The Chemical Suicide Phenomenon
By Jacob Oreshan, III and Teresa Stevens

Chemical suicides have plagued the United States since 2008, and continue to be on the rise. This method of suicide originated in Japan in 2007, where they have seen over 2000 such cases. Chemical suicide, or detergent suicide, involves mixing common household chemicals to create deadly hydrogen sulfide (H2S) gas, which is lethal in contained areas. In 2008, first responders in the United States responded to 3 incidents; while in 2009 there were 9 incidents, 2010 saw more than 30 incidents. It is important to realize that analysts believe these cases are drastically underreported in the United States at this time.

Hydrogen sulfide

Hydrogen sulfide, H2S, is a colorless gas that has a strong odor of rotten eggs or sulfur associated with it. It is extremely toxic by inhalation, posing a large risk to first responders who do not wear proper respiratory protection when dealing with it or who are unaware of its presence. H2S is an olfactory nerve paralyzer, meaning it will rapidly fatigue the sense of smell, even when present in lower concentrations. Overall, 25% of the deaths associated with hydrogen sulfide gas occur in rescuers, first responders, bystanders, or professionals who deal with it on a regular or routine basis. However, when discussing chemical suicides, there have been no deaths to first responders to date.

Hydrogen sulfide has a vapor density of 1.19, making it heavier than air. As first responders approach the space where a suspected chemical suicide has occurred and they are performing air-monitoring tasks, vapors will be found lower to the ground. However, once they enter the space or begin air monitoring within the space, it can be expected that diffusion will have occurred and we will find the space consumed with vapors. Vapors may be knocked down with a water spray if it is felt that that is the best course of action for the incident, however, all runoff created should be contained and disposed of properly as it will be toxic and corrosive.

Hydrogen sulfide is made by mixing hydrochloric acid with a sulfur-containing compound (in a high enough concentration to react with the hydrochloric acid). In many of the cases we have seen, the two chemicals mixed have been hydrochloric acid and lime sulfur. Lime sulfur (Bonide) is a 28% solution of calcium polysulfide. Both products are easy to obtain and can be purchased at a local hardware, grocery, or big box store. Approximately ½ cup of each product will produce about 1000 ppm H2S inside a confined space (approximately 3500 cubic feet).

The individuals who have mixed these chemicals have been mixing several containers of each product, not increasing the concentration of gas produced but increasing the volume of gas produced. As one of the chemicals being mixed is an acid and the other a base, a mildly exothermic, somewhat violent reaction can be expected. Because of this, evidence that the reaction has occurred may be visible from outside of the confined space.

Personal protective equipment utilized for dealing with chemical suicide incidents involving hydrogen sulfide should be adequate and appropriate for the degree and type of contamination encountered. Each incident will be slightly different and PPE needs should alter to meet the specific needs of the incident. As the IDLH threshold for hydrogen sulfide is 100 ppm, self-contained breathing apparatus must be utilized.
Chemical protective clothing is not necessary and is not generally recommended for dealing with hydrogen sulfide gas. Hydrogen sulfide poses a minimal risk through cutaneous absorption and also a minimal risk of secondary contamination by first responders. Structural firefighting turnout gear or Tyvek suits will provide adequate skin protection for dealing with hydrogen sulfide gas.

By DOT definition, hydrogen sulfide meets the criteria to be considered a flammable gas, as the flammable range is 4.3% to 45%. The auto-ignition temperature is 500 degrees Fahrenheit. However, in these particular situations, the flammability risk is fairly low. In the essence of first responder safety, all ignition sources should be eliminated to reduce the flammability risk. A charged hand-line should be made ready in case a source of ignition is found. The vapors in the space should be ventilated properly once all precautions have been taken to safely do so.

Hydrogen sulfide decontamination

Decontamination for first responders should be set up appropriately for the degree of contamination encountered at the scene. A full technical decontamination setup may not be necessary or appropriate for the incident. At minimum, skin should be washed with water for three to five minutes. If eyes or skin appear to be irritated, continue to flush with water during medical observation and transport to a nearby medical facility. Contamination for victims of chemical suicides will be more acute and decontamination will require more time and attention.

All clothing should be removed and double bagged. Decontaminate the body as dictated per normal standard operating procedures or guidelines. Victims may off-gas from their lungs after they have been deceased for a significant period of time. This may pose a risk for those transporting victims and those performing autopsies. Body bags are recommended for transporting victims only if they must be transported in an enclosed vehicle in which they will be occupying the same space as the driver.

The best option for moving a victim of chemical suicide would be to wrap them in sheets and tarps, then transport in an "open" vehicle such as an official pickup truck (i.e.: one belonging to the local police/Sherriff's department, fire department vehicle, etc.). Protocols should be established in a preplan prior to an incident occurring. These protocols should be written with the involvement of the county coroner's office, local hospital in which a contaminated victim may be transported to, and local transporting agencies.

Hydrogen sulfide will act as a mucous membrane and respiratory tract irritant. In extremely high concentrations, it may also act as a skin irritant. Low concentrations would be considered anything below 50 ppm. Symptomatology associated with exposure to low concentrations would be irritation of the eyes, nose, and throat. Symptomatology associated with higher concentrations is much more severe and will target different body systems. Central nervous systems stimulation (excitation, rapid breathing, and headache) will precede central nervous system depression (impaired gait, dizziness, respiratory paralysis, and death). Exposure to high concentrations of H2S may also cause an accumulation of fluid in the lungs. This may be an immediate symptom or delayed up to 72 hours.

Other symptoms associated with hydrogen sulfide exposure include, but are not limited to:

- Tachycardia: abnormally rapid beating of the heart, usually over 100 beats per minute
- Bradycardia: slowness of the heartbeat, usually under 60 beats per minute
- Dyspnea: difficult, labored breathing
- Tachypnea: excessively rapid respiration
- Cyanosis: blueness or lividity of the skin, as from imperfectly oxygenated blood
- Delirium: a state of violent excitement or emotion
- Photophobia: abnormal sensitivity or intolerance of light
- Chemical Conjunctivitis: inflammation of the conjunctiva (mucous membrane that covers the exposed portion of the eyeball and the under surface of the eyelid) caused by exposure to chemicals.
- Headache
- Throat Irritation
- Taste of garlic in the mouth

**Physiological Response to H2S**
- .00047 ppm Odor threshold
- 10 ppm TLV-C. Eye Irritation
- 50-100 ppm Slight conjunctivitis and respiratory tract irritation
- 100 ppm Coughing, loss of sense of smell. Altered respirations, drowsiness.
- 320-530 ppm Pulmonary edema
- 530-1000 ppm Strong stimulation of the CNS. Rapid breathing, leading to loss of breathing
- 800 ppm LC50, less than 5 minutes
- ≈1000 ppm Immediate collapse with cardiopulmonary arrest, even after only one breath

Treatment for those exposed to hydrogen sulfide mainly involves supporting cardiovascular and respiratory functions. Nitrite therapy has been recommended as a therapy for hydrogen sulfide exposure. Amyl nitrite should be given by inhalation for 30 seconds every minute until an intravenous line can be established. This should be followed by administration of intravenous sodium nitrite. This may aid recovery by forming sulfmethemoglobin, thus removing sulfide from combination in tissue. This treatment is only recommended if it can be started shortly after exposure and if it can be started without interfering with the establishment of adequate ventilation and oxygenation procedures.

Hydrogen sulfide has a rate of decay that ranges from 12 to 37 hours. This will be dependent on ambient air temperature. The colder the ambient air temperature, the longer the rate of decay will be. The warmer the ambient air temperature, the shorter the rate of decay.

**Hydrogen cyanide**

Hydrogen cyanide, HCN, is a colorless gas or a bluish-white liquid that may have an odor association of bitter or burnt almonds. Approximately 20 to 40% of the population cannot make the odor association due to a genetic trait. HCN will rapidly fatigue the olfactory senses for those that can detect the odor. It is extremely toxic by inhalation, skin absorption, and ingestion. HCN is considered a blood agent when used as a chemical weapon.

It should be noted that not all cyanide incidents that have been encountered have been hydrogen cyanide cases. Other cyanide-based compounds have been encountered in varying states of matter (solids, liquids, and gases). This is extremely important because it will play a major role in what level of PPE first responders enter the contaminated atmosphere.

Hydrogen cyanide has a vapor density of 0.94, making it lighter than air. As first responders approach the space where a suspected chemical suicide has occurred and they are performing air-monitoring tasks, vapors will be found above the ground. However, once they enter the space or begin air monitoring within the space, it can be expected that diffusion will have occurred and we will find the space consumed with vapors. Vapors may be knocked down with a water spray if it
is felt that that is the best course of action for the incident, however, all runoff created should be contained and disposed of properly.

Mixing hydrochloric acid with cyanide containing compounds makes hydrogen cyanide. In May 2008, an Arizona man mixed potassium cyanide with muriatic acid in his vehicle. However, many of the cases involving cyanide that have been seen have not involved the mixing of two chemicals. These cases have been situations in which the individuals involved have ingested or inhaled the cyanide. This will be discussed further on in the program.

Personal protective equipment utilized for dealing with chemical suicide incidents involving hydrogen cyanide should be adequate and appropriate for the degree and type of contamination encountered. Each incident will be different and PPE needs should alter to meet the specific needs of the incident.

IDLH for hydrogen cyanide gas is 50 ppm and self-contained breathing apparatus must be utilized when dealing with cyanide compounds in gaseous form. Level A, totally encapsulated chemical protective clothing must also be donned when entering an atmosphere contaminated by hydrogen cyanide gas or liquid. Cutaneous absorption must be avoided as HCN may be readily absorbed through intact skin, causing systemic poisoning with little or no skin irritation. Lower levels of protection may be utilized depending on the incident. Someone on scene should determine this with expertise on the hazard encountered. If unknown, choosing the highest level of protection is the safest action.

By DOT definition, hydrogen cyanide meets the criteria to be considered a flammable gas, as the flammable range is 5.6% to 40%. The auto-ignition temperature is 1000 degrees Fahrenheit. However, in these particular situations, the flammability risk is fairly low. In the essence of first responder safety, all ignition sources should be eliminated to reduce the flammability risk. A charged hand-line should be made ready in case a source of ignition is found. The vapors in the space should be ventilated properly once all precautions have been taken to safely do so.

Hydrogen cyanide decontamination

Decontamination for first responders should be set up appropriately for the degree of contamination encountered at the scene. A full technical decontamination setup may be necessary and appropriate for the incident. If responders are exposed and are symptomatic, medical treatment should be given simultaneously with decontamination.

Contamination for victims of chemical suicides will be more acute and decontamination will require more time and attention. All clothing should be removed and double bagged. Decontaminate the body as dictated per normal standard operating procedures or guidelines. Victims may off-gas from their lungs after they have been deceased for a significant period of time. This may pose a risk for those transporting victims and those performing autopsies. Body bags are recommended for transporting victims only if they must be transported in an enclosed vehicle in which they will be occupying the same space as the driver. The best option for moving a victim of chemical suicide would be to wrap them in sheets and tarps, then transport in an "open" vehicle such as an official pickup truck (i.e.: one belonging to the local police/Sherriff's department, fire department vehicle, etc.). Protocols should be established in a preplan prior to an incident occurring. These protocols should be written with the involvement of the county coroner's office, local hospital in which a contaminated victim may be transported to, and local transporting agencies.
Hydrogen cyanide is a tissue asphyxiant that will affect virtually all body tissue. The red blood cells carry tissue asphyxiants to the body's cells. The asphyxiants are given to the cells in exchange for the carbon dioxide they hold. The cells are poisoned and cannot ever again accept oxygen from the red blood cells. Unlike carbon monoxide, which attaches itself to the red blood cell so tightly that it will not let go and renders the red blood cell incapable of picking up oxygen, the tissue asphyxiant allows itself to be "dumped" to the receiving body cell just as oxygen does. The most common tissue asphyxiants are hydrogen cyanide, cyanogen, and cyanogen chloride. An increased production of lactic acid will cause metabolic acidosis. Fatality may be induced in minutes depending on the route of exposure to the chemical.

Cyanide poisoning is marked by abrupt onset of profound and dramatic symptoms. Symptomatology associated with exposure to lower concentrations (25-50 ppm) of hydrogen cyanide may be eye irritation, headache, nausea, and vomiting. Symptomatology associated with exposure to higher concentrations may include syncope, seizures, coma, gasping respirations, and cardiovascular collapse. Central nervous systems symptoms may vary and include, but are not limited to excitement, dizziness, nausea, vomiting, headache, weakness, drowsiness, lockjaw, convulsions, hallucinations, loss of consciousness, and death. Respiratory symptoms are progressive and include, but are not limited to shortness of breath, chest tightness, rapid breathing, increased depth of respirations, slowing of respirations, gasping, and respiratory arrest. In cases involving cyanide, NEVER attempt resuscitation without a barrier in place.

Other symptoms associated with hydrogen cyanide exposure include, but are not limited to:
- Bradycardia with hypertension: unusually slow heart rate with an elevated blood pressure, especially the diastolic pressure
- Tachycardia with hypotension: abnormally high heart rate with a decreased blood pressure
- Pulse oximetry: a measurement of the percentage of oxygen is a person's blood. This number will be high and falsely reassuring.
- Cherry red skin color: as you would see in a patient with carbon monoxide poisoning
- Bright red retinal arteries and veins
- Smell of bitter almonds on the breath
- Physiological Response to HCN
- 25 ppm Slight unspecified symptoms (general weakness, malaise and/or collapse)
- 110 ppm Death (30-60 minutes)
- 250 ppm Instant death

Treatment involves providing patients with 100% oxygen with the administration of specific antidote kits. The Cyanide Antidote Kit contains amyl nitrate, sodium nitrate, and sodium thiosulfate. The sodium nitrate followed by the sodium thiosulfate, injected intravenously is capable of detoxifying one lethal dose of sodium cyanide and may be effective after respiration has stopped, as long as the heart is still beating.

(http://www2.mooremedical.com/index.cfm?PG=CTL&FN=ProductDetail&PID=7058) The Cyanokit is another cyanide antidote treatment available. The active ingredient in this kit is hydroxocobalamin. This forms a strong bond with the cyanide, forming a nontoxic cyanocobalamin, another form of B12, which is then safely excreted in the urine.
(http://www.cyanokit.com/pdf/CYKT_Detail_Tool_FINAL_Web.pdf) No medications should be administered without direct orders from a doctor who has been notified of the victim's current status.

Chemical suicide instructions spread online
Instructions for chemical suicides are readily available on the Internet. Most sites encourage anyone planning to use this method to provide appropriate warnings about the presence of the deadly gas to people who might respond to the suicide. Newer versions of Internet instructions are providing very explicit information on how to make and generate hydrogen sulfide gas. Premade signs continue to be available as well.

The easily recognizable incidents will have signs posted in the vehicle windows or inside the structure, as is the case 90% of the time. There are however the not so easily recognizable incidents where there are no signs and little in the way of clues. This is where we need to have a heightened sense of awareness.

In several incidents individuals manufactured hydrogen cyanide (HCN) instead of hydrogen sulfide. These instances of hydrogen cyanide are rare because the chemicals needed for the reaction are not as readily available as chemicals used to make hydrogen sulfide.

Responders must do a thorough scene safety check before attempting to a vehicle with unresponsive patients(s). It is recommended that the responders observe a "10 seconds to save your life" rule. Responders should take an extra 10 seconds during size up to peer into the vehicle and look for pails, buckets or other mixing vessels in the front or rear seats, containers of acids and pesticides, a yellow or green residue in the vehicle and vents that may be taped off. If the incident occurs in a structure, such as an outbuilding or other contained area, there may not be any written warnings present. Responders need to be extremely cautious when investigating suspicious odor calls inside a structure.

Currently, in the United States, the use of hydrogen sulfide or hydrogen cyanide has been limited to individual suicides. Approximately a half a cup of an acid containing product and a half a cup of a sulphur-containing product will generate enough gas to fill a standard 4-door sedan with more than 1000 ppm hydrogen sulfide gas. Most individuals are mixing several gallons inside their vehicles, generating an incredibly lethal atmosphere in a matter of seconds that lingers for several hours.

There is the potential for chemical suicide incidents to start occurring at middle and high schools. Internet chat sites are suggesting a shift to younger and younger individuals who are looking to use, or choose this method for committing suicide. The concern is that there will be a shift to the "suicide pact" method, as has been seen in the UK. The concern is that two or three students may make their way to the school parking lot and commit suicide using the hydrogen sulfide method.

The National HazMat Fusion center has established best practice guidelines for a response to a chemical suicide incident. The information is available in a flow chart and may be downloaded from their web site, www.hazmatfc.com . It is recommended the flow chart be laminated and placed in all response vehicles.

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