

44.348: ADVANCED SEMINAR ON WEAPONS OF MASS DESTRUCTION AND TERRORISM



Week 2: Chemical Weapons

Dr. James Forest

CHEMICAL WEAPON ATTRIBUTES



- Use the toxic properties of chemical substances to cause physical or psychological harm to an enemy
- Can be delivered through bombs, rockets, artillery shells, spray tanks, and missile warheads; can be dispersed as vapors, aerosols or liquids
- Many kinds have been developed since WWI, including choking agents, blister agents, blood agents, nerve agents, incapacitants, riot-control agents, and herbicides.
- Some are highly lethal; a few drops can kill victims within minutes
- Some evaporate in minutes or hours and lose their effect rapidly.
 - Sarin is a lethal but nonpersistent nerve agent.
 - VX can persist for days or weeks in lethal form

TYPES AND CATEGORIES



- *Biotoxins*
- *Blister agents/vesicants*
- *Blood agents*
- *Caustics (acids)*
- *Choking/lung/pulmonary agents*
- *Incapacitating agents*
- *Long-acting anticoagulants*
- *Metals*
- *Nerve agents*
- *Organic solvents*
- *Riot control agents/tear gas*
- *Toxic alcohols*
- *Vomiting agents*

HAZARDOUS CHEMICALS



- *Abrin*
- *Arsine (SA)*
- *Benzene (CA)*
- *Bromine (CA)*
- *Bromobenzylcyanide (CA)*
- *Chlorine (CL)*
- *Chloroacetophenone (CN)*
- *Chlorobenzylidenemalononitrile (CS)*
- *Chloropicrin (PS)*
- *Cyanide*
- *Cyanogen chloride (CK)*
- *Dibenzoxazepine (CR)*
- *Hydrogen fluoride (hydrofluoric acid)*
- *Hydrogen cyanide (AC)*
- *Lewisite (L, L-1, L-2, L-3)*
- *Mustard gas (H)*
- *Nitrogen mustard (HN-1, HN-2, HN-3)*
- *Paraquat*
- *Phosgene (CG)*
- *Phosgene oxime (CX)*
- *Potassium cyanide (KCN)*
- *Ricin*
- *Riot control agents/tear gas*
- *Sarin (GB)*
- *Sodium azide*
- *Sodium cyanide (NaCN)*
- *Soman (GD)*
- *Stibine*
- *Strychnine*
- *Sulfur mustard (H)*
- *Tabun (GA)*
- *Tear gas/riot control agents*
- *VX*

CHOKING AND BLOOD AGENTS



- Choking agents cause respiratory damage and asphyxiation
 - Include chlorine, phosgene, fentanyl gas
 - Phosgene was responsible for roughly 80 percent of all deaths caused by chemical arms in World War I ([see film clip](#))
- Blood agents prevent the transfer of oxygen to the cells, causing the body to asphyxiate
 - Include hydrogen cyanide and cyanogen chloride
- Both choking and blood agents are delivered as gas clouds to the target area
- Best defense is a good gas mask

EXAMPLE: CHLORINE



- Used during World War I
- One of the most commonly manufactured chemicals in the U.S.,
 - Bleach, pesticides (insect killers), rubber, and solvents
 - drinking water, swimming pools
 - industrial waste and sewage
- Chlorine gas is heavier than air
- Contact with chlorine gas can damage moist tissues such as the eyes, throat, and lungs.
- Potential exposure through skin contact, eye contact, touching, or drinking water that contains chlorine.

Immediate signs and symptoms of exposure:

- Coughing
- Chest tightness
- Burning sensation in the nose, throat, and eyes
- Watery eyes
- Blurred vision
- Nausea and vomiting
- Burning pain, redness, and blisters on the skin
- Difficulty breathing or shortness of breath
- Fluid in the lungs

BLISTERING AGENTS



Examples include sulfur mustard, nitrogen mustard and lewisite

Delivered in liquid or vapor form, blistering agents burn the skin, eyes, windpipe, and lungs

Mustard gas is most popular due to ease of production, low cost, predictable properties, persistence

- Penetrates leather and fabrics
 - Causes painful burns requiring immediate medical attention
 - This consumes an enemy military's resources more than fatalities
- Best defense is a good gas mask and protective clothing

NERVE GASES



- Nerve agents attack the nervous system when inhaled or absorbed by the skin, causing a loss of muscle control, respiratory failure, and eventually death ([see film clip](#))
- Require much lower quantities than blood, choking, blister agents
- Can be classified as either
 - G agents (like sarin or tabun)
 - V agents (like VX)
- Some nerve agents such as sarin, tabun, soman, and VX can kill almost instantly; a few droplets absorbed through the skin can paralyze and cause death in minutes.
- Defense against nerve agents requires skintight gas mask and protective clothing

OTHER TYPES



- Incapacitants
 - can incapacitate, disorient, or paralyze opponents
 - may attack the nervous system and derange a victim's mental processes, causing (for example) hallucinations or psychotic thinking
- Binary
 - use toxic chemicals produced by mixing two compounds immediately before or during use
 - Safer, easier to store and handle

WEAPONIZATION AND DELIVERY

- Hazardous chemicals must be “weaponized”
 - May include the addition of chemical stabilizers to extend its shelf-life or to facilitate its delivery as an aerosol or spray
- Effective delivery system is necessary
 - Sprayer systems (Crop dusters, small airplanes, or helicopters)
 - Explosives (though some of the chemicals would be destroyed in the explosion)
 - Food and water contamination

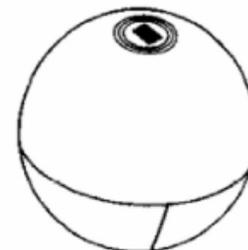
BACKPACK SPRAYER



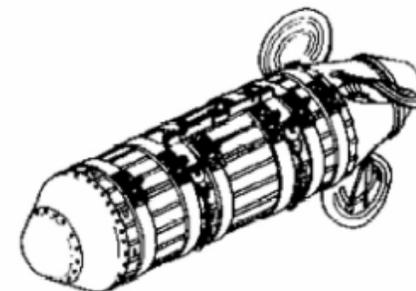
155 MM ARTILLERY SHELL
(POSSIBLE CHEMICAL FILL)



CHEMICAL BOMBLET AND BOMBLET DISPENSER



OKT-8 OR OKT-11 CHEMICAL BOMBLET



RRAB-1 BOMBLET DISPENSER

BRIEF HISTORY OF CHEMICAL WEAPONS

- History of chemical weapons use by States:
 - Athenians poisoned water supplies
 - Mongolians catapulted burning pitch and sulfur into cities during a siege
 - World War I: Chlorine and mustard gas were first developed and used, leading to an estimated 1,300,000 casualties, including 91,000 fatalities
 - Between World Wars: Used by British, Spanish, Italian, Soviet and Japanese forces in various conflicts
 - World War II: Lots of CW types developed, but not used in WWII (except possibly Japan)

BRIEF HISTORY OF CHEMICAL WEAPONS

- **Post-WWII:**
 - Vietnam War: Agent Orange used by US forces
 - Yemen Civil War: Egyptians use mustard gas and phosgene
 - Soviet occupied Afghanistan: mustard gas used against rebels
 - Libya used mustard gas against rebels in Chad
 - 2002, Fentanyl gas used to kill Chechen terrorists in Moscow

IRAQ



- During the 1980s, Iraq had a huge stockpile of mustard gas made with chemicals from several countries, including 500 tons of TDG manufactured in Baltimore that were sold to Iraq, via a trafficking network orchestrated by a Dutch businessman.
 - Iraq used mustard gas and nerve agents against Iran's human wave attacks during the Iran-Iraq War
 - Used against Iraqi Kurds
 - The Australia Group, which monitors the export and shipping of chemical precursors and equipment and supports the CWC, had no impact on Saddam Hussein's efforts to expand his chemical weapons program.

MODERN CHEMICAL WEAPONS PROGRAMS

- Chlorine, phosgene, hydrogen cyanide, and sulfur mustard are relatively easy to manufacture
- Production of nerve agents requires high temperatures, dangerous chemicals, expertise in synthetic organic chemistry
- Dozens of countries had CW programs; least expensive form of WMD; most CW programs have been abandoned
- Even poor countries; for example, Libya
 - Began CW program in the 1980s
 - Declared intent “to balance Israel’s WMD capabilities”
 - Built two of the largest chemical weapons facilities in the world, near Rabta and Tarhuna
 - December 2003: Abandons program, allows international inspections

PROLIFERATION CONCERNS



- Geneva Convention
- Chemical Weapons Convention
 - Signatories agreed to destroy all chemical weapons and facilities
 - Countries that have not joined CWC include Angola, Egypt, North Korea, Somalia and Syria
 - Israel, China and Iran have signed CWC, but are suspected of having secret CW programs; Israel has never ratified the CWC
- **Dual use** problem of precursor chemicals, technologies for commercial industries

CHEMICAL WEAPONS STOCKPILES



- Declared CW stockpiles (slated for destruction) in 4 countries: Albania, Libya, Russia, and the United States
- Russia has largest amount (44,000 tons of mustard gas, VX, sarin, etc.) but limited means to dispose of it safely
- India and South Korea just completed destruction of their CW stockpiles
- Special case of “riot control” chemicals

U.S. CHEMICAL WEAPONS



- Chemical weapons destruction program in the U.S. led by U.S. Army Chemical Materials Agency
- The last 10% of US stockpiles, at Pueblo Chemical Depot in Colorado and the Blue Grass Army Depot in Kentucky, should be destroyed by 2017 and 2021, respectively



U.S. 155-millimeter chemical munitions, shown in storage at the Pueblo Chemical Depot in Colorado.

TERRORIST INTERESTS IN CW



Chemical terrorism: “Use or threat of use of chemical agents by a Non-State Actor for furtherance of political, social, religious or any other ideological goals”

Instruction manuals reflect terrorists interests in chemical weapons

- 11th volume of Al-Qaeda’s 5,000-page *Encyclopedia of Jihad* is “How to construct chemical and biological weapons”
- The *Mujahideen Poisons Handbook* – see *Blackboard folder*

Acquisition and use of chemical weapons by terrorists

- April 1985, United States: stockpile of cyanide discovered in a compound of the Covenant, Sword and Arm of the Lord
- June 1990, Sri Lanka: Liberation Tigers of Tamil Eelam (LTTE) used chlorine gas in an assault on a Sri Lankan Armed Forces camp
- June 2003, Malaysia: chemicals found in a Jemaah Islamiyah compound
- March-June 2006, Iraq: Insurgents use chlorine gas as component in improvised explosive devices

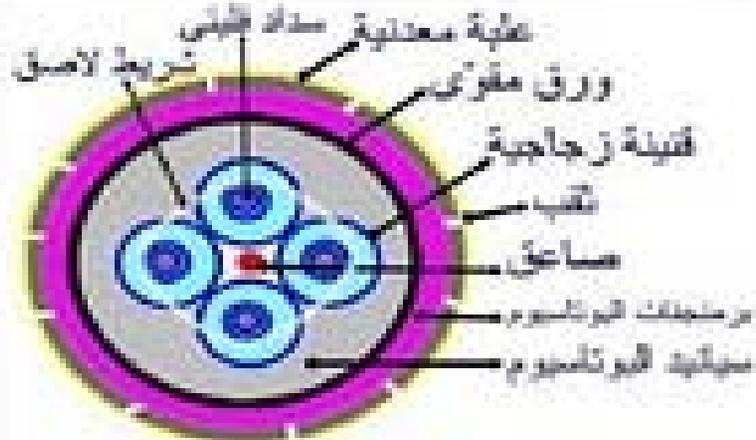
AUM SHINRIKYO



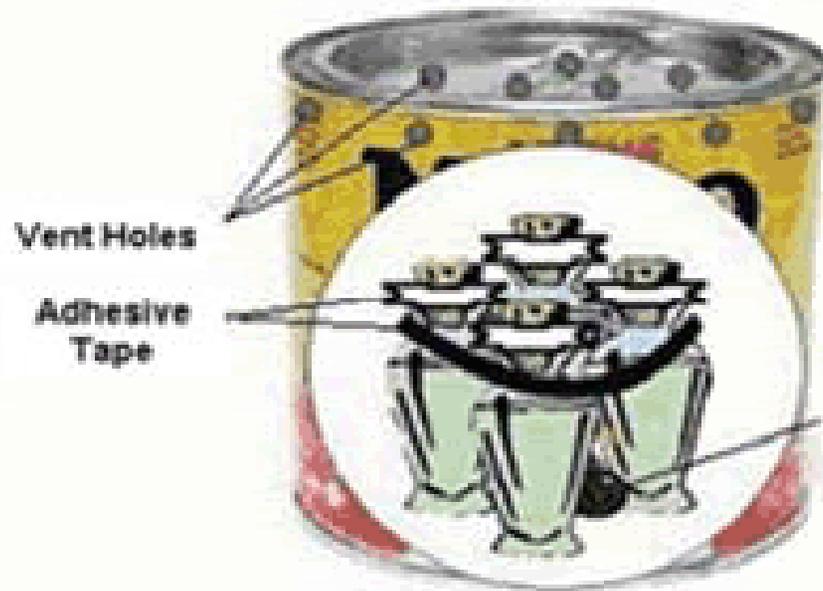
- Production facility, Satian 7
 - Produced Sarin, VX
- June 1994, Matsumoto
 - How? Why? Impact?
- March 1995, Tokyo subway
 - How? Why? Impact?
- Anomaly or harbinger of future WMD terrorist scenario?

AL-MUBTAKKAR ("THE INVENTION")

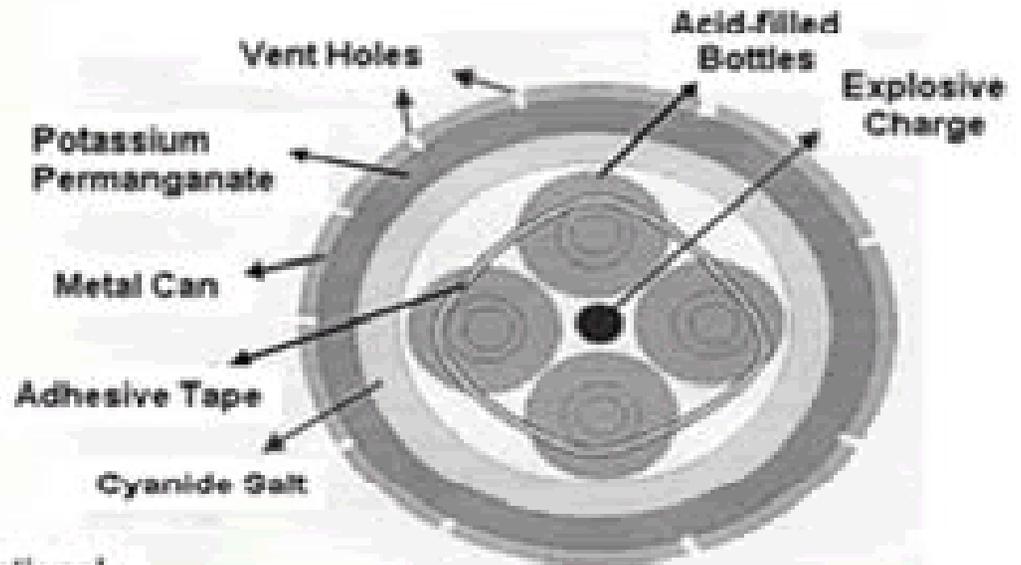
Designed by al-Qaida operatives for potential deployment in attack against the New York City subway system



منظر علوي للمبتكر



(U) External View with Cutaway



(U) Top-down View

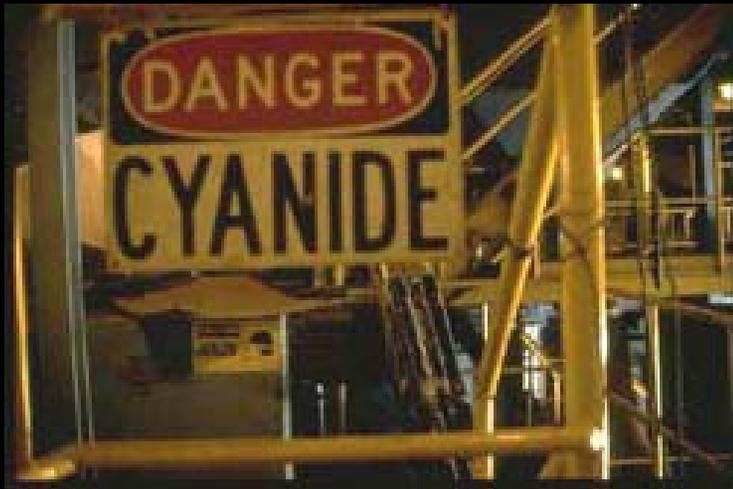
RESPONSES TO THE CW THREAT



- Gas masks, protective clothing for military
- Atropine-filled hypodermic needles to fight the effects of nerve gas exposures
- Chemical agent sensors deployed by military, and increasingly by cities in public gathering spaces, airports, train stations, etc.
- Chemical hazard suits and Hazmat teams
- Crowd decontamination facilities
- Public health system capacity for medical triage and treatment of large numbers of casualties
- Role of public health providers, hospitals, physicians, monitoring for potential chemical exposure emergencies
- **CDC Chemical Emergencies website: <http://www.bt.cdc.gov/chemical/>**

PRE-POSITIONED CHEMICAL WEAPONS?

- Chemical storage facilities
- Urban transportation of toxic chemicals



CONCLUSION



- Summary of attributes
 - Relatively inexpensive WMD
 - Can be delivered through bombs, rockets, artillery shells, spray tanks, and missile warheads
 - Many kinds, including choking agents, blister agents, blood agents, nerve agents, incapacitants, riot-control agents, and herbicides.
 - Nerve agents are the most lethal
 - Widely available (commercial chemicals)
- Specific infrastructure concerns include storage facilities, transport tankers

CONCLUSION



- Historical uses of chemical weapons
 - Most widely used WMD
 - Massive stockpiles were developed, slowly being destroyed
- National programs (known and clandestine) have led to modern availability of chemical weapons
- Dual use chemicals and technologies
- Terrorists are clearly interested in these weapons