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INDIAN SAFETY ENGINEER

QUARTERLY JOURNAL OF SAFETY ENGINEERS ASSOCIATION
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FROM THE DESK OF PRESIDENT

Wish you all a Happy & Prosperous New Year!!

This is particularly relevant because the end of past year was not so good mainly for the people of Chennai. Chennai and other coastal districts of Tamil Nadu, Pondicherry and Andhra Pradesh have witnessed unprecedented rainfall and consequent floods during Nov / Dec 2015 and many areas have become inundated affecting lakhs of people, over and above hundreds of casualties. It is heartening to know that many of our members have extended voluntary services in rescue and rehabilitation measures provided in those areas. Let us all salute them and other voluntary agencies for their unstinted services and thank them abundantly.

Forty Second Professional Development Programme on "Process Hazard Analysis" was held by Mr. S. Govindarajan, a specialist in Process Safety on 27-12-2015. 81st Executive Committee meeting of SEA was held on 19th December 2015. Our quarterly journal "Indian Safety Engineer" and the monthly 'Safety Alerts' are brought out and distributed to Members periodically. We are trying to organize the next Factory visit programme shortly.

Mumbai Chapter of SEA has organized a Technical Meet programme during November 2015 which was attended by a large number of professionals. Their next technical meet programe is expected to be held during April/ May 2016. Coordinator for forming a SEA Chapter at Gujarat has given some positive indications and hopes on constituting the Chapter soon.

Students Chapter at Anna University, Chennai is active and most of the members participate in our Technical Meet programmes and get benefitted. As requested by them, guest lectures on select topics covering their semester syllabus have been delivered by experts from SEA.

NEBOSH, I G C course could be conducted only if more than fifteen candidates are enrolled as otherwise it is not economical. Hence SEA India members are requested to advice and encourage members to register with SEA India for this certificate course so that we can organize the next batch..

Safety Professionals Meet (SPM) for the year 2016 is planned to be held during June 2016 and it is also considered to provide opportunity for the members and other industry personnel to meet the Regulatory Authorities for Electrical and Boiler operations.

Soliciting members for their active participation and support to SEA activities.

Best Wishes and Seasons Greetings!

S. Ulaganathan
President, SEA (India)

Inside...

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MUMBAI CHAPTER TECHNICAL MEET

The Q4 2015 Technical meet of SEA members of Mumbai Chapter was conducted on 17.10.2015 at the Technical Center of Siemens TUV Rheinland Global Center for Occupational Safety Siemens, Kalwa, Thane. A total of 14 members attended this meet.

The members shared a presentation on the Technical centre and the safety equipment's available at this training facility. This was followed by a meeting wherein Mr. Murali presented the role and requirement of SEA for the benefit of existing and new members. The technical team of TUV Rheinland then gave a demonstration of all the training facilities and also briefed to the members on safety aspects. The meeting concluded with the vote of thanks by Mr. Bala.

42ND PROFESSIONAL DEVELOPMENT PROGRAMME

The 42nd Professional Development Programme was held on Sunday, 27th December, 2015 at Hotel Pratap Plaza, Chennai.

Mr S Govindarajan, B.Sc, AMIE, Safety Consultant delivered a Technical talk on **"Process Hazard Analysis".**

Large number of SEA India members and Invitees participated and enriched their knowledge.

Gist of the talk is available on page 15.

(Contd. on page 15)

WELDING FUME HEALTH EFFECTS - ACUTE AND CHRONIC

Acute Effects of Welding Fume Exposure

The most common acute effect of exposure to intense welding fume is called Metal Fume Fever with symptoms similar to the common flu: chills, low level fever, fatigue, nausea, sore throat, body aches and pains usually lasting 24 hours. Zinc, the coating used in galvanized metal, is often associated with Metal Fume Fever but most other forms of welding fume exposure have also been implicated.

Chronic Illnesses Attributable to Welding Including COPD

There is a variety of components of welded materials and welding methods that may have chronic detrimental effects, including permanent disability, to welders. They include Lead (Pb), Cadmium (Cd), Beryllium (Be), Mercury (Hg), fluorides from fluxes, Iron (Fe), Nickel (Ni), Copper (Cu), Aluminum (Al), and of course Carbon Monoxide (CO) and Carbon Dioxide (CO2).

Chronic effects of exposure to the variety of welding elements can take the form of many serious illnesses. This includes COPD (Chronic Obstructive Pulmonary Disease) COPD is either emphysema or chronic bronchitis. Studies have shown that chronic bronchitis (thus COPD) can be the result of work as a welder over a lengthy period of time. Prolonged exposure to both cadmium and beryllium fumes can cause severe lung complications and pulmonary edema. Long term exposure to mercury fumes is known to cause tremors, emotional problems, and hearing and vision loss. Exposure to lead oxide fumes can permanently damage several main body systems including the reproductive, circulatory and central nervous systems.

Within the last few years, it has been confirmed that exposure to hexavalent chromium (also referred to as "Hex Chrome" or "Chrome Six") from welding on stainless steel or chrome, is a cancer causing substance and specifically regulated by a separate OSHA Standard (29CFR1910. 1026). Manganese, a component of many forms of steel and welding rods, has been strongly implicated in causing Parkinson's-type tremors in welders who have used manganese containing welding rods.

In addition to the toxic effects of excessive exposures to each of these agents, there is the collective effect of exposure to all of the welding emissions which ultimately may result in contracting Chronic Obstructive Pulmonary Disease (COPD). The two most recognized components of COPD are Chronic Bronchitis and Emphysema. Most often, welders diagnosed with COPD have chronic bronchitis. (Of course, smoking history can have a significant effect on development and aggravation of COPD with the most likely effect being emphysema.)

How to Control Welding Fumes?

Logically, the most effective method of control of welding fumes is ventilation. And the most effective form of ventilation to control welding fumes to protect the individual welder is local exhaust ventilation-that is, capturing the welding fumes (the visible smoke) at the point of welding. Though effective in protecting the welder, this manner of ventilation control can be problematic to use because it can introduce oxygen into the area. Applying a strong air current across the point of the weld can cause oxidation, resulting in defective welds.

Further, welding inside a pipe, vessel or container requires a restricted air space that does not allow enough room for adequate ventilation. The inert gas shield around the weld must be preserved while attempting to capture the welding fume before it reaches the breathing zone of the welder or the general air space. Some effective local exhaust ventilation systems have been developed, but the application and control of air capture must be effective but not interfere with the inert gas shield. All this must occur in a work environment that is somewhat less than pristine-as is the case in most welding environments!

An alternative is the use of respiratory protection on the welder.

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Welding Fume....

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But respiratory protection for welders is the least effective means of controlling exposure, not just because the welder already must wear glasses, a hood, hard hat, leather apron, gloves, and safety shoes but because the variation in welding methods (MIG, TIG, STICK, ARC, TORCH) further exacerbates the ability to uniformly control each worker's exposure.

This is only a brief summary of the problems encountered during the process of protecting welders from fumes. Even if employers are in compliance with all PELs and TLVs for the individual welding components, workers are not necessarily safe from acquiring illnesses at their jobs.

Welding Fume Sampling

Monitoring welders to determine exposure is relatively easy. Small battery powered air samplers can be clipped to the welder's belt or apron with a sampling line to a collecting filter clipped to the collar or shield.

An industrial hygienist will use the Safety Data Sheet (SDS, formerly MSDS) of both the welding consumable and the metal surface that is cut or joined, to identify the components. Lab analysis of metals is achieved by Atomic Absorption (AA) or Inductively Coupled Plasma (ICP).

Using local exhaust ventilation systems are the most effective but they're also the most tricky to design so as to not interfere with the welding process. To get the exposure levels as low as you can, it's important to use controls that have been skillfully engineered to control the fumes for the specific welding method being used. It is also vital to monitor welders regularly to verify the effectiveness of the controls. ■

FIRE PREVENTION WEEK IN USA)

OCTOBER 4-10, 2015

Theme: "HEAR THE BEEP WHERE YOU SLEEP: EVERY BEDROOM NEEDS A WORKING SMOKE ALARM"

Every bedroom needs a working smoke alarm. If you didn't know that, you're not alone. An online questionnaire distributed by the National Fire Protection Association (NFPA) showed that less than half (42 percent) of approximately 36,000 respondents did not know that a smoke alarm should be installed in each bedroom of the home.

In an effort to better educate the public about this "sleepy" smoke alarm requirement, NFPA - the official sponsor of Fire Prevention Week for more than 90 years - today announced "Hear the Beep Where You Sleep: Every Bedroom Needs a Working Smoke Alarm" as the theme for this year's Fire Prevention Week campaign, October 4-10, 2015. NFPA 72, National Fire Alarm Code®, requires a smoke alarm in every bedroom, outside each sleeping area and on every level of the home.

About Fire Prevention Week

NFPA has been the official sponsor of Fire Prevention Week since 1922. According to the National Archives and Records Administration's Library Information Center, Fire Prevention Week is the longest running public health and safety observance on record. The President of the United States has signed a proclamation proclaiming a national observance during that week every year since 1925. Visit www.firepreventionweek.org for more safety information.

Kind Attention of Members....

Even after repeated reminders to UPDATE the Postal Address and PERSONAL E-MAIL ID's many members have not taken it seriously. **Since most of the companies do not entertain bulk E-mails you would not be able to view the SAFETY ALERTS & other communications sent by us.** Hence, SEA (India) members are once again requested to send their **current postal address** and **active Email ID (personal)** to us at the earliest to:

seaindiachennai@gmail.com / seaindiachennai@rediffmail.com

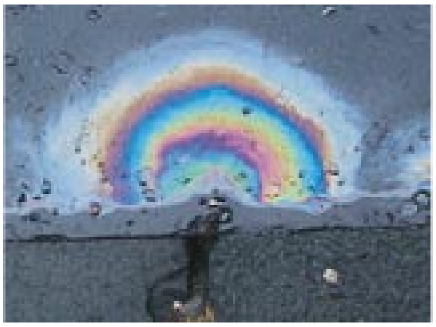
ENVIRONMENTAL IMPACT OF THE PETROLEUM INDUSTRY

The environmental impact of petroleum is often negative because it is toxic to almost all forms of life and its extraction fuels climate change. Petroleum, commonly referred to as oil, is closely linked to virtually all aspects of present society, especially for transportation and heating for both homes and for commercial and industrial activities.

A beach after an oil spill

Toxicity

Petroleum distillates can create a sheen on the surface of water as a thin layer creating an optical phenomena called interphase.



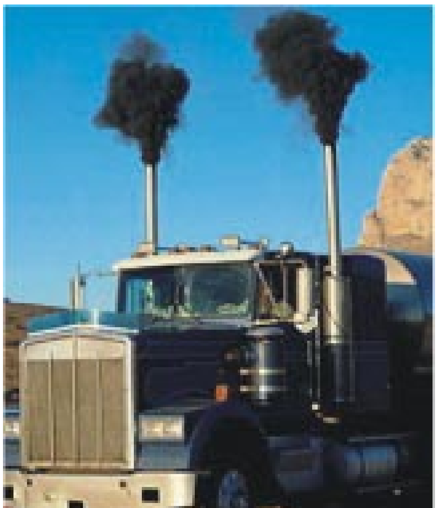
Petroleum distillates can create a sheen on the surface of water as a thin layer creating an optical phenomena called interphase

Crude oil is a mixture of many different kinds of organic compounds, many of which are highly toxic and cancer causing (carcinogenic). Oil is "acutely lethal" to fish - that is, it kills fish quickly, at a concentration of 4000 parts per million (ppm (0.4%). Crude oil and petroleum distillates cause birth defects.

Benzene is present in both crude oil and gasoline and is known to cause leukaemia in humans. The compound is also known to lower the white blood cell count in humans, which would leave people exposed to it more susceptible to infections. "Studies have linked benzene exposure in the mere parts per billion (ppb) range to terminal leukemia, Hodgkin's lymphoma, and other blood and immune system diseases within 5-15 years of exposure.

Exhaust

When oil or petroleum distillates are burned (see combustion), usually the combustion is not complete. This means that incompletely burned compounds are created in addition to just water and carbon dioxide. The other compounds are often toxic to life. Examples are carbon monoxide and methanol. Also, fine particulates of soot blacken humans' and other animals' lungs and cause heart problems or death. Soot is cancer causing (carcinogenic) material.



Petroleum diesel exhaust from a truck

Acid rain

High temperatures created by the combustion of petroleum cause nitrogen gas in the surrounding air to oxidize, creating nitrous oxides. Nitrous oxides, along with sulfur dioxide from the sulfur in the oil, combine with water in the atmosphere to create acid rain.

Trees killed by acid rain, an unwanted side effect of burning petroleum

Acid rain causes many problems such as dead trees and acidified lakes with dead fish. Coral reefs in the world's oceans are killed by acidic water caused by acid rain.

Acid rain leads to increased corrosion of machinery and structures (large amounts of capital), and to the slow destruction of archaeological structures like the marble ruins in Rome and Greece.

Climate change

Humans burning large amounts of petroleum create large amounts of CO_2 (carbon dioxide) gas that

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Environmental....
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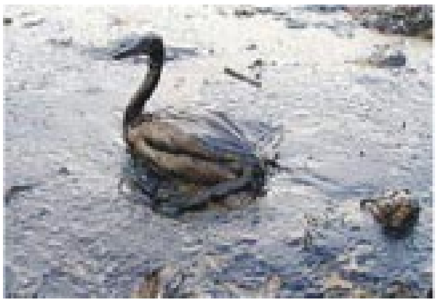
traps heat in the Earth's atmosphere.

Oil spills

An oil spill is the release of a liquid petroleum hydrocarbon into the environment, especially marine areas, due to human activity, and is a form of pollution. The term is usually applied to marine oil spills, where oil is released into the ocean



A bird covered in oil from the Black Sea oil spill.

or coastal waters, but spills may also occur on land. Oil spills may be due to releases of crude oil from tankers, pipelines, railcars, offshore platforms, drilling rigs and wells, as well as spills of refined petroleum products (such as gasoline, diesel) and their by-products, heavier fuels used by large ships such asbunker fuel, or the spill of any oily refuse or waste oil.

Major oil spills include the Kuwaiti oil fires, Kuwaiti oil lakes, Lakeview Gusher, Gulf War oil spill, and the Deepwater Horizon oil spill. Spilt oil penetrates into the structure of the plumage of birds and the fur of mammals, reducing its insulating ability, and making them more vulnerable to temperature fluctuations and much less buoyant in the water. Cleanup and recovery from an oil spill is difficult and depends upon many factors, including the type of oil spilled, the temperature of the water (affecting evaporation and biodegradation), and the types of shorelines and beaches involved. Spills may take weeks, months or even years to clean up.

Volatile organic compounds

Volatile organic compounds (VOCs) are gases or vapours emitted by various solids and liquids, many of which have short- and long-term adverse effects on human health and the environment. VOCs from petroleum are toxic and foul the air, and some like benzene are extremely toxic, carcinogenic and cause DNA damage. Benzene often makes up about 1% of crude oil and gasoline. Benzene is present in automobile exhaust. More important for vapors from spills of diesel and crude oil are aliphatic, volatile compounds. Although "less toxic" than compounds like benzene, their overwhelming abundance can still cause health concerns even when benzene levels in the air are relatively low. The compounds are sometimes collectively measured as "Total Petroleum Hydrocarbons" (TPH). Petroleum hydrocarbons such as gasoline, diesel, or jet fuel intruding into indoor spaces from underground storage tanks or brownfields threaten safety (e.g., explosive potential) and causes adverse health effects from inhalation.

Waste oil in the form of motor oil

Waste oil

Waste oil contains not only breakdown products but also impurities from use. Some examples of waste oil used are hydraulic oil, transmission oil, brake fluids, motor oil, crankcase oil, gear box oil and synthetic oil. Many of the problems associated with natural petroleum exist with waste oil. When waste oil from vehicles drips out of engines over streets and roads, the oil travels into the water table bringing with it such toxins as benzene. This poisons both soil and drinking water. Runoff from storms carries waste oil into rivers and oceans, poisoning them as well.

Source: WIKIPAEDIA

Mitigation

Conservation and phasing out

- Creating laws to completely phase out the use of petroleum.
- Making use of petroleum more efficiently via better technology.

Substitution of other energy sources

- Using “cleaner” energy sources such as natural gas and biodiesel, especially in critical areas like cities where there are people.

Use of biomass instead of petroleum

- It is suggested that cellulose from fibrous plant material, such as hemp, can be used to produce alternatives to many oil-based products.
- Plastics can be created from cellulose instead of from oil.
- Lubricants like motor oil and grease can be made from plants and animal fat.

Safety measures

- Decreasing the risk of spills
- False floors at gasoline stations to catch gasoline and oil drips from making it into the water table ■

HAVE A SEDENTARY JOB? DON'T SIT ON IT, STAND UP

If you sit all day at work, you may want to pay attention to the first-ever United Kingdom guidelines designed to curb health risks of too much cumulative sitting time.

The guidelines, prepared by a panel of international experts, recommend at least two hours of light activity and standing during working hours for all office workers whose jobs are predominantly desk based.

The experts claim that minor changes in lifestyle can help prevent a host of non-communicable diseases (NCDs), chiefly diabetes and cardiovascular diseases, which are affecting younger people. "Regularly breaking up seated-based work with standing-based work is likely to be more achievable than targeted exercise," the guideline, published online in the British Journal of Sports Medicine, states.

It adds that employers should encourage staff to embrace other healthy behaviour, such as cutting down on drinking and smoking, eat ing a nutritious diet, and alleviating stress.

Dr Vijay Viswanathan of MV Hospital for Diabetes says the problem of NCD is turning into a health and economic crisis. "Due to current lifestyles, people in their 20s and 30s are suffering from diabetes and hypertension, which were generally observed in people aged over 50. These youngsters are usually off their beds and off to work, where they stay seated most of the time," he says.

"Offices must introduce workouts to their sedentary lifestyles. Besides, their work should, as much as possible, entail moving about for basic communications rather than messages and emails," he adds.

Even a leisurely walk can help you burn more calories and may lead to weight loss and increased energy , doctors say.

They add that being seated for long hours leads to obesity and it also affects the bowel movement.

The incidence of heart attack among the youth has also gone up. "Earlier, heart attacks were common among people aged between 50 and 60. Today we have patients aged between 20 and 25 who suffer from cardiac arrest and coronary heart disease" says Suresh Rao, head of the department of cardiac critical care at Fortis Malar.

Experts say, when we sit for long hours without a break our muscles burn less fat and blood flows more sluggishly . This leads to clogging of the heart by fatty acids.

"People with the most sedentary lifestyle are twice at risk to have cardio-vascular diseases than the physically active ones," says a senior doctor.

He adds that lifestyle changes such as regular exercise, controlling obesity , reducing smoking and alcohol consumption can help delay onset of heart disease.

A review of data from the American Cancer Society's Cancer Prevention Study II (CPS-II) concludes that sitting for six or more hours daily can elevate the chances of cancer and other major diseases even if one maintains a healthy weight. ■

National Pollution Control Day 2015

The National Pollution Control Day is celebrated every year on 2nd of December in India in order to give the honor and memorialize the thousands of human beings who had lost their existence because of the Bhopal gas calamity.

Kindly share information about types of pollution, about reduction, laws, local issues and finding solution from students. Promote ecofriendly practices like ban of polythene, use of cycle or by walk, plantation, water conservation practices.

For further details visit: **indiacelebrating.com**

HYDROGEN SULFIDE IN INDUSTRY

Every year, workers are accidentally exposed to unsafe levels of hydrogen sulfide (H_2S), also called sour gas, sewer gas, stink damp, and hydrosulphuric acid. H_2Scan be deadly; too much of the gas can kill a worker in a few seconds. This document describes the dangers of H_2Sin the workplace, and how to avoid them. It also explains how to recognize and prevent H_2Spoisoning, and the type of first aid to give to people overcome by the gas.

What is hydrogen sulfide?

H_2S is a very toxic gas. It has no colour, but it smells like rotten eggs. In larger amounts, H_2S quickly blocks the sense of smell. That is why odour should never be used to rate H_2S levels.

The gas can irritate the eyes, nose, throat, and lungs.

Too much H_2S can halt the breathing centre in the brain, which can cause death. It may be possible to revive the victim, but only if first aid is given right away.

H_2S dissolves in water and oil, and it may be released when these liquids are heated, depressurized, or agitated.

Because H_2S is heavier than air, it may settle in low spots. This can pose risks when entering areas where the gas may be present.

H_2S burns and explodes easily. When it burns, H_2S gives off sulphur dioxide, another dangerous gas that is toxic, strong smelling, and irritating.

Where is H_2S found?

H_2S is often found in oil and natural gas deposits, and in some mineral rock. It may also form when organic material such as manure or vegetable matter breaks down without oxygen. This may happen, for example, with sewage in a septic tank. H_2S is often a by-product in the making of pulp and paper, fertilizers, glues, dyes, plastic wrap, and other products.

Workers are likely to find H_2S in:

- The pulp and paper industry, where H_2S is a by.product of wood breaking down into pulp
- The petroleum industry, especially at oil and natural gas wells; in refineries, where H_2S is removed from natural gas and oil; and in pipelines used to carry unrefined petroleum
- The construction industry, where H_2S could be released during excavation work in swamps or old landfills.
- Sewers, sewage treatment plants, manure tanks, and other places where organic material breaks down without oxygen
- Iron smelters, coke ovens, and other places where H_2S may be a by-product
- In some mines and tunnels where mineral rock may contain H_2S

H_2S warning signs

With high levels of H_2S, poisoning can be swift and deadly – with little warning. A worker who is not wearing protective equipment may pass out quickly. The body may tremble, and death may follow in seconds or minutes as a result of breathing failure.

At lower levels of the gas, the following symptoms may appear a few minutes after exposure, or be delayed for several hours:

- *Eye irritation* – soreness, light sensitivity, seeing "rainbows" around bright lights, or a gritty pain with a spasm of the eyelids known as "gas eye"
- *Breathing irritation* – sore nasal passages; sore throat; a tight, burning feeling in the chest; or fluid buildup in the lungs
- *Other symptoms* – headache, confusion, nausea, disorientation, or vomiting

The following table describes the symptoms that may occur at specific H_2S levels.

H_2S warning signs

Concentration in parts per million (ppm)*	Observations and health effects
Less than 1	Most people smell "rotten eggs."
3 to 5	Odour is strong.
20 to 150	Nose and throat feel dry and irritated. Eyes sting, itch, or water; and "gas eye" symptoms may occur. Prolonged exposure may cause coughing, hoarseness, shortness of breath, and runny nose.
150 to 200	Sense of smell is blocked (olfactory fatigue).
200 to 250	Major irritation of the nose, throat, and lungs occurs, along with headache, nausea, vomiting, and dizziness. Prolonged exposure can cause fluid buildup in the lungs (pulmonary edema), which can be fatal.
300 to 500	Symptoms are the same as above, but more severe. Death can occur within 1 to 4 hours of exposure.
Above 500	Immediate loss of consciousness. Death is rapid, sometimes immediate.

* 1 ppm = 1 part of gas per million parts of air by volume

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Hydrogen Sulphide....

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H_2S levels of 100 ppm and higher are considered immediately dangerous to life and health (IDLH). The Short Term Exposure Limit (STEL) is 15 ppm as per statutes.

Besides its poor warning properties, H_2S is so dangerous because the level that can kill is much lower than that of many other toxic gases. That is why workers must be very careful when they encounter H_2S.

Workers usually recover quickly and completely from minor symptoms of H_2S poisoning. In fact, low doses of the gas (for example, less than 10 ppm) have not been shown to cause lasting harm. H_2S is not known to cause cancer.

Detecting hydrogen sulfide

As a rule, if you smell H_2S, and don't know how much of the gas is in the air, leave the area right away. Return only when the amount of the gas has been measured and found to be at a safe level.

Never use odour to assess H_2S levels. Tools for measuring H_2S levels include the following:

- *Gas detector tubes* — These clear tubes are about the size and shape of a ballpoint pen, and can be read much like a thermometer. The tube contains a material that may change colour when it reacts with air drawn through it by a small hand pump. The amount of colour change depends on the H_2S level.
- *Passive dosimeters and badges* — These monitors range in size from a watch to slightly larger than a credit card. They can be worn like a badge or placed in a specific location. They contain a material that reacts with the gas in the air to produce a colour change. The colour changes over time to show the total H_2S exposure of workers over a specified time period.
- *Electronic detectors* — These range from small personal samplers to large, stationary monitors. A display screen shows the gas level. When H_2S levels exceed a set limit, these detectors sound an alarm, flash a light, or vibrate.

H_2S incident

An oil worker operating a valve collapsed when exposed to H_2S. The foreman tried to rescue him and was overcome, as was a third rescue worker. Neither of the would-be rescuers had gas monitors or wore respiratory protection. Remaining crew members wearing self-contained breathing apparatus finally removed the injured workers from the area. The third worker was revived, but the first worker and the foreman died.

Exposure limit

Employers must ensure workers are not exposed to H_2S levels above the occupational exposure limit (OEL). The OEL is the level of an airborne substance that workers may be exposed to without wearing protective equipment, and without normally suffering adverse health effects.

The OEL for H_2S is a Ceiling Limit (not to be exceeded) of 10 ppm. At levels above this ceiling, only workers who are trained in the hazards of H_2S and are wearing required protective equipment may enter the work area. If an H_2S leak occurs, the area must be evacuated; only workers wearing appropriate protective equipment may enter to correct the problem.

Employer Responsibilities

Employers must develop and implement an effective exposure control plan (ECP), which includes training workers and supervisors in relevant sections of the plan.

An effective ECP for any workplace where workers are exposed to H_2S must include:

- A written policy that:
  - States the employer's commitment to health and safety
  - States the plan's objectives
  - Defines the responsibilities and roles of the employer, supervisors, and workers
- An assessment of the workplace hazards (for example, where workers are likely to be exposed to H_2S)
- Controls used to reduce the hazards (for example, ventilation, barriers, or personal protective equipment)
- Written safe work procedures and emergency response procedures (for example, rescue procedures)
- Monitoring for H_2S (for example, when, where, and how monitoring devices such as dosimeters or personal monitors will be used in the workplace)
- Training for supervisors and workers
- Records and statistics (for example, first aid records for workers "knocked down" by H_2S)

Worker Responsibilities

Workers also have responsibilities to help reduce the risk of exposure to H_2S. Workers (including subcontractors) must:

- Attend education and training sessions provided by the employer
- Use controls and follow safe work practices outlined in the ECP
- Use available personal protective equipment (for example, self-contained breathing apparatus) and personal monitors, as required
- Know how to report exposure incidents

Breathing Protection

In areas with high H_2S levels or where an H_2S leak has occurred,

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Hydrogen Sulphide....

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workers must wear one of the following two types of breathing protection:

- *Positive-pressure, self-contained breathing apparatus (SCBA)* — This consists of an air cylinder, which is normally worn on the back, and a full-face mask to protect the eyes and face. A hose connects the face mask to the regulator and the air cylinder. "Positive pressure" means that the air pressure in the mask is higher than the air pressure outside the mask. This reduces the chance of toxic gases entering the face piece.
- *Positive-pressure, supplied-air (airline) respirator* — This consists of an airline attached to a regulator and a full-face mask. The worker must also wear an "escape" air bottle to allow escape if the air supply is cut off.

Workers who use respirators must be clean shaven where the respirator seals with the face. This helps provide a good seal that keeps harmful gases out.

Air-purifying respirators (APRs) should not be used where H_2S levels are above the 10 ppm Ceiling Limit. These respirators — when fitted with the appropriate acid-gas cartridges — may be used for escape only.

The protection factor of APRs, with the proper filter cartridges, can approach or exceed the IDLH for H_2S (100 ppm). Concentrations above the IDLH can quickly block a worker's sense of smell, so the worker would not be able to smell the gas if it seeped in around the respirator seal or penetrated through the filters. If APRs are used, the employer must guarantee that the H_2S levels will not approach the IDLH. Other workplace requirements (e.g., specific employer- or industry-related restrictions) may prohibit the use of APRs with H_2S.

At sites with a high risk of exposure, workers must have easy access to escape respirators, or must carry them while working. An SCBA must be used for escape where workers might have to flee from high H_2S levels or over long distances where escape air-purifying respirators would not provide enough protection.

First aid and rescue

If H_2S causes the eyes to sting, itch, or water, see the first aid attendant. Flush the eyes with lukewarm water immediately, for at least 30 minutes. If the eyes keep itching, see a doctor as soon as possible.

If a worker is overcome by H_2S:

- To attempt a rescue in an area with high H_2S levels, wear only a positive-pressure, self-contained breathing apparatus (SCBA), or a full-face, supplied air (airline) respirator with an "escape" air bottle.
- Move the worker to fresh air and give oxygen, if available.
- If the worker is having trouble breathing or is not breathing, start assisted ventilation using a pocket mask, and add oxygen to the mask if available. If the worker has no pulse, begin cardiopulmonary resuscitation (CPR). Because the body rids itself of H_2S if removed from the exposure, it is critical to

continue to give the worker assisted ventilation with oxygen until medical aid arrives.

Transport the worker to the nearest hospital as soon as possible.

H_2S incident

Workers complained of a rotten-egg smell, dizziness, and nausea while working in an excavation along the waterfront. H_2S had been released when workers drilled anchor holes in the excavation. The gas concentration was as high as 100 ppm (IDLH) near the holes.

H_2S risk factors

The following factors may increase the risk of workers being exposed to unsafe levels of H_2S:

- *Confined spaces* — Workers who enter a confined space such as a sewer or tank could be overcome by H_2S.
- *Smoking and other ignition sources* — H_2S explodes easily near lit matches, cigarettes, pipes, and other sources of spark or intense heat. The gas can explode when its concentration in the air ranges from about 4% (40,000 ppm) to 46% (460,000 ppm).
- *Worker attitude* — Workers are more likely to be harmed if they don't know the hazards of H_2S, or if they're so used to working with H_2S they become lax about safety.
- *Still air* — The gas can build up to unsafe levels if there is no breeze or air movement.
- *Contact lenses* — Workers who are exposed to H_2S should be aware that wearing soft contact lenses may pose a risk. Soft contact lenses may absorb irritants and hold irritants such as H_2S against the eye.

Reducing the H_2S risk

The risk of unsafe levels of H_2S can be reduced with the following controls:

- *Engineering* — Where practical, install effective exhaust ventilation.
- *Isolation controls* — Isolate workers from dangerous work areas.
- *Regular maintenance* — To lessen the risk of leaks, regularly check pipes, valves, tanks, and containers of dangerous gases and liquids.
- *Education* — Workers must be taught how to prevent and recognize H_2S poisoning, and how to give first aid to those overcome

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PLASTIC RECYCLING

Plastic recycling is the process of recovering scrap or waste plastic and reprocessing the material into useful products, sometimes completely different in form, from their original state. Since plastic is non- biodegradable, recycling it is a part of global efforts to reduce plastic in the waste stream, especially the approximately eight million metric tonnes of waste plastic that enter the earth's ocean every year. This helps to reduce the high rates of plastic pollution.

Plastic recycling includes melting down soft drink bottles and then casting them as plastic chairs and tables. However, this kind of "recycling" is rather a misnomer since plastic beverage bottles (soda, juice, milk) are never truly reformed into new beverage bottles, as this requires virgin plastic. So there is actually no true cycle in the "recycling" of plastic beverage containers, which more precisely should be referred to as "downcycling". Plastics are also recycled during the manufacturing process of plastic goods such as polyethylene film and bags. A percentage of the recycled pellets are then re-introduced into the main production operation. This closed-loop operation has taken place since the 1970s and has made the production of some plastic products amongst the most efficient operations today.

Compared with lucrative recycling of metal, and similar to the low value of glass, plastic polymers recycling is often more challenging because of low density and low value. There are also numerous technical hurdles to overcome when recycling plastic.

A macro molecule interacts with its environment along its entire length, so total energy involved in mixing it is largely due to the product side stoichiometry . Heating alone is not enough to dissolve such a large molecule, so plastics must often be of nearly identical composition to mix efficiently.

When different types of plastics are melted together, they tend to phase-separate, like oil and water, and set in these layers. The phase boundaries cause structural weakness in the resulting material, meaning that polymer blends are useful in only limited applications.

Another barrier to recycling is the widespread use of dyes, fillers, and other additives in plastics. The polymer is generally too viscous to economically remove fillers, and would be damaged by many of the processes that could cheaply remove the added dyes. Additives are less widely used in beverage

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Hydrogen Sulphide....

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by the gas. Workers must be taught — and practice — how to use protective breathing equipment.

- *Monitoring* — H_2S levels must be monitored where there is a risk of H_2S exposure.
- *Labelling and posting* — Where H_2S is used, collected, or produced, all piping and valves that carry the gas must be clearly identified. Workers must also have easy access to the material safety data sheet (MSDS) for H_2S. Wherever an H_2S leak or buildup is possible, warning signs bearing "Hydrogen Sulfide" plus precautions must be posted just outside or at the entrances to the area.

H_2S incident

Two workers were asked to investigate an H_2S leak of unknown origin or strength in a "suspect" building. Without respiratory protection, the workers entered the building to conduct air quality tests.

One worker's personal H_2S alarm went off at the entrance to the building, and both workers left the area. One worker returned with a monitor on a broom handle and measured 250 ppm H_2S (more than twice the IDLH) in the problem area. Both workers sought medical attention.

- *Emergency plans* — Where H_2S is used, employers must train workers in H_2S hazards, emergency procedures, escape routes, and the location of emergency equipment and safe areas.
- *Confined space precautions* — Confined spaces must be tested, ventilated, and confirmed safe before workers enter them.
- *Proper storage* — Keep cylinders containing H_2S clean, isolated, shaded, and in a ventilated area. In case of fire, remove the cylinders (if it is safe to do so) and cool with water. ■

Plastic Recycling....

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containers and plastic bags, allowing them to be recycled more often. Yet another barrier to removing large quantities of plastic from the waste stream and landfills is the fact that many common but small plastic items lack the universal triangle recycling symbol and accompanying number. An example is the billions of plastic utensils commonly distributed at fast food restaurants or sold for use at picnics.

The percentage of plastic that can be fully recycled, rather than downcycled or go to waste can be increased when manufacturers of packaged goods minimize mixing of packaging materials and eliminate contaminants. The Association of Plastics Recyclers have issued a Design Guide for Recyclability.

Processes

Before recycling, most plastics are sorted according to their resin type. In the past, plastic reclaimers used the resin identification code (RIC), a method of categorization of polymer types, which was developed by the Society of the Plastics Industry in 1988. Polyethylene terephthalate, commonly referred to as PET, for instance, has a resin code of 1. Most plastic reclaimers do not rely on the RIC now; they use automatic sort systems to identify the resin. Ranging from manual sorting and picking of plastic materials; to mechanized automation processes that involve shredding, sieving, separation by rates of density i.e. air, liquid, or magnetic, and complex spectrophotometric distribution technologies e.g. UV/VIS, NIR, Laser, etc. Some plastic products are also separated by color before they are recycled. The plastic recyclables are then shredded. These shredded fragments then undergo processes to eliminate impurities like paper labels. This material is melted and often extruded into the form of pellets which are then used to manufacture other products.

Thermal depolymerization

Another process involves the conversion of assorted polymers into petroleum by a much less precise thermal depolymerization process. Such a process would be able to accept almost any polymer or mix of polymers, including thermoset materials such as vulcanized rubber tire separation of wastes and the biopolymers in feathers and other agricultural waste. Like natural petroleum, the chemicals produced can be made into fuels as well as polymers. A pilot plant of this type exists in Carthage, Missouri, United States, using turkey waste as input material. Gasification is a similar process, but is not technically recycling, since polymers are not likely to become the result.

Heat compression

Yet another process that is gaining ground with startup companies (especially in Australia, United States and Japan) is heat compression. The heat compression process takes all unsorted, cleaned plastic in all forms, from soft plastic bags to hard industrial waste, and mixes the load in tumblers (large rotating drums resembling giant clothes dryers). The most obvious benefit to this method is the fact that all plastic is recyclable, not just matching forms. However, criticism rises from the energy costs of rotating the drums, and heating the post-melt pipes.

Distributed Recycling

For some waste plastics, recent technical devices called recyclebots enable a form of distributed recycling. Preliminary life-cycle analysis (LCA) indicates that such distributed recycling of HDPE to make filament of 3-D printers in rural regions is energetically favorable to either using virgin resin or conventional recycling processes because of reductions in transportation energy.

Other processes

A process has also been developed in which many kinds of plastic can be used as a carbon source in the recycling of scrap steel. There is also a possibility of mixed recycling of different plastics, which does not require their separation. It is called Compatibilization and requires use of special chemical bridging agents compatibilizers. It can help to keep the quality of recycled material and to skip often expensive and inefficient preliminary scanning of waste plastics streams and their separation/purification. ■

CASE STUDY

Pollution from Production Operations due to Improper Diversion of Production Flow and Rupture Disc Failure

During the night shift, the platform operator discovered that the fire deluge system had been activated, the platform had shut in, the platform flare was no longer burning, and there was oil on the flare boom and the side of the platform. The operator, who was the only person on board at the time, began responding to the situation, called to shore for assistance, and notified oil spill response and cleanup personnel. As a result of the incident, more than 35 barrels of oil was released into the ocean, most of which was recovered. No oil reached the nearby shoreline and there were no reported impacts to wildlife.

The Safety Department completed a panel investigation into the incident. The investigation concluded that the platform shut-in resulted in the shutdown of the shipping pumps and activation of the platform deluge system. Because the sump and surge tank pumps continued to run, the rupture of the pressure safety element (PSE) in the piping from the surge tank combined with improper routing of piping from the flare header allowed water and hydrocarbons to be released from flare boom.

Although the initial cause of the process upset that led to the platform shut-in was unable to be conclusively determined, the findings of the investigation identified the following causes of the spill:

- Flow from the flare header, which was normally routed to a settling tank that served as the flare scrubber, had been diverted to the disposal tube because the settling tank was out of service for repair. No alternate scrubbing vessel was provided as required by the regulations and approvals related to the settling tank repair. This allowed flow from the sump and surge tanks to migrate from the flare header to the disposal tube, then out of the flare boom into the ocean.

- The rupture of the PSE in the piping from the surge tank allowed the release of liquid hydrocarbons into the flare header. Based on the production volumes and normal operating pressure, it is believed that the PSE failed at a pressure well below its rated pressure. A laboratory analysis of the ruptured PSE (pictured above) indicated corrosion pitting, fatigue, and brittle cracking. There was no documentation indicating when the PSE was installed or when, if ever, it had been replaced. It is possible that the PSE had been in service for more than 20 years.

The panel investigation also identified the following causes that contributed to the severity of the incident:

- The audible alarm designed to alert platform personnel of process upset conditions failed to sound. In addition, the alarm panel providing a visual alert to the situation was located in a room separate from the production office. As a result, the platform shut-in and the release of fluids overboard was not discovered until the operator left the production office to make a routine check of the platform -- approximately 2 hours after the platform shutin.
- The platform operator was not aware that the surge and sump pumps needed to be shut down manually after a platform shut-in. As a result, these pumps continued to run for approximately 5 hours after the initial platform shut-in, circulating the influx of deluge water and existing production fluids to the surge tank, until additional personnel arrived on the platform to assist with the response.

Based on the investigation findings, Safety Department recommends that operators review their Safety and Environmental Management System plans to ensure that:

- Platform piping, safety devices, and shutdown systems are designed and maintained to handle anticipated process upset conditions.
- Management of Change procedures are adequate to identify and implement new or modified measures needed to ensure the integrity of the production process when equipment is removed for repair.
- Maintenance, testing, and documentation procedures of PSEs and other safety devices are adequate to ensure those devices will perform as intended. Operators should check the status and condition of any PSEs or similar devices in use in their production systems. Operators should be especially aware of the age of such discs as well as the working conditions that the discs are subjected to, which may result in fatiguing or failure. The rupture disc marking identification tags should be attached and legible. Operators should inspect rupture discs for damage or pre-existing flaws before installing replacements.
- Maintenance and testing procedures are adequate to ensure that audible alarms will function as intended.
- Visual alarms are designed and installed so that platform personnel are alerted to process upset conditions in a timely manner.
- Training programs are adequate to ensure that personnel can respond effectively to anticipated process upset conditions. ■

IN THE NEWS

Experts Stress Industry Safety in meet

Experts spoke about the importance of industrial safety at a workshop organised by the Environment, Health and Safety (EHS) cell of the Chamber of Marathwada Industries and Agriculture (CMIA) .

“Unsafe working conditions are among the biggest causes of accidents. These are associated with detective plants, tools, equipments, machines, and materials. Such causes are known as technical causes. They arise when there are improperly guarded or defective equipments, faulty layouts and plant location, inadequate lighting arrangements and ventilation, unsafe storage, inadequate safety devices and others.”

Psychological reasons such as working overtime, monotony, fatigue, exhaustion, frustration and anxiety are also some other causes that cause accidents. Safety experts have identified that there are some high-danger zones in an industry. These are, for example, hand-lift trucks, wheelbarrows, gears and pulleys, saws and hand rails, chisels and screw drivers, electric drop lights and others, where about one-third of industrial accidents occur.

Industrial accidents happen due to certain actions by workers. These actions may be the result of lack of knowledge or skill on the part of the worker, certain bodily defects and wrong attitude.

The workshop also highlighted key topics such as direct and indirect impact of accidents, methods of accident investigation, techniques for prevention and case studies. The ever increasing mechanisation, electrification, chemicalisation and sophistication have made industrial jobs more and more complex and intricate. This has led to increased dangers to human life in industries through accidents and injuries.

Economic and Social Councils adopt declaration to promote workplace compliance

Representatives from Economic and Social Councils and other Similar Institutions (ESC-SIs) have adopted a Declaration in order to promote workplace compliance, including in global supply chains (GSCs).

After reiterating the importance of the Fundamental Principles on which the ILO was founded, ESCs have, among other commitments, affirmed to:

- Reinforce their actions at national level on this important matter;
- Further engage in the national debate on promoting workplace compliance including in-global supply chains;
- Mobilize all available resources towards addressing the issue of workplace compliance;
- Enhance the role and capacity of their members especially the social partners;
- Cooperate with enforcement agencies and national and international organisations of employers and workers to strengthen their role and capacity to promote workplace compliance.

For its part, the ESC global body, the International Association of Economic and Social Councils and Similar Institutions (AICESIS) , proposed to facilitate exchanges of information and good practices between national bodies, follow up with specific initiatives to reinforce ESC-SIs capacity at the country level and document effective cooperation between ESC's and labour law enforcement institutions.

PROCESS HAZARDS ANALYSIS

Gist of the Talk of Professional Development Programme held on 27th December, 2015

An overview of Process Hazards Analysis (PHA) is presented below. It answers questions as to what is PHA, why PHA is needed, how to do it, and the benefits of doing it.

Any industrial process used for manufacturing products uses raw materials and intermediate products to produce the final finished product. At the various stages of production, there are hazards inherent, which, if not properly understood and controlled could lead to unwanted consequences like- fatalities, damage to property, and environmental impact. The main purpose of an industrial activity being production, sales and making profits to benefit the shareholders. Hence any unwanted consequence will lead to loss of production and profits. It becomes essential then; to understand the hazards and risks should something go wrong. PHA is a tool that will help in understanding the hazards and the risk should unwanted event occur and help to eliminate the hazards if possible or control them at an acceptable level before something could go wrong.

Manufacturing activities in metal fabrication, for instance, have lesser hazards and low probability of something going wrong in a serious manner. However manufacturing chemical products involves use of many toxic and flammable chemicals in large quantities, subjecting them to high temperatures, high pressures. In many cases the reactions could lead to "Run Away " conditions which could not be controlled in time. These conditions have resulted in many major incidents resulting in deaths and destruction of assets. Flixborough, Bhopal, Piper Alpha, Philips Petroleum are some of the well known and studied incidents. The website of Chemical Safety Board of America catalogues many such incidents with detailed analysis of what went wrong and why.

PHA is a synthetic exercise which helps in identifying the hazards, the consequences and the risks before something could go wrong. It uses a structured methodology. Various stages of PHA are: Hazard identification, estimating the probability of occurrence of major incident, quantifying the consequences of an event should something occur, and the resulting risk and loss of lives and property. For doing this, many well known methods, and empirical equations are used. This method is being used increasingly especially in Chemical, petrochemical, Pharmaceutical industries which has helped in reducing number of incidents and limiting the impacts to an acceptable level.

Hazard Identification: A common misconception is that all hazards is easily visible, or could be easily identified. However many of the hazards are inherent in many chemicals and are not externally visible. Many hazards do arise because of reaction with other chemicals or due to conditions under which they are processed. Many of the effects in incidents are due to these reasons. The first step in PHA and the important step is to identify what can go wrong. There are many methods available for identification. The oft used methods are: What-If analysis, Failure mode and effect analysis and Hazard and operability study. In What If analysis questions are raised asking What If something does not happen as planned or as expected. The reason for such occurrence is identified and built in protections are evaluated and residual risk is calculated. If residual risk is unacceptable then methods or protections are added to reduce the risk. In Failure Mode and Effect Analysis the same process is followed but the focus is on equipment failure. In Hazard and Operability study a set of questions are asked for every step in operation and hazards are identified. The questions are same for every step in process. This is the most popular method commonly used. However this requires training in the use of this method and also updated technical documents like P&Id's. This method also requires a trained team and it is time consuming.

Probability Identification: Having identified the hazards in the previous step, the next step is to evaluate the probability of such hazard becoming real. This is a difficult task and requires lot of data. There is one mathematical method known as Fault tree analysis (FTA). However this is a time consuming process. Another method generally adopted is to get failure data and probability from international data banks.

Consequence analysis: Once failure probability is estimated then the next step is to estimate the effects and consequence of such an event. This requires many inputs such as the property of the chemical, quantity of material involved, rate of release to atmosphere, atmospheric conditions etc. Altogether nearly 15 parameters are required. Once these are gathered and then there are mathematical software available wherein these data are entered and consequences and the impact distances are plotted on the site plan. While there are commercial software available for this, a free to use software called ALOHA published by EPA of USA can also used.

Final step is to calculate the risk. Risk is a number arrived at by multiplying probability or frequency of occurrence with consequence. Consequence is generally number of deaths likely in the area impacted.

This is the result that will tell the management of any company whether they are operating the production process with acceptable risk or whether the risk is unacceptable. Risk acceptance varies from organization to organization and from country to country.

An attempt has been made give an overview of the PHA method in the foregoing paragraphs. Intensive training is required to understand and practice this useful method. ■

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