Chemical Vignettes

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Chemical vignettes are true stories that reveal what can and does happen when hazardous chemicals are improperly managed.

Contents:

Dioxane Delivery

In the mid-nineties a company delivered over 30 boxes of bottles containing old laboratory chemicals (over 1000 containers) from one of their facilities to another, located several miles away. Inside one of the boxes were two, 12 year old, one-gallon bottles of 1,4-Dioxane, a flammable solvent. While the bottles were being prepared by a contractor for shipment as hazardous waste, it was discovered the dioxane had peroxidized (formed peroxide crystals through contact with air). Peroxide crystals are shock-sensitive explosives, a class of chemicals that have characteristics similar to nitroglycerin.

The bottles were clear, so it was plainly visible that there were several inches of crystals in the bottom of both bottles. The Fire Department's bomb squad was called and decided the materials were photo-sensitive, so they would not allow pictures of the crystalline dioxane to be taken. They carefully removed the material from the building and safely detonated it on site.

The transportation route passed by a regional medical center and several major arterials. The vehicle contained several other containers of flammable chemicals that likely would have ignited or exploded if the dioxane exploded. The explosive power of the dioxane was probably equivalent to several hand grenades based on reported explosive power of other peroxidizable materials like ethyl ether and isopropyl ether.

Most experts agree it was a "miracle" the materials did not detonate in the employee's vehicle during transport.

An Exploding Rodent Tale (Tail?)

In 1984, I worked as a hazardous waste technician at a large university with over 1000 laboratories. While collecting hazardous wastes at one of the labs, I noticed their refrigerator was labeled "Not Explosion Proof". I asked about the warning sign and was asked, "Haven't you heard about the exploding rodents?" I said I hadn't. The researcher then told me this tale.

Sometime in the seventies a researcher was doing behavioral studies of small rodents. After the rodents were put through their paces and the data were evaluated, the rodents were killed and preserved for future tissue analysis. The preservative he used was Diethyl Ether, one of the most flammable liquids on Earth. After awhile, the refrigerator was full of preserved specimens.

One day the refrigerator's compressor kicked in, sparked and ignited the ether fumes in the refrigerator. The resulting explosion blew the refrigerator's door off the hinges and embedded it in the wall across the room. Small flaming rodents were scattered across the room, torching it in seconds. Fortunately the door was closed, so the fire didn't spread.

In response to this incident, I was told, the university immediately took strong steps to prevent its reoccurrence. All refrigerators were immediately required to be labeled "Not Explosion Proof". I have no idea if the practice of injecting rodents with ether as a preservative is still practiced.

Evaporating Chromium

A university hazardous waste coordinator in the seventies recommended a chemistry instructor take approximately ten gallons of chromic acid up to the roof of the building and let it evaporate as an acceptable disposal method. The chromic acid was to be poured in uncovered tubs, open to the elements to enhance the evaporation. The chemistry labs only occurred during the Fall, Winter and Spring quarters.

Have you ever tried to evaporate water in the winter in Seattle from an open tub? Ten years later the new, "improved" hazardous waste coordinator happened to walk up on the roof of the chemistry building and notice an interesting series of bright orange and yellow stains. It

appeared that, even though the practice had been discontinued after a few years, the solutions had never been removed from the tubs and disposed.

Cleaning Plastics

In a plastics manufacturing company, plastic sheets would come out of a process and need to be cleaned thoroughly without any remaining residue. The method the company used was to wipe down the plastic sheets by hand with paper towels soaked in lacquer thinner (flash point 28° F). They discovered, over time, that plastic sheets often have significant build-ups of static electricity. They figured this out when the towels periodically burst into flames.

Moving Large Gas Cylinders

"I once worked for an unnamed computer manufacturer in their research laboratories. One of my co-workers was a brilliant polymer chemist who had a reputation for being somewhat absent minded, not to mention the world's sloppiest lab partner. While he had a long, long litany of chemical spill incidents which he was involved in, the most amazing example was when he was working in a GC/MS laboratory, and decided to move a cylinder of high pressure nitrogen across the Lab. Rather than properly transport the cylinder using a dolly and tie-downs, he decided to move the cylinder by rolling it on its edge across the lab (after all, it was only 30 feet, no problem, right?)."

"Somewhere around half-way across the lab, he dropped the cylinder, which fell against the floor (with regulator still attached, and the cylinder bottle valve still "on"). The regulator snapped off from the force of the fall, and the cylinder released its contents violently. Newton's laws of force and motion kicked in, and the bottle did a decent impersonation of a rocket engine, shooting across the room, through an open door, and lodged itself eight inches into a concrete block wall."

"Fortunately, the cylinder contained only Nitrogen! No one was injured, and of course there was no chemical hazard -- but the incident triggered a review of safety procedures in the lab. Of course, the worker involved had been ignoring EXISTING safety procedures, and was disciplined - but was still working for the company when I was last there."

A Cryonic Gas Tale

We had one not too long ago in which a lab worker was removing a small Eppendorf tube out of liquid nitrogen. He wasn't sure it was the correct one and was examining the small lettering very closely. Some liquid nitrogen had seeped into the tube over time and as it was now approaching room temperature it went into the gaseous state and expanded. The tube did not. Pressure increased, the tube shattered. The plastic shrapnel ripped into his eye. He was rushed to hospital for emergency surgery. The kicker was he had protective eyewear in his lab coat pocket!

Spill Response in a Biology Laboratory

A college biology lab contained a refrigerator holding numerous organic and inorganic chemicals. One day a shelf in the refrigerator collapsed, breaking several bottles on the shelves below. Staff and students heard the boom and called campus services. They sent custodians who wore proper protective equipment to evaluate and clean-up the mess. They opened the refrigerator, releasing a gaseous cloud. At that point the laboratory coordinator entered the lab to observe the progress. Unfortunately, he wasn't wearing personal protective equipment.

He breathed in the fumes and was put on temporary medical leave with chemical bronchitis.

A hazardous waste management contractor was contracted to clean up the contaminated refrigerator and spilled liquids. They sent trained spill response staff in proper personal protective equipment to clean it up. As they began the clean up, the company's industrial hygienist joined them to ensure they were doing a good job. Unfortunately, he too was not wearing his protective equipment and was exposed to the hazardous fumes and had to receive medical attention.

Household Bleach Hazards (I)

A hazardous waste technical assistance inspector came home one day and found that his teenager had burned popcorn kernels onto the bottom of the family's nice, copper-clad Revere Ware pot. Vigorous scrubbing and scraping would not remove the carbon deposits from the bottom of the pan. With his years of experience working with chemicals, he knew that an oxidizer could remove the carbon.

He added some undiluted household-strength chlorine bleach to the pot and let it soak overnight in a safe place on a shelf. The next evening he added some water and poured out the liquid. It was a very satisfying black color. Unfortunately, there was still quite a bit of carbon residue left on the bottom of the pot. So he added more bleach and let it sit for four more days.

When he removed the pot from the shelf, he noticed the bottom of the pot was wet. He rinsed out the pot and found, to his pleasure, that all the carbon was gone. He then went back and wiped the liquid off the shelf where the pot had been. It was an interesting green color. He returned to the kitchen and looked at the pot. There was no copper cladding left! When he held the pot up to the light he could see hundreds of tiny holes in the bottom of the pot.

Household Bleach Hazards (II)

One day, the safety officer for a large corporation came home from work, opened the front door and smelled chemical fumes. Seconds later, his dog staggered out the front door, threw up on the porch, and collapsed in the front yard. The man became very concerned for the health of his wife, so he entered the house, calling his wife's name. He opened all the windows

on the ground floor of the house to allow the fumes to escape. When he entered the kitchen, he noticed a large cloud of blue gas hovering by the ceiling. An intense smell of chlorine was in the air.

He became even more concerned and walked back into the living room, calling his wife's name loudly. He heard a groan from upstairs. As he ran upstairs, he noticed vomit stains along his path. He entered his bedroom and found his wife on the bed, barely conscious. The window by the bed was open. He called 911 immediately and dragged his wife out of the house onto the grass in the front yard by the now reviving dog.

On the way to the hospital in the ambulance, his wife revived and told him she had been cleaning the oven with ammonia. It hadn't worked well enough to suit her so she liberally applied liquid chlorine bleach. The next thing she knew she was coughing explosively and vomiting. She crawled upstairs, opened the window and collapsed on the bed.

It took the Fire Department several hours to completely siphon off the chloramine gas cloud from the kitchen. She smelled **strongly** like a swimming pool every time she perspired for over two weeks following her return from the hospital.

Sodium Azide Story

Plumbers were replacing the old metal P-trap pipes in all university laboratories with glass pipes. One lab hadn't been used in a long time, so the trap was dry when they pulled it. When they tossed it in the trash can, a loud explosion occurred, to their intense surprise. They walked over to the trash can, pulled out the metal pipe and found it had a flared-out hole in the side of it.

After shaking their heads over this unusual occurrence, they dropped the pipe into the trash can, where it proceeded to blow-up again. They immediately ran out of the room and pulled the fire alarm. When the hazardous waste coordinators and the fire department inspected the pipe, they found it was coated with crystals of Copper Azide, a shock sensitive explosive. By checking on past use of the lab, it was found that large volumes of dilute Sodium Azide solutions were poured down the drain for several years. The P-trap pipe was made of copper.

Neutralizing Corrosive Bases

"I worked for a company which considered chemists 'support personnel' and paid them as such. They tended to hire people who were either fresh out of college, fresh in the country or those who had a degree, but not necessary in chemistry. These practices appeared to be their way to underpay employees.

One of my colleagues had a degree in physics and statistics. We had ongoing discussions on how relevant a degree is, when and why do you need one, can you be just trained (on the job)

or not, etc. She was doing hazardous waste pretreatment, with very little guidance or knowledge of chemistry, basically being trained on the job. She felt that having specific education in chemistry was not necessary to work in a chemistry lab.

After one of our discussions, she went ahead and started to neutralize a five-gallon bucket of caustic hydroxide waste that was sitting in the hood. She directly poured a significant volume of concentrated acid in the bucket and, within a minute or so, watched the fuming bucket melt and start to actually flow down the outside of the hood like a Salvador Dali clock painting. I think the point was made for her."

Sodium Chloride Conductivity Lesson

A custodian was waiting outside an elevator when she heard a muffled "BOOM". A few seconds later the elevator door opened and a man dressed in a business suit crawled out the door, obviously in great pain, and equally obviously with his fly unzipped.

It turned out the fellow "had to go" and decided to urinate in the elevator. Unfortunately he aimed at an electrical outlet.

Perchloric Acid Vignette

Perchloric Acid is a powerful oxidizing acid that can cause a fire or explosion in contact with organic materials such as wood, paper or charcoal. Labs that use Perchloric Acid are required to use it in a special fume hood that is separately piped to the roof and is equipped with water spraying scrubbers to prevent vented residues from drying on the walls of the ductwork. These residues could then react with other evaporating chemicals that are used later.

One day a carpenter was working in the chemistry building of a large university. At one point he needed to drill a hole in a four by eight foot sheet of plywood. He began to drill when suddenly the entire board burst into flames. Fortunately, he escaped with only a photogenic sunburn and a complete lack of facial hair. The fire was put out fairly quickly and damage was not significant.

During the investigation, it was determined that a lab had a Perchloric Acid hood that was vented up a pipe that ran adjacent to the exploding board. It was determined that there was a poor seal between two sections of the vent pipes. This allowed Perchloric Acid fumes to impregnate the wood.

Another Laboratory Fire Story

No one is positive of how it started. This is the best estimate of how it occurred. A researcher working in a research hospital laboratory had a Bunsen burner lit on a counter. They left the room unoccupied for a short time, with the Bunsen burner still going. A few minutes later, the smoke alarm sounded from the lab.

Within three minutes, firefighters estimated, the temperature in the room exceeded 1000°F. It was hot enough to melt the Pyrex(tm) water pipes and turn a compound microscope into a slag paperweight. The fire was so violent it forced air through the fume hood exhaust vent at a rate that it caused extremely hot air to flow out of the fume hood in the adjacent chemical storeroom. Over 500 containers of stock chemicals in this storeroom had their labels blackened and their contents ruined. Disposal costs for these unused and unusable chemicals cost thousands of dollars.

Fortunately, the lab's door was closed so the fire was pretty much limited to one room, though associated damage closed the entire floor. During the clean-up, firefighters noticed a small, metal flammable storage cabinet in a corner of the charred room. The outside was burned to bare metal and warped from the heat. They opened it and found, to their surprise, three gallons of flammable solvents. The xylene and toluene containers appeared to be undamaged! Their labels were not even discolored.

Earthquakes and Labs - A Lesson from Kobe, Japan

I've only been able to find one reference on the world wide web to the effects of the Kobe Earthquake (force 7.2) on laboratories. It consisted of a .GIF photograph of a lab several days after the quake. The image was very grainy, probably because the photographer was unwilling to walk inside.

All that was visible was blackened metal covered with melted glass. Most of the room was covered with a flat, cracked layer of glass. The photographer's comment was that it was assumed the quake broke many bottles of chemicals which mixed and ignited, torching the lab.

Creative Solvent Venting

Lab staff at a biotechnology company regularly placed five or six, nearly empty, one-gallon bottles of flammable solvents at a time on the floor of a large, walk-in fume hood. They then removed the lids and allowed the remaining solvents to evaporate up the stack. When an environmental inspector walked through the laboratory he asked them about the practice. They explained they wanted the solvent fumes to go up the stack so they wouldn't pose a risk to people's health in the lab.

The inspector said he appreciated that, but wondered why they decided to place their electrical hot plates in the same hood, three feet above the bottles. As the lab technicians stood there, quietly, they watched the liquid in the clear beakers on the hot plates boiling merrily.

Ron's Dimethyl Mercury

While visiting a biotechnology firm recently, an inspector saw his first container of dimethyl mercury, a truly nasty chemical. One drop (!!!) on a latex-gloved hand has caused the death of a

researcher. The one-pint container was 5 years old and had never been opened. When asked what they used it for, the chemists all said they were shocked to see it. They looked at the can and saw a post-it note with one word on it, "Ron". Simultaneously they all said, "Ah Ha! It's Ron's." The inspector asked, "Who's Ron." They said, with sneers, "A Biologist" in the same tone of voice most folks would say "A heroin dealer". When the inspector asked if he could speak to Ron, they said, "He left the company five years ago." The inspector then suggested they dispose of the compound as hazardous waste since it wasn't needed. With gleams in their analytical eyes, the chemists asked, "Can we send it to Ron?". Following a short pause, the inspector said, "I don't think so…"