
Case Study: Bhopal Gas Tragedy

Harmandeep Singh & Arvind Rehalia

Student, Bharati Vidyapeeth, College of Engineering, New Delhi, India

Associate Professor, Bharati Vidyapeeth, College of Engineering, New Delhi, India

Abstract: Bhopal gas Tragedy is one of the biggest process industry disaster in the world. It occurred on 2-3 December 1984 in BHOPAL. It leads to several thousand deaths and more than 500,000 people being exposed to MIC and other hazardous chemicals and causing a disaster which is sometimes referred to as the world's worst industrial disaster. In this paper author provides a case study on Bhopal gas tragedy. Author also finds the reasons and suggested the measures so that such kind of event should not happen again.

Keywords: Methy Isocyanate, Phosgene

I. INTRODUCTION

On the night of 2nd-3rd December, methyl isocyanate (MIC) a deadly gas leaked over the city of Bhopal from the plant of union carbide India limited(UCIL) at Bhopal, Madhya Pradesh which manufactured pesticides. It leads to several thousand deaths and more than 500,000 people being exposed to MIC and other hazardous chemicals and causing a disaster which is sometimes referred to as the world's worst industrial disaster.

The chemical spill turned the UCIL factory into a gas chamber. The people were running, dying, vomiting. The city ran out of cremation grounds. The government had no idea on how to help the affected people. The plant was controlled by UCIL which is a subsidiary of the used based company UCC (Union Carbide Corporation), which provided negligible help to deal with the ongoing tragedy.

The main problem was nobody knew anything about its antidote or how to treat the toxin. The disaster resulted in people suffering from ailments such as anemia, tuberculosis but nobody could find the complete health effects caused by MIC and how to treat it. The treatment research was even more complicated by the fact that children born to mothers who were exposed to the gas were also the victims of the release.

Another factor which makes it worse is that till date, even after 32 years there has been no closure in the report on what actually caused the disaster. Negligent management and poor maintenance standards being observed caused the routine pipe maintenance to backflow of water into the MIC storage tank triggering the disasters claimed by the government and the local activists, while at the same time UCC still claims that it was caused by water entering the tank due to some act of sabotage.

Pre-Leak Phase

The UCIL factory started its production of the pesticide sevin in 1969 using mic as an intermediate. A plant was set up in 1979 to produce MIC. The chemical process used in the Bhopal plant controlled a reaction of methylamine with phosgene to form MIC, which was further reacted with 1-naphthol to give the final product known as carbaryl.

Earlier leaks

In 1976, there were complaints of pollution by the production employees of the plant. In 1986, a maintenance employee was splashed with phosgene and died within 72 hours. In 1982 24 workers inhaled phosgene gas and were admitted to a hospital and another 18 workers were affected. A chemical engineer in August 1982 suffered 30% burns over his body on coming in contact with liquid MIC. Later that year there was another MIC leak. In 1983 and 1984 there were several leaks of

hazardous gases such as MIC, chlorine, phosgene and monomethylamine. Hence these kinds of occurrences were not uncommon in the UCIL plant and it was not a safe working place.

The leak and its effects

The UCC facility used three tanks to store 15000 gallons of liquid MIC produced which and it was to be kept under pressure using inert nitrogen which helped the pumping of MIC when needed and also kept impurities at bay. The safety regulations specified that the maximum 50% of the tank should be used for storage. Another disadvantage of using MIC was that it had to be stored at 0 degree Celsius at all times to keep it inert.

In the last days, October 1984, the E610 tank lost its ability to maintain the nitrogen pressure which halted the production of MIC in the plant. The production was soon started again despite a failed attempt of reestablishment of the system and the 42 tons of remaining MIC was ignored.

On the night of 2nd December 1984 around 10:30 pm, with the MIC safety systems not working to their full efficiency, water from a connecting pipe was introduced in the E610 tank causing a catastrophic exothermic reaction damaging the system and causing the leak of MIC. It did not take long for the gas to spread over the city of Bhopal causing great panic among the residents.

The initial effects were breathlessness, severe irritation in the eyes, coughing, a feeling of suffocation and burning of the respiratory tract. People realizing the symptoms ran away from the plant. Several thousand people were victims and had died before the following morning. The primary factors causing the deaths were choking, collapse of circulatory systems, changes in the lungs and improper functioning of the kidneys are a few among many. The neo natal mortality rate rose manifold. The Indian council of medical research (ICMR) was forbidden to give out the data to the public but estimates say that more than 500,000 people were affected by it. The few implications known were in eyes, respiratory tracts, neurological systems and psychological effects.

What caused the leak and how it could have been avoided?

The route chosen for the production of the pesticide sevin using mic as an intermediate, was itself a major mistake as it had a lot of complications tagged with it. The liquid MIC had to be stored at 0 degree Celsius at all times even while transporting it in barrels from the storage to the production house which is next to impossible. And for proper use it had to be kept at a high pressure using inert nitrogen which was again required a strong technical system. Other manufactures were using an alternate MIC free route for producing sevin.

The MIC supervisor ignored the complaint by the workers of a pollution caused by MIC leak and made the decision to consider it after the tea time which gave the gas enough time to escape to the city. Even after this mistake, the alarm for the residents near the plant was not used to its function and most of the people figured it out when they started to feel its symptoms.

The safety specifications set up by the UCC were not implemented properly and were given a blind eye whenever it caused a malfunction. The storage tanks were filled much over the specified limit of 50%. the refrigeration system used to maintain the temperature of liquid MIC was not in working condition since January 1982. The flare tower used to burn the MIC was faulty and also of improper size to deal with a leak of MIC. The storage system was lacking the specifications needed to control a leak of this magnitude. The production workers were not trained properly about the safety procedures to follow at all times. This was done to reduce the training time and costs of training being bared by the company.

All the effects of the disaster could have been mitigated if the government had information about the effects and composition of the chemicals used. The UCC used trade secrecy as a right to contain

information about the true composition of the leaked gases. Though it was known that upto 300 toxic chemicals but insufficient research was done and that too only on animals. it was a clear case of criminal negligence.

The diseases could have been managed if the government had been given the complete information about the composition of chemicals used and their long-term effects on the human body. ICMR started 24 studies about the effects of MIC but unfortunately none of them were completed and were shut down by 1994.

Will there ever be ever a closure?

It's been more than 32 years since the disaster struck and yet an exact causative of the disaster has not been established. The sufferings of the victims have continued to haunt their lives ever since. The compensation has only been offered to 20% of the real number of victims and many of those have also not been given the complete proposed composition. The paltry composition given is nothing in comparison to their mounting medical bills. The victims continue to fight for justice and nobody pays heed to their continuing struggle. The complete responsibility has been put upon the courts to decide and the state and central government have taken a backseat. The government needs to step up and complete all the promises made to the victims and help them mitigate the effects it has made on their lives.

II. BHOPAL GAS TRAGEDY 2.0

The legacy of UCIL still is still haunting the people of Bhopal. The three pesticides produced by the company, namely carbaryl (trade name Sevin), aldicarb (trade name Temik) and a formulation of carbaryl and gamma-hexachlorocyclohexane (g-HCH). 15 years before the disaster it continued to dump process waste and other hazardous by products in and around the area of the factory. Since then 350+ tonnes of waste has been kept leaking at the site and it is still lying there. Nobody is ready to pay for the disposal of the waste and keep playing the blame game on each other. This has resulted in adulteration of the ground water in a 3km radius around the premises of the factory. The test results have been found toxic for the fish. If not taken proper care this Bhopal gas tragedy 2.0 threatens a greater no of people than the first one as some of these chemicals can remain there up to 100 years unless taken care of and the site is decontaminated.

The work does not end herein India we continue to see mini Bhopal like industrial disasters. Hazardous waste piling up at factories. There are various industries in India where the waste has been dumped improperly and hazardous chemicals like chromium, mercury waste and pesticide waste are lying and no care is being taken.

There have been numerous laws and policies made by the government like the environment protection act (EPA) of 1986 which gives direct authority to the Centre to close, prohibit or regulate any industry. There were also amendments made in the factories act of 1948. Many other rules and regulations have been put up but despite all this legislation India has never been able to overpower the problem of hazardous waste management and environmental protection as a whole. We still do not have the proper means and methods to decontaminate and purify these toxic sites. We not just need proper rules and regulations but also some higher authorities to ensure that those rules are being implemented and followed to prevent another Bhopal like tragedy from happening ever again.

Conflict of interest: The authors declare that they have no conflict of interest.

Ethical statement: The authors declare that they have followed ethical responsibilities

REFERENCES

- [1] Management in India", Water Global Common and Global Problems, 2006.
- [2] Available at: www.kractivist.org
- [3] Available at: www.downtoearth.org.in
- [4] Available at: www.en.wikipedia.org