Short Communication

iMedPub Journals
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Global Journal of Research and Rreview
ISSN 2393-8854

2020
Vol.7 No.1:50

DOI: 10.36648/2393-8854.7.1.50

A Chemical Disaster in Vizag during Covid-19 Pandemic

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Received date: May 23, 2020; **Accepted date:** July 20, 2020; **Published date:** August July 27, 2020

Citation: Simha K (2020) A Chemical Disaster in Vizag during Covid-19 Pandemic. Glob J Res Rev Vol.7 No.1:50. DOI: 10.36648/2393-8854.7.1.50

Abstract

The disastrous leak of a toxic styrene has killed several people and left nearly thousand people sick near Visakhapatam in Andhra Pradesh. The toxic gas was leaked from the LG polymers plant that is situtatedin a densely populated suburb, the company uses raw material styrene to make products used in manufacturing electric fan blades, cups and cutlery and containers for cosmetic products such as makeup. The present paper gives a breif outline regarding chemical and physical properties of styrene, and its toxic effects.

Keywords: Styrene; Monomer; Polymer; Toxic; Pandemic; Pollutant; Vinyl benzene; Neurotoxic; Carcinogenic

Short Communication

The disastrous leak of a toxic styrene has killed several people and left nearly thousand people sick near Visakhapatam in Andhra Pradesh comes as a shock to our country when actually we are struggling to cope with a prolonged lockdown. The toxic gas was leaked from the LG polymers plant that is situtated in a densely populated suburb, the company uses raw material styrene to make products used in manufacturing electric fan blades, cups and cutlery and containers for cosmetic products such as makeup. The residents of Gopalapatam, R.R Venkatapuram, Padmapuram, B.C.Colony, and Kamparapalem were severely effected as the hazardous styrene vapour swept through the area at night, killing several people and many becoming unconsious making them the first victims of exit from the lockdown. Inhalation is the major route of styrene exposure with 60–70% of the inhaled styrene being rapidly absorbed. The primary metabolic pathway involves the oxidation of styrene to styrene-7,8-oxide by several CYP isoforms followed by subsequent hydrolysis to styrene glycol. The general population is primarily exposed to low levels of styrene in ambient air, in drinking water, and by consuming food contained in styrene-based packaging material. Majority of the styrene exposure occurs among occupationally exposed workers in the reinforced plastics industry. Styrene the present air pollutant, the emission factors are reported as representative values that attempt to relate the quantity of a styrene pollutant released to the ambient air with an activity associated with the release of that pollutant. These factors are usually expressed as the weight of pollutant divided by a unit weight, volume, distance, or duration of the activity emitting the pollutant (e.g., kilograms of particulate emitted per tonne of coal burned). Such factors facilitate estimation of emissions from various sources of air pollution. In most cases, these factors are simply averages of all available data of acceptable quality, and are generally assumed to be representative of long-term averages. The present paper gives a brief description of the dangerous styrene, a chemical in the LG polymers plant that had been unattended since March due to the Covid-19 lockdown.

Styrene is a colorless, sweet smelling liquid that serves as a key ingredient for plastics and polymers [1-3], also known as ethenylbenzene, vinylbenzene, and phenylethene, is an organic compound with the chemical formula C6H5CH=CH2. This derivative of benzene is a colorless oily liquid although aged samples can appear yellowish. The compound evaporates easily and has a sweet smell, although high concentrations have a less pleasant odor. Styrene is the precursor to polystyrene and several copolymers. The compound is widely used to make plastics and rubber. Consumer products like packaging materials, insulation for wiring and appliances, fibreglass, plastic pipes, automobile parts and drinking cups contain styrene.

Styrene is insoluble in water; soluble in acetone, diethyl ether, and ethanol; and highly soluble in benzene and petroleum ether. Styrene, produced naturally by plants, bacteria, and fungi, was first isolated in 1831 by distillation of storax, a natural balsam from trees of the genus Liquidambar. Styrene is named after storax balsam, the resin of Liquidambar trees of the Altingiaceae plant family. Styrene occurs naturally in small quantities in some plants and foods like cinnamon, coffee beans, and peanuts [4] and is also found in coal tar. Commercial production of styrene via dehydrogenation of ethylbenzene began in Germany in 1925 and is also synthesised from ethyl benzene, from toulene and methanol and pyrolysis gasoline etc,

Polymerisation: Styrene is a highly reactive molecule, which tends to polymerize strongly at temperatures >90°C. The presence of the vinyl group allows styrene to polymerize. Styrene is a polymerizable substance of formula CH2=CH(C6H5), whose homopolymerization yields polystyrene (PS). It can be polymerized with numerous other monomers to yield copolymers. Styrene units have a strong UV absorption, which

means that polystyrene and styrene-containing copolymers can be monitored by UV detectors. Commercially significant products include polystyrene, ABS, styrene-butadiene (SBR) rubber, styrene-butadiene latex, SIS (styrene-isoprene-styrene), S-EB-S (styrene-ethylene/butylene-styrene), styrene-divinylbenzene (S-DVB), styrene-acrylonitrile resin (SAN), and unsaturated polyesters used in resins and thermosetting compounds. These materials are used in rubber, plastic, insulation, fiberglass, pipes, automobile and boat parts, food containers, and carpet backing.

Styrene is regarded as a "known carcinogen", especially in case of eye contact, but also in case of skin contact, of ingestion and of inhalation, according to several sources [5,6]. Styrene is largely metabolized into styrene oxide in humans, resulting from oxidation by cytochrome P450. Styrene oxide is considered toxic, mutagenic, and possibly carcinogenic. Styrene oxide is subsequently hydrolyzed in vivo to styrene glycol by the enzyme epoxide hydrolase. The U.S. Environmental Protection Agency (EPA) has described styrene to be "a suspected toxin to the gastrointestinal tract, kidney, and respiratory system, among others". On 10 June 2011, the U.S. National Toxicology Program has described styrene as "reasonably anticipated to be a human carcinogen". However, a STATS author describes a review that was done on scientific literature and concluded that "The available epidemiologic evidence does not support a causal relationship between styrene exposure and any type of human cancer". Despite this claim, work has been done by Danish researchers to investigate the relationship between occupational exposure to styrene and cancer. They concluded, "The findings have to be interpreted with caution, due to the company based exposure assessment, but the possible association between exposures in the reinforced plastics industry, mainly styrene, and degenerative disorders of the nervous system and pancreatic cancer, deserves attention". In 2012 the Danish EPA concluded that the styrene data do not support a cancer concern for styrene. The U.S. EPA does not have a cancer classification for styrene, but it has been the subject of their Integrated Risk Information System (IRIS) program. The U.S. National Toxicology Program of the U.S. Department of Health and Human Services has determined that styrene is "reasonably anticipated to be a human carcinogen" [7]. Various regulatory bodies refer to styrene, in various contexts, as a possible or potential human carcinogen. The International Agency for Research on Cancer considers styrene to be "probably carcinogenic to humans".

The neurotoxic properties of styrene have also been studied and reported effects include effects on vision although unable to reproduce in a subsequent study and on hearing functions. Studies on rats have yielded contradictory results, but epidemiologic studies have observed a synergistic interaction with noise in causing hearing difficulties.

Conclusion

The low levels of chronic exposure to styrene may be carcinogenic. According to the United States Environmental Protection Agency (EPA), short-term exposure to low levels of styrene in humans can cause irritation in the mucous membrane and eye, and gastrointestinal effects. Long-term exposure, on the other hand, results in effects on the central nervous system, leading to headaches, fatigue, weakness, hearing loss, nerve damage and depression [3]. According to the Health and Safety Executive, a UK government agency responsible for regulation and enforcement of workplace health, safety and welfare, the chemical can cause loss of consciousness and death at high exposure levels.

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