



Sunday Night
2nd December 1984

“WHAT IS BHOPAL GAS TRAGEDY ?”

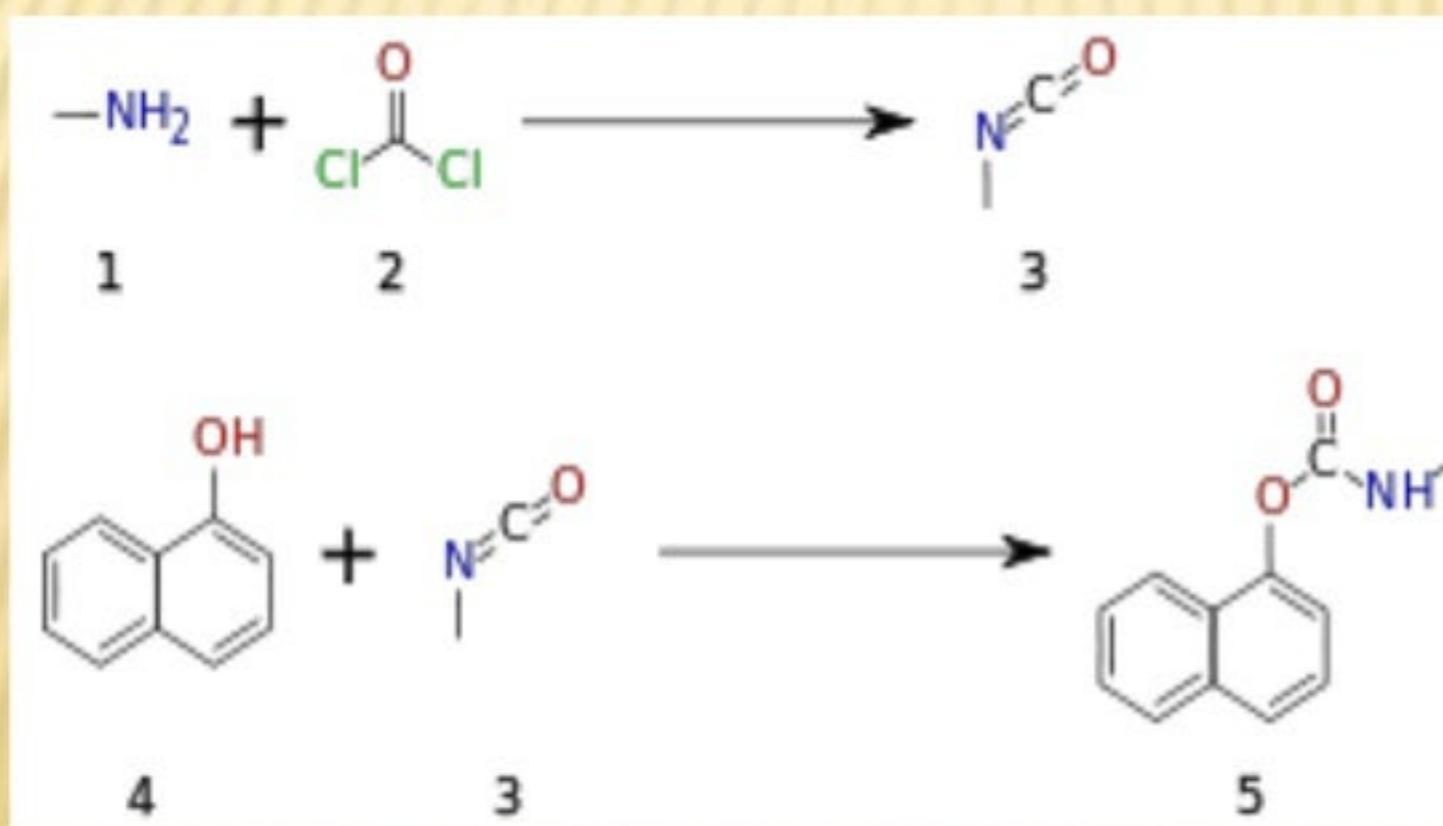
- ✖ The **Bhopal gas tragedy** (commonly referred to as **Bhopal disaster**) was a gas leak incident in India, considered one of the world's worst industrial catastrophes.
- ✖ It occurred on the night of **2nd–3rd December 1984** at the Union Carbide India Limited (UCIL) pesticide plant in Bhopal, Madhya Pradesh.
- ✖ A leak of **methyl isocyanate (MIC)** gas and other chemicals from the plant resulted in the exposure of hundreds of thousands of people.

BACKGROUND OF “UCIL”

- ✖ UCIL, built in 1969, which was the Indian subsidiary of ***Union Carbide Corporation*** (UCC), with Indian Government controlled banks and the Indian public holding a 49.1% stake.
- ✖ In 1994, the Supreme Court of India allowed UCC to sell its 50.9% share. Union Carbide sold UCIL, the Bhopal plant operator, to ***Eveready Industries India Limited*** in 1994.
- ✖ The Bhopal plant was later sold to ***McLeod Russel (India) Ltd.*** Dow Chemical Company purchased UCC in 2001.

PLANT PRODUCTION PROCESS

- The UCIL factory was built to produce the pesticide **Sevin** (UCC's brand name for **carbaryl**) using **methyl isocyanate** (MIC) as an intermediate.



Methylamine (1) reacts with phosgene (2) producing methyl isocyanate (3) which reacts with 1-naphthol (4) to yield carbaryl (5)

THE ACCIDENT

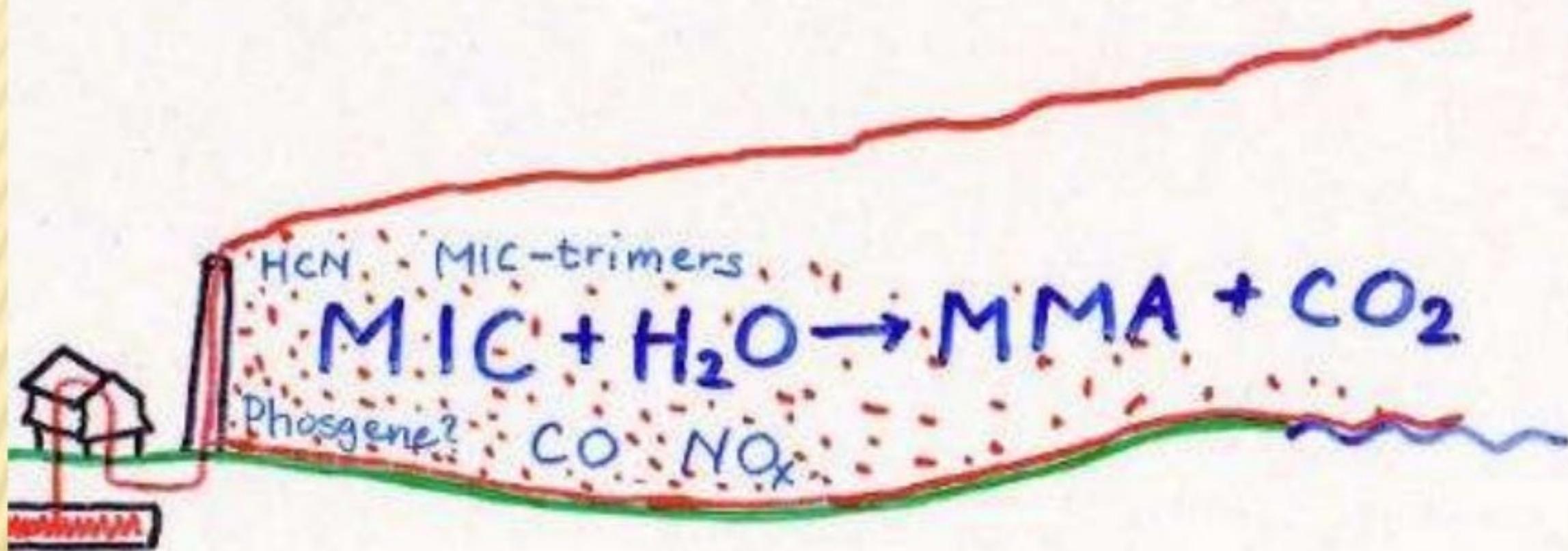
- ✖ During the night of 2–3 December 1984, water entered Tank E610 containing 42 tons of MIC.
- ✖ The resulting exothermic reaction increased the temperature inside the tank to over 200 °C (392 °F) and raised the pressure.
- ✖ About 30 metric tons of methyl isocyanate (MIC) escaped from the tank into the atmosphere of Bhopal in 45 to 60 minutes.



FACTORS LEADING TO THE GAS LEAK

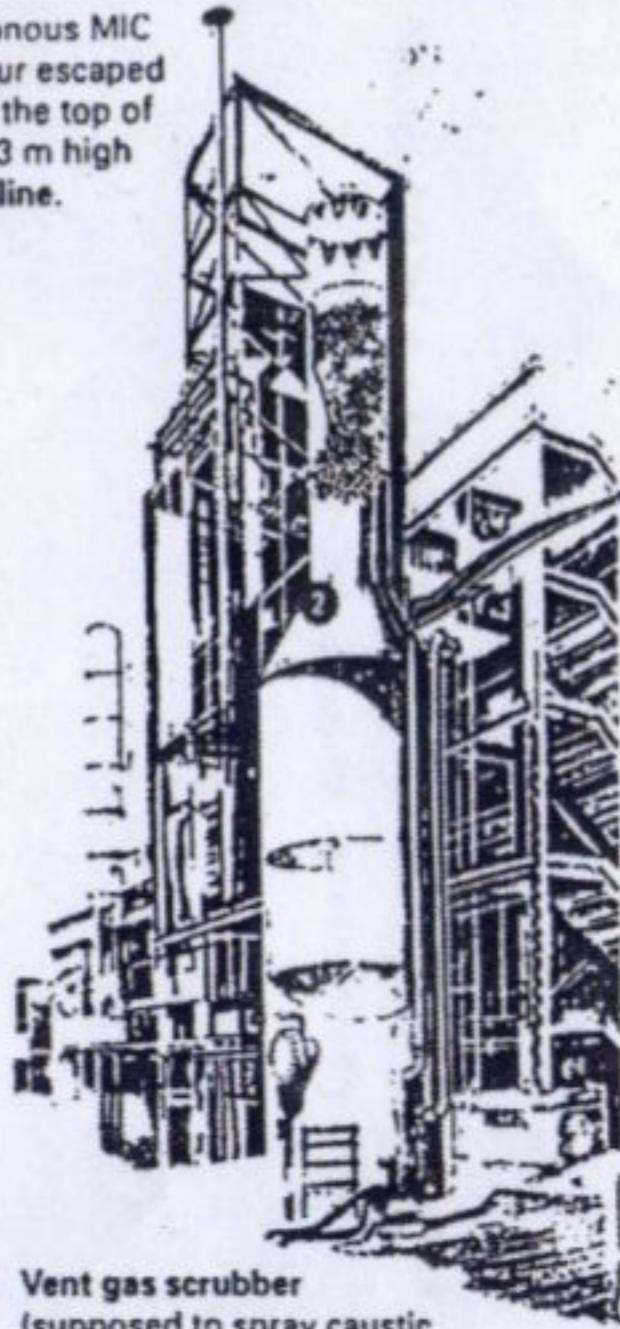
- ✖ Storing MIC in large tanks and filling beyond recommended levels,
- ✖ Poor maintenance,
- ✖ Failure of several safety systems,
- ✖ Safety systems being switched off to save money—including the MIC tank refrigeration system which could have mitigated the disaster severity,
- ✖ Plant location close to a densely populated area,
- ✖ Undersized safety devices,
- ✖ The dependence on manual operations,

- ✖ Plant management deficiencies were also identified –
 - + lack of skilled operators,
 - + reduction of safety management,
 - + insufficient maintenance,
 - + inadequate emergency action plans.
- ✖ Use of a more dangerous pesticide manufacturing method, or “ROUTE”, where same raw materials are combined in a different manufacturing order, with phosgene first reacted with naphthol to form a chloroformate ester, which is then reacted with methyl amine.
- ✖ In the early 1980s, the demand for pesticides had fallen, but production continued, leading to buildup of stores of unused MIC

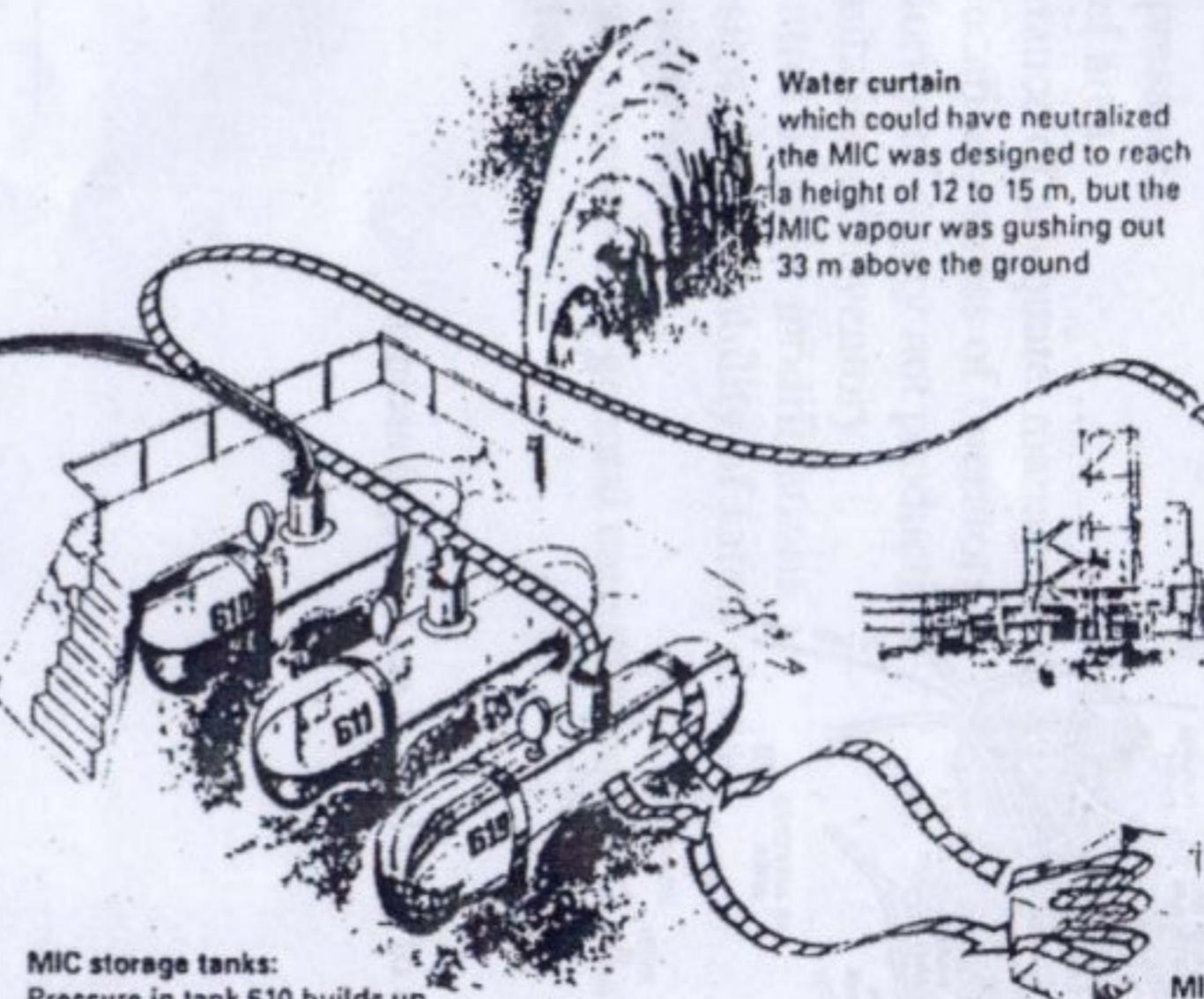


The cloud contained a mixture of substances. Concentrations were higher close to the plant. The gases were heavier than air, displacing oxygen.

Poisonous MIC vapour escaped from the top of the 33 m high vent line.



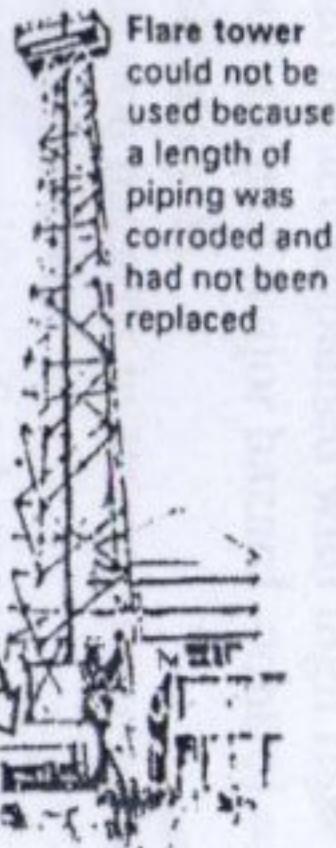
Vent gas scrubber (supposed to spray caustic soda on escaping vapours to neutralize them) was shut down for maintenance



MIC storage tanks:

Pressure in tank 610 builds up alarmingly because of an extremely violent chemical reaction and MIC vapour escapes rupturing a safety disc and popping the safety valve. Tank 619 was empty but nobody opened the valves between the two tanks to relieve pressure in 610.

Water curtain which could have neutralized the MIC was designed to reach a height of 12 to 15 m, but the MIC vapour was gushing out 33 m above the ground



Flare tower could not be used because a length of piping was corroded and had not been replaced

MIC refrigeration system was out of commission and tank 610 could not be cooled to slow down the reaction

State of safety features of MIC plant at Bhopal at time of disaster.



Gas Vent Scrubber

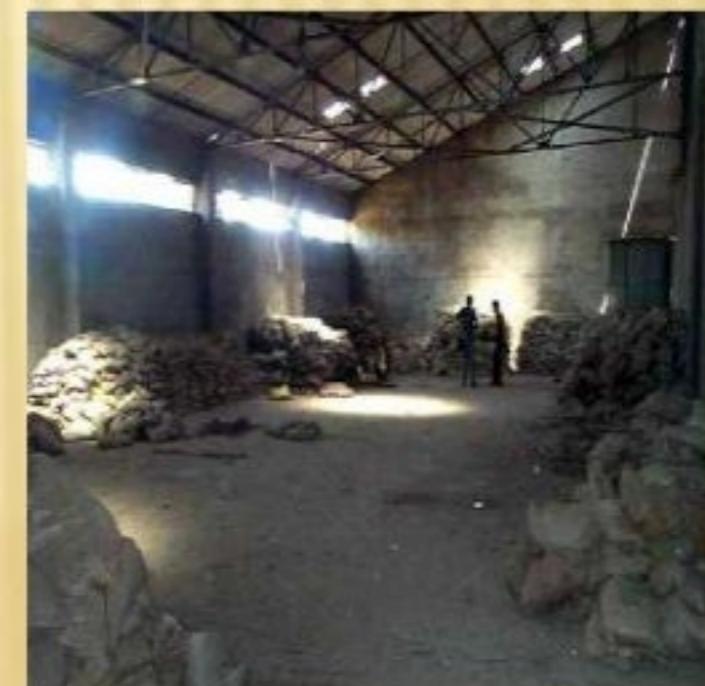


Gas Vent Scrubber Stack

Chemicals Dumped by Union Carbide in Bhopal

S.No	Chemical	Amount	Use in factory	Nature of original pollution
1	Methylene Chloride	100 MT	Solvent	Air
2	Methanol	50 MT	Solvent	Air
3	Ortho-idichlorobenzene	500 MT	Solvent	Air, Water, Soil
4	Carbon tetrachloride	500 MT	Solvent	Air
5	Chloroform	300 MT	Solvent	Air
6	Tri methylamine	50 MT	Catalyst	Air
7	Chloro benzyl chloride	10 MT	Ingredient	Air, Water, Soil
8	Mono chloro toluene	10 MT	Ingredient	Air, Water, Soil
9	Toluene	20 MT	Ingredient	Air, Water, Soil
10	Aldicarb	2 MT	Product	Air, Water, Soil
11	Carbaryl	50 MT	Product	Air, Water, Soil
12	Benzene Hexachloride	5 MT	Ingredient	Air, Water, Soil
13	Mercury	1 MT		Water, Soil
14	Mono methyl amine	25 MT	Ingredient	Air
15	Chlorine	20 MT	Ingredient	Air
16	Phosgene	5 MT	Ingredient	Air
17	Hydro chloric acid	50 MT	Ingredient	Air, Soil
18	Chloro sulphonic acid	50 MT	Ingredient	Air, Soil
19	Alpha Naphthol *	50 MT	Ingredient	Air, Soil
20	Napthalin	50 MT	Ingredient	Air
21	Chemical waste Tar	50 MT	Waste	Water, Soil
22	Methyl Isocyanate	5 MT	Ingredient	Air, Water, Soil

DUMPING OF HAZARDOUS MATERIAL



THE DEVASTATION

- ✖ The official immediate death toll was 2,259 and the government of Madhya Pradesh has confirmed a total of 3,787 deaths related to the gas release.
- ✖ Others estimate 8,000 died within two weeks and another 8,000 or more have since died from gas-related diseases.
- ✖ A government affidavit in 2006 stated the leak caused 5,58,125 injuries including 38,478 temporary partial and approximately 3,900 severely and permanently disabling injuries.
- ✖ 2,000 bloated animal carcasses had to be disposed.

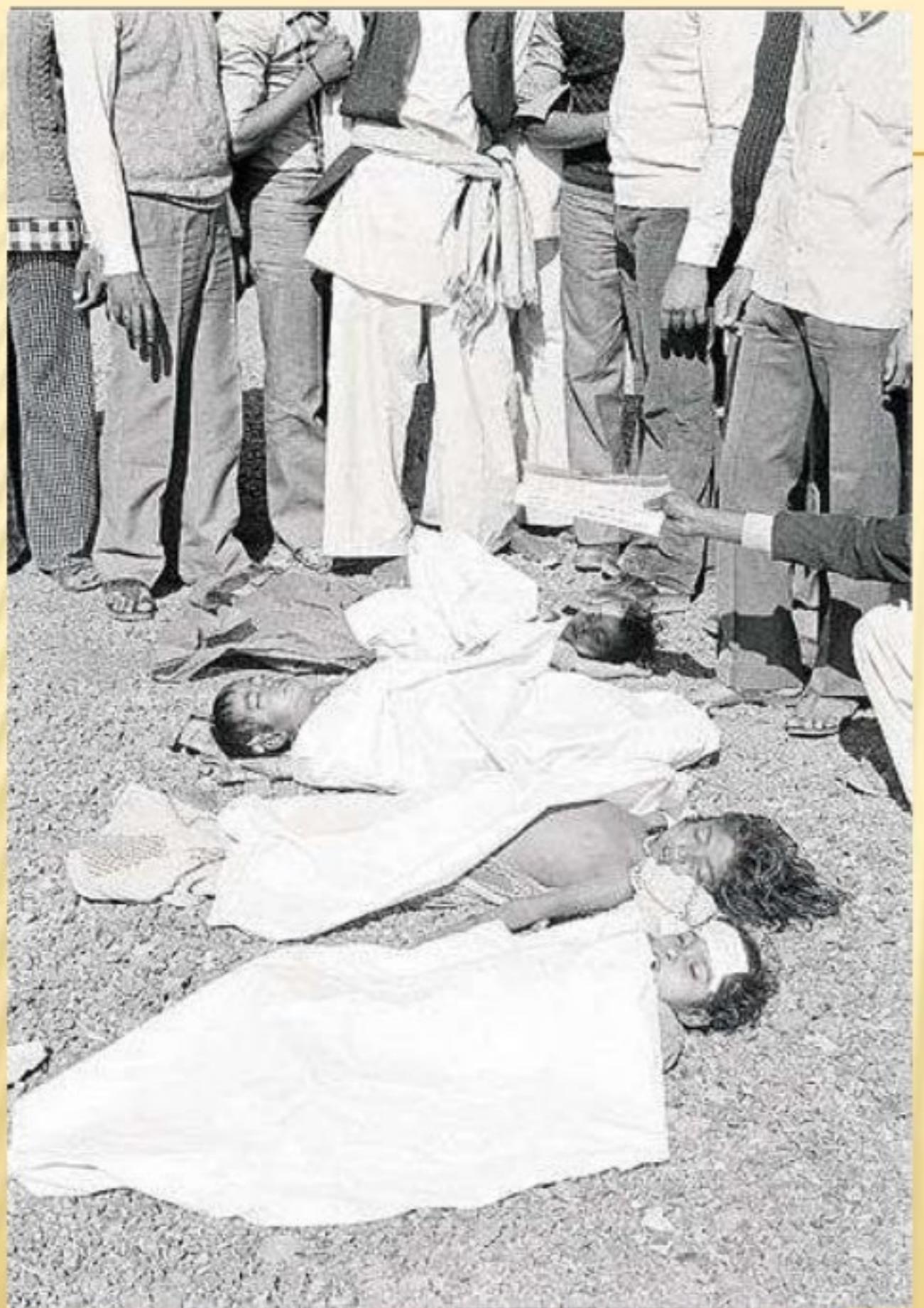






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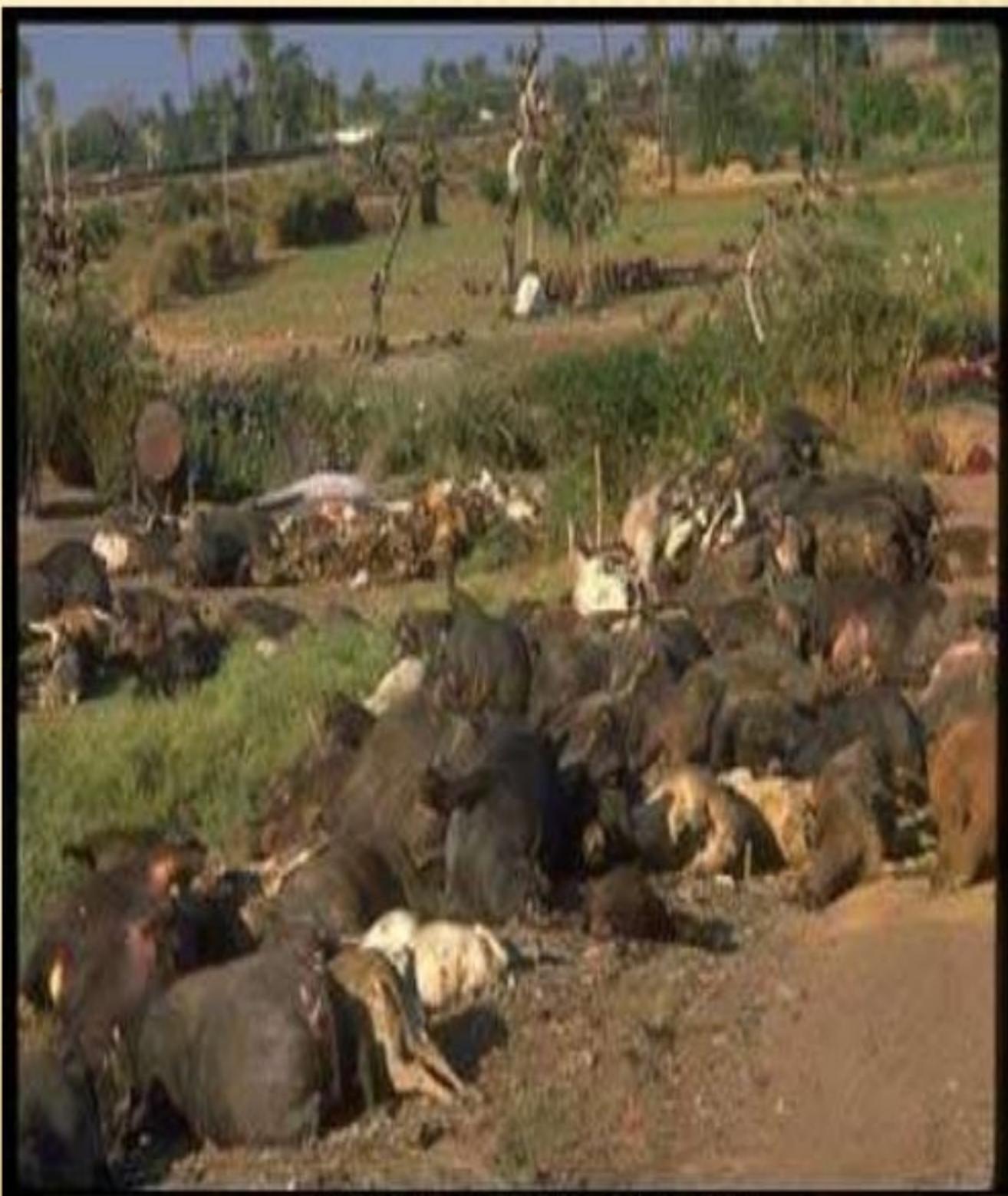


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HEALTH EFFECTS

★ Short term health effects

- + Apart from MIC, the dense gas cloud may have contained
 - ✖ phosgene,
 - ✖ hydrogen cyanide,
 - ✖ carbon monoxide,
 - ✖ hydrogen chloride,
 - ✖ oxides of nitrogen,
 - ✖ monomethyl amine (MMA) and
 - ✖ carbon dioxide, either produced in the storage tank or in the atmosphere.
- + The initial effects of exposure were coughing, vomiting, severe eye irritation and a feeling of suffocation.

- The acute symptoms were burning in the respiratory tract and eyes, blepharospasm, breathlessness, stomach pains and vomiting.
- The causes of deaths were choking, reflexogenic circulatory collapse and pulmonary oedema.
- Findings during autopsies revealed changes not only in the lungs but also cerebral oedema, tubular necrosis of the kidneys, fatty degeneration of the liver and necrotising enteritis.
- The stillbirth rate increased by up to 300% and neonatal mortality rate by 200%.







LONG TERM HEALTH EFFECTS

- ✖ It is estimated 100,000 to 200,000 people have permanent injuries.
- ✖ Reported symptoms are
 - + eye problems,
 - + respiratory difficulties,
 - + immune and neurological disorders,
 - + cardiac failure secondary to lung injury,
 - + female reproductive difficulties and
 - + birth defects among children born to affected women.
- ✖ The Indian Government and UCC deny permanent injuries were caused by MIC or the other gases.



AFTERMATH OF THE LEAKAGE

- ✖ Medical staff were unprepared for the thousands of casualties.
- ✖ Doctors and hospitals were not informed of proper treatment methods for MIC gas inhalation. They were told to simply give cough medicine and eye drops to their patients.[
- ✖ The gases immediately caused visible damage to the trees. Within a few days, all the leaves fell off.
- ✖ "Operation Faith": On 16 December, the tanks 611 and 619 were emptied of the remaining MIC. This led to a second mass evacuation from Bhopal.

- ✖ Formal statements were issued that air, water, vegetation and foodstuffs were safe within the city. At the same time, people were informed that poultry was unaffected, but were warned not to consume fish.
- ✖ A total of 36 wards were marked by the authorities as being "gas affected", affecting a population of 520,000.
- ✖ Of these, 200,000 were below 15 years of age, and 3,000 were pregnant women.
- ✖ There were mass funerals and mass cremations. Bodies were dumped into the Narmada River, less than 100 km from Bhopal.

COMPENSATION FROM UNION CARBIDE

- The Government of India passed ***the Bhopal Gas Leak Disaster Act*** that gave the government rights to represent all victims in or outside India.
- UCC offered US \$350 million, the insurance sum. The Government of India claimed **US\$ 3.3 billion** from UCC.
- In 1989, a settlement was reached under which UCC agreed to pay **US\$470 million** (the insurance sum, plus interest) in a full and final settlement of its civil and criminal liability.

- ✖ When UCC wanted to sell its shares in UCIL, it was directed by the Supreme Court to finance a 500-bed hospital for the medical care of the survivors. Bhopal Memorial Hospital and Research Centre (BMHRC) was inaugurated in 1998. It was obliged to give free care for survivors for eight years.
- ✖ A US court rejected the law suit blaming UCC for causing soil and water pollution around the site of the plant and ruled that responsibility for remedial measures or related claims rested with the State Government and not with UCC.

ECONOMIC REHABILITATION

- ✖ Immediate relief was decided two days after the tragedy.
- ✖ Relief measures commenced in 1985 when food was distributed for a short period and ration cards were distributed.
- ✖ Madhya Pradesh government's finance department allocated Rs 874 million for victim relief in July 1985.
- ✖ Widow pension of Rs 200/per month (later Rs 750) was provided.
- ✖ One-time ex-gratia payment of Rs 1,500 to families with monthly income Rs 500 or less was decided.
- ✖ Each claimant was to be categorized by a doctor.
- ✖ In court, the claimants were expected to prove "beyond reasonable doubt" that death or injury in each case was attributable to exposure.

- From 1990 interim relief of Rs 200 was paid to everyone in the family who was born before the disaster.
- The final compensation (including interim relief) for personal injury was for the majority Rs 25,000 (US\$ 830). For death claim, the average sum paid out was Rs 62,000 (US\$ 2,058).
- Effects of interim relief were more children sent to school, more money spent on treatment and food, and housing improvements.
- In 2007, 1,029,517 cases were registered and decided. Number of awarded cases were 574,304 and number of rejected cases 455,213. Total compensation awarded was Rs.1,546.47 crores.
- On 24 June 2010, the Union Cabinet of the Government of India approved a Rs1265cr aid package. It will be funded by Indian taxpayers through the government.

OCCUPATIONAL REHABILITATION

- 33 of the 50 planned work-sheds for gas victims started. All except one was closed down by 1992.
- 1986, the MP government invested in the Special Industrial Area Bhopal. 152 of the planned 200 work-sheds were built. In 2000, 16 were partially functioning.
- It is estimated that 50,000 persons need alternative jobs, and that less than 100 gas victims have found regular employment under the government's scheme.

HABITATION REHABILITATION

- ✖ 2,486 flats in two- and four-story buildings were constructed in the "Widows colony" outside Bhopal.
- ✖ The water did not reach the upper floors.
- ✖ It was not possible to keep cattle.
- ✖ Infrastructure like buses, schools, etc. were missing for at least a decade.

HEALTH CARE

- In the immediate aftermath of the disaster, the health care system became tremendously overloaded. Within weeks, the State Government established a number of hospitals, clinics and mobile units in the gas-affected area.
- Radical health groups set up JSK (the People's Health Centre) that was working a few years from 1985.
- The Government of India has focused primarily on increasing the hospital-based services for gas victims. Several hospitals have been built after the disaster. In 1994, there were approximately **1.25 beds** per 1,000, compared to the recommendation from the World bank of 1.0 beds per 1,000 in developing countries.

- The Bhopal Memorial Hospital and Research Centre (BMHRC) is a 350-bedded super speciality hospital. Heart surgery and hemodialysis are done. Major specialities missing are gynecology, obstetrics and pediatrics.
- Eight mini-units (outreach health centers) were started. Free health care for gas victims should be offered until 2006.
- Sambhavna Trust is a charitable trust that registered in 1995. The clinic gives modern and Ayurvedic treatments to gas victims, free of charge.
- Since the leak, a very large number of private practitioners have opened in Bhopal. In the severely affected areas, nearly 70 percent do not appear to be professionally qualified.

ENVIRONMENTAL REHABILITATION

- ✖ When the factory was closed in 1985–1986, pipes, drums and tanks were sold. The MIC and the Sevin plants are still there, as are storages of different residues. Isolation material is falling down and spreading.
- ✖ The area around the plant was used as a dumping area for hazardous chemicals.
- ✖ Tubewells in the vicinity of the UCC factory had to be abandoned. UCC's laboratory tests in 1989 revealed that soil and water samples collected from near the factory and inside the plant were toxic to fish.

- In order to provide safe drinking water to the population around the UCC factory, there is a scheme for improvement of water supply.^[43]
- In December 2008, the Madhya Pradesh High Court decided that the toxic waste should be incinerated at Ankleshwar in Gujarat.^[49]
- In October 2011, the Institute of Environmental Management and Assessment published an article and video by two British environmental scientists, showing the current state of the plant, landfill and solar evaporation ponds and calling for renewed international efforts to provide the necessary skills to clean up the site and contaminated groundwater^[50]

SOURCES

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THANK YOU



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