Course Learning Outcomes for Unit III

Upon completion of this unit, students should be able to:

2. Evaluate laws regulating WMD proliferation.
   2.1 Summarize the development of chemical weapons in recent wars and the present Chemical Weapons Convention (CWC) regulations limiting the production, use, and storage of such weapons.

3. Characterize the four main types of weapons of mass destruction (WMD).
   3.1 Explain the development of white phosphorous and the use of this chemical as a weapon in present and previous wars.
   3.2 Explain the technology and production of ammonium nitrate and other fertilizer products designed for agricultural purposes and how this chemical is used to develop a WMD.
   3.3 Explain the technology and development of the chemical known as Agent Orange, and how the use of the chemical during the Vietnam War created lasting negative effects on combat veterans and the indigenous populations of Vietnam even to this day.

Course/Unit Learning Outcomes	Learning Activity
2.1	Unit III Lesson Chapter 3 Unit III Assessment
3.1	Chapter 3 Unit III Assessment
3.2	Chapter 3 Unit III Assessment
3.3	Unit III Case Study

Reading Assignment

Chapter 3: Toxic Industrial Chemicals, pp. 67-100

Unit Lesson

Toxic Industrial Materials/Chemical (TIMs/TICs)

TIMs or TICs are industrial items manufactured, stored, and transported in a gas, liquid, or solid state and can cause physical and health hazards (Occupational Safety and Health Administration [OSHA], n.d.). The phrase *toxic industrial materials* refers to materials that can be used to create weapons. An example of this would be using radiology equipment to create a *dirty bomb*, which is using high explosives to disburse radioactive materials into the air using the prevailing winds. TICs can be extremely volatile or explosive chemicals as well. TICs and TIMs can be found primarily in manufacturing facilities, treatment facilities, waste storage facilities, laboratories, fuel areas, and transportation centers (OSHA, n.d.).

TICs are associated with the following hazards:

- physical hazards and
  - TICs may be pyrophoric (explosive),
  - TICs may be flammable chemicals,
  - TICs may be combustible chemicals, and
  - TICs may be oxidizers (Pichtel, 2016).

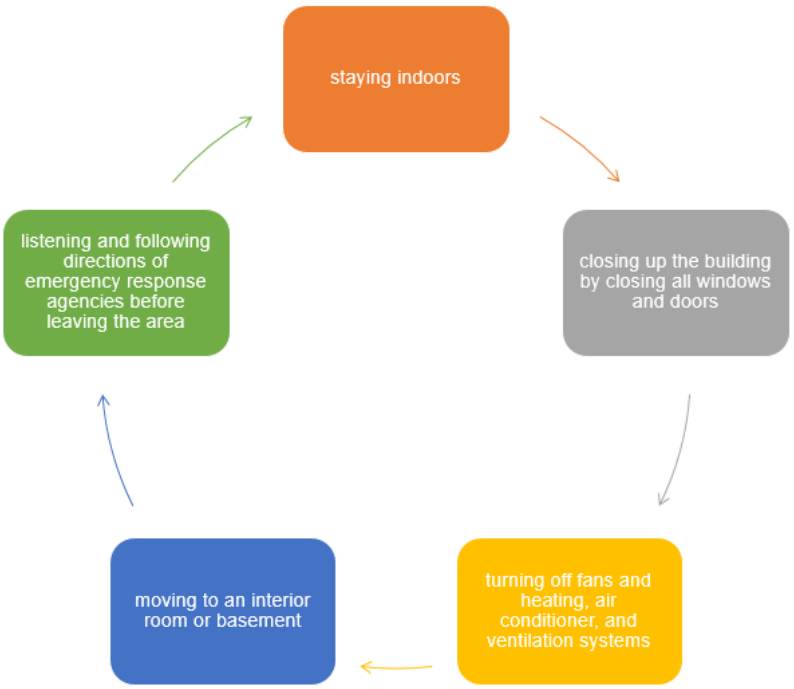
- health hazards
  - TICs may be irritants that inflame skin or eyes upon contact.
  - TICs may be corrosives that destroy tissue.
  - TICs may be sensitizers that cause allergic reactions.
  - TICs may be target-organ chemicals that damage specific organ function and systems.
  - TICs may be reproductive hazards that alter the genetic characteristics of an egg or sperm or cause damage to a fetus after conception.
  - TICs may be carcinogens that cause cancer (OSHA, n.d.).

Exposure to TICs: Exposure can occur from accidental releases, damage to infrastructure or storage where the chemical is housed, or intentional dispersion. Health effects can vary depending on the type and the amount of chemical. Acute exposure can lead to death.

A U.S. riverboat (Zippo monitor) deploying napalm during the Vietnam War.
(U.S. Naval War college museum, n.d.)

Threat of a TIC/TIM event: Since there is a large quantity of TICs/TIMs available, it is easier for a terrorist to acquire these types of materials. One of the best examples of how industrial materials can be used as a weapon was the U.S. military's use of a volatile chemical known as *napalm* during the Vietnam War. Napalm is nothing more than a highly volatile petroleum fuel-based substance that can exceed 2,000° F. The substance was designed as a defoliant, but was used during WWII and the Vietnam War as a chemical weapon. During the Vietnam War, it was typically used during aerial attacks and dropped in large, cylindrical canisters that exploded on contact, spreading intense heat and flame that stuck to anything within range. Even if the flaming chemical did not immediately contact the victim, the intense heat served to effectively consume the oxygen in the immediate vicinity of the burning chemical. Unfortunately, as with any WMD, the burning chemical killed or maimed any form of life in its path indiscriminately (Rohn, 2014).

Shelter in place: During the release of a TIC, if evacuation is not feasible, the best protection for a civilian population that does not have protective equipment is to shelter in place. Shelter in place consists of the following:



Shelter-in-place steps
(Pichtel, 2016)

If the chemical is the highly flammable/explosive type as mentioned above, only bomb shelters or concrete basements would afford much defense (Pichtel, 2016).

Safety and Guidelines

OSHA defines occupational exposure levels for workplace exposure. The Environmental Protection Agency (EPA) recommends acute exposure guidelines. The National Institute for Occupational Safety and Health (NIOSH) works with OSHA and other agencies to define occupational exposure levels (OSHA, n.d.).

Chemical Agent Detection Equipment

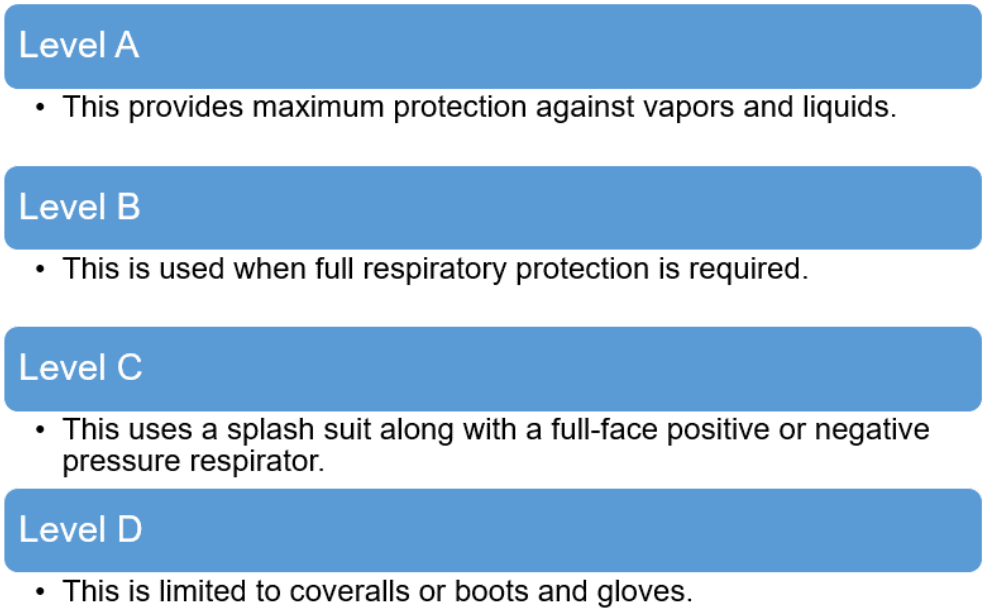
- The following are examples of military detection equipment:
  - M8 paper and M9 tape: These detect liquid nerve and blister agents. M8 paper distinguishes this type of agent. M9 tape shows contamination but does not distinguish agent type (Pichtel, 2016).
  - M256A1 kit: This detects and identifies liquid or vapor blood, blister, and nerve agents. The M256A1 kit has ampoules that, when crushed, react with three impregnated spots shaped like a square (blister), circle (blood), and star (nerve). The kit also has a Lewisite-detecting tablet. The kit takes about 20 minutes to run. The best method of getting an accurate answer is to create a vapor trap to conduct the test (Pichtel, 2016).
  - Automated detectors (most have a radiological source):
    - M22 (automated chemical agent detector alarm [ACADA]): This detects nerve and blister agents (Edgewood Chemical Biological Center [ECBC], 2009).
    - M90: This detects nerve, blood, and blister agents (McKone, Huey, Downing, & Duffy, 2000).
    - JCADS: This replaced ACADA and M90 and detects nerve and blister agents (McKone et al., 2000).
    - Chemical agent monitor (CAM) or improved chemical agent monitor (ICAM): This is a handheld nerve and blister detector (Pichtel, 2016).
- Civilian chemical agent detectors: There are so many different civilian detectors that it is best to view the different categories of civilian agent detectors. This list is inclusive of all of the categories of chemical agent detectors.
  - Ion mobility spectrometry (IMS): These machines are similar to the automated military detectors. They operate by drawing air out of the atmosphere; samples are ionized through an ion-molecule

reaction, which generates the spectrometry of the agent presented. These are used mainly for mobile detection of nerve, blister, and blood agents (McKone et al., 2000).

- Electrochemical sensors: These function by quantifying the interaction between the molecular chemistry and the properties of an electrical circuit (Taylor & Schultz, 1996). Detection occurs when the agent produces a reaction from the change in the electrical potential. Electrochemical detectors are used in mobile devices for blister, nerve, blood, and choking agents (McKone et al., 2000).
- Flame photometry: Burning an air sample in a hydrogen-rich flame with a photosensitive detector produces a unique wavelength of light that detects the specific elements. This is mainly used in gas chromatographs (McKone et al., 2000).
- Thermo-electric conductivity: The change in conductivity can detect the changes in the element, allowing for identification. This is not used often for detection (McKone et al., 2000).
- Infrared spectroscopy: This is used in mobile detectors for blister and nerve agents (McKone et al., 2000).
- Photo ionization detectors: These detect nerve and blister agents by passing the air sample between metal electrodes in a vacuum (McKone et al., 2000).

Personal Protective Equipment (PPE) Levels

There are four levels for PPE:



Four levels of personal protective equipment
(Environmental Protection Agency, n.d.)

References

Edgewood Chemical Biological Center. (2009, June). *CBRN Handbook: An industrial base product guide for chemical, biological, radiological, and nuclear items for the U.S. Army*. Retrieved from http://www.ecbc.army.mil/cr/docs/a9rba4d.pdf

Environmental Protection Agency. (n.d.). Personal protective equipment. Retrieved from http://www.epa.gov/emergency-response/personal-protective-equipment

McKone T. E., Huey B. M., Downing E., & Duffy L. M. (Eds.). (2000). *Strategies to protect the health of deployed U.S. forces: Detecting, characterizing, and documenting exposures, Appendix D.* Retrieved from http://www.ncbi.nlm.nih.gov/books/NBK225346/

Occupational Safety and Health Administration. (n.d.). Toxic industrial chemicals (TICs) guide. Retrieved from https://www.osha.gov/SLTC/emergencypreparedness/guides/chemical.html

Pichtel, J. (2016). *Terrorism and WMDs: Awareness and response* (2nd ed.). Boca Raton, FL: CRC Press.

Rohn, A. (2014, January 18). Napalm in the Vietnam War. Retrieved from http://thevietnamwar.info/napalm-vietnam-war/

Taylor, R. F., & Schultz, J. S. (1996). *Handbook of chemical and biological sensors.* Philadelphia, PA: Institute of Physics.

U.S. Naval War College Museum. (n.d.). *A U.S. riverboat (Zippo monitor) deploying napalm during the Vietnam War* [Photograph]. Retrieved from https://commons.wikimedia.org/wiki/File:US_riverboat_using_napalm_in_Vietnam.jpg

Suggested Reading

In order to access the following resources, click the links below.

The following Occupational Safety and Health Administration website presents valuable information on toxic industrial chemicals (TICs).

Occupational Safety and Health Administration. (n.d.). Toxic industrial chemicals (TICs) guide. Retrieved from https://www.osha.gov/SLTC/emergencypreparedness/guides/chemical.html

The following video discusses Agent Orange. (Notice: This video presentation is graphic in nature. Please view this at your own discretion).

Vietnamjourno. (2010, September 17). *Vietnam 35 years later: Agent Orange* [Video file]. Retrieved from https://www.youtube.com/watch?v=kkbnFfldsOc

Click here to access the video transcript.

Learning Activities (Nongraded)

Nongraded Learning Activities are provided to aid students in their course of study. You do not have to submit them. If you have questions, contact your instructor for further guidance and information.

What chemical methods may be deployed against American citizens? How might terrorists employ such methods? What do you think about this?