

## Hazardous Material Spillage

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**Abstract:** Hazardous material is commonly referred to as HAZMAT or Dangerous Goods by the industry and these are chemicals that can constitute a health hazard" or physical hazard. In the early hours of 06<sup>th</sup> May 2017, on 06<sup>th</sup> May 2017, the driver of a truck carrying a container with eighty drums of an agrochemical pesticide powder, observed leakage from some containers. A total of six drums had sprung leaks and, at 0730 h, local labourers spread soil over the ground spill and poured water to wash the crystals away. This triggered a chemical reaction that caused release of toxic fumes. The chemical cloud was carried by winds into a local school where students inhaled the gas and developed burning sensation in the eyes, breathlessness, pain abdomen and nausea. A total of 578 symptomatic girl students and 37 teachers were shifted to local hospitals and treated. The symptoms were mild and responded to symptomatic treatment. No specific antidotes were necessary and all the schoolchildren were discharged by the same evening

**Keywords:** Hazardous chemicals, poisoning

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Date of Submission: 08-01-2018

Date of acceptance: 26-01-2018

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### I. Introduction

Hazardous Material is commonly referred to as HAZMAT or Dangerous Goods by the industry Any item or chemical is classified as a "health hazard" or "physical hazard" if it belongs to any of the following categories:

1. Chemicals that are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, hepatotoxins, nephrotoxins, neurotoxins, agents that act on the hematopoietic system, and agents that damage the lungs, skin, eyes, or mucous membranes;
2. Chemicals that are combustible liquids, compressed gases, explosives, flammable liquids, flammable solids, organic peroxides, oxidizers, pyrophorics, unstable (reactive) or water-reactive; and
3. Chemicals that, in the course of normal handling, use or storage, may produce or release dusts, gases, fumes, vapors, mists or smoke having any of the above characteristics.

Any item or chemical which, when being transported or moved, is a risk to public safety or is an environmental hazard, and has to be regulated. (1) Many products containing hazardous chemicals are routinely used and stored in homes, and are transported every day on the nation's highways, railroads, waterways, and pipelines. Hazchem transportation accidents or leakage poses serious hazards that can adversely affect the health and environment of those living in the vicinity. Such incidents require coordinated and consistent efforts by different agencies, from both handling and transportation management of HAZCHEM to minimize leakage incidents and also to tackle and neutralize the harmful health and social consequences of the HAZCHEM leakage. This paper reports a leakage of toxic gas in a suburb of New Delhi and its effects and containment.

#### 1.1 Details of the Incident

At around 0330 a.m. on 06<sup>th</sup> May 2017, the driver of a truck carrying a container with eighty in number drums of a chemical powder, observed leakage from some containers while passing through Nathupur Road, Sonipat, Haryana. Concerned about safety aspects, he pulled into the Bharatiya Inland container depot near Pul Praladpur area, Tughlakabad, South East Delhi. (Fig 1) Scutiny of the MSDS (Material Safety Data Sheet) identified that the HAZCHEM was 2-CHLORO-5-(CHLOROMETHYL) PYRIDINE (60%) {C<sub>6</sub>H<sub>5</sub>Cl<sub>2</sub>N commonly known as CCMP}, an organic corrosive, acidic compound and a pesticide intermediate. A total of six drums had sprung leaks. At about 0730 h, local labourers spread soil over the ground spill and poured water to wash the crystals away. This triggered a chemical reaction that caused release of toxic fumes. Carried by winds, the chemical cloud wafted into the local Rani Jhansi Sarvodaya Kanya Vidyalaya. (Fig 2) Students present inhaled the gas and developed burning sensation in the eyes, breathlessness, pain abdomen and nausea. The school principal alerted local authorities at 7:43 am and evacuated the all students. The NDRF, Police, Fire and

Medical services responded and evacuated the affected children to nearby hospitals. HAZMAT experts identified the HAZCHEM, monitored the wind speed, temperature and atmospheric conditions and drew up a hazard map based on concentration of toxic chemical at spillage site and cordoned off the area while the NDRF undertook decontamination of the contaminated zone. (Fig 2) A total of 578 symptomatic girl students and 37 teachers were shifted to local hospitals. 310 were sent to Hakim Abdul Hamid Zamia (Majeediya) Centenary, 66 to Apollo, 171 to Okhla ESI, 65 to Batra hospitals and 03 to the AIIMS Trauma hospitals where they were given first aid and discharged after and after 6-7 hours of observation. Of those affected, 378 had burning sensation of the eyes, 164 had spasmodic cough and breathing difficulty, 51 had abdominal cramps and nausea/vomiting and 22 developed mild skin rash. The symptoms were mild and responded to symptomatic treatment. No specific antidotes were necessary and all the schoolchildren were discharged by the same evening. (2,3,4)

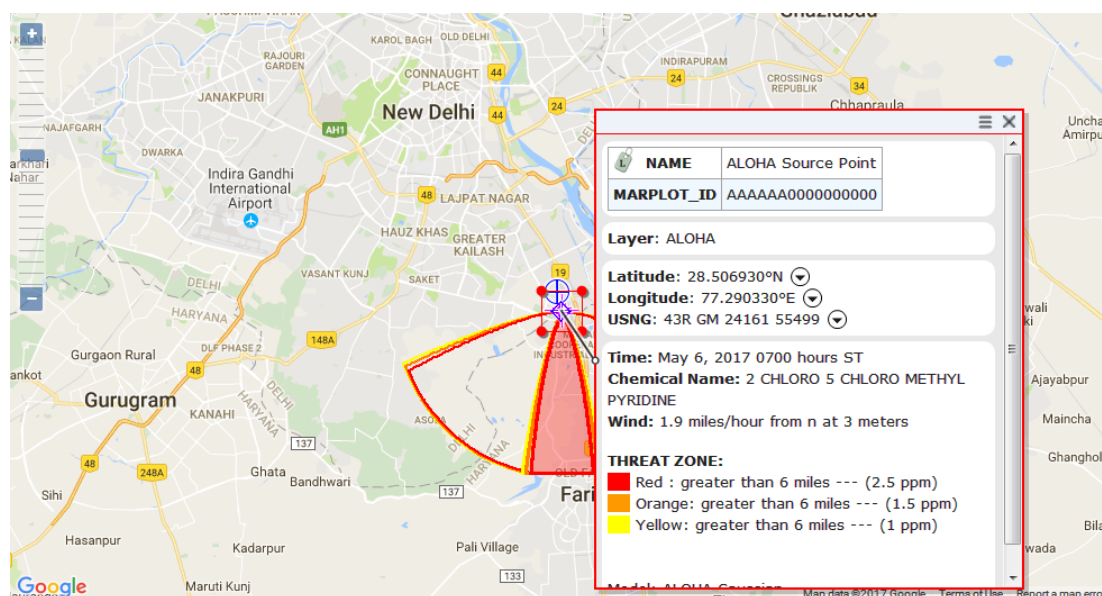


Fig 1: Geographical Details Of Affected Zone

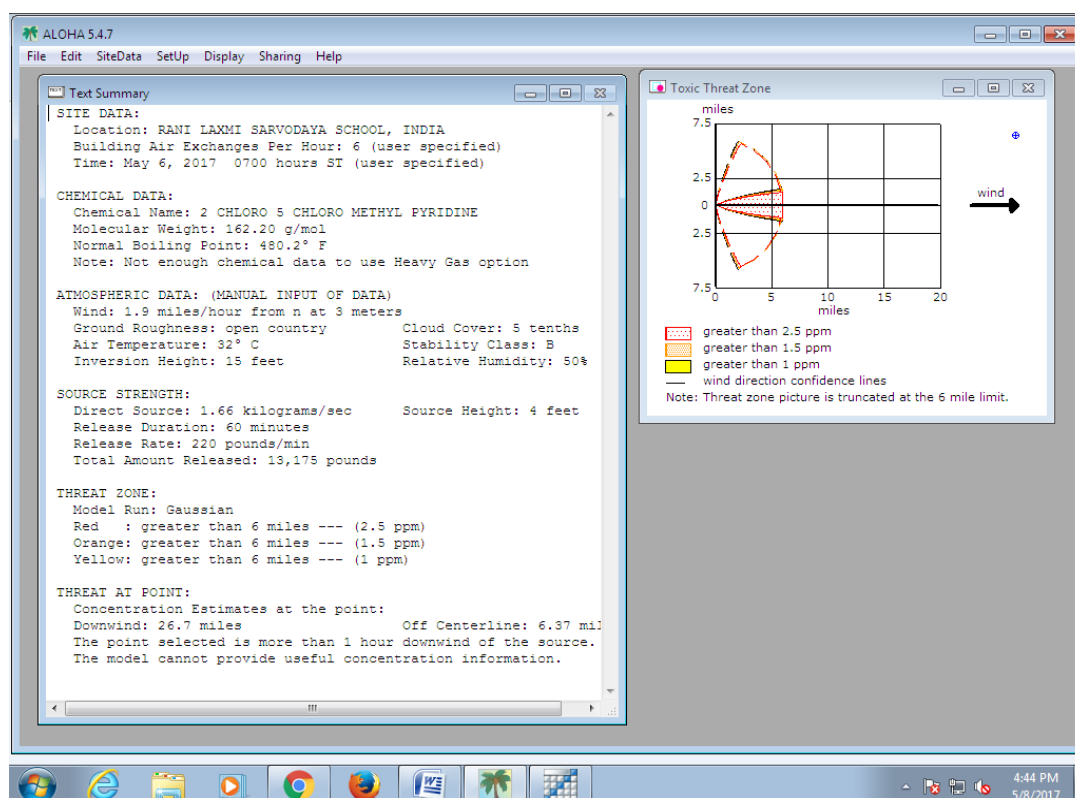


Fig 2: Meteorological data and Toxic Concentrations at Site of Spill

## II. Discussion

The production and use of chemicals are fundamental factors in the economic development of all countries, whether they are industrialized or developing. In one way or another, chemicals affect directly or indirectly the lives of all humans and are essential to our feeding (fertilizers, pesticides, food additives, packing), our health (pharmaceuticals, cleaning materials), or our well being (appliances, fuels, etc). The first and most essential step leading to safe use of chemicals is to know their identity, hazards to health and the environment, and the means to control them. This knowledge must be available in such a way that protective measures can be identified and conveyed to the user in a form that is easy to understand. Hazard classification and labelling process is an essential tool for establishing the degree of the hazard the chemical represents, or man and the environment and also the appropriate actions to be taken to minimize and neutralize its effects. The International Labour Organization (ILO) has adopted the Convention No. 170 and Recommendation No. 177 on 'Safety in the use of chemicals at work' in 1990. This enables rapid identification of the hazardous properties of chemicals, the risks to health, property or the environment, and action to be taken in the event of spillage. (5) The primary concern during Hazchem leak or spill is protection of personnel in the vicinity, while secondary concerns are to confine and neutralize the contamination. Hazchem release will require different responses based on a variety of factors including the quantity, type and location of the spill. Clean up operations are also chemical specific and must be followed by all personnel handling such materials. The approach advised is Control, Contain and Clean Up. It is important to delineate the core zone, buffer zone and unaffected zones with "Caution Spill Area" barrier tape, safety cones and reflective bars. It is also vital to obtain meteorological data like local atmospheric movements and air turbulence using an anemometer to predict toxic gas drift into buffer/unaffected zones.

### 2.1 CCMP

Substituted pyridines are heterocyclic organic compounds used as privileged scaffolds in medicinal chemistry. 2-Chloro-5-(chloromethyl)pyridine (Synonyms: 2,5-Dichloro-4-Methyl-Pyridine/2-Chloro-5-Chloromethylpyridine or CCMP) is an organic intermediate used for the production of neonicotinoid class of agrochemical pesticides. (Fig 3) It is marketed as beige/yellow crystals in argon filled 250 kg plastic barrels and stored at 2-8°C in well ventilated areas. The molecular weight of CCMP is 162.013 g/mol, melting point in the range of 37-42 °C, flash point > 110°C and boiling point 249.8°C at 760 mmHg. The chemical is insoluble in water. Hazard code for CCMP is C (corrosive), Xi (irritant), F (flammable) and hazard class is lachrymator/corrosive. The symptoms of exposure are blistering of the skin and ulceration, corneal burns and scarification at areas of contact, corrosive burns of the lips, epistaxis and hematemesis when ingested, shortness of breath, spasmodic cough, burning sensation in the throat or wheezing when inhaled. Doses of 250 mg/kg and above are fatal. Protection methods advised by manufacturers of CCMP are to avoid contact with the eyes, and wear suitable protection work clothes and protection glasses and eye pads when handling the chemical. (6)

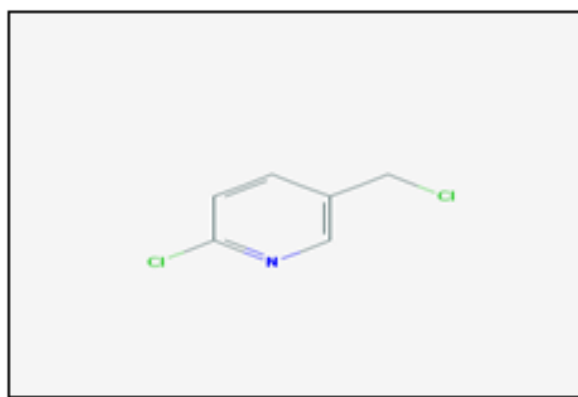


Fig 3. Chemical structure of CCMP molecule

### 2.2 The Emergency Action Code (EAC)

The HAZCHEM code (also called Emergency Action Code) gives vital information to fire brigade and other emergency services on the action to be taken to combat spillage, leakage or fire in an emergency involving a hazardous substance. The HAZCHEM code consists of a number from 1 to 4 and any one of the letters, P, R, S, T, W, X, Y, Z followed at times by the letter E.

1	JETS
2	FOG
3	FOAM
4	DRY AGENT

The numbers signify the extinguishing medium to be employed.

The letters signify 4 aspects viz.

1. Method of controlling spillage a) by diluting or b) by containing
2. Personal protective equipment to be worn by fire fighters
3. Reactive nature of chemical, and
4. Need for evacuation.

Where the letter appears as white on black background, the police and other non-fire service personnel need to wear breathing apparatus only for a fire and not for a spillage, but firemen are required to wear it in both cases. The letter E indicates that the officer in charge should consider civil evacuation of the area. The Indian Chemical Manufacturers Association (ICMA) recommends that a radius of 300m from spill site should be considered for evacuation wherever 'E' appears in HAZCHEM code. (7) The "Dry Agent" method must be used for chemicals that have an undesirable reaction with water and must not be allowed to come in contact with water, as it has a likelihood to spontaneously combust, explode or release toxic clouds of chemicals in to the atmosphere. Personal protection is divided into three categories- personal PPE, full breathing apparatus (BA) and BA for fire only. In the event of a spill, actions to be taken are either dilute or contain. Dilute means that the chemical may be washed down the drain with large quantities of water. Contain requires that the spillage must not come in contact with drains or water courses. (Fig 4)

HAZCHEM CODE		
1.	JETS	
2.	FOG	
3.	FOAM	
4.	DRY AGENT	
P	V	FULL
S	V	BA
S		BA for FIRE only
T		BA
T		BA for FIRE only
W	V	FULL
Y	V	BA
Y		BA for FIRE only
Z		BA
Z		BA for FIRE only
E CONSIDER EVACUATION		
<p>Notes for Guidance</p> <p>FOG : In the absence of fog equipment a fire spray may be used.</p> <p>DRY AGENT : Water must not be allowed to come into oontact with the substances at risk.</p> <p>V : Can be violently or even explosively reactive</p> <p>FULL : Full body protective clothing with BA.</p> <p>BA : Breathing apparatus plus protective gloves.</p> <p>DILUTE : May be washed to drain with large quantities of water</p> <p>CONTAIN : Prevent by any means available, the spillage from entering drains or water course.</p>		

Fig 4: Hazchem spill actions based on Code

#### First aid during a spill:

Relocate to an area with fresh, clean air. Remove all contaminated clothing, wash contact area with soap cool water for 15 minutes after removing watch and jewelry remove spectacles/contact lens and irrigate eyes for at least 15 minutes with saline. Seek medical attention if symptoms persist.

#### Management of Spills

Safe clean up of a chemical spill requires knowledge of the properties and hazards posed by the chemical. Do not pour water unless indicated in the Safety Data Sheet (SDS). In the event of a major spill, alert

the local population, evacuate contaminated to a safe location and administer appropriate first aid. Remove contaminated clothing, flush contaminated areas with lukewarm water and mild soap, restrict access.

Hazchem spill kits, also known as chemical spill kits are available for virtually all chemicals, aggressive acids and bases (alkalis), paint, solvents, oils, fuels, coolants, degreasers, herbicides and pesticides. They are durable and mobile kits that can be taken directly to a Hazchem spill and contain a variety of polypropylene absorbents which are able to absorb up to 20 times their own weight in liquid. This surface-modified polypropylene is inert and dust-free and does not degrade or chemically react with absorbed liquids. Chemical absorbents are colour-coded pink for easy identification. They are applied with brushes and pans. Hazchem pads are ground absorbents that will soak up all liquids and consists of organic floorsweeps and inorganic mineral absorbents. The appropriate disposal of contaminated absorbents through high temperature incineration is a simple yet highly-effective method of waste volume reduction. The bioremediation of contaminated soil or water is often required as the final stage of spill clean-up using a range of bioremediation liquids that can be used on soil and water contaminated with hydrocarbons and phenols. (8)

### **Personal Protection Equipment (PPE)**

PPE packs are vacuum sealed packages prefilled with appropriate PPE selected for specific spill types or industrial scenarios. Purpose-made PPE packs enable spill responders to clean-up spills in a safe and efficient manner whilst providing maximum protection. PPE pack for hazchem spill kits includes one of each of the following:

1. Profile half mask respirator with twin A1B1E1K1P2 filter cartridges.
2. Nitrile gloves (46cm) with chemical gauntlets.
3. Tychem C chemical protective coveralls.
4. Browguard polycarbonate visor.
5. Chemical safety goggles, clear, unvented, foam bound.
6. Safety vest, high-visibility, day/night, orange.
7. Personal and portable, pocket eyewash flask – 200ml
8. Heavy-duty, labelled, 100 micron, polyethylene, contaminated waste bag supplied with cable tie for disposal of used or contaminated PPE.(9)

### **III. Recommendations**

The following recommendations were made following the above incident:-

1. Ensure that the HAZCHEM transported from a source unit to the ultimate destination will have a dedicated consignment tracking system within and also be linked to fire, police and emergency control rooms including medical services
2. Strict instruction should be given to the concerned department to check the condition of the transport vehicle. It should be very sound with regard to tyres, brakes, steering system, lighting, indicator system, and especially a leak-proof fuel and fail-safe wiring circuit to avoid explosion risks. Procedures for examination of vehicles carrying Hazchem should be strengthened.
3. Develop a comprehensive training structure for inspection staff who issue fitness certificates regarding design of the containers, requirement for their inherent safety.
4. Implementation of a Global Positioning System (GPS) based continuous Hazchem transport tracking by consignor and consignee.
5. Maintain comprehensive database for accidents and lessons learned while responding for future reference. It is recommended to harmonize the relevant rules governing Hazchem transportation, and appoint a single agency/authority for collection of accident information, database generation and clear-cut distribution of roles to each responding agency and reporting requirements.
6. Ensure the round-the-clock availability of emergency professional technical teams with the MAH or cluster of MAH that should extend advise/help or should be able to reach transport accident spots for help.
7. Parking areas for overnight parking of Hazchem vehicles should be away from residential areas.
8. The consignor of hazardous materials shall ensure affixing of the following on the consignment:
  1. HAZMAT Labels
  2. Markings
  3. Shipping Papers
  4. Placards

TERM (Transport Emergency) card containing all mandatory information both in English and in language that can be read by the crew accompanying. Internal recommendations at the NDMA include the formation of proper monitoring committee for CBRN within NDMA, stocking of basic equipment & PPE sets, creation of a database of Hazmat depots, transportation routes, container stoppages and storage areas in India,

database of manufacturers of common, bulk produced Hazmat/Hazchem in India. Initiation of training and capacity building programs specially for Hazmat transportation sector throughout the country and enhancement of medical preparedness, response, training and capacity building with regards to CBRN, especially the conduct of regular and multi agency mock drills for Hazmat industry and transportation sector.

### **References**

- [1]. Institute of hazardous materials management, Rockville, MD-20852-2624,USA. Ihhm.org
- [2]. Control Room, NDMA, New Delhi. Daily Situational Report of 09 May 2017.0900h
- [3]. Halder Ritam. Hindustan Times epaper report. Delhi gas leak ; Pollution body starts probe, container corp put on notice.08 May 2017
- [4]. Karn Pratap Singh.Hindustan Times epaper. 200 students taken to hospital after gas leak near school in Delhi's Tughlakabad. 10 May 2017
- [5]. International Labour organization. Chemicals Convention, 1990 (No. 170)
- [6]. Geneva, 77th ILC session (25 Jun 1990)
- [7]. Modern Crop Protection Compounds. 2<sup>nd</sup> Edn. Kramer W, Schirmer U, Jeschke P and Witschel M. Wiley- VCH Verlag GmbH.2012
- [8]. Dangerous goods emergency action code. H.M. Fire Service Inspectorate. 2005. TSO. London. Great Britain.
- [9]. Global spill control International. www.globalspill.com
- [10]. Sullivan JB and Krieger GR. Clinical environmental health and toxic exposures.2<sup>nd</sup> Edn.2001. Lippincott Williams & Wilkins, Philadelphia,USA.

Dr Chandrasekhar Krishnamurti."Hazardous Material Spillage." IOSR Journal of Dental and Medical Sciences (IOSR-JDMS), vol. 17, no. 1, 2018, pp. 47-52