Albrecht, Linda

From: Dan Laba [danlaba@shaw.ca]
Sent: Thursday, July 09, 2015 7:12 AM
To: Albrecht, Linda
Subject: Proposed Trinity Development
Attachments: CityTrinity.docx; When the Winter Olympics were in Vancouver four years ago.docx; terrorism Copy.pdf; Anhydrous Ammonia insurance.docx; Is Anhydrous Ammonia a Risk to Your Communit1.docx; hazardsofammoniareleases.pdf; ammonia hazards Copy.pdf

(Please print out the attached documents for letter reference)

Office of the City Clerk, City of Calgary:

Proposed Trinity LOC2014-0080

Proposed Bylaws: 120D2015, 121D2015, 122D2015, 123D2015, 124D2015, 125D2015, 25P2015, 9C2015

When the original proposal for the Calgary Olympics was made in the 1980's the Paskapoo slopes ski hill looked good on paper, being in the City limits, a natural slope for a short ski jump event. What was also known but not advertised was the amount of potential winds and chinook winds across the hillside.

When the bid was won, to provide the reliable freezing potential of the ski jump facilities that were build, ammonia was chosen as the cooling compound. Even though it is a deadly chemical, it is one of the most effective and used materials for refrigeration. So in spite of the adjacent communities, and to mitigate the worst case scenarios for warm weather, tons of ammonia hydrate was stored on this site and was used to cool the ski jump, bobsled and luge

Industrial ammonia at 99.8% pure and according to the New York State Department of Health's "The facts about ammonia' paper- July 28th 2004 :

How can people be exposed to ammonia?

Most people are exposed to ammonia from inhalation of the gas or vapors. Since ammonia exists naturally and is also present in cleaning products, exposure may occur from these sources. The widespread use of ammonia on farms and in industrial and commercial locations also means that exposure can occur from an accidental release or from a deliberate terrorist attack.

Anhydrous ammonia gas is lighter than air and will rise, so that generally it dissipates and does not settle in low-lying areas. However, in the presence of moisture (such as high relative humidity), the liquefied anhydrous ammonia gas forms vapors that are heavier than air. These vapors may spread along the ground or into low-lying areas with poor airflow where people may become exposed.

What is ammonia's mechanism of action?

Ammonia interacts immediately upon contact with available moisture in the skin, eyes, oral cavity, respiratory tract, and particularly mucous surfaces to form the very caustic ammonium hydroxide. Ammonium hydroxide causes the necrosis of tissues through disruption of cell membrane lipids (saponification) leading to cellular destruction. As cell proteins break down, water is extracted, resulting in an inflammatory response that causes further damage.

What are the immediate health effects of ammonia exposure?

Inhalation: Ammonia is irritating and corrosive. Exposure to high concentrations of ammonia in air causes immediate burning of the nose, throat and respiratory tract. This can cause bronchiolar and alveolar edema, and airway destruction resulting in respiratory distress or failure. Inhalation of lower concentrations can cause coughing, and nose and throat irritation. Ammonia's odor provides adequate early warning of its presence, but ammonia also causes olfactory fatigue or adaptation, reducing awareness of one's prolonged exposure at low concentrations.

Children exposed to the same concentrations of ammonia vapor as adults may receive a larger dose because they have greater lung surface area-to-body weight ratios and increased minute volumes-to-weight ratios. In addition, they may be exposed to higher concentrations than adults in the same location because of their shorter height and the higher concentrations of ammonia vapor initially found near the ground.

Skin or eye contact: Exposure to low concentrations of ammonia in air or solution may produce rapid skin or eye irritation. Higher concentrations of ammonia may cause severe injury and burns. Contact with concentrated ammonia solutions such as industrial cleaners may cause corrosive injury including skin burns, permanent eye damage or blindness. The full extent of eye injury may not be apparent for up to a week after the exposure. Contact with liquefied ammonia can also cause frostbite injury.

Ingestion: Exposure to high concentrations of ammonia from swallowing ammonia solution results in corrosive damage to the mouth, throat and stomach. Ingestion of ammonia does not normally result in systemic poisoning.

How is ammonia exposure treated?

There is no antidote for ammonia poisoning, but ammonia's effects can be treated, and most people recover. Immediate decontamination of skin and eyes with copious amounts of water is very important. Treatment consists of supportive measures and can include administration of humidified oxygen, bronchodilators and airway management. Ingested ammonia is diluted with milk or water.

Will laboratory tests assist in making treatment decisions if someone has been exposed to ammonia?

Laboratory testing for ammonia exposure will not be useful in making emergency treatment decisions. Medical tests that can detect ammonia in blood or urine are available. However, because ammonia is normally found in the body, these test results cannot serve as biomarkers of exposure. After exposure to low levels, ammonia is either rapidly cleared from the body or metabolized to compounds found endogenously at appreciable levels. Clinical indices of body ammonia or nitrogen levels after exposure to exogenous ammonia have shown no or minimal change from prior levels. Exposure to high concentrations is immediately and overtly toxic, generally providing an adequate basis for diagnosis.

In other words exposure to a resulting cloud of concentrated ammonia from a leak would drift along the hillside as a cloud (winds tend to blow East towards the proposed development, or drift down into the valley into Bowness). Exposure to this cloud from any organic life results in a chemical reaction to the water in that life such as lungs, causing a chemical reaction similar to a burn in which there is no cure. In high concentrations with a couple of breaths you drop in searing pain and quickly begin to die. If you happen to get rescued before you die you live with permanent burns as any fire burn victim (skin exposure even looks like a fire burn).

I have included a news release from the "Time Colonist" in which Karen Magnessen was exposed to an ammonia leak while in a skating rink in Vancouver and how a limited exposure ended her career and the consequences to her health.

I was living in Bowness when a small spill of liquid ammonia entered the drainage system and into the Bowness lagoon, killing all the fish in the lagoon and flowing into the Bow River. The skating rink in Bowness has also had a small ammonia leak.

I have also included a copy of a report on terrorism in which the terrorists no longer have to create their weapons, just exploit ones in which we have provided.

There used to be a dynamite factory in SE Calgary when I was young. It existed in a valley where there was NO development at all for a mile in all directions. It was a high security facility in which safety was paramount and only those choosing to risk their lives for a paycheck entered the grounds. As I remember there were two accidents before they closed it in which people lost their lives. They knew the risks.

What you have at COP is the same deadly potential in which a group of enthusiasts seem to feel it is OK to expose existing neighbourhoods to risk for the sake of Olympic games and when that is over with the deadly substance on site and in immense quantity, try and exploit the surrounding, relatively empty lands for further profit. Not telling people they are living or shopping next to tons of deadly gas in which if there was a major leak they would most likely be severely injured or die. Trying to create high-rises and surrounding neighbourhoods in which people take a risk even being anywhere near the facilities, never mind living next to them.

At least with the dynamite factory common sense dictated NO SURROUNDING DEVELOPMENT. The plant can blow up and no one in their right mind wants to blow up with it.

With these people it seems to be the "don't tell and everything will work out fine" attitude is carrying them forward.

I have also included a paper from an insurance perspective as far as what insurance can be obtained and the problems with insurance with industrial ammonia on site for skating rinks. If there was a major accident (I will include a paper on how many accidents have happened with this material) and the resulting lawsuits, when the overseeing committee for the Paskapoo site declared bankruptcy, because the City of Calgary gave permission for such facilities to exist within City limits and further approved adjacent developments, would it not fall on the City to pay for any damages? Then when the City faltered under the weight of such lawsuits would it not fall on the province to help with the damages?

As a taxpayer I strongly object to any development that is close to this much tonnage of stored ammonia.

Irrespective of traffic problems, visual pollution on the hillside, sound pollution (in which when COP has an event now it sounds like the loud speakers are in my backyard), potential shortcutting traffic through my community, all of this pales against the safety issues.

Now is the time to close the potential for any more density next to this facility, declare the surrounding lands for safety sake, uninhabitable, and buy the surrounding land as park.

Ill thought out plans, hidden dangers, greedy landowners and an indecisive City council has brought us to this circumstance. It is time to close the door to further development or remove the ammonia from this site.

Yours sincerely

Dan Laba

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This is the mail archive of the `binutils@sources.redhat.com` mailing list for the binutils project.

Ice Rink Insurance << ALERT >>- Ammonia Incidents - New Case Law Removes Liability Insurance Coverage

- *From*: "Arena-Watch" <Arena-Watch at thenhl dot com>
- *To*: <binutils at sources dot redhat dot com>
- *Date*: Mon, 13 Jan 2003 06:48:02 -0500
- *Subject*: Ice Rink Insurance << ALERT >>- Ammonia Incidents - New Case Law Removes Liability Insurance Coverage
- *Reply-to*: "Arena-Watch" <Arena-Watch at thenhl dot com>

```
<<<     INSURANCE ALERT    >>>>
To be removed from this list, follow instructions at bottom. We honor all
remove requests and are only sending this
because your name was registered as an interested party.

This is only a partial report. For a complete FREE REPORT by email in PDF
format, respond with the word "REPORT"
in the subject line.

Because of several recent landmark legal decisions, ice rinks with ammonia
systems will likely be denied any liability
coverage for any damage, injury, or death resulting from an ammonia leak
regardless of cause. Basically, these new
court rulings in favor of insurance providers mean those who own, operate,
sell, or have stamped drawings as
professional architects and engineers now do not have insurance coverage
for claims resulting from an ammonia
incident with most standard liability or errors and omissions insurance.
More information and actual case-law summaries,
scroll down.

Who Is Affected By This Ruling Against Ammonia Leaks As A Non-Covered
Insurance Claim?

Imagine an NHL arena with 16,000 fans having an unusual ammonia leak
resulting in evacuation, potential injury, or
even death and not having any insurance company to ward off the legal
bills and medical claims. Imagine a community
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recreational rink with several hundred people public skating with a similar event. Even if not one person were severely injured other than the need for oxygen or examination, their residual physiological or psychological claims would hit our industry without any insurance coverage. Without coverage, such a claim could severely impact the deepest pockets of an entity like the NHL. The thought of being so exposed from a liability viewpoint is unthinkable. However, because of some recent events in the legal system, those with ammonia based refrigeration systems and typical liability insurance policies now face this very situation.

Based upon the precedence tested at State Supreme court levels, few businesses operating in or for the ice-rink industry with ammonia refrigeration systems are covered. If, after reading this information, you are still an unbeliever, contact your insurance provider and ask for written confirmation of coverage. We wish these acts were not true as they could have an affect on many operators. After the call, you will become a believer fast and see why this is such a critical alert for the ice-rink industry.

On January 20, 1999, in Ducote v. Koch Pipeline, No. 98-CC-0942, a majority of the Louisiana Supreme Court ruled that when an insurance policy contains an "absolute pollution exclusion", "The plain language of the insurance contract precludes coverage for bodily injury or property damage arising from a polluting discharge...regardless of whether the release was intentional or accidental, a one time event or part of an on-going pattern of pollution."

To run any business without liability insurance would be considered economic suicide. For those who have installed or own ammonia-based systems you are naked from an insurance standpoint unless you immediately purchase a �Pollution And Remediation Legal Liability (PARLL) policy. The frightening detail is that insurance providers say the PARLL policy will be extremely expensive if one can even obtain such a policy. The writer contacted representatives from K&K Insurance, Rice Specialty Insurance, and Richardson Insurance who all confirmed these new rulings to be an issue for those at risk with a hazardous material incident such as an ammonia leak.

What Changed With Ammonia Specifically And Why?

With environmental claims providing probably the greatest ongoing exposure for any one type of claim in the history of the industry, it�s clear why insureds and insurers have employed every conceivable argument in their coverage interpretation battles. Billions (some say a trillion) are at stake, with the coverage results sometimes turning on how many justices prefer one dictionary definition over another. To stave off future litigation, in the mid `80�s, insurers removed the qualified pollution exclusion from CGL policies and crafted a new �absolute pollution exclusion.� While the intended purpose of the new exclusion was to minimize litigation of pollution-related claims, the absolute pollution exclusion is now the most litigated coverage issue. With the above noted case going to the supreme court level, with the ruling resulting in ammonia leaks not being covered, along with several other states equally ruling, it appears the debate over �Ammonia Emitted From A Refrigeration System� is over. Those of us in the ice-rink industry who have an ammonia system must reside themselves to the fact that any future claim will likely be denied meaning they have no insurance to protect them from one of the most high risk systems in their complex.

Quoting one insurance provider who specializes in the ice-rink industry:

�This is a major issue. The insurance industry has changed dramatically since the 9-11 event. In the past, insurance companies may have settled small claims that they are simply unwilling to settle voluntarily today. No serious ice-rink claim has yet tested the insurance industry since the 9-11 tragedy. Given the recent case law that specifically excludes coverage for �Ammonia Emitted From A Refrigeration System,� we as brokers cannot represent coverage under current General Liability Policies. We also are concerned if the special insurance can be obtained at all, and if so, it could double insurance rates for ice rinks.�

So, Who Is At Risk?

Literally anyone associated, past or present, with an operating ammonia refrigeration system! Some may say an ammonia refrigeration system is safe if properly installed in accordance with all code requirements. This insurance alert is not meant to open the debate on ammonia safety or risk. We all believe automobiles are considered very safe today, but who would own and drive one without having adequate insurance? No one!

Why Ammonia? Ammonia is classified as a highly toxic and highly hazardous by both the EPA and OSHA. It is regulated under the Hazardous Chemical Reporting Law for any complex over 100 lbs which all ice rinks fall under. See the EPA Ammonia Alert at the end of this document for all the rigid requirements of legal ammonia use. Ammonia and the extreme governmental classifications and legal statutes governing its use provided an ample arsenal for the insurance providers to argue pollution exclusion with. For the legal cases to be argued all the way to the state (the supreme court in some cases) regarding ammonia claims, the fact of any ammonia claim being excluded has been tested. To date, three major cases have been argued. With each win for the insurer, the likelihood of policyholders for future claims becomes increasingly dismal. Based upon the recent events, it is the opinion of top insurance experts that most claims for injury or damage from ammonia will be denied.

This means if a worker, skater, patron, or community member is killed, hurt, or makes claims of long lasting medical illness, the chance of having the insurance company fight any claim legally, much less payout on a claim, will not occur based on standard general liability policies. Even if a claim is without any merit by a disgruntled employee who simply smells ammonia typical of some ammonia mechanical rooms, all expert fees and legal costs will come out of the pockets of the defendants. Even the simple legal defense of a claim without merit could cost in upwards of hundreds of thousands of dollars depending upon the case's complexity. And, this is if you win the case on your ammonia claim.
For claims, which are covered, the insurance provider assumes the legal cost of defense. Now with no insurance, only you will pay. Boiler and equipment policies also do not normally provide protection under this ruling for an ammonia leak. Only a special pollution policy would provide the protection, which all ammonia owners thought they had in the past with general liability policies. Those at risk include but may not be limited to the following:

A) Any architect/engineer to a project, as the professional of record, since they, too, have no coverage for claims under these new rulings. Errors & Omissions insurance policies typically mirror the same exclusions as general liability policies for commercial businesses. Even if a professional is able to obtain a pollution policy now, which is questionable, they are still responsible without coverage for all ammonia systems installed prior to having such a policy instated. Professional designers when told about this new case law offered extreme skepticism whether they would specify ammonia systems any longer.

B) Ice rink owners and operators with ammonia systems. Not only do they not have insurance coverage, their installing contractor, architect/engineer, or even service provider also likely will not have coverage they can rely upon.

C) All contractors and service providers who either installed or support ammonia systems.

D) Any financing institution, which provides funding for the ice arena, past or future. One accident and claim could result in collapse of the business without insurance coverage.

E) All persons living in a community where an ammonia system is installed and considered in the risk area as defined by the EPCRA (Emergency Planning And Community Right-To-Know) zone according to law since they have no protection with claims without an insurance provider to assure payout on claims.

F) Local planning and zoning boards since they could be at risk for permitting ammonia systems should an incident occur where no insurance is provided to protect it citizens. In such a situation it would not be reaching in today�s society for claims to be made against the planning board for permitting such systems.

G) Any insurance broker writing policies for ice rinks that does not clearly disclose the exclusion of ammonia-based systems being covered.

Other Topics & Information In The Report Include:

1) Now That You Know You May Not Have Insurance, How At Risk Are You?
2) What Can Cause An Incident With Ammonia Systems?
3) A New Leak Risk - Ammonia Theft May Cause Releases And Injuries
4) What About Contractors Installing And Promoting Ammonia Systems?
5) How Does This Case Law Precedence With Ammonia Refrigeration Systems Affect Financial Relationships?
6) Is Disclosure Of Insurance Gap A Requirement?
7) What Is a "Pollutant" As Defined By Your Insurance Policy?
8) Pollutants As Available & Defined Through The International Risk Management Institute
9) What About An Ice Rink Ammonia Leak From Corrosion?
10) Impact With Protection From Ice Rink Indoor Air Quality Claims
11) Sample Claim Scenario With PARLL
12) Ammonia Gas Release Coverage Provided Only Because Of PARLL (Pollution and Remediation Legal Liability)
13) If Special Insurance Can By Bought And How Much Will It Cost?
14) What About Other Refrigerant Leaks Other Than Ammonia?
15) LINKS WITH MORE INFORMATION ABOUT AMMONIA INCIDENTS AND HOW THE INSURANCE INDUSTRY TREND IS GOING
16) Pollution Exclusion Enforced by Louisiana Supreme Court
17) Numerous Case Law Summaries
18) Hazardous Material Alert From The EPA (Environmental Protection Agency) and OHSA.

The referenced report was assembled by John Burley. It contents are the result of an investigation of legal cases along with the consultation of experts within the insurance field. This report is not to be interpreted or substituted for appropriate legal or insurance advice. You should consult with trained professionals who are engaged in your specific legal or insurance matters for conclusions or actions relevant to your businesses best interests. If you have any question or want clarification of the facts contained within this document, we urge you to contact your lawyer and insurance provider. Get confirmation in writing now to avoid risk later from your insurance provider. John Burley is president of Burley's Rink Supply and has been engaged in the ice-rink industry for over 20 years and is a leading authority regarding ice-rink design, construction, and operations. John

Burley can be reached at 1-800-428-7539 FREE. A complete copy of the FREE report can be requested in PDF format by

replying with the word �REPORT� in the subject
line.

If you are receiving this notice because you had indicated an interest in the subject matter promoted by Arena-Watch.
If you would like to be removed from this list you will be missing out on tremendous specials and beneficial industry
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Arena-Watch is produced by John Burley as an informational resource to the ice arena industry.

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involve great or very great risks of danger to health in a possible accident are presented in table 3.

Table 3. Risk grouping

Mainly dangerous to health	Main dangers fire and explosions	Both health and fire/explosion danger
Very high risks		
Chlorine	Propane	Acetonitrile
Sulphur dioxide	Butane	Hydrogen cyanide
Ammonia	Acetylene	Hydrogen sulphide
Phosgene		
High risks		
Phenol	Acetone	Methanol
Hydrofluoric acid	Methyl ethyl ketone	Styrene
Hydrochloric acid	Carbon disulphide	Butyl acetates
Nitric acid	Thinner	
Sulphuric acid		
Tetraalkyl lead		
Radioactive substances		
Moderate risks		
Trichlorethylene	Toluene	
Perchlorethylene	Xylene	
	Petroleum distillates	
	Kerosene	

Source: Effektiv räddningstjänst (Efficient Rescue Service), SOU 1983:77

Examples of accidents and disaster simulations

Ammonia

During 1997 there were two train derailments in Sweden (Kävlinge and Kälarne) in which trucks containing chemicals overturned. On these occasions there was no leakage of chemicals that involved any injury to persons but during the rescue work the inhabitants of large parts of two residential areas were evacuated for several days because of the risk of leakage of, among other things, ammonia during the actual salvage work.

In March 1989 there was a breakdown of an ammonia system in an artificial fertiliser plant in Lithuania. Fire broke out and spread to a building some 50 metres from the ammonia cistern in which nitrophosphate was produced. Seven persons lost their lives and at least 55 were more or less seriously injured.

A disaster simulation was run in which an overfilled (brimful) ammonia tank cracked (it was filled with 58 tons instead of 50 tons) when the lorry was in central Uppsala. According to calculations 80 persons would have died immediately, 400 would have received serious lung injuries requiring hospital care and between 4,000 and 5,000 would have sought care at hospitals and medical care centres. According to the calculations, concentrations of 10,000 ppm were measured at a downwind distance of about 300 metres from the leakage and 2,500 ppm at a distance of approximately 750 metres (SOU 1995:24. Preliminary report from the Commission for preparedness against severe peacetime disturbances).

In a number of plant failure models run by the Swedish Defence Research Establishment FOA) (Dreborg et al 1978, Lundmark T 1984), the following emerged. If 3,000 kg of ammonia is released over fourteen minutes at a wind speed of 5 m/s, a concentration of 3,200 ppm (50%–100% suffer fatal injuries) at a distance of up to 500 metres is obtained. After 1.5 minutes there is a concentration of 1,400 ppm (at least 50% suffer severe injuries, possibly death) 500–1,000 metres from the site of release; after three minutes a concentration of 1,000 ppm at 1,000–1,500 metres and after 4.5 minutes, 550 ppm (some serious injures, most slight) at 1,500–2,000 metres from the failure site.

In another model of an accident (Dreborg et al 1978) in which ammonia leaked at a rate of 2,500 kg per minute for seventy minutes (until the tank was empty) the following concentrations would have occurred for seventy minutes: 2,800 ppm (50%–100% fatal injuries) at a distance of 500 metres, 1,500 ppm (at least 50% serious injuries, possibly deaths) at 500–1,000 metres, 550–700 ppm (possibly a number of serious injuries, most slight) 1,000–2,000 metres from the site of the accident.

Failure of a compressor at an ice rink in which ammonia leaks out could possibly have the following consequences (FOA 1997). The cooling system contains 1,350 kg of ammonia and the imagined damage causes leakage of some 2 kg/s which leads to the leakage continuing for just over eleven minutes. The outside temperature is 15°C and the wind two m/s. After approximately two minutes the ammonia is smelled (without causing irritation) some 400 m from the leak, after four minutes at 500 m and after eight minutes at 750 m from the leak. During the whole period of leakage the concentration is some 130 ppm (irritating) 200–250 m from the leakage, 650 ppm (a number of severe injuries, most slight) some 125 m away and 1,300 (at least 50% serious injuries, possible deaths) just under 100 m from the leak.

Fires

Fires involving toxicity

In November 1997 there was fire in the underground railway station at King's Cross in London. The fire started in an escalator and was probably caused by a match that was discarded and fell between the steps of the escalator and a side wall. Inflammable gases were generated and these collected in the space below the escalator and spread further to the spaces above and to the ticket hall. Suddenly there was rapid combustion. The toxic gases were formed during the burning of material in the ceiling and walls. Thirty-one persons died and over 60 were injured. All those who died did so as a consequence of exposure to hydrogen cyanide formed when plastic material in the roof and walls caught fire.

In spring 1990 there was a fire on the passenger ferry Scandinavian Star in traffic between Oslo and Copenhagen. A total of 158 persons died and most, more than 90%, died as a consequence of exposure to toxic gases formed during the burning of material on the ship. The toxic gases were carbon monoxide and hydrogen cyanide.

Fires involving the release of chemicals

The Schweizerhalle accident at the Sandoz factory in Basle in Novem-

Ex-Olympian Karen Magnussen says accident ruined her life - See more at: http://www.timescolonist.com/news/b-c/ex-olympian-karen-magnussen-says-accident-ruined-her-life-1.802521#sthash.5kjn9Fin.dpuf

When the Winter Olympics were in Vancouver four years ago, Karen Magnussen was one of the fans sitting in the Pacific Coliseum taking in the figure skating.

With the Sochi Games approaching, she'll again be an avid and passionate fan, watching world champion Patrick Chan and the rest of Team Canada take on the world on TV.

But in the intervening four years, almost nothing else has stayed the same for Magnussen, the 1973 world champion women's singles figure skater.

Her world turned upside down on Nov. 28, 2011. It started as a typical Monday morning for Magnussen as she prepared to teach some young skaters at the North Shore Winter Club. Then, at about 5:45 a.m., she was hit by a blast of ammonia from the club's refrigeration unit.

The ammonia filled her lungs, searing them, along with her vocal cords.

"It's ruined my life," she said recently, sitting in the living room of her family home in North Vancouver's Upper Lonsdale neighbourhood.

Since that day, when she was taken to hospital after she made sure her students got out, she has not been able to work because of the damage to her lungs. WorkSafe B.C. has since classified her as permanently disabled.

"I'd never left skating from the time I was seven years old," said Magnussen, now 61.

'WASN'T SOMETHING I WAS GOING TO LEAVE'

"And I wasn't going to. It wasn't something I was going to leave at 65."

She points to the legendary Ellen Burka, who coached world champions Elvis Stojko, Toller Cranston and daughter Petra Burka. Ellen Burka is 92 and still coaching at Toronto's Granite Club.

"I could have still been coaching into my 80s and 90s," Magnussen said.

Magnussen's skating career began when she was seven, her mom driving her across town to Kerrisdale Arena, where the lessons took place on sheets of pebbly curling ice.

"The ice was anything but perfect, but I think that made you tough," she said. "You weren't like a hot-house plant. It gave you character."

The first pair of quality skates she ever wore are bronzed and on display in her house.

Magnussen won a bronze medal at the world championships in 1971. She went on to win silver medals at both the worlds and the Olympics in 1972 and then gold at the world championships in 1973.

SKATED AT COLISEUM BEFORE CANUCKS ARRIVED

The City of Vancouver used to allow her free early morning ice time at the Coliseum, before Canucks players would arrive for practice.

"The coach [Hal Laycoe] would tell his players, 'Look how perky this girl is!' " she recalled.

Magnussen retired after her world gold and skated professionally with ice shows for a few years before settling into her coaching career, first in Boston, where her husband of 36 years, Tony Cella, was based, then back on the North Shore.

Magnussen coached with the same steely sense of purpose that drove her to the top of the world in her sport.

Want to know what drives her crazy?

"When I hear an announcer say, 'They performed a personal best!'

"I hate that phrase. It just drives me nuts. I want to throw something at the TV when I hear that. That's not your aim, to do your personal best. No, your aim is to be in the top three. Every one of those athletes is there to win a gold, silver or bronze medal."

NOW VIRTUALLY HOUSEBOUND

The elite athlete turned coach, who always had such determination to succeed, is now housebound except for trips to the hospital or, occasionally, to the mall with her husband.

She can't even walk her dogs, a Chihuahua named Frankie and a Pomeranian named Pacino, around the block due to the side effects of the drugs she's on.

According to B.C. Safety Authority, the ammonia leak that injured Magnussen was caused when a condenser pump control unit began to fail. Lack of proper training for employees who dealt with the refrigeration unit was also cited.

Magnussen started coughing violently after the accident, and the coughing continued day and night for eight months before she was put on prednisone, a powerful steroid that comes with a long list of side effects.

"It was 24/7," she said of her bone-rattling cough.

"I never slept that whole time while the doctors tried various things."

She has been taking prednisone for a year and a half. The potent drug's nasty side effects include weight gain and swelling of the face.

Magnussen, who has gained 60 pounds since she started on prednisone, declined to have her photo taken for this story mainly for those reasons.

PEOPLE 'WERE VERY CRUEL, VERY HURTFUL'

After she appeared in a TV news story in December, some people "were very cruel, very hurtful" about her physical appearance, said her husband, Cella.

"Ammonia is a strong irritant," said Dr. Christopher Carlsten, a respiratory expert at the UBC school of medicine and one of the doctors treating Magnussen.

"The reason it was so powerful for Karen is she had a large exposure that penetrated very deeply into the mucous membrane of her lungs.

"Unfortunately, she's needed steroids. The pills are associated with side effects, especially when taken for months at a time like she has needed."

Prednisone, which can cause mental confusion, fatigue and weakness, is associated with the rheumatoid arthritis she now suffers from as her immune system attacks her joints. She has also developed temporal arteritis, a dangerous swelling of the blood vessels that supply the head and brain.

The ammonia exposure also triggered a condition known as central sensitivity syndrome, which affects how the brain and vocal cords interact, Carlsten said.

ANY VAPOUR CAN TRIGGER BAD REACTION

In Magnussen's case, he added, that means inhaling any vapour — such as diesel exhaust or perfume — could trigger a reaction similar to the one she had to the ammonia.

"This can go on for years," said Carlsten. "That's the worst part. It's hard to get rid of. It's a sad story. She's too young to be disabled for a lifetime. I try to get her to keep her chin up."

Magnussen, who was twice named Canada's female athlete of the year and is an Officer in the Order of Canada, thinks she knows now what all her hard work, all those early mornings training on the ice, was really for.

At the time, she thought all that discipline was about giving her a chance at a world championship or an Olympic medal.

"But as I look back, it really was all to prepare me to get through this," she said. "My whole life's work, everything I've worked for, when I think about it — and I've had a lot of time to sit and think — was to prepare me to be able to get through this and not curl up in a ball from it all.

"For me, in sports, you've got this incredible fight inside of you, this fire that no matter what you have to tackle later on in life, you're able to get through.

'A LOT OF KIDS DEPENDED ON ME'

"It has ruined my life, that's one shame," she said. "The other shame is a lot of kids depended on me as a coach."

In addition to the figure skaters she coached, Magnussen taught hockey players about edges, power, balance and stops and starts on the ice.

Seventy-five players who have been drafted by the NHL have learned from her, she said, including former Canucks Cliff Ronning and Dave Babych, and their sons Ty Ronning (Vancouver Giants) and Cal Babych (Calgary Hitmen).

There were about 150 youngsters skating under Magnussen's tutelage when the tragedy struck, she said.

"I just loved it, as cold as it was and as crappy as the rinks were sometimes, the kids made it all worth it."

She and her family wish the North Shore Winter Club had reached out after the accident and had been more vigilant about maintenance prior to it.

Magnussen says she would take legal action against the North Shore Winter Club if the incident weren't a WorkSafe B.C. case.

"The [Workers' Compensation] Board was founded and based on a compromise in 1917," a WorkSafe spokeswoman said. "Workers gave up their right to sue and employers agreed to fund a no-fault insurance system.

WOULD SUE WINTER CLUB IF SHE COULD

"The benefit to workers is they receive timely health care and wage-loss support for work-related injuries or illnesses paid for by the Accident Fund. Previously, a worker's only option when injured was to sue their employer at their own expense."

Magnussen, who is considered an employee by WorkSafe even though she was an independent contractor working at the rink, wishes she had that option.

"Absolutely, I would have pursued that after what they put me through, after they took away my life," she said.

Winter Club general manager David Long said the club has no comment.

These days, Magnussen is battling WorkSafe to get the money she says she's owed.

She's buoyed by the emails, letters and phone calls of support she has received.

"Hopefully," said her husband, "things will work out in the future, that's all we can hope for.

"That she gets off the medicine and be able to walk around the block."

- See more at: http://www.timescolonist.com/news/b-c/ex-olympian-karen-magnussen-says-accident-ruined-her-life-1.802521#sthash.5kjn9Fin.dpuf

Is Anhydrous Ammonia a Risk to Your Community?

by Sofia Plagakis, 5/7/2013

Safeguarding Public Health and the Environment, Environmental Right to Know, Open, Accountable Government, Government Matters

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Anhydrous ammonia and ammonium nitrate are the two substances that have been investigated as possible causes of the April 17 explosion of the West Fertilizer Company plant in Texas. Though experts now believe the explosion was due to the ammonium nitrate, the facility did have two 12,000-gallon tanks of anhydrous ammonia, which could have exacerbated the tragedy in Texas had they leaked or exploded.

In the past 15 years, almost 10,000 facilities nationwide have stored large amounts of anhydrous ammonia. Communities in every state are living near large quantities of a dangerous toxin, and residents may not even know it. We hope their emergency personnel do. To allow citizens to see if there are facilities with anhydrous ammonia in their communities, the Center for Effective Government created a new interactive map tool.

What Is Anhydrous Ammonia?

Anhydrous ammonia is a pungent gas, most often used as a source of nitrogen fertilizer for corn, milo, and wheat. It is also commonly used as an industrial refrigerant for cold storage facilities and meat-packing plants. If heated, it can explode.

Exposure to even small amounts of anhydrous ammonia can cause serious burning of the eyes, nose, and throat. Exposure to higher levels causes coughing or choking to occur and can cause death from a swollen throat or from chemical burns to the lungs. When the eyes are exposed to concentrated gas or liquid anhydrous ammonia, serious corneal burns or blindness can occur. In general, the severity of symptoms depends on the degree of exposure.

Anhydrous Ammonia Facilities Nationwide

The Clean Air Act requires facilities handling large quantities of toxic, flammable, or otherwise reactive chemicals to submit risk management plans. For anhydrous ammonia, the reporting threshold is 10,000 pounds. In the last 15 years, almost 10,000 facilities have filed risk management plans because they are storing or producing over 10,000 pounds of anhydrous ammonia. Since anhydrous ammonia is often used as a fertilizer, it isn't surprising that the states with the highest number of facilities are located across the Corn Belt, including Iowa, Illinois, and Kansas. Iowa is the only state that has had more than 1,000 facilities storing large quantities of the chemical. (See Table 1.)

Table 1. Facilities Using Anhydrous Ammonia (1996-2011)

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State	Number of Facilities	Number of Accidents	Number of Facilities with Accidents	Accident Rate	Number of Facilities with Multiple Accidents	Multiple Accident Rate	Total Number of Deaths	Total Number of Injuries	Total Number of People Evacuated Due to Accidents	Total Amount of Property Damage
States with 300 or More Facilities (11) Using Anhydrous Ammonia										
IA	1,052	75	61	5.8%	10	1.0%	2	95	1,434	$891,726
IL	969	57	50	5.2%	5	0.5%	0	339	4,983	$821,370
KS	803	49	22	2.7%	6	0.7%	1	165	479	$6,524,121
CA	685	75	56	8.2%	11	1.6%	0	91	31,048	$2,102,248
NE	684	18	15	2.2%	2	0.3%	0	21	807	$3,402,800
TX	587	84	52	8.9%	11	1.9%	2	136	1,153	$45,509,391
MN	500	24	23	4.6%	1	0.2%	3	105	3,024	$88,434
IN	420	51	36	8.6%	6	1.4%	1	23	413	$6,372,325
ND	359	15	9	2.5%	1	0.3%	0	18	320	$34,200
MO	355	26	23	6.5%	3	0.8%	0	7	603	$2,688,000
OH	312	30	23	7.4%	6	1.9%	0	39	151	$2,500
States with 100-299 Facilities (13) Using Anhydrous Ammonia										
OK	246	17	11	4.5%	4	1.6%	0	12	200	$893,600
WI	243	15	15	6.2%	0	0.0%	1	19	202	$524,786
WA	225	11	11	4.9%	0	0.0%	0	10	327	$0
GA	182	26	18	9.9%	4	2.2%	0	28	1,065	$10,051,100
MI	163	15	10	6.1%	3	1.8%	0	19	102	$696,280
PA	158	18	16	10.1%	2	1.3%	0	27	724	$586,400
FL	156	32	23	14.7%	7	4.5%	0	59	45	$2,001,634
CO	147	11	9	6.1%	1	0.7%	0	31	0	$251,100
KY	135	13	10	7.4%	3	2.2%	2	28	1,150	$12,021,412
SD	121	4	4	3.3%	0	0.0%	0	2	0	$0
NC	113	24	20	17.7%	4	3.5%	5	133	255	$55,104,250
TN	104	27	10	9.6%	5	4.8%	0	16	0	$2,500
AR	100	41	21	21.0%	9	9.0%	0	45	1,210	$289,513
States with Fewer Than 100 Facilities (26) Using Anhydrous Ammonia										
MT	98	3	3	3.1%	0	0.0%	0	0	0	$0
AL	92	17	14	15.2%	2	2.2%	0	20	1,415	$4,517,490
OR	92	15	13	14.1%	2	2.2%	0	31	1,651	$673,900
NY	88	9	8	9.1%	1	1.1%	0	6	2,629	$131,595
VA	84	11	8	9.5%	2	2.4%	0	8	498	$140,030
LA	83	47	25	30.1%	11	13.3%	0	27	6,971	$10,985,747
AZ	80	11	8	10.0%	2	2.5%	0	2	35	$1,200,000
ID	73	3	3	4.1%	0	0.0%	0	2	0	$10,500
MS	60	6	6	10.0%	0	0.0%	0	0	3	$190,000,000
SC	57	8	7	12.3%	1	1.8%	1	25	25	$4,400
MD	56	3	1	1.8%	1	1.8%	0	3	0	$0
UT	43	5	4	9.3%	1	2.3%	0	5	0	$54,134
MA	40	5	5	12.5%	0	0.0%	0	2	45	$141,562
AK	30	7	5	16.7%	2	6.7%	0	8	0	$1,030,103
NJ	26	4	4	15.4%	0	0.0%	0	5	0	$0
NM	25	4	4	16.0%	0	0.0%	0	8	0	$1,000
WV	24	9	4	16.7%	2	8.3%	0	9	100	$100
WY	19	1	1	5.3%	0	0.0%	0	2	0	$0
DE	17	7	3	17.6%	1	5.9%	1	16	0	$500
ME	17	0	0	0.0%	0	0.0%	0	0	0	$0
NV	16	3	1	6.3%	1	6.3%	0	0	0	$0
CT	13	0	0	0.0%	0	0.0%	0	0	0	$0
NH	10	2	2	20.0%	0	0.0%	0	1	9	$240,000
RI	8	0	0	0.0%	0	0.0%	0	0	0	$0
HI	7	1	1	14.3%	0	0.0%	0	0	600	$0
VT	5	0	0	0.0%	0	0.0%	0	0	0	$0
Totals	9,982	939	678	6.8%	133	1.3%	19	1,651	63,676	$359,990,801

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Currently, almost 8,000 facilities report storing large quantities of anhydrous ammonia. About 2,000 facilities have "deregistered" and no longer submit risk management plans to the U.S.

Environmental Protection Agency (EPA). Deregistration does not necessarily mean that a facility no longer stores the chemical. It may just be that the quantity produced or stored has fallen below 10,000 pounds. Deregistration could also mean that the facility switched to a safer alternative, or the facility may have closed down entirely.

Questionable Safety Record

Over the past 15 years, almost 1,000 accidents have occurred at 678 of the facilities storing large quantities of anhydrous ammonia, and 133 of those facilities had multiple accidents. In other words, 6.8 percent of the facilities storing anhydrous ammonia had an accident in the past 15 years, and over a fifth of these had multiple accidents. These accidents resulted in 19 deaths, 1,651 injuries, and almost $350 million in property damage. Moreover, 63,676 people in the facilities and surrounding communities had to be evacuated when accidents occurred. Although not all the accidents at these facilities were the result of anhydrous ammonia releases, many were.

Though accidents at facilities using anhydrous ammonia as a refrigerant do not usually involve fires or explosions, they can result in dangerous releases of toxins. Last month, Tyson Foods, Inc. agreed to pay $4 million in civil penalties to settle charges from eight releases of anhydrous ammonia in Iowa, Kansas, Missouri, and Nebraska that resulted in multiple injuries and one death.

Iowa has the largest number of facilities storing anhydrous ammonia (1,052) and a good safety record. Only 61 of these facilities experienced any accidents in the past 15 years, leaving its accident rate (5.8 percent) below the national average. Nonetheless, the Iowa accidents resulted in two deaths, 95 injuries, and almost 1,500 people evacuated over the past 15 years.

Among the eleven states with more than 300 anhydrous ammonia facilities, Texas had the largest number of accidents (84) and the highest accident rate (8.9 percent). Two people died, 136 were injured, and 1,153 were evacuated. Moreover, the most financially costly reported accident involving anhydrous ammonia in Texas over this period occurred at Bayer Material Science in Baytown, TX.

In September 2006, 39 workers at the facility were injured at the site when a process vessel containing toluene diisocyanate, a toxic chemical used to make household products and foam furniture cushions, exploded, releasing carcinogenic chemicals and anhydrous ammonia. The workers were treated for burns and eye, nose, and throat irritations, and the plant was closed down for three months.

The following year, workers injured in the explosion filed a class action lawsuit against the company, alleging that the explosion occurred as a result of unsafe workplace practices. Workers claimed that plant officials were having problems with the toluene diisocyanate unit before the explosion but failed to warn contractors. The claims were settled in 2008, but the amount of the settlement has not been made public.

The accident rate at California facilities was slightly higher than the national rate at 8.2 percent. The 75 accidents that occurred at 56 of California's 685 facilities over the past 15 years did not result in any deaths, but they did lead to over 30,000 people being evacuated and 91 injuries. The high evacuation rate in California appears to be related to population density around the facilities that use or produce anhydrous ammonia. For example, an August 2009 incident at Columbus Manufacturing, a meat processing facility located in South San Francisco, released approximately 200 pounds of anhydrous ammonia into the air from a leak in a rooftop cooling system. The release resulted in the evacuation of all facility employees and several neighboring businesses. Nearly 30 people from a nearby corporate campus sought medical attention, and 17 individuals were hospitalized. In addition, several local streets and highway off-ramps were shut down.

The damage from the release would have been much worse had it not occurred around 5.30 a.m. – before more people arrived for work and dropped their children off at three nearby daycare facilities, said Jared Blumenfeld, EPA's regional administrator in San Francisco. The leak was also the second one in 2009 for the meat-packing facility (there was a prior leak in February of that year). The meat processing company agreed to pay nearly a $700,000 penalty to the EPA and spend about $6 million on a new refrigeration unit. The company will also improve its alarm and ammonia release notification procedures.

Although not among the states with the highest number of anhydrous ammonia facilities, Louisiana and Arkansas have the highest accident rates, 30 and 21 percent, respectively. Louisiana has only 83 facilities that have stored anhydrous ammonia, but 25 of those facilities (30.1 percent) have had accidents and 11 facilities (13.3 percent) have had multiple accidents. These accidents have not resulted in any deaths but have caused 27 injuries, 6,971 evacuated, and just shy of $11 million in property damage.

The single most expensive accident at an anhydrous ammonia facility in Louisiana occurred at Mosaic Fertilizer's Faustina Plant in St. James. On Oct. 11, 2006, a process vessel failed, resulting in an explosion and fire that caused an estimated $3.5 million in damages. The vessel contained 16,450 pounds of process gas, including 2,405 pounds of ammonia.

Out of 100 Arkansas facilities that have used anhydrous ammonia, 21 had accidents and nine had more than one. No deaths occurred from these accidents, but 45 injuries did. These facilities, including Tyson Foods, Simmons Foods, and Zero Mountain Inc., mainly use anhydrous ammonia as a refrigerant for cold storage and meat packing. Following the West, TX explosion, the Arkansas Department of Emergency Management stated that anhydrous ammonia is not primarily used in Arkansas as a fertilizer but is mostly used as a refrigerant in the state. The Arkansas Department of Agriculture said that only one plant (out of 180 facilities that store fertilizer) has both anhydrous ammonia and ammonium nitrate (similar to the West Fertilizer Company plant) on site. The facility, El Dorado Chemical Co. in El Dorado, AR uses anhydrous ammonia to produce ammonium nitrate.

Property Damage

In the last 15 years, Mississippi had the highest amount of property damage ($190 million) associated with accidents at anhydrous ammonia facilities, but it was almost entirely the result of a single accident. In August 2007, a fire broke out in Chevron's largest U.S. oil refinery, located in Pascagoula, MS. Although extinguished two hours later, the fire burned near the main part of the refinery, and 200-foot flames were visible for miles. Chevron reportedly offered free car washes to dislodge the black soot that fell on nearby cars as a result of the fire. The refinery's risk management plan report noted that although the fire did not initially involve any chemicals required to be reported under its risk management plan, as the fire progressed, more toxic chemicals became involved.

It is important to note that the property damage estimates recorded in the accident reports sent to the EPA only include damage to the facility's property. These estimates do not include additional costs to the community that resulted from the incident – such as medical costs for treating the injured or costs for emergency first responders, police, and any loss to other property or businesses. All of the damages reported in Table 1 are estimates of private damages to the companies, not the costs to the public.

Transportation Accidents

Anhydrous ammonia-related emergencies also occur during transportation accidents, such as train derailments or highway incidents involving tanker trucks. These accidents can release large quantities of anhydrous ammonia, sometimes forcing the evacuation of entire sections of a city or town. According to data from the Emergency Response Notification System, a database of reported spills, releases, and incidents involving chemicals and oil, there were 870 reported incidents involving anhydrous ammonia in 2012. The majority of the incidents (662) were at fixed sites, but there were also 37 vehicle, 10 boat, nine pipeline, and seven railroad incidents.

One of the most well-known transportation accidents involving anhydrous ammonia occurred in January 2002, when a freight train derailed and 31 of its 112 cars careened off the tracks just outside of Minot, ND. Five tanker cars carrying anhydrous ammonia ruptured, and a plume covered the site and surrounding area. As a result of the accident, one resident died, 11 people sustained serious injuries, and 322 people, including the train's conductor and engineer, suffered minor injuries.

Six months earlier, in June 2001, a tanker spill at the Harvest Land Co-op near West Milton, OH created a "two-mile plume of anhydrous ammonia" in Ludlow Creek, which feeds the Stillwater River. The state's Environmental Protection Agency closed the West Milton water plant to protect the water in the village's emergency towers. The chemical discharge killed more than 103,300 fish, according to the Ohio Division of Wildlife.

Better Regulation of Dangerous Chemicals Critical

Anhydrous ammonia is just one of many dangerous but common chemicals that are used in various industrial processes and can pose a risk to communities and emergency personnel. Community groups, local officials, and public interest organizations have been pushing companies to replace dangerous substances with safer chemicals for decades. The EPA does not have sufficient authority under the outdated Toxic Substances Control Act (TSCA) of 1976 to effectively regulate these chemicals.

On April 10, Sen. Frank Lautenberg (D-NJ), who has been working on TSCA reform since 2005, reintroduced the Safe Chemicals Act, which would increase chemical safety, improve consumer access to information on chemical hazards in products, and protect vulnerable populations, such as low-income communities, children, and pregnant women.

Some communities have heeded the call for safer alternatives. In 2009, the Clorox Company announced its replacement of bulk quantities of chlorine gas with safer chemicals. Reportedly, 220 facilities, including water treatment facilities, power plants, and fertilizer companies, have switched to safer and more secure chemicals and processes since 2001, but this represents a miniscule number of the plants that report high volumes of risky chemicals on site.

Environmental activists believe the EPA could do more to push safer alternatives. The National Environmental Justice Advisory Council argues that EPA could use its authority under Section 112(r) of the Clean Air Act to require plants to shift to less toxic chemical alternatives.

State governments can also do more. After the Oklahoma City bombing in 1995, several states essentially regulated out of existence the use of ammonium nitrate as a fertilizer. In Michigan, ammonium nitrate (which was once commonly used in farming in the state) is "virtually nonexistent" thanks to a movement to encourage farmers to use safer alternative chemicals.

If they choose to do so, both state and federal agencies can reduce the risks that a disaster like West, TX will occur in the future. Let's hope they do so – before more lives are lost.

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SCIENTIFIC REVIEW

Toxic Industrial Chemicals (TICs) – Chemical Warfare Without Chemical Weapons

Filiz HINCAL*°, Pınar ERKEKOĞLU*

Toxic Industrial Chemicals (TICs) – Chemical Warfare Without Chemical Weapons
Summary

Over the second half of the 20th century, numerous chemical incidents have threatened civil populations and the environment in several parts of the world. Hazardous properties of industrial chemicals range from explosive or highly flammable to corrosive or poisonous. Their toxicity is much lower than that of chemical warfare agents. However, even simple common chemicals can be extremely hazardous when released into the environment in large amounts. Hazardous material incidents may be either the result of transportation-related accident or release, or generated from a fixed site by deliberate or accidental causes or natural disasters, including fire, flood, storm or earthquake. On the other hand, a number of military actions against chemical plants and installations clearly showed that "toxic warfare" or "chemical warfare without chemical weapons" is possible. The dual-use potential of chemicals certainly attracts the attention of terrorist organizations because they are more available, less securely protected, easy to access and handle or disperse, and less costly compared to classical warfare chemicals. Hence, industrial chemicals may provide terrorists with effective, readily accessible materials to develop improvised explosives, incendiaries and poisons. An attack of a chemical plant by terrorists or regular military forces has the potential to expose responding personnel as well as the surrounding civil population to many different kinds of chemicals at once, and the result may be highly destructive. Awareness and recognition of potential threats of industrial chemicals are the first requirements to mitigate and prevent their public health hazards. The need for preparedness via knowledge, equipment, emergency planning and exercise; implementation and reinforcement of legislations; and establishment of a leading and coordinating foundation must be emphasized, and their materialization must be supported by all parties, including academia, industry and government.

Key Words: *Toxic industrial chemicals (TICs), chemical warfare without chemical weapons, terrorism*

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Toksik Endüstriyel Kimyasallar- Kimyasal Silahsız Kimyasal Savaş
Özet

20. yüzyılın ikinci yarısında, çok sayıda kimyasal olay dünyanın çeşitli yerlerinde sivil toplumları ve çevreyi tehdit etmiştir. Endüstriyel kimyasalların tehlikeli özellikleri patlayıcı veya ileri derecede parlayıcı olmalarından, aşındırıcı veya zehirli olmalarına kadar çeşitli şekillerde olabilir. Toksisiteleri bilinen kimyasal savaş ajanlarından çok daha düşüktür. Ancak yaygın kullanılan kimyasal maddeler bile, çevreye büyük miktarlarda salındıklarında son derece tehlikeli olabilirler. Tehlikeli materyallerle ilgili olaylar, ya taşımayla ilgili kazalar veya salımlar sonucu meydana gelir, ya da bulundukları sabit bir yerde oluşan kasıtlı veya kazai nedenlerden ya da yangın, sel, fırtına veya deprem gibi doğal afetlerden kaynaklanabilir. Diğer taraftan, kimyasal üreten fabrikalara ve tesislere karşı yapılan askeri eylemler "toksik savaş" ya da "kimyasal silah kullanmaksızın kimyasal savaş"ın mümkün olduğunu açıkça göstermektedir. Kimyasal maddelerin iki yönlü kullanım potansiyelleri terörist kuruluşların ilgisini de tabii ki çekmektedir. Klasik kimyasal savaş ajanlarına kıyasla çok daha fazla miktarlarda ve daha az güvenli koşullarda bulunabilmeleri, kolay ulaşılabilmeleri, kolay kullanımları ve daha ucuz maliyetleri nedeniyle, teröristler endüstriyel kimyasal madde ve materyallere kolayca elde edebilirler ve patlayıcı, kundaklayıcı ve zehirli ajan geliştirme olanağı bulabilirler. Endüstriyel kimyasal maddelerin toplum sağlığı üzerindeki tehlikelerinin önlenmesi ve azaltılması için ön koşul, potansiyel tehlikelerinin farkında olmak ve algılamaktır. Bilgi, donanım, acil durum planlaması ve tatbikat yönünden hazırlıklı olmanın, yasa ve yaptırımların geliştirilip güçlendirilmesinin, liderlik ve koordinasyon görevini yürütecek bir kuruluşun oluşturulmasının gerekliliği akademik kuruluşlar, endüstri ve hükümetler dahil ilgili taraflarca vurgulanmalı ve hayata geçirilmesi desteklenmelidir.

Anahtar Kelimeler : *Toxic endüstriyel kimyasallar, kimyasal silahsiz kimyasal savaş, terörizm*

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INTRODUCTION

It is now increasingly evident that a new kind of warfare is emerging in the world. Conventional warfare and battlefields are left behind, and despite the existence of various examples of unconventional warfare applications, particularly in the second half of the 20th century, the 21st century seems to becoming a more intense era of unconventional-asymmetric war. The extent of the new warfare is now much wider than generally recognized.

HISTORY and TOXIC WARFARE

It is a fact that the history of chemical and biological weapons (CBW) is as old as the history of mankind. They were used by various means over the centuries. The use of decaying animal carcasses to contaminate wells goes back over 2,000 years. Bodies of plague victims were catapulted into cities under siege to cause sickness and death in the Middle Ages. Blankets contaminated with smallpox were given to Native American tribes to decimate their ranks during the French and Indian War. The issue gained a more organized feature in the early 20th century and modern chemical warfare began on a significant scale in 1915 during World War I. While hundreds of thousands of soldiers died as victims of gases like chlorine, phosgene and mustard in battlefields in Europe, the history of modern biological warfare also began in the same period. During the invasion of China, the Japanese conducted biological weapon experiments on ethnic Chinese and captive soldiers of the Allied Forces. Later, applications of chemical weapons were mainly against unprotected peoples. CBW were not used in combat during World War II; however, in Nazi gas chambers possibly millions were killed by exposure to poisonous chemicals including cyanide compounds, and the war was ended by a nuclear bombing. In spite of ongoing efforts to reduce or prohibit unconventional warfare, the period after World War II witnessed a growing interest in weapons of mass destruction (WMD), and there are many examples of applications in conflicts in many areas of the world (1,2). The threat and fear of terrorism today have the same potential components.

Until recently, the definition of WMD has included nuclear, biological and chemical (NBC) weapons. Now, however, the coverage has been extended by inclusion of radiologicals, and the term CBRN was adapted. However, today's concern is not limited to classical CBRN war and/or terrorism. In other words, the sources of CBRN are not only the misuse of military means or the production of one's own CBRN weapons, but also the deliberate or unintentional release of toxic industrial chemicals (TICs), which have great potential of hazard and even mass destruction capability. This type of threat is specific for the 20th century and onwards, recognition is relatively new, and although it is generally underestimated, the terms "toxic warfare" or "chemical warfare without chemical weapons" are now frequently used to refer to the threat potential of TICs (3,4).

TOXIC INDUSTRIAL CHEMICALS

Industrial chemicals have become an integral part of daily life in modern societies following the industrial revolution that started after World War II. They are developed and used for peaceful conditions and to improve quality of human life, and exist in numerous qualities and quantities. A TIC is defined as any substance that is produced and used by industry for various purposes and that, because of its chemical, physical or biological properties, poses a potential risk for life, health, the environment, or property when not properly contained (5). Median lethal toxicity of TICs is 10-100 times lower than the classical chemical warfare agents, but their availability in quality and quantity is much higher. While the most frequently used chemical warfare agents number about 70, approximately 70,000 TICs are produced, used and stored in large amounts and circulated around us by hundreds of thousands of vehicles, and/or they enter our environment as toxic wastes (6). Therefore, the likelihood of exposure to them in large amounts is relatively high.

TOXICITY vs HAZARD

A toxic substance is any agent capable of producing a deleterious response in a biological system, seriously injuring function or producing death. Toxicity is, thus, defined as the capacity of the substance to produce injury, and is related with the chemical structure and physico-chemical properties of the agent. However, toxicity is not a quality or quantity that can be defined as an "all or none" phenomenon. Every known chemical has the potential to produce toxicity if present in a sufficient amount (7).

Hazard, on the other hand, is the likelihood that injury will occur in a given situation or setting. It includes considerations of both inherent toxicity and circumstances specific to exposure. In other words, it is the function of intrinsic toxicity of the substance and the degree of exposure, including dose, time and route. Therefore, depending on the conditions under which it is used, a relatively nontoxic chemical may be more hazardous than a very toxic one (7). Gasoline is a good example of how a single material can be safe, hazardous or dangerous depending on the circumstances. It is considered safe in the fuel tank of a car. However, if it is spilled when pumping gas, a flammability hazard exists, and depending upon the concentration, a skin and breathing hazard could also exist. A spill of gasoline in a basement is very dangerous and could result in serious injury from breathing of toxic fumes, displacement of oxygen, or explosion.

Today, over 11 million chemical substances are known to mankind, 60,000-70,000 of them are in regular use, and between 200 to 1000 chemicals are produced in quantities in excess of one ton annually. New chemicals are entering the market at a rate of 600 per month, which means that some 7,000 new entities are entering our environment annually (6). The consumption of fertilizers, weed killers and insecticides is in very large quantities in agricultural areas, most of them are highly toxic, and according to the principles of nature's self-control, increasing amounts of pesticides are needed to obtain the same performance. More than a billion tons of hazardous chemicals are moved each year around the world via motorways and rail and pipeline systems. In the USA alone, about 10 million tons of material with toxic inhalation hazard are shipped by railway every year, while 3.1 billion tons of hazardous materials are shipped annually by all modes of transportation (8). Hence, uncontrolled releases of TICs/hazardous materials may occur at any time, anywhere and impact water, air, life, land or a combination of them.

CLASSIFICATION and REGULATION of DANGEROUS SUBTANCES

Regulation of dangerous substances in the European Union is based on the Directive 67/548/EEC on Dangerous Substances (9). The European Inventory of Existing Commercial Chemical Substances (EINECS), which lists and defines those chemicals that are deemed to be in the European Community (EC) market between 1971-1981 and for which the pre-marketing notification provision of the EC Directive does not apply, contains 100,204 chemicals. According to the European List of Notified Chemical Substances (ELINCS), which currently contains 4,381 substances, the number of notifications is 300-400 per annum, referring to the entrance of about 250-300 new substances per annum to the EC market (10). Currently there are 15 classes of danger in the Directive, including "explosive", "flammable", "oxidizing", "corrosive", "very toxic", "carcinogenic" or "dangerous for the environment". Furthermore, the term "hazardous substance" implies substances having one or more hazardous properties. Annex I to the Directive, which is the published list of substances with a harmonized classification and labelling, currently contains approximately 2,700 existing and 1,100 new substance entries covering approximately 8,000 substances (9,10).

In the USA, there is a law called "Emergency Planning and Community Right-to-Know Act" (EPCRA) that was passed in 1986 in response to concerns regarding the environmental and safety hazards posed by the storage and handling of toxic chemicals (11). Those concerns were triggered by the disaster in Bhopal, India in which more than 2,000 people died or suffered serious injury from the accidental release of methyl isocyanide (MIC) (6). To reduce the likelihood of such a disaster, the US Congress imposed requirements for federal, state and local governments, Indian tribes and industry regarding emergency planning and

"Community Right-to-Know" reporting on hazardous and toxic chemicals. The chemical industry was required to evaluate their facilities with respect to risk of and vulnerability to a terrorist attack, increase plant security accordingly, and change production methods in an attempt to monitor use of toxic chemicals. EPCRA has four major provisions:

i. Emergency planning
ii. Emergency release notification
iii. Hazardous chemical storage reporting requirements
iv. Toxic chemical release inventory

Information gathered by these four requirements helps to increase the public's knowledge and access to information at individual facilities regarding their uses and releases into the environment, and thus, to develop a broad perspective of chemical hazards. There are four groups of chemicals subject to reporting under this act and EPCRA's "Consolidated List of Lists" includes the threshold planning quantities (TPQ) (minimum limits) for each substance (12):

1. *Extremely Hazardous Substances (EHS):* Includes 356 substances with high acute toxicity, and it is considered that "the release of any substance which causes death or serious injury because of its acute toxic effect or as a result of an explosion or fire or which causes substantial property damage by blast, fire, corrosion or other reaction would create a presumption that such substance is extremely hazardous". TPQ: 0.5-5 tons on site at any one time.

2. *Hazardous Substances:* Includes >1,000 substances. Reportable quantity 0.50-2.5 tons, released in a 24-hour period.

3. *Hazardous Products:* Inventories of these chemicals and material safety data sheets for each must be submitted if they are present at any chemical facility in certain amounts (0.2 tons of EHS and 5,000 tons for other chemicals on site at any one time).

4. *Toxic Chemicals:* Includes 650 toxic chemicals and categories that appear on the list because of their chronic or long-term toxicity (12,000 tons per year manufactured or processed; 5,000 tons a year used),

EPCRA allows civil and administrative penalties ranging up to $10,000- $75,000 per violation or per day violation when facilities fail to comply with the reporting requirements. Criminal penalties up to $50,000 or 5 years in prison apply to any person who knowingly or willfully fails to provide emergency notification. Penalties of not more than $20.00 and/or up to one year in prison apply to any person who knowingly or willfully discloses any information entitled to protection as trade search (12).

NATO International Task Force-25 (ITF-25) identified the potential use of TICs as weapons in a report entitled "Hazar d for Industrial Chemicals: Reconnaissance of Industrial Hazards" (13). ITF-25 considered that for a given chemical to present a hazard in a military situation, the chemical must be present in sufficient quantity in the area of concern, must exhibit sufficient toxicity by inhalation, and must normally exist in a state that could give rise to an inhalation hazard. Thus, NATO ITF-25 ranked chemicals not only based on the toxicity, but according to a "hazard index" reflecting such factors as volume of the chemical's production and storage, toxicity, and vapor pressure. The number of the listed chemicals is approximately 100, and most of them are those chemicals that are readily found in households and industrial facilities, such as paper mills, waste management facilities, research labs, and plastic manufacturers, etc. The list includes those TICs that are produced in quantities higher than 30 tons in a single facility, the toxicity (LCt50 inhalation) of which are lower than 100 g/min/m3, and that have appreciable vapor pressure at 20°C. Those chemicals categorized as "High Hazard TICs" are widely produced, transported and stored, and have high level of toxicity and volatility (Table 1). "Medium Hazard TICs" covers those substances that are produced in large amounts, have high toxicity, but do not readily vaporize. Chemicals that are not considered as a threat under normal circumstances and are not likely to be used as terrorist weapons are ranked as "Low Hazard TICs" (Table 2).

RELEASE and HAZARD OF TICs

TICs can be released into the environment by any of the following means:

Table 1. High hazard toxic industrial chemicals (TICs) *

TISSUE IRRITANTS	SYSTEMIC POISONS
Ammonia	Arsine
Boron trichloride	Boron trifluoride
Fluoride	Diborane
Formaldehyde	Ethylene oxide
Phosphorus trichloride	Hydrogen fluoride
Phosgene	Hydrogen sulfide
Hydrogen bromide	Carbon disulfide
Hydrogen chloride	Cyanide
Chlorine	Tungsten hexafluoride
Nitric acid	
Sulfur dioxide	
Sulfuric acid	

*from NATO ITF-25 (13)

Table 2. Medium and low hazard toxic industrial chemicals (TICs) *

Medium Hazard TICs	Low Hazard TICs
Acrolein	Arsenic trichloride
Nitrogen dioxide	Bromine
Ethylene dibromide	Nitric oxide
Phosphine	Parathion
Hydrazines	Tetraethyl lead
Carbon monoxide	Toluene 2,4 diisocyanate
Methyl bromide	
Methyl isocyanate	
Stibine	

*from NATO ITF-25 (13)

1. Unintentional operational releases
2. Industrial accidents/ transportation accidents
3. Deliberate acts of enemy forces or terrorists (toxic war/terrorism)
4. Natural disasters (fire, flood, storm, earthquake)

If TICs enter into the environment in large amounts, they will pose a substantial threat to both civil populations and military forces and may cause large scale human losses and economic damage. Natural disasters in the form of fire, flood, storm or earthquake may result in catastrophes with the release of TICs in huge amounts, particularly in territories where preparedness, planning and emergency response are lacking (6,14). An attack on a chemical plant by terrorists or regular military forces has the potential to expose responding personnel as well as the surrounding civil population to many different kinds of chemicals at once. Those hazards and risks are in many ways different from those resulting from use of chemical warfare agents. Battlefield use of military chemicals is directed at the military force, whereas military attacks against an industrial facility could be intended to destroy that capacity, to reduce fighting capability of a nation during war and to cause economic damage (15). However, the secondary effects, not necessarily designed, could be civilian casualties and environmental damage. Such an attack is not a new phenomenon and there are clear evidences that during the World War II, a number of raids were conducted by the Allied Forces against chemical plants in Germany, as well as in Japan (2,16). Recent examples have also been witnessed during the dissolution of former Yugoslavia in 1991-1995 (17). On the other hand, today, it is a fact that both local and global terrorism are threatening all states and nations, and although terrorist groups' attention has become focused on acquisition or production of their own CBRN weapons, sabotaging industrial facilities or targeting distribution systems cannot be overlooked since those actions are less expensive and much easier to accomplish.

Industrial accident is defined as unexpected and unwanted events caused by spilling out of hazardous substances in the course of production, storage or transportation. They occur unexpectedly, unpredictably (regarding location, time, type of danger, atmospheric conditions, scale, and consequences) and fast, and any combination of these makes the event more complex and demanding. A typical example showing the threat potential of the accidental release of TICs and dimensions of a chemical plant accident and its outcomes is the Bhopal, India event (6,18). During the night of December 2-3, 1984, the world's worst industrial accident took place in the city of Bhopal, at a pesticide-manufacturing factory, owned by the US-based multinational Union Carbade. Approximately 40 tons of toxic gas, namely MIC, leaked from the plant into the surrounding densely populated area. The gaseous cloud caused immediate lung and eye problems. Estimates of the mortality and morbidity in the aftermath vary. Greenpeace reported that 16,000 died and half a million were injured (18). In other sources, the number of the deaths varies from 2,800 to 3,800, with between 50,000 to 150,000 people injured and debilitated and 1,400 immediately hospitalized, and the incident caused widespread panic in the 5 million local residents (6). The predominating ocular syndrome is now known as "Bhopal eye syndrome" (18). It is believed that there is a growing list of chemical contamination episodes today, but none of which can be compared to the Bhopal accident. The reason for this accident's far-reaching dimension is that the first aid was not sufficient, medical support and research were delayed, and knowledge about MIC was poor. Today, critics argue that there has been no systemic effort to document the medical and social impacts of the disaster. Last, but not least, the long-term effects of the gas leak on the environment seem to be forgotten. One good thing, however, is that after the Bhopal incident, the chemical industry recognized a need for better protection of hazardous substances.

TOXIC WARFARE / TOXIC TERRORISM

TICs are used in war or terrorism for various goals, such as incapacitation of or damage to the opponents, destruction and/or contamination of military or civilian infrastructures, generation of fear and panic, and for acquisition of tactical and psychological advantages. While contamination of public food or water supply with hazardous substances has been a readily and frequently used method of toxic war or terrorism over the centuries, threatening military and public food and water resources, directly or indirectly, is still possible at any time, and therefore demands continuous and vigorous attention and protection. Various properties of TICs (Table 3) are favorable and various reasons make them the terrorist's weapons of choice:

Table 3. Comparison of toxic industrial chemicals (TICs) with conventional chemical warfare (CW) agents

TICs	CW AGENTS
Not designed for warfare	Purposely designed for warfare
Have low toxicity, inexpensive	Have high toxicity, expensive
Available legally and in high volumes	Produced and stored under high security
Accessible	Lack of accessibility
Difficulty in detection	Have established detection methods
Can be effective without lethality	Designed to create casualty
Have acute and/or chronic effects	Primarily acute effects

1. Toxicity of TICs is much lower than those of classical warfare agents, but the risk/hazard they produce is much higher due to the release of higher amounts. For example, based on the "Immediately Dangerous to Life and Health" value (IDLH), the nerve agent Sarin (GB) is about 100 times as toxic as MIC, the causative agent in the Bhopal incident. However, if we compare the lethality potential of MIC released from a storage tank of ~200,000 kg, with the potential quantity involved in a 2-battalion volley of 155 mm GB (18 guns, 36 rounds, ~ 3 kg agent per round, which is equal to ~106 kg GB), we can realize that the MIC has a potential lethality almost 19 times greater than that of the GB attack (200,000 kg MIC/ (106 kg GB x 100) = 18.8) (16).

2. Several factors limit the use of chemical weapons by many terrorists, including controlled access to precursor chemicals, difficulty and danger in producing the agent and developing the proper delivery systems, and security surrounding chemical agent stockpiles. Nevertheless, TICs are much easier for terrorists to obtain, manufacture, handle and deliver because they are produced in large amounts, widely available, less costly and stored and/or transported under relatively less secure conditions.

For example, chlorine is the first chemical warfare agent used during World War I and it caused mass casualties (1). It is a powerful irritant to the eyes and both the upper and lower respiratory tract. However, it is widely used by a large number of industrial-process facilities in the manufacture of chemicals, plastics, and paper, and is commonly used in water treatment plants, swimming pools and laboratories (6,7). Accidental or intentional release of chlorine into the environment can cause lethality of a large number of people in a very short time (<30 minutes). In fact, numerous industrial exposures have been reported to produce a large number of injuries. Estimations have shown that a chlorine cloud emanating from a ruptured railcar either by an attack or accident can move 3 km in 10 minutes and produce a cloud of deadly gas stretching over 20 km (19,20). A simulation study showed that if an attack occurred during a celebration or political event in the USA in a setting similar to the Capitol Hill area in Washington, DC, people could die at a rate of over 100 per second and up to 100,000 people would die within the first 30 minutes. The likely economic impact would be over $5 million. Hence, the total outcome was calculated to be far exceeding that of the September 11 event. It is also estimated that even under less-crowded conditions, an attack in an urban area in the US would result in 17,500 deaths, 10,000 severe injuries and 100,000 hospitalizations (19).

Ammonia, a common refrigerant for skating rinks, produced and stocked in large amounts in cooling facilities and tanks, has the same range of hazard potential as chlorine. It is a toxic gas that can be lethal, and turns highly combustible when mixed with oil. Common ailments associated with exposure to ammonia include nose and throat irritation, convulsive coughing, severe eye irritation, and respiratory spasms. If a town is located 1 km away from an ammonia manufacturing facility, where 63 tons of ammonia have been spilt from the main transfer pipeline, 80% (or 50 tons of chemical) will immediately form a cloud made of aerosols, ammonia vapor or drops. If a wind is blowing towards the town with a velocity of 2 m per second, the cloud with a hazardous concentration will reach the town in less than 10 minutes. The first couple of minutes represents the line between life and death, and demands a real-time emergency response (21).

Chlorine and ammonia top the list of chemicals that most frequently create accident risk, followed by the chemicals propane and butane (6). The threat that could be produced by jet fuel tanks in airports, fuel oil refineries and pipelines, gas stations and storages, and transportation vehicles, on the other hand, can be greater than one could ever imagine.

3. Terrorists¢ use of some TICs can cause panic and chaos without lethal effects; in fact, their goal may be not to immediately kill/incapacitate civilians, as in the case of classical chemical warfare agent use, but to instill fear and cause mass suffering over a period of time.

4. The potential variety of materials makes TIC detection very difficult; however, relatively simple detection and identification equipment and methods have been developed for the known chemical warfare agents. On the other hand, military protective filters are optimized against chemical warfare agents while many hazardous materials are not very well filtered.

DISCUSSION and CONCLUSION

Awareness and recognition of potential threats of TICs are the first requirements to mitigate and prevent public health hazards resulting from exposure to them by any of the above-mentioned means. This task should be carried out by a central authority that determines the fundamental measures and procedures and coordinates the country-wide applications concerning risk analysis and assessment, planning, preparedness and response in case of an emergency involving TIC exposure. Measures and principles would be specific to each territory, each region and each social or administrative unit; therefore, proper guidance and coordination should be undertaken by a specific governing body. General and local tasks should include identifying and prioritizing potential threats and local sources of chemicals, establishment of inventories, recording and reporting systems, preparation of toxicity profiles and databases, research and information gathering, emergency response plans for accidental or deliberate exposures or natural disaster events, and training exercises.

Turkey imports approximately 7-8 million tons of chemicals per year. Meanwhile, she exports 1.5-2 million tons of chemicals annually (22). This shows that the chemical industry in Turkey depends on the chemical products produced in foreign countries. However, contrary to the relatively low economic significance of the chemical industry at present, Turkey has been one of the fast-growing countries in which chemical industry plays a critical role. As pointed out by an earlier UNIDO report, the most important issues in managing the safety and risk of industrial chemicals in the country are (22):

1. The registration process for TICs in Turkey still does not require detailed data as required in developed

countries.
2. Implementation of regulations on chemicals is not well coordinated among the concerned ministries and experts in the field to create science-based processes and to make proper risk assessments, though academic capacity is sufficient to enlighten the problems.
3. On-site monitoring systems for the early warning of chemical accidents and incidents should be put in operation (22).

The earliest legislation in Turkey on human and environmental health is the Law of Public Health (Code 1593) that sets the main principles for the protection of humans and environment. A specific Environment Law (Code 2872) came into force in 1983, and for its implementation several regulations have been put into action including Pollution Prevention, Control of Air Quality, Noise Control, Water Pollution Control, Solid Waste Control and Hazardous Chemical Substances and Products. The latter regulation provides the framework for the determination of programs, policies and principles regarding the control of dangerous chemicals in terms of production, packaging, storage, labeling and handling. Recently, a draft of a regulation on the control of major industrial accidents has been prepared (23). Individual classes of chemicals are regulated by different ministries; however, there is no exact data on the amount, names, toxicological significance, and sites of chemical production, distribution, use and transport in Turkey. While the Ministry of Health is responsible for controlling the production, marketing, registration, and control of pharmaceuticals, cosmetics, food additives, and household pesticides; the Ministry of Agriculture, Forestry, and Rural Affairs is responsible for controlling the same criteria for agrochemicals; the Ministry of Environment is responsible for general industrial chemicals; and the Ministry of Labor is responsible for the protection of workers from the hazardous working environment. However, due to the interdisciplinary, inter-ministerial, inter-sectoral and interdepartmental nature of the issue of potential threats of TIC, a high level of coordination is needed. As a first step, we suggest that a foundation like the Agency for Toxic Substances and Disease Registry (ATSDR) in the United States (24) should be established with specific responsibilities for evaluating the risks of environmental hazardous substances and for developing and disseminating information. This foundation should work in association with related ministries, institutions and universities to play a leadership role in hazardous substance registration, chemical accident/chemical attack management, gathering and improvement of information, conduct of research, creation of databases for accidental, intentional incidents or natural disasters, preparation of toxicity profiles, emergency response planning, and education and training.

In conclusion, chemical terrorism is typically described as a "high probability" event, TICs represent one class of agents usable in a terrorist attack, and the threat potential of TICs cannot be underestimated. The necessity of preparedness via knowledge, equipment, emergency planning and exercise; implementation and reinforcement of legislation; and establishment of a leading and coordinating foundation must be emphasized and their materialization must be supported by all parties, including academia, industry and government.

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Hazards of Ammonia Releases at Ammonia Refrigeration Facilities (Update)

The Environmental Protection Agency (EPA) is issuing this *Alert* as part of its ongoing effort to protect human health and the environment by preventing chemical accidents. We are striving to learn the causes and contributing factors associated with chemical accidents and to prevent their recurrence. Major chemical accidents cannot be prevented solely through regulatory requirements. Rather, understanding the fundamental root causes, widely disseminating the lessons learned, and integrating these lessons learned into safe operations are also required. EPA publishes *Alerts* to increase awareness of possible hazards. It is important that facilities, State Emergency Response Commissions (SERCs), Local Emergency Planning Committees (LEPCs), emergency responders, and others review this information and take appropriate steps to minimize risk. This document does not substitute for EPA's regulations, nor is it a regulation itself. It cannot and does not impose legally binding requirements on EPA, states, or the regulated community, and the measures it describes may not apply to a particular situation based upon the circumstances. This guidance does not represent final agency action and may change in the future, as appropriate.

Chemical Safety ALERT

Problem

Anhydrous ammonia is used as a refrigerant in mechanical compression systems at a large number of industrial facilities. Ammonia is a toxic gas under ambient conditions. Many parts of a refrigeration system contain ammonia liquefied under pressure. Releases of ammonia have the potential for harmful effects on workers and the public. If the ammonia is under pressure, risk of exposure increases since larger quantities of the refrigerant have the potential for rapid release into the air. Also, some explosions have been attributed to releases of ammonia contaminated with lubricating oil. This Alert further discusses these potential hazards and the steps that can be taken to minimize risks. This Alert should be reviewed by personnel who operate and maintain refrigeration systems, managers of facilities, and emergency responders (e.g., haz mat teams).

Accidents

A number of accidental releases of ammonia have occurred from refrigeration facilities in the past. Releases result from a number of situations that include plant upsets leading to over pressure conditions and lifting of pressure relief valves; seal leaks from rotating shafts and valve stems; refrigerant piping failures due to loss of mechanical integrity from corrosion; physical damage of system components from equipment collisions; hydraulic shock; and hose failures that occur during ammonia deliveries. Some of these incidents have led to injury and fatalities on-site as well as causing adverse off-site consequences. In addition to risks of personal injury, ammonia releases have the potential of causing significant collateral damage including: product loss due to ammonia contamination, interruption of refrigeration capacity, product loss due to refrigeration interruption, and potential for equipment and property damage resulting from the incident. In many cases, ammonia releases have resulted in multi-million dollar financial losses. The Factory Mutual Loss Prevention Data Bulletin 12-61 describes several incidents with property damage ranging from $100,000 to $1,000,000 per incident. The following describes several recent incidents in more detail.

One type of accident that is easily preventable is equipment failure due to physical impact. In a 1992 incident at a meat packing plant, a forklift struck and ruptured a pipe carrying ammonia for refrigeration. Workers were evacuated when the leak was detected. A short time later, an explosion occurred that caused extensive damage, including large holes in two sides of the building. The forklift was believed to be the source of ignition. In this incident, physical barriers would have provided mechanical protection to the refrigeration system and prevented a release.

Another incident highlights the need for an adequate preventive maintenance program and scheduling. In a 1996 incident involving a cold storage warehouse facility, compressor oil pressure progressively dropped during a long weekend. The low oil pressure cutout switch failed to shutdown the compressor leading to a catastrophic failure as the compressor tore itself apart. A significant release of ammonia ensued. Periodically testing all refrigeration-related safety cutout switches is absolutely necessary to minimize the likelihood of such incidents.

Two other incidents illustrate the potential for serious effects from accidental releases from ammonia refrigeration systems, although the causes of these releases were not reported. In a 1986 incident in a packing plant slaughterhouse, a refrigeration line ruptured, releasing ammonia. Eight workers were critically injured, suffering respiratory burns from ammonia inhalation, and 17 others were less severely hurt. A 1989 ammonia release in a frozen pizza plant led to the evacuation of nearly all of the 6,500 residents of the town where the plant was located. The release started when an end cap of a 16-inch suction line of the ammonia refrigeration system was knocked off. Up to 45,000 pounds of ammonia was released, forming a cloud 24 city blocks long. About 50 area residents were taken to hospitals, where they were treated with oxygen and released, while dozens of others were treated with oxygen at evacuation centers.

Hazard Awareness

Ammonia is used widely and in large quantities for a variety of purposes. More than 80% of ammonia produced is used for agricultural purposes; less than two percent is used for refrigeration. Ammonia can safely be used as a refrigerant provided the system is properly designed, constructed, operated, and maintained. It is important to recognize, however, that ammonia is toxic and can be a hazard to human health. It may be harmful if inhaled at high concentrations. The Occupational Safety and Health Administration (OSHA) Permissible Exposure Level (PEL) is 50 parts per million (ppm), 8-hour time-weighted average. Effects of inhalation of ammonia range from irritation to severe respiratory injuries, with possible fatality at higher concentrations. The National Institute of Occupational Safety and Health (NIOSH) has established an Immediately Dangerous to Life and Health (IDLH) level of 300 ppm for the purposes of respirator selection. Ammonia is corrosive and exposure will result in a chemical-type burn. Since ammonia is extremely hygroscopic, it readily migrates to moist areas of the body such as eyes, nose, throat, and moist skin areas. Exposure to liquid ammonia will also result in frostbite since its temperature at atmospheric pressure is –28°F.

The American Industrial Hygiene Association (AIHA) has developed Emergency Response Planning Guidelines (ERPGs) for a number of substances to assist in planning for catastrophic releases to the community. The ERPG-2 represents the concentration below which it is believed nearly all individuals could be exposed for up to one hour without irreversible or serious health effects. The ERPG-2 for ammonia is 200 ppm. EPA has adopted the ERPG-2 as the toxic endpoint for ammonia for the offsite consequence analysis required by the Risk Management Program (RMP) Rule under section 112(r) of the Clean Air Act.

In refrigeration systems, ammonia is liquefied under pressure. Any liquid ammonia released to the atmosphere will aerosolize producing a mixture of liquid and vapor at a temperature of –28°F. The released ammonia rapidly absorbs moisture in the air and forms a dense, visible white cloud of ammonium hydroxide. The dense mixture tends to travel along the ground rather than rapidly rising. This behavior may increase the potential for exposure of workers and the public.

Although pure ammonia vapors are not flammable at concentrations of less than 16%, they may be a fire and explosion hazard at concentrations between 16 and 25%. Mixtures involving ammonia contaminated with lubricating oil from the system, however, may have a much broader explosive range. A study conducted to determine the influence of oil on the flammability limits of ammonia found that oil reduced the lower flammability limit as low as 8%, depending on the type and concentration of oil (Fenton, et al., 1995).