthermore, the main toxic element in the foundry workplaces is airborne manganese which inhales by exposed worker. The threshold limit value (TLV) for Mn exposure according to NIOSH standards for fine particulate matters in the factories should not exceed 1 mg/m^3 (NIOSH).

Mn Biomarkers of Exposure

According to occupational health studies, blood and urine Mn levels have been the most widely used biomarkers of exposure for researchers. The range of manganese (Mn) for normal whole blood is from 7-12 µg/l and 0.6 to 4.3 µg/l in serum [13]. Blood Mn (Mn B) is not

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a good indicator of the quantity of Mn absorbed for short term before sampling or occurring during the earlier days, because it changes very little with inhalation exposure [14]. Urinary Mn (MnU) excretion is not a good indicator of Mn exposure, because Mn is typically excreted in the bile, and only approximately 1 percent is excreted in urine [13]. Mn toxicology assessment related to human hair is also not a reliable indicator of exposure, as there is possible for external Mn exposures that may affect Mn levels in hair [15]. Mn level for normal urine is usually less than 1 μg/l and hair levels are normally below 4 mg/kg1. Mn half-life in blood is 10 to 42 hours [16] and less than 30 hours in urine [17].

Carcinogenic in Humans

Numerous cohort studies revealed the effect of manganese exposure on human who working as iron and steel founding workers in various parts of the world. Closely all of these show a significantly increased risk for lung cancer, either in the entire cohort or in high-exposed subgroups [18-24]. Based on a cohort study from the United Kingdom [22] an internal dose–response in terms of years of employment was found. Other researchers from the USA explained a significantly increased lung-cancer risk after adjustment for smoking history [25]. According of two additional cohort studies, relative mortality revealed supporting proof for an increasing of lung cancer chance among furnacemen [26,27]. Other researches demonstrated a statistically significant increasing of lung cancer in association with foundry workers with adjustment for smoking [28,29].

Conclusion

Mn is a neurotoxic substance at convinced exposure levels despite of route of exposure; however, there is a lake of data on the time weighted average for the development of subclinical neurological or neurobehavioural. While the understanding of the occupational exposure of Mn continues to be developed for the various types of Mn and in different working groups, more refined and health risk assessments may be developed for Mn.

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