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WORST LABORATORY ACCIDENTS AND LABORATORY SAFETY PRACTICES

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Abstract:-Chemistry laboratories have been a focus of concern of most scientists in recent past because of the dangerous procedures and toxicity of the chemicals used. They are considered as unsafe places to work. By following safety protocols and precautions, accidents can be avoided and understanding Chemistry, by practically doing it can be fun.

Keywords: Chemistry laboratories, accidents, safety boards, safety practices, precautions.

INTRODUCTION :-

Chemistry laboratories can be dangerous places to work in, as a wide variety of chemicals of toxic, flammable, acidic, explosive and corrosive nature are present. Research may also involve the use of radioactive isotopes. If we work carelessly, it may lead to accidents. These risks can be effectively managed if precautions are taken and proper training is given to the students. There is nothing more important than being safe. However, accidents may occur. Anyone who has spent considerable time in a laboratory, must have come across an accident or known someone who has met these accidents. And some of these accidents may be very severe.

Some of the worst laboratory accidents are mentioned here.

1. Fire sparked and sent chemicals into the air at Princeton University's Frick Laboratory and three people were injured. A post doctoral student added solvent waste to nitric acid, sparking a flash and the smoke, as the chemicals were not compatible and the container containing the chemicals broke, and chemical spilled on the woman's face causing chemical irritations.
Source: Bridget Clerkin, For The Times of Trenton
on May 23, 2012 at 5:14 PM.
2. On April 13, 2011, at Yale University's, Sterling Chemistry Laboratory, Michele Dufaults was found dead in the the Chemistry lab's machine shop. The 22-year-old, Yale physics student was working alone at night using an industrial lathe. Nobody was around her to help, when her hair entangled in the rapidly spinning tool, which wrapped around her neck and she died of asphyxiation. A subsequent review found that the lathe lacked necessary safety features, such as an emergency stop button.

Yale established the Michele Dufault Endowment for Yale Women in Science, a $14 million fund to offer scholarships, fellowships, and research opportunities to women pursuing STEM fields at the university.
Sources: Yale News, Science, New York Times
Published online 18 April 2011 | Nature 472, 270-271 (2011) | doi:10.1038/472270a
3. In late 2008, 23-year-old research assistant, Sheharbano Sangji at the University of California, Los Angeles (UCLA), died due to burn injuries in a laboratory fire. She was working with a pyrophoric chemical t-butyl lithium, a compound that ignites on exposure to air. She violated several important laboratory safety rules. Working alone in the laboratory is prohibited and she was working alone during holiday and she was not wearing the appropriate protective clothing. She was withdrawing reagent t-butyl lithium dissolved in pentane with syringe. She accidentally pulled the plunger all the way out, introducing air and creating a flash fire.

Also instead of goggles, she was wearing safety glasses, nitrile gloves and a synthetic sweater and no lab coat. Because of gloves and the sweater, when the flash fire ignited she sustained third degree burns over 40 per cent of her body and

she died after 18 days. After this incident, UCLA launched a full review of its laboratory safety protocols.
Sources: Rebecca Trager, US correspondent for Research Day USA; Wired, C&EN
4. Preston Brown, a graduate student in Chemistry at Texas Tech University in Lubbock, lost three fingers of his left hand while preparing derivative of an explosive compound, nickel hydrazine perchlorate. He and his colleague made 10 grams of the substance, which was 100 times more than their professor considered safe. Brown was grinding up chunks of nickel hydrazine perchlorate with mortar and pestle. These types of substances can explode under friction or pressure. This happened and the student suffered from burns and lost three fingers.
5. Karen Wetterhahn, a chemist died after receiving a toxic dose of dimethylmercury, even though she was following proper safety precautions. A few drops of dimethylmercury accidentally fell on her glove-covered hand. But, the chemical seeped and touched her skin and entered her body. A few months later, she began to experience symptoms of mercury poisoning, such as trouble with balance, as well as impaired speech, vision and hearing. She then slipped into a coma and died, becoming the fourth laboratory victim of dimethylmercury. The LD50 of dimethylmercury is 50 micrograms per kilogram of body weight i.e. 59 kg woman could be killed by about 3 mg of the substance.
Source: Science Now
6. Hydrofluoric acid is commonly used in geology to extract microscopic fossils from sedimentary rock. The rock dissolves in the acid, leaving the acid-insoluble fossils behind.

A technician in Australia accidentally spilled hydrofluoric acid on himself which led to burning 9% of his body. As a result large amount of fluoride was absorbed which caused hypocalcemia – i.e. low concentration of blood calcium by forming fluorapatite, a compound which contains both calcium and fluoride ions. This may lead to cardiac arrest. To prevent this, calcium gluconate gel is applied to burns induced by hydrofluoric acid, in order to remove the fluoride ions. In the case of the Australian technician, no gel was applied, but he was injected with both calcium and calcium gluconate. But one of his burned legs was amputated and he died two weeks after the initial accident from multiple organ failure.
Source: UC-Santa Barbara
7. In UCSB Chemistry building, in 1980's a postdoctoral researcher, inappropriately mixed a strong oxidizing acid (nitric acid) with organic solvents inside a waste container within a fume hood resulting in explosion causing a flash fire within the hood. The student was lucky to escape uninjured and the fire was extinguished. The fume hood was seriously damaged.
The blast continued up through the hood ductwork into the corridor where a secondary explosion blew out the false ceiling panels. When oxidizers and organic materials are mixed a strong, often violent, oxidation-reduction reaction will occur.

CHALLENGES AND SOLUTIONS:

Accidents in chemistry laboratories have drawn attention of scientists and researchers in recent years. Fatality adds further momentum to calls for a shake-up in academic safety culture. Jim Kaufman, president of the Laboratory Safety Institute in Natick, Massachusetts has stated that "In many cases, academic freedom is more important than safety". Still today, significant attention is not being paid to improve safety culture. "It's very difficult to change attitude of researchers". Researchers in laboratories around the country still work alone, and without proper supervision or protection.

Several safety boards like the US Chemical Safety Board (CSB), National Academies Board on Chemical Sciences and Technology and agencies like the federal Occupational Safety and Health Administration (OSHA) have been set up to look about safety protocols and procedures. This board had gathered reports of around 120 university chemistry laboratory accidents since 2001, and concluded that "safety practices at US universities leave a lot to be desired".

Researchers have pointed out that industry is better in maintaining safety standards than academia due to fewer inexperienced students, accountability to management and work alone in laboratories.

Staying safe in the laboratory means knowing what dangers you may encounter, as well as how to avoid them. To avoid the risk of accidents proper laboratory practices should be followed and precautions should be taken.

Laboratory Safety Practices: Dos and Don'ts in the laboratory

1.No unauthorized experiments should be performed.
2.Work under direct supervision at all times. Never work alone in the laboratory.
3.Always be alert and proceed with caution at all times in the laboratory. Immediately notify the supervisor of any unsafe conditions.
4.Know the locations and operating procedures for all safety equipments. This includes the eyewash station and safety shower.
5.Know the locations of the nearest fire alarms and at least two ways out of the building and you should also know how to use fire extinguisher.
6.Conduct yourself in a responsible and professional manner at all times. Take everything seriously.
7.Always dress properly for working in the laboratory. Wear clothing and shoes that cover exposed skin and protect you from potential splashes. Don't wear synthetic clothes. Tie back long hair as anything may catch in equipment. Also wear personal protective equipment – for eye protection and laboratory coat. Use long acid resistant rubber gloves and a facemask when handling acids.
8.We should not taste the chemicals nor eat or drink anything in the laboratory not even distilled water. A good practice is to

assume that everything in the laboratory is toxic.
9.Do not leave active experiments unattended. Never leave anything that is being heated or is visibly reacting unattended.
10. Keep your working place always clean. No unwanted chemicals should be placed there.
11.The mouth of test tube and ignition tube must not be facing you or your neighbor.
12.Never heat volatile liquids directly on flame. Never keep inflammable chemicals near flame.
13.Never handle hot items with bare hands. Use tongs, water baths.
14.Never put sodium metal in basin or water it will catch fire.
15.Acids like conc. sulphuric acid and poly phosphoric acids are dangerous as they are dehydrating agents. They will absorb moisture from skin and burn skin creating scars.
16. Before starting the experiment we should be well aware of the nature of the chemicals involved, hazards which can be caused by them and precautions to be taken while handling them.
17.All chemicals in the laboratory have a Material Safety Data Sheet (MSDS). Read the MSDS before using a chemical. The MSDS also indicates if any special handling of the chemical is required. For eg. when diluting acids, always add acid to water, the reverse may cause splattering of the acid because of the heat generated due to dilution.
18.Proper labeling should be done. All containers of the chemicals must be correctly & legibly labeled.
19.Use a chemical fume hood for experiments as directed by your supervisor so that any fire occurring is partially contained. Ensure that your face is not inside the fume hood window. Hoods should be for chemical use, and not for chemical storage.
20.Proper disposal of chemicals should be done. Organic chemicals should not be poured in the drain.
21.Ensure that the pH of inorganic chemicals is neutral before pouring them down the drain.
22. Wash your hands after removing gloves, before leaving the laboratory, and after handling a potentially hazardous material.

Laboratory Safety Practices: In case of Accidents
In chemical spills:

Spilling liquids and dropping glass beakers occurs when we do the things hastily. We should always proceed stepwise and steadily.

If chemical spills in eyes, use Eyewash fountain immediately. Use fresh water over eyes for several minutes. If you suffer a spill of a dangerous chemical, Safety shower should be used. In both the cases, after washing with water go to the health centre immediately.

In case of burns:

In case of fire, use Fire Extinguisher to extinguish fire. If you or anyone in laboratory suffers burns on whole body then stand under the safety shower. In case of severe burns, apply acriflavine emulsion. In case if burn is due to sodium metal, remove the metal piece. Wash the burnt part with water and then wash it with dil. Acetic acid solution.

Inhalation:

Accidentally inhaling gases can cause headaches, nausea, vomiting and even fainting. Open windows, use exhaust fans, when doing experiments involving fumes and gases. Go to open space if such feeling persists.

Broken Glass handling:

To avoid breakage always hold glass rod, thermometer in vertical position. Sweep up the broken glass immediately and carefully. Don't walk around on broken glass. Do not throw glass pieces in sink. Dispose the broken glassware in the cardboard carton.

Properly segregate and dispose of all laboratory waste. "Wash your hands" before and after interacting with any foreign substances, and also protect clothing and skin with lab. aprons, gloves, and/or glasses as needed. Leaving the laboratory without washing hands can result in contamination of desks or lunch tables, causing illness.

CONCLUSION:

• Awareness about the dangers of working in a chemistry laboratory should be raised.
• Safety protocols should never be neglected.
• Work culture should be developed such that researchers should consider safety foremost. Changing the culture is really going to be a long-term challenge.
• There is always a tension between research freedom and safe working conditions in academia. Research freedom at the cost of safety should be avoided. Working alone in the laboratories should be avoided.
• There is a need for flame-resistant lab coats.
• Specific safety-training should be given.

• Scientists should not wait for the changes from the regulatory board before taking the initiative on safety.
• Laboratory safety procedures should be followed by academic chemistry departments.
• The threat of legal action can be a powerful incentive for the change. Rapid toughening of safety policies should be done.
Protect yourself, others, your research, and the environment.

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