Chemically Speaking LLC

TMAH Leak LG Display Paju, Korea

Jan 16, 2021

The following is based on news articles and was not confirmed with LG Display:
On Jan 12, 2021, piping work was being conducted in the 8th or 5th floor cleanroom at the LG Display factory in Paju, Gyeonggi-do when a piping connection leaked Tetramethylammonium Hydroxide (TMAH). The leak occurred at approximately 2 PM and lasted 20 minutes spilling 300-400 liters. This caused serious respiratory injuries to three employees in the cleanroom. Two were reported to have gone into cardiac arrest and to have been resuscitated by CPR. This could not be confirmed and may have been shortness of breath/panic. They appeared to be ok at the hospital. In addition, three in-house emergency medical personnel were injured with respiratory injuries while rescuing the employees.

TMAH Safety Background

TMAH is strong base similar to sodium hydroxide, (pH 14) however it is also an acute systemic toxin. It is a clear colorless liquid like water. There is no effective medical treatment for exposure! Large quantities are used in a typical Semiconductor Fab in concentrations from 1-25% supplied from bulk containers or tanks. In some large fabs these are pipe throughout the Fab.

Of all the reactive/pyrophoric or toxic chemicals used in the Fab, TMAH is one of the top 5 that I have a concern with as there appears to be no effective medical treatment protocol. I spoke to Dr. Wu at my 2008 training class on Trichlorosilane Safety and ER in Taiwan about TMAH exposures. As a consultant to the Taiwan Poison Control Center, he has been involved in a number of TMAH incidents, 3 of which were fatal. He spoke of one in which a worker was alone and was splashed with a 25% solution over 29%

of his body. He immediately went to the safety shower. He was found 15 minutes later barely conscious. Prior to arrival at the hospital he went into cardiac arrest. He was resuscitated but he slipped into a coma and died 8 days later.

In another incident in Korea as reported by Park et al., J Occup Health, 2013

- 39 yr old male splashed 8.75% TMAH on his hands, arms and legs
- 12% body surface area affected
- Continued working and went to the shower room 25 mins after the spill
- He was found dead outside the shower ~60 mins later
- Second degree burns on skin

IBM conducted extensive animal exposure testing as well as a detailed review of incidents. Their findings were presented at the 2011 SESHA Conference "Toxicity and Methods for Reducing Risk in the Workplace" by the medical and safety teams.

They reported:

Between 1986 and 2009, Taiwan Poison Control reported that there had been 13 exposure cases in Taiwan. Four were exposed to 25% to an area greater than 7% of body surface and 3 died.

TMAH concentration is the most important factor associated with serious poisoning/intoxication

% body surface area also appears important. Taiwan poison control reported 9 exposures of 2.38% conc. In one case 28% of body with 1st and 2nd degree burns, no fatalities

– Differences in contact with skin and the effectiveness of personal protective equipment make a direct comparison difficult

Time to decontamination does not appear as important

– Absorption thru the skin may be very rapid

Lack of 2nd and 3rd degree burns in the mouth and nasal passages indicates lesser exposure via inhalation

Exposure times were not a factor (1-30 minutes), fatalities occurred even with a 1 minute exposure. The absorption through the skin is rapid. Decon with water wash, neutralizers and treatment with atropine was ineffective.

Laboratory testing of dermal exposures of rats 1 mg/kg with 12-25% concentration. All died dying in 3 hours. 2 oz spread over the skin is fatal. Threshold for irritation is 0.55%.

Muscarinic Stimulation Symptoms

1. Constricted pupils
2. Salivating
3. Sweating
4. Irregular/slow heartbeat
5. Burns
6. Constricted Bronchi

PPE Test with >480 min breakthrough using 25% TMAH

1. Tychem SL Coverall
2. Ansell Solvesx 37-165 22 mil gloves
3. Trionic Gloves

In air TMAH can hydrolyze to form Trimethylamine which smells fishy but is not as toxic

Inhalation of TMAH aerosol can cause inflammation and edema of larynx and bronchi, pulmonary edema.

They concluded that prevention of exposure and use of appropriate PPE is critical.

IBM implemented significant engineering controls to prevent exposures. These include plastic bags over totes to divert any leaks, maximum. of 10 sec travel to safety shower. Special clear plastic drum lid with gloves attached to open drum. Special training program for employees and contractors

ER Actions

Remember 7% of body surface is an arm!

1. Shower within 10 sec
2. Remove clothing
3. Respiratory support, oxygen
4. Responders must wear proper PPE such as gloves before handling victim
5. Medical treatment guideline training

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