LESSON 13: Controlling Toxic Industrial Materials (Non-NBC)

TYPE OF INSTRUCTION: Lecture

TRAINING TIME: 2 Hours

TOOLS, EQUIPMENT, AND MATERIALS: None

PERSONNEL: One instructor, MOS 91S or AOC 72 series

INSTRUCTIONAL AIDS: Projection equipment, screen, PowerPoint presentations

REFERENCES: FM 21-10, Field Hygiene and Sanitation; FM 4-25.12, Unit Field Sanitation Team; FM 100-14, RISK MANAGEMENT.

STUDY ASSIGNMENT: FM 4-25.12, Chapter 2.

STUDENT UNIFORM AND EQUIPMENT: Duty uniform; Soldier's Guide and pencil/pen; FM 21-10; FM 4-25.12

TRANSPORTATION REQUIREMENTS: None

Section I. INTRODUCTION

Show Slide FSTCC013-1: Title

OPENING STATEMENT: The chance of U.S. soldiers being exposed to Toxic Industrial Materials (TIMs) during operations increases each year as the world becomes more and more industrialized. Many operations in recent history involve U.S. units deploying into urban areas devastated by civil unrest and war. These areas are filled with industrial production and storage facilities that have been damaged or destroyed in the conflict. Our soldiers may be exposed to harmful and potentially deadly chemicals that have been spilled or released either by accident or intentionally.

The U.S. has agencies like the Environmental Protection Agency and the Occupational Safety and Health Administration to ensure such TIMs are kept away from the population. But in most war-torn areas there are no such agencies available to protect the civilian population or U.S. soldiers from these TIMs. The army has Preventive Medicine experts who can help to protect our soldiers from exposure to TIMs, but there are a relatively small number of these technical experts. Accordingly, the FST needs to be able to identify areas of possible contamination and recommend actions to reduce exposure of their unit's troops as well as request Preventive Medicine support to evaluate the possible TIM hazards.

Show Slide FSTCC013-2: Lesson Objectives

NOTE: Inform the students of the enabling learning objectives for this lesson.

LESSON OBJECTIVES After completing this lesson, you should be able to:

13-1. Classify toxic industrial materials according to their physical states.

13-2. Identify the routes of entry of toxic industrial materials into the body.

13-3. Identify the biological effects of toxic industrial materials.

13.4. Identify the toxic industrial materials threat and their sources.

Show Slide FSTCC013-4: Lesson Objectives (5-8)

13-5. Identify the harmful effects of carbon monoxide, hydrogen chloride, bore/gun gases, and solvents, greases, and oils.

13-6. Describe the risk management process as it pertains to toxic industrial materials.

13-7. Describe the preventive medicine measures necessary to protect personnel from the exposure to toxic industrial materials.

13-8. Describe the individual preventive medicine measures necessary to protect personnel from the exposure to toxic industrial materials.

SECTION II. EXPLANATION

Show Slide FSTCC013-5: Physical States of Toxic Chemical Substances

13-1. PHYSICAL STATES OF TOXIC INDUSTRIAL MATERIALS (TIMs)

a. Gas.

(1) A state of matter in which the material is in a gaseous phase at room temperature.

(a) Carbon monoxide.

(b) Hydrogen chloride.

(c) Bore/gun gases.

(2) Gases expand and contract significantly in response to changing temperature and pressure. By increasing pressure and decreasing temperature, gases can be changed into either a liquid or solid state.

(3) Gases mix easily with other gases and uniformly distribute themselves throughout work areas or other contaminated areas.

b. Liquid.

(1) The state of matter in which a substance is free flowing and formless at room temperature.

(2) Capable of existing in three forms.

(a) Water.

(b) Vapor.

1 Finely separated particles of gas floating in air.

2 Normally seen as fog or smoke.

3 TIMs existing in the form of vapor can be inhaled deeply into the lungs.

(c) Mist

1 A suspension of liquid droplets generated by condensation from the gaseous to the liquid state.

2 Breaking up a liquid into a dispersed state can also cause mist.

NOTE: An example of mist would be spraying water from a household spray bottle.

c. Solids.

(1) Solids include fumes such as those from lead soldering, welding and brazing. These fumes consist of very small solid particles that are dispersed into the air.

(2) Dust is another form of a solid that is very common to most soldiers. Dust consists of very small solid particles that have been mechanically removed from a larger solid by handling, grinding, impacting, detonating and weathering.

Show Slide FSTCC013-6: Toxic Chemical Routes of Entry

13-2. ROUTES OF ENTRY INTO THE BODY

Show Slide FSTCC013-7: Routes of Entry – Inhalation (1)

a. Inhalation.

(1) The most significant route of entry into the body.

(2) Frequency and duration of exposure effect onset of symptoms.

(3) Inhaled TIMs enter the bloodstream through the gas exchange region of the lungs.

Show Slide FSTCC013-8: Routes of Entry – Inhalation (2)

(4) Symptoms of TIM inhalation.

(a) Instant effects.

1 Cough.

2 Burning in throat or chest.

(b) Delayed effects may develop in periods as short as 24 hours or as long as several years.

NOTE: An example would be asbestosis, from inhaling asbestos, or other chronic lung disorders.

Show Slide FSTCC013-9: Routes of Entry - Absorption

b. Absorption. Chemicals absorbed through the skin can have local as well as systemic effects.

(1) Local effects. The most common local effect is dermatitis, which is indicated by reddening of the skin or the appearance of raised, blister like lesions on the skin.

(2) Systemic effects. Systemic poisoning, such as cancer, can result from absorption.

NOTE: An example is cancer of the liver caused by absorption of carbon tetrachloride.

Show Slide FSTCC013-10: Routes of Entry - Ingestion

c. Ingestion.

(1) The result of eating or smoking with contaminated hands or utensils.

(2) Accidental ingestion may occur if toxic materials are stored with food or beverages.

Show Slide FSTCC013-11: Routes of Entry - Injection

d. Injection.

(1) Normally accidental. May occur from the rupture of high-pressure air or liquid lines.

(2) Toxic materials may enter the body through a traumatic injury such as a puncture wound or laceration.

Show Slide FSTCC013-12: Five Biological Effects

13-3. BIOLOGICAL EFFECTS OF TIMs

Show Slide FSTCC013-13: Biological Effects - Irritation

a. Irritation.

(1) Caused by irritants such as sulfur dioxide, acetic acid, formaldehyde, sulfuric acid, iodine, ozone and oxides of nitrogen.

(2) Symptoms include inflammation of the mouth, nose and lung tissue.

Show Slide FSTCC013-14: Biological Effects - Asphyxiation

b. Asphyxiation.

(1) Caused by asphyxiants such as nitrogen, nitrous oxide, hydrogen, helium, methane, ethane, carbon monoxide and cyanide.

(2) Asphyxiants do not damage the lungs; they displace oxygen or cause the body to become incapable of using oxygen.

Show Slide FSTCC013-15: Biological Effects - Anesthesia

c. Anesthesia.

(1) Results from exposure to chemical solvents such as acetone and trichloroethylene.

NOTE: Both of these chemicals are commonly used as degreasing agents in motorpool operations.

(2) Biological effect is a depressant effect on the brain and central nervous system.

(3) The degree of anesthetic effect depends on the type of contaminant as well as the concentration and amount you are exposed to.

Show Slide FSTCC013-16: Biological Effects – Systemic Poisoning

d. Systemic poisoning.

(1) May occur from exposure to organic solvents such as methylene chloride and carbon tetrachloride.

NOTE: These chemicals are found in many paints, degreasers and propellants.

(2) Damage internal organs such as the liver, kidney, central nervous system and the cardiovascular system.

Show Slide FSTCC013-17: Biological Effects - Cancer

e. Cancer. Chemicals suspected of causing cancer, based on animal studies, are called carcinogens.

13-4. MEDICAL THREAT TO SOLDIERS

NOTE: Explain that the discussion will be limited to the three TIMs that soldiers are likely to encounter, carbon monoxide, hydrogen chloride, bore/gun gases, and liquid chemicals (i.e. solvents, oils and greases).

Show Slide FSTCC013-18: Medical Threat – Carbon Monoxide

a. Carbon monoxide poisoning.

NOTE: Carbon monoxide is a by-product of the incomplete burning of carbon substances such as coal, gasoline and natural gas. Understanding where and how carbon monoxide is produced is a critical step in avoiding exposure to it.

(1) Sources of carbon monoxide.

(a) Internal combustion engines.

1 Vehicle engines – exhaust is a significant source.

2 Generators.

(b) Space heaters.

(c) Dynamite and other explosives.

(2) Carbon monoxide hazard.

(a) Because it is odorless, colorless and tasteless its presence may go undetected.

(b) By the time the presence of carbon monoxide is detected, you may be too overcome to remove yourself or your soldiers from the area.

Show Slide FSTCC013-19: Medical Threat – Hydrogen Chloride

b. Hydrogen chloride.

(1) Sources of hydrogen chloride. Hydrogen chloride is produced as an exhaust from rocket systems such as shoulder fired or vehicle mounted rockets.

NOTE: During recent years, the development and use of better rocket systems has increased the incidence of exposure to hydrogen chloride.

(2) Hydrogen chloride hazard. When hydrogen chloride is combined with water it produces hydrochloric acid.

Show Slide FSTCC013-20: Medical Threat – Bore/Gun Gases

c. Bore/gun gases.

(1) Sources of bore/gun gases.

(a) Tank guns.

(b) Artillery cannons.

NOTE: When conventional weapon systems are fired, the ammunition propellant produces toxic gases.

(2) Bore/gun gas hazard. Gases produced when weapons are fired include carbon monoxide and oxides of nitrogen.

NOTE: The ventilation systems on tanks and artillery cannons reduce the chances of exposure to these gases. When conducting PMCS on these weapon systems soldiers must ensure that the ventilation systems are working at peak efficiency.

Show Slide FSTCC013-21: Medical Threat – Liquid Chemicals (1)

d. Solvents, greases and oil. Used in the maintenance of vehicles and weapon systems, these are the most prevalent TIMs and pose a significant risk to soldiers. NOTE: Most of these substances are used in liquid form. Due to their properties, these substances evaporate into vapor readily and the vapors can easily be inhaled into the body.

(1) Most substances in this category are organic compounds. Organic compounds pose a hazard due to their ability to cause cancer and other medical problems.

(a) Solvents.

1 Carbon tetrachloride.

2 Trichloroethylene.

3 Weapons cleaning solvents.

(b) Fuels.

1 Gasoline (MOGAS).

2 Diesel fuel.

(c) Lubricants.

1 Oil.

2 Grease.

NOTE: Other organic compounds commonly found are the pesticides used to control rodents and arthropods.

Show Slide FSTCC013-22: Medical Threat – Liquid Chemicals (2)

(2) Hazards. The widespread use of these substances in day-to-day military operations, both in peacetime and war, put soldiers at a significantly increased risk of exposure. Many times soldiers can be exposed to TIMs most unexpectedly.

Show Slide FSTCC013-23: Medical Threat – A True Story

NOTE: Relate the following story involving U.S. soldiers deployed to Bosnia, to the students:

Deployed soldiers were tasked to remove cardboard boxes from an abandoned warehouse. The warehouse was not well ventilated and was very warm; the soldiers removed their BDU tops as they worked. As the detail went on, many of the soldier's arms became red and started to itch, eventually blisters developed.

When Preventive Medicine personnel were called to evaluate the situation, they determined that the boxes had been treated with a fungicide to prevent the cardboard from deteriorating. Since the boxes were not manufactured in the U.S., there were no controls on how much fungicide should be applied to the boxes. During storage, the fungicide had condensed and formed crystals on the outside of the boxes. In this concentrated form, the fungicide had become a blistering agent. As the soldiers worked, the concentrated fungicide mixed with their perspiration, was absorbed into the skin causing the blisters.

Although no obvious hazardous material was seen, the hazard was there.

Show Slide FSTCC013-24: Harmful Effects – Carbon Monoxide

13-5. HARMFUL EFFECTS CAUSED BY EXPOSURE TO TIMs

a. Symptoms of carbon monoxide poisoning.

(1) Headache.

(2) Sleepiness.

(3) Coma.

(4) Death.

NOTE: The symptoms of carbon monoxide poisoning do not reverse themselves quickly. If you remove yourself and your soldiers from the exposure source and your health conditions do not improve, you cannot assume that it is not carbon monoxide poisoning. Ventilate the area completely before returning.

Show Slide FSTCC013-25: Harmful Effects – Hydrogen Chloride

b. Symptoms of hydrogen chloride exposure.

(1) Irritation of the eyes, throat and lungs. (Caused by the action of hydrochloric acid on the mucous membranes.)

(2) Cough.

(3) Acid burn.

(4) Flu-like symptoms.

NOTE: These flu-like symptoms may actually indicate the presence of lung disease.

Show Slide FSTCC013-26: Harmful Effects – Bore/Gun Gases

c. Symptoms of bore/gun gas exposure.

(1) Watch for symptoms of carbon monoxide poisoning.

(2) Lung irritation (oxides of nitrogen).

Show Slide FSTCC013-27: Harmful Effects – Solvents, Greases & Oils

d. Symptoms of exposure to solvents, greases and oils.

(1) The most common symptoms are skin irritations.

(a) Rashes

(b) Burns

(c) Abnormally dry skin

(d) Infections

(2) Occupational skin diseases account for the greatest number of reported occupational diseases.

(a) May temporarily limit ability to work.

(b) Normally not severe enough to cause permanent disability.

(c) Healthy skin cells provide natural protection from injury due to exposure to many chemicals.

(d) Cracked, dry or otherwise irritated skin provides less protection.

(e) Type and severity of skin disorders due to exposure to TIMs depends on the chemical involved and the duration of exposure.

(3) Other effects.

(a) Organ involvement such as liver and/or brain.

(b) Permanent damage including cancer.

Show Slide FSTCC013-28: Risk Management

13-6. MANAGING RISKS ASSOCIATED WITH TIMs

a. Identify the sources of toxic chemicals in your unit and maintain an up to date list of all chemicals used in the unit for quick reference.

b. Maintain Material Safety Data Sheets (MSDS) for all chemicals used.

(1) Up to date health information.

(2) Hazardous properties.

(3) Control methods.

Show Slide FSTCC013-29: Risk Management Process

c. Include risk assessment in planning at all levels.

(1) Incorporate risk management into all operations including training.

(2) 5-steps of risk management (FM 100-14).

(a) Identify hazards.

(b) Assess hazards to determine risks.

(c) Develop controls and make risk decisions.

(d) Implement controls.

(e) Supervise and evaluate.

NOTE: Time permitting, allow students to practice performing risk assessments using various TIMs.

13-7. PREVENTIVE MEDICINE MEASURES (PMM) FOR TOXIC CHEMICALS

Show Slide FSTCC013-30: PMM for Carbon Monoxide

a. Carbon monoxide.

(1) Prevent accumulation of engine exhaust.

(a) Run engines outside.

(b) When engines must be run inside, use tailpipe extensions.

(2) Provide adequate ventilation of work/sleep areas in which space heaters are being used.

Show Slide FSTCC013-31: PMM for Hydrogen Chloride

b. Hydrogen chloride (from rocket systems).

(1) Position soldiers upwind from rocket systems.

(2) Use respirators designed to protect personnel from these gases.

Show Slide FSTCC013-32: PMM for Bore/Gun Gases

c. Bore/gun gases (tanks, cannons).

(1) Use on-board ventilation systems.

(2) Ensure proper maintenance and function of bore evacuators.

Show Slide FSTCC013-33: PMM for Solvents, Greases & Oils

d. Solvents, greases and oils (liquid chemicals).

(1) Environmental controls.

(a) Minimize exposure of soldiers.

(b) Substitute a safer, less toxic substance for the more toxic substance being used.

NOTE: The use of stoddard solvents is recommended. A stoddard solvent is a chemical preparation that gives you the advantage of a solvent without the hazards present in gasoline, kerosene, etc.

(2) Ensure personal protective devices/clothing are available.

(a) Gloves.

(b) Goggles.

(c) Respirators.

NOTE: Ensure soldiers are fit tested for respirators.

(3) Medical controls. Medical controls refer to programs such as periodic physical exams and/or medical surveillance of soldiers to detect early signs of occupational disease.

13-8. INDIVIDUAL PREVENTIVE MEDICINE MEASURES (IPMM) FOR TOXIC CHEMICALS

Show Slide FSTCC013-34 and FSTCC013-35: Plan for Toxic Chemical Protection

a. Identify source of toxic chemicals in your unit.

b. Develop a protective action plan to reduce sickness or injury.

Show Slide FSTCC013-36 to FSTCC013-43: IPMM for TIMs (Note: Another IPMM will appear with each slide change)

c. Adhere to the following guidelines.

(1) Run engines outside or use tailpipe extensions.

(2) Ventilate work/sleeping areas when space heaters are in use.

(3) Do not use vehicle engines as a heat source.

(4) Use/maintain vehicle ventilation systems.

(5) Properly maintain bore evacuator systems.

(6) Substitute harmful solvents with safer ‘stoddard solvents.’

(7) Use protective equipment/clothing.

d. Practice good personal hygiene.

Section III. SUMMARY

Show Slide FSTCC013-44: Summary

NOTE: Review the main points with the audience. Ask and answer questions to ensure understanding of the material presented in this lesson.

CLOSING STATEMENT: The loss of personnel due to injury or illness caused by non-NBC chemicals, or TIMs, can have a serious impact on a unit's ability to accomplish its mission. Awareness and the use of simple preventive measures can prevent most injuries caused by these substances. One of your jobs as a member of the FST will be to assist the commander in identifying these hazards and implementing the preventive measures necessary to protect your fellow soldiers.