



Impact of firecracker factory accident on environment: A case study

Kirti Gour, Navneet Sen, Raksha Pandey, Ram Krishna Shrivastava

Department of Chemical Sciences, Institute for Excellence in Higher Education, Bhopal, India

Abstract

There is always a risk involved in firecrackers factories and this can have a significant impact on the environment. The present study deals with the causes, consequences and mitigation approaches related to the recent firecracker factory accident occurred in Harda district of Madhya Pradesh. It also examines the environmental impact on air, soil, water and loss of biodiversity as a consequence of the accident. The factory explosion exposed the harsh realities of industrial mismanagement and ignorance, a tragic reminder of its dire consequences. The study also analyses the significant impact on human health and overall safety in the workplace. To effectively reduce environmental risks within a firecracker factory, the study's findings reveal an urgent need for vigorous safety measures and sustainable practices.

Keywords: Firecrackers, explosion, environmental impacts, pollution

Introduction

The firecrackers industry is a most profitable business in India and many such industries are now a days operating across the country. The use of firecrackers on many occasions in the country are well known. At the same time, the production of firecrackers leading the threatening of many lives in the country by other means^[1-2]. In the month of February, 2024 when several serial explosions in a firework factory in Harda, Madhya Pradesh occurred, the workers and other neighbourhood people were struggling to save their life and leading to the deaths of eleven individuals and causing injuries to more than 200 others^[3-4]. The firecracker factory located in the Bairagah area of Harda got massive explosion and damaged several houses, vehicles, animals and other structures situated in the vicinity of the area. The entire area of kilometres filled with black smokes and unbearable sound of explosion. People were helpless to do anything and it was a horrible scene not to forget for the years to come. The incident took place when a fire broke out in the factory building, leading to massive explosions and the collapse of the building within minutes. Such incidents have not happening first time in the history but several at times we have witnessed of many industrial accidents in the country. The blasts also encompass environmental repercussions such as pollution, health issues, soil pH alterations and various other forms of environmental damage that transpired on that day.

Methodology

The potential environmental impacts of the firecracker factory accident were investigated. The study covers various sources of information such as print and electronic media coverage, views of victims, eyewitnesses to the accident, local administration and face-to-face discussions.

Root causes of the firecracker factory accidents

Over the years, several firecracker explosion incidents have occurred in various regions of India such as Tamil Nadu, Kerala and Madhya Pradesh are among the other states^[5]. Firecracker explosions can be caused by a number of factors including illegal and improper storage of firecrackers and

gunpowder. Based on investigation of findings, the major contributing factors to the occurrence of the incident are

- 1. Safety lapses:** The major cause of explosions in firecracker factory was safety oversights, including mishandling of explosive substances, substandard storage facilities and improper manufacturing procedures. Failure to comply with safety protocols and standards are the reasons behind the accidents. The utilization of diverse chemicals in firecrackers poses a risk of unexpected reactions and potential explosions, if mishandled or improperly combined.
- 2. Unskilled and untrained human resources:** The manpower engaged from the nearby localities in the manufacturing process of the firecrackers were not enough skilled. It was observed that the understanding about the handling of hazardous chemicals was not up to the level. Improper handling of explosives and failure to adhere to safety protocols were among the reasons to lead to accident. Lack of training and unawareness of safety procedures act as a contributing factor to the incident.
- 3. Inadequate safety protocols & fire alarm system:** For every hazardous manufacturing unit, certain safety protocols are designed and fire alarm system to be in place, but such intensive approaches looking to the safe production of firecrackers was not realised. Firefighting facilities and adequate safety measures were not taken care properly.
- 4. Regulatory non-compliance:** Timely renewal of licence or getting a new licence from competent licensing authority need to be followed and other regulatory compliances was also not realised.
- 5. Environmental factors:** There is always a risk of impact on the environment due to the use of various chemicals in the production of firecrackers and hence adequate care and precautions should be taken, but this was lacking in the case.

The understanding about these root causes is crucial for implementing effective prevention strategies and mitigating environmental risks. Now, the study reveals the following impacts on the environment:

Firecracker factory accident's impacts and consequences on the Environment

There are many consequences and impact of the accident on environment and human health such as air pollution due to formation of toxic gases and particulate matter, noise pollution due to unexpected explosion, water pollution due to percolation of chemicals in water sources, ground water contamination, imbalanced in entire ecosystem, soil pollution due to heavy metals and other biproducts of chemical reactions along with long term loss to the biodiversity of the area ^[6-7]. Some important impacts are as follows

Impact on Air and its consequence: The major impact on air is due to the explosion of firecrackers in the factory which generate smog and toxic gases. It has severe repercussions on health for both humans and animal, led to respiratory issues, hormonal disruptions and other health complications. During the explosion, the harmful fumes emitted also containing various chemicals and heavy metals such as sulphur, lead, copper, barium, strontium, cadmium and toxic gases. Particularly, sulphur dioxide which is a harmful gas known to exacerbate respiratory issues and contribute to the formation of acid rain. The nitrogen dioxide is another air pollutant generated and that can irritate the lungs and worsen respiratory conditions. Other air pollutant as fine particulate matter impact on the lungs deeply, posing risks to human health and the environment. These include asthma, chronic obstructive pulmonary disease and lung cancer. These substances linger in the air for several days, leading to a substantial increase in air pollution levels. Prolonged exposure to these pollutants can give rise to serious health complications, encompassing respiratory ailments and cardiovascular diseases. Particles from air pollution has infiltrate the bloodstream, increasing the possibility of heart attacks, strokes, and additional cardiovascular issues. Air pollution inducted through firecrackers incidents has also linked to cognitive decline, diabetes, and specific birth defects, among other health concerns. Many of residents of the area are facing such health-related challenges.

Impact on soil and its consequences: Severe firecrackers explosion exacerbates soil pollution through releasing harmful chemicals and deposition heavy metals on soil surface, even at very high temperature, percolation of such chemicals inside the soil. Soil composition degradation of the area has also reported. Very high temperature along with harmful chemical reaction on soil surface affected the vegetation and agricultural practices of the area ^[8]. The soil's fertility and an increase in soil acidity and consequently a decrease in pH adversely affects the habitat of microorganisms and destroying ecosystem and biodiversity. At the time of accident, adversely the raise in temperature of the area, deadly affected the beneficial soil organisms.

Impact on surface water resource and groundwater sources: Toxic gases released during the incident, heavy metals and other residual harmful chemicals used in the

factory comes out in the atmosphere and pollute water sources on contact. They even percolate into the soil and pollute groundwater reserves. The explosion of firecrackers releases a variety of chemicals such as nitrates, perchlorates and heavy metals into the atmosphere, which then get deposited in nearby water bodies, and can pollute them ^[8]. The immediate and long-term impacts of the Harda firecracker factory accident on human lives, the environment, and the local economy will also be observed as the time progresses.

Impact of noise and its consequences: As we know that the significant noise generated during the explosion have detrimental effects. The level of explosion noise goes beyond the optimum decibel range in the area on that day of incident and was spread in the periphery of more than five kilometres. Such a huge level of noise has a capacity to induce anxiety or stress, affecting mental well-being. Individuals have struggle with sleep-related issues, hearing loss, cardiac issues, stress and growth-related issues. Such level of noise pollution has influence on stress hormone levels and the nervous system can contribute to the onset of diseases related to the cardiovascular system and mental health. Even the child in the womb of a mother can have an impact of it. In the plant kingdom vibrations occurred during the incidence disrupted their growth and other aligned issues. Even in the animals some abnormal changes in their behaviour have been reported in the area after the incidence ^[9-10].

Measures for prevention of incident and Recommendations

As the study revealed that an enormous impact of incident on the environment has observed and hence some proactive measures like safety of the workers on workplace, prior training, follow strict safety protocol, technological upgradation and regulatory compliance can overcome the risk of accidents and provide better workplace environment. Some of the mitigation are as follows

- 1. Proper training of the workers:** As mishandling of hazardous chemicals and lack of awareness of the protocols are the main reasons behind the accidents, so it is necessary to employ the works only after the proper training related to production of firecrackers.
- 2. Automation in production:** By which human errors can be minimise.
- 3. Advanced safety system:** Ensure the proper working of firefighters and fire alarms.
- 4. No production activity should be allowed outside the factory premises:** Strictly avoid home-based working culture, production of firecrackers should be only within the factory campus. Carelessness and mishandling of hazardous chemicals at home by individuals exacerbates the risk of accidents. To mitigate these risks, it is imperative to prohibit such activities.
- 5. Proper disposal of waste:** From environmental and ecological point of view, it is mandatory to dispose any waste generated as per protocols.

6. **Safety and environmental audit:** Periodical audit can help to assess the vulnerability involved in the operation of factory and can minimise the environmental impact.
7. **Supervision and compliance monitoring by government authority:** To ensure the compliance of guidelines, rules and regulations related to the production of firecrackers, the regular visits of the authority should be compulsory, particularly the validity of licence, safety equipment and compliance of the regulations should be up to date.
8. Awareness and vigilance of local citizens can also play a significant role to report any illegal operations of factories in their areas.

Result and Discussion

The impact analysis and their consequences clearly indicate the seriousness of the issues. Such incidence not only affect the environment at the time of happening but they affect the entire eco-system for the years to come. Therefore, it should be a fervent need of a clear action plan with the standard operating procedures from the respective agencies of the government to execute it in an imperative basis. Mandatorily, an effective surveillance system, reviewing the storage facilities, training of men power involved in the factories and issuing cum renewal of licence should be in a planned manner. The firecrackers blast incident was a negligence of regulations and human error which damaged not only the environment but also the happiness of many families, create pollution, and harm inflicted are permanent. The honourable Supreme Court of India has already issued restrictions to use firecrackers and banned crackers that are loud and toxic to man, animal and the environment^[11]. It is a big challenge for the authorities to stop producing such firecrackers which create not only huge air pollution but also create noise pollution along with solid waste problems.

Conclusion

The firecracker factory accident stands as a tragic reminder of the devastating consequences of industrial mishaps. How utter ignorance can lead the threatening of life of innocent people and their families. In conclusion, the study highlights the importance of proper vigilance and compliance of rules and regulations in factory operations. It is equally important to train the workers to work in the safe workplace. At the same time, it is an ardent need to protect the life and livelihood of the workers, so that the risk of accidents in firecracker factories can be reduced.

References

1. Accident data analysis and hazard assessment in fireworks manufacture, S. Mahadevan, *et al.*, Science and Technology of Energetic Materials, 2008;69(5):161-168.
2. A Review of Risks to Workers Associated with Fireworks Industry, D. Katoria, *et al.*, International Journal of Environmental Engineering and Management, 2013;4(3):259-264.
3. <https://timesofindia.indiatimes.com/city/bhopal/madhya-pradeshs-harda-firecracker-factory-blast-fire-dozen-injured/liveblog/107455125.cms>

4. <https://www.hindustantimes.com/india-news/madhya-pradesh-fire-live-updates-mp-harda-firecracker-factory-blast-death-injury-latest-news-today-6-february-2024101707212148779.html>
5. Accident analysis in fireworks industries for the past decade in Sivakasi, N. Rajthilagam, A. Azhagurajan, International journal of research in social sciences, 2012;2:170-183.
6. https://www.researchgate.net/publication/367559475_Toxicological_impact_of_Fireworks_on_Environment_and_Human_Health
7. <https://www.sciencedaily.com/releases/2023/01/230130213944.htm>
8. <https://www.britannica.com/science/soil/Soil-pollution>
9. <https://www.cdc.gov/niosh/topics/noise/default.html>
10. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9503271/>
11. <https://www.pcbassam.org/Supreme%20Court%20Order%20reg%20Ban%20on%20Sale%20&%20Use%20of%20Firecracker.pdf>