SEA (INDIA)
(Regn No: 1391 / 2000)
[Registered under Societies Act, 1975]

INDIAN SAFETY ENGINEER

QUARTERLY JOURNAL OF SAFETY ENGINEERS ASSOCIATION

Block III, Flat No. 28, Maanasarovar Apartments, 11-A, Arcot Road, Chennai – 600 116.

Tel : 044-24764101 E-mail: info@seaindia.org Website: **www.seaindia.org**

VOL: 11 No. 3 **JULY – SEPTEMBER 2012**

31st PROFESSIONAL DEVELOPMENT PROGRAM

31st Professional Development Program was held on Sunday, 29th July 2012 at Chennai.

Mr G N Venkata Subramaniam, Executive Director, Sri Ram Safety Management Services (P) Ltd, Chennai delivered a talk on "Fire Safety Standards and Requirements in High Rise Buildings". Large number of SEA members participated and enriched their knowledge.

The salient topics discussed in the program is given in this article for the sake of SEA India members who could not attend the program.

The requirements of the fire protection for the multi-storied buildings (high rise buildings) and the buildings, which are of 15 m. and above in height and categories such as Assembly, Institutional, Educational, commercial complexes like Malls, IT Parks Office Buildings, Hotels, Hospitals & Nursing Homes, are clearly specified in the National Building Code.

The emphasis is on The Safety of the Buildings and occupants with particular reference to a fire accident.

The code specifies all precautions to be taken to prevent a fire – like Fire Alarm systems, smoke detectors and other such gadgets.

In the unfortunate event of a fire the provisions are clearly specified for rescue of residents/occupants of the buildings.

(Contd. on next page)

Inside....

Printed at Sunitha Printers, Chennai – 600 014

NEBOSH Course Update

SEA India has renewed the MOU with Sri Ramachandra University till March 2013 to conduct the NEBOSH classes in their premises. It has been proposed to have the next contact classes from 8th to 18th of October 2012. This time On demand (Special Exam) will be conducted on 20th & 21st of October 2012 at S R U premises and the candidates will be permitted to have the I G C 3, practical examination in their own premises within a specified time.

Admission for the October 2012 batch has been completed and all arrangements have been made for the contact classes. As all the aspiring candidates could not be accommodated in this batch, it has been proposed to have the next batch shortly.

SEA India encourages its members and other safety professionals to pursue this course to enhance their professional knowledge and career prospects. All those aspiring to join this course are requested to contact Secretary, SEA India by mail, info@seaindia.org with copy to seaindiachennai@rediffmail.com for getting admission.

31st Professional....

(Contd. from previous page)

The Code specifies that the first step is to design the buildings as per the code and this has to be approved by the governmental agencies which give clearance for construction. They in turn get an NOC from Fire & Rescue Services. Normally the NOC is given with certain conditions, which will be verified on completion. For certain cases the License has to be renewed.

The NBC is very clear on provisions like Access, Exits, number of exits, type of doors, width of doorways etc., Staircases, number and sizes and types, interior, exterior etc., the egress paths are also specified.

The Fire escapes and staircase enclosure details are also to be as per norms specified. The staircase widths, handrail designs and sizes are to be made to ease the rescue operations of the occupants.

Fire Escape Ramps and their widths are specified to help rescue operations easier during an emergency.

Provision of Lifts in high Rise Buildings is mandatory. The number of lifts and capacities are to be designed to take care of peak load of the building. All lifts to be grounded in an emergency. The code specifies the Lift Room location and the lift door material of construction keeping in view the Fire Rating of two hours or as per the size of the buildings. Separate Fire Lift to be provided with stand by power source and its specifications should help rescue operations unhindered. All lifts, fire exits and stairways are to be landing in the ground floor.

Design of escape chutes, etc. are strictly as per norms as they are very critical in the rescue.

The major cause of Fire being electrical short circuit ELCBS, MCBS etc., are mandatory. The power generator, transformer yard are too designed in keeping with the fire risk mitigation.

Fire Fighting provisions like Fire hydrants, fire extinguishers, alarms, beam detectors, smoke detectors sprinklers etc., are very critical in the design.

The whole code is designed so that in spite of all precautions and in case of a fire the rescue services and firefighting to be very effective and least damage to occupants and buildings.

The fire prevention should be the most important objective and therefore the provisions in the NBC regarding Fire Prevention should be very critically designed and reviewed. ■

FROM THE DESK OF PRESIDENT

Dear Members,

Our 60th Executive Committee meeting was held on 08th September 2012 and the 31st Professional Development Programme was held on 29th July 2012. The Journal "Indian safety Engineer" for the second quarter 2012 was released in July 2012 and hopefully next issue will reach you soon and in time. We are also trying to fix up a factory visit during end October 2012. As discussed in the last AGM, our Executive Committee has recommended Mr. R. Tiruvengadam, Chief Inspector of Factories (TN), (Retd.) to be the Advisor for SEA India during the term of the committee.

Secretary of Mumbai Chapter visited Chennai office recently and discussed on ongoing activities and plans to improve the activities further. There are no further news from Hazira Chapter. But, some volunteers from New Delhi / Gurgaon region are interested to form a Chapter for their area. Recently, "Guidelines for forming SEA Chapters" has been prepared and a copy is sent to the volunteers at New Delhi for their reference and guidance. Let's wish them good luck.

We are planning to conduct the eleventh batch of NEBOSH IGC course by SEA India during October 2012 and the seats are already filled in. we are planning to conduct another batch shortly.

SEA (India) website, www.seaindia.org is now fully functional, but periodical updates into the site are still not complete. Members may advise their Service providers / vendors to make use of our exclusive web page available in our website and advertise their products / services.

Library maintained at SEA office is now well established with more than 300 useful safety books / standards. Members are advised to find time to visit our office and make use of the books available in the library. Remember that the SEA Office is open on weekends including Sundays and is closed only on Tuesdays.

During recent days we have witnessed few cases of police arresting safety officers of factories where fatal accidents have occurred. Our members are mentally disturbed and SEA will take this up with appropriate forum.

Seasons Greetings & Best Wishes!!

S. Ulaganathan
President, SEA (India)

BEST PRACTICES FOR ARC EXPOSURES AND USE OF FR CLOTHING

Arc flash burns can be some of the most devastating injuries suffered in the workplace. Engineering controls, administrative controls and appropriate PPE can reduce the risk to employees.

Something that happens in a split second can impact a worker and his or her family for the rest of their lives. While arc flash injuries can be fatal, those that aren't fatal still require significant recovery time. Studies indicate workers suffering from arc flash and electrical injuries require an average of 22-23 days off work to recover.

An arc flash is the sudden release of electrical energy through the air when a high-voltage gap exists and there is a breakdown between conductors. An arc flash gives off thermal radiation (heat) and bright, intense light that can cause burns, according to the National Institute for Occupational Safety and Health (NIOSH).

Temperatures have been recorded as high as 35,000 degrees F. High-voltage arcs also can produce considerable pressure waves by rapidly heating the air and creating a blast. This pressure burst can hit a worker with great force and send molten metal droplets from melted copper and aluminum electrical components great distances at extremely high velocities.

According to a NIOSH study, "Reducing Non-Contact Electrical Arc Injuries: An Investigation of Behavior and Organizational Issues," an estimated five to ten arc flash explosions occur in electric equipment every day in the United States.

Study authors Kathleen Kowalski-Trakofler and Edward Barrett noted, "Personal accounts from electricians also note that many workers have experienced some degree of exposure to an electric arc flash during the conduct of their work. However, because these occurrences did not result in an injury, they were not reported. Explanations for escaping injury have ranged from 'pure chance' to practicing proper work procedures, such as using personal protective equipment (PPE)."

Engineering Controls

When trying to eliminate any potential arc-related injuries, the first effort should be to eliminate the exposure through engineering design. If eliminating all arcrelated exposures is not possible, employers should to try to limit the extent of such exposures through administrative controls, including work practices (for example, reducing the available fault current or using work techniques that will put more distance between the worker and the point of the potential arc).

According to OSHA, the four major factors that affect how much heat a worker receives from an arc are:

- Fault current
- Arc length
- Arc duration
- Distance the worker is from the arc.

If any one of the first three factors - fault current, arc length or arc duration - changes by a certain amount in a certain direction (increases or decreases), a worker's heat exposure will change by approximately the same ratio or percentage in the same direction (increase or decrease). For example, if the arc duration is reduced by one-half, the amount of heat exposure is also reduced by approximately one-half: arc duration (or fault current or arc length) ÷ 2 = heat exposure ÷ 2

The relationship between the fourth factor - distance from an arc - and heat exposure is different than the first three factors. Heat exposure changes inversely (in the opposite direction) with the approximate square of the distance.

This inverse relationship between heat exposure and distance can be expressed as: Heat exposure = 1 Distance^2

For example, doubling a person's distance from a potential arc by using a longer live-line tool would result in a worker receiving approximately one-quarter of the original heat exposure; tripling the distance would result in approximately a nine-fold decrease in heat exposure.

Selecting Appropriate FR Clothing

OSHA's Electric Power Generation, Transmission and Distribution Standard, 1910.269(l)(6), requires that workers be trained in the potential hazards of electric arcs and the flames they can produce by igniting other materials in the area. It also prohibits workers from wearing clothing that potentially can increase the extent of injury; for example, if it would ignite and continue to burn, or if it melts on the skin. Thus, workers generally are prohibited from wearing clothing materials made entirely of, or blended with, materials such as acetate, polyester or rayon.

(Contd. on next page)

OCCUPATIONAL ACNE

Occupational acne is an inflammation of the glands (the sebaceous glands) that produce oil to lubricate the skin. The inflammation occurs when certain chemicals block the pores of the skin causing accumulation of the oil and formation of a skin protein called keratin. The accumulation of the oily substance and the formation of keratin produce black plugs that mark occupational acne.

Three different groups of chemicals are known to cause three different forms of acne:

Group 1 - petroleum and its derivatives, especially all compounds found in crude oils, cause oil acne; cutting oils, metalworking oils.

Group 2 - certain coal-tar products cause coal-tar acne.

Group 3 - halogenated aromatic compounds, like polychlorinated biphenyls, cause chloracne.

What causes oil acne?

Grease and petroleum-based cutting oils cause oil acne. Blisters and small spots in areas where oil exposure is heavy, such as the arms and hands, mark oil acne. But other areas such as the abdomen and thighs may be affected especially if they are covered with oil-soaked clothes. The obstructed pores of the skin develop plugs formed by the oil and keratin which the presence of air turns black.

People with oil acne should see a physician. Without treatment, the condition may persist for months after the exposure to oil stops. Skin lesions caused by repeated exposure to petroleum products, if not treated properly, may develop over a long period into skin cancer.

The features associated with oil acne include darkening of the skin and an abnormal reaction of the skin to sunlight. Darkening of the skin is caused by excessive

(Contd. on next page)

Best Practices ....

(Contd. from previous page)

Clothing made from 100 percent natural fibers may be acceptable if its weight is appropriate for the flame and electric arc conditions to which a worker could be exposed. As heat levels increase, these materials will not melt, but they can ignite and continue to burn. The amount of heat required to ignite these materials is dependent upon a number of factors, including the weight, texture, weave and color of the material. This type of clothing does not comply with the "269" standard if it can ignite (and continue to burn) under the electric arc and flame exposure conditions found at the workplace.

When choosing appropriate PPE, look for FR clothing that is rated for particular heat exposures. The FR clothing industry has developed a heat energy rating system for FR fabrics. To identify the appropriate FR clothing to use, the heat energy, measured in calories per square centimeter (cal/cm^2), to which workers are exposed needs to be calculated. Guidance for calculating an arc's heat energy can be found in numerous sources, including NFPA 70E.

FR clothing contaminated with grease, oil, solvents or other flammable substances should not be used because such contamination greatly reduces the effectiveness of the material. As with any PPE that becomes damaged, damaged FR clothing must be replaced or repaired before resuming work.

Contaminated FR clothing must be thoroughly cleaned, if possible, or replaced. (For more information about care and maintenance of FR clothing, see ASTM F1449-01, Standard Guide for the Care and Maintenance of Flame, Thermally and Arc Resistant Clothing). FR clothing must be cared for as instructed by the manufacturer. Clothing that is damaged (for example, torn) often requires special repair techniques. For example, using common nylon thread may reduce the value of the clothing's FR protection.

The NIOSH study also concluded that "many workers knew of the potential consequences of their actions, yet made a decision to engage in risky behaviors that led to arc flash incidents.

"Using the argument that victims had, on average, significant electrical experience and job experience, it can be conjectured that they recognized the hazards of the task … when the arc flash incident occurred but made a conscious decision to engage in a risky behavior that led to the event. For example, an experienced electrician should know when to turn the power off while performing a specific task or when to use the correct tool."

Engineering and administrative controls, training and appropriate PPE eliminate the potential for arc flash - or risky behaviors - that contribute to injuries in the workplace.

Courtesy: **EHS today** ■

Occupational ....

(Contd. from previous page)

production of the pigment melanin. It occurs mainly on sites that are heavily exposed to cutting oils and are simultaneously exposed to sunlight. It occurs because of exposure to a chemical alone and also depends on the presence of sunlight, which can make some chemicals more toxic.

What causes coal-tar acne?

Coal-tar products cause coal-tar acne. The oily substance and keratin form the black plugs that mark coal-tar acne. These plugs are typically found around the eyes. In general, coal-tar acne clears rapidly but in some cases it may persist long after the exposure stops. People with coal-tar acne may experience skin darkening. They also may report burning sensations and flushing of the skin after exposure to light. As with oil, the skin lesions caused by exposure to coal-tar products, if not treated properly, may develop into skin cancer.

What causes chloracne?

Exposure to various halogenated aromatic compounds causes chloracne. The oily substance and keratin form the yellow cysts and gray plugs that mark chloracne. The skin lesions occur mainly in the face, but in more severe cases they involve the shoulders and chest, the back, and the abdomen. In the most serious cases, the lesions appear also on the arms, thighs, legs, hands and feet. Direct skin contact is the most common way of developing chloracne, but ingestion and inhalation are also responsible. Chloracne can develop from three to four weeks after exposure and it may last up to fifteen years even if exposure stops.

The complications associated with chloracne include liver disease, bronchitis, nausea, vomiting, and diarrhea. There is also a poisonous effect on the nervous system resulting in symptoms such as headache, fatigue, irritability, sweating of the palms, and numbness in the legs.

How can we prevent acne?

Occupational acne can be avoided by measures such as personal hygiene, engineering controls and personal protection. Personal hygiene, including hand washing, is very important to prevent occupational acne. Workplaces should provide change rooms, showers and bath facilities, and workers should wear clean coveralls daily.

Engineering controls are important to reduce exposures. Enclosing processes separates workers from the harmful substances with which they work. Using adequate local exhaust systems avoids direct skin contact and inhalation. Using well-designed spray apparatus reduces splashes of harmful substances. Where possible, workplaces should substitute nonhazardous substances for hazardous substances.

Personnel protection includes splash goggles, gloves, apron, and so on, as required by the task and the chemicals being used. Make sure that they are properly selected because not all protective clothing provides protection against all substances. Canadian legislation requires that all workers be informed about the nature of substances they are exposed to and the hazards of the work processes.

Workers should review the material safety data sheets (MSDSs) which provide information on health effects of exposure and safe use of the product. Workers should also ensure that substances used at work are properly labelled and that they know how to work safely with the products. ■

Table: Causes of occupational acne in various occupations

Agent	Type of Acne	Occupational Group
Petroleum and its derivatives:		
Crude oil and fractions Cutting oils	Oil acne	Machine-tool operators, mechanics, workers exposed to petroleum and its derivatives
Coal-tar products:		
Coal tar oils Pitch Creosote	Coal-tar acne	Coal-tar plant workers, construction workers, roofers, road paving workers, paper tube impregnation workers, conduit manufacturers, wood and cable preservation workers
Halogenated aromatic compounds:		
Chloronaphthalenes Polychlorinated biphenyls (PCBs) Polychlorinated dibenzofurans (PCDFs) Polychlorinated dibenzo-p-dioxins (PCDDs) for example 2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD) 3,4,3',4'-Tetrachloroazoxybenzene (TCAOB) 3,4,3',4'-Tetrachloroazobenzene (TAB.)	Chloracne	Chemical manufacturing workers, laboratory workers, maintenance workers, waste handling workers, workers in different industries using certain halogenated hydrocarbons

FLUE-GAS DESULFURIZATION

Flue-gas desulfurization (FGD) is a set of technologies used to remove sulfur dioxide (SO_2) from exhaust flue gases of fossil-fuel power plants, and from the emissions of other sulfur oxide emitting processes.

Methods

As stringent environmental regulations regarding SO_2 emissions have been enacted in many countries, SO_2 is now being removed from flue gases by a variety of methods. The below is among the common methods used:

- Wet scrubbing using a slurry of alkaline sorbent, usually limestone or lime, or seawater to scrub gases;
- Spray-dry scrubbing using similar sorbent slurries;
- Wet sulfuric acid process recovering sulfur in the form of commercial quality sulfuric acid;
- SNOX Flue gas desulfurization removes sulfur dioxide, nitrogen oxides and particulates from flue gases;
- Dry sorbent injection systems.

For a typical coal-fired power station, flue-gas desulfurization (FGD) will remove 95 percent or more of the SO_2 in the flue gases.

Methods of removing sulfur dioxide from boiler and furnace exhaust gases have been studied for over 150 years.

Sulfuric acid mist formation

Fossil fuels such as coal and oil contain a significant amount of sulfur. When fossil fuels are burned, about 95 percent or more of the sulfur is generally converted to sulfur dioxide (SO_2). Such conversion happens under normal conditions of temperature and of oxygen present in the flue gas. However, there are circumstances, under which such reaction may not occur.

When flue gas has too much oxygen, the SO_2 further oxidizes into sulfur trioxide (SO_3). Too much oxygen is only one of the ways that SO_3 is formed. Gas temperature is also an important factor. At about 800 °C, formation of SO_3 is favored. Another way that SO_3 can be formed is through catalysis by metals in the fuel. Such reaction is particularly true for heavy fuel oil, where a significant amount of vanadium is present. In whatever way SO_3 is formed, it does not behave like SO_2 in that it forms a liquid aerosol known as sulfuric acid (H_2SO_4) mist that is very difficult to remove. Generally, about 1% of the sulfur dioxide will be converted to SO_3. Sulfuric acid mist is often the cause of the blue haze that often appears as the flue gas plume dissipates. Increasingly, this problem is being addressed by the use of wet electrostatic precipitators.

Basic principles

Most FGD systems employ two stages: one for fly ash removal and the other for SO_2 removal. Attempts have been made to remove both the fly ash and SO_2 in one scrubbing vessel. However, these systems experienced severe maintenance problems and low removal efficiency. In wet scrubbing systems, the flue gas normally passes first through a fly ash removal device, either an electrostatic precipitator or a wet scrubber, and then into the SO_2-absorber. However, in dry injection or spray drying operations, the SO_2 is first reacted with the sorbent, and then the flue gas passes through a particulate control device.

Another important design consideration associated with wet FGD systems is that the flue gas exiting the absorber is saturated with water and still contains some SO_2. These gases are highly corrosive to any downstream equipment such as fans, ducts, and stacks. Two methods that can minimize corrosion are:

(1) reheating the gases to above their dew point, or

(2) choosing construction materials and design conditions that allow equipment to withstand the corrosive conditions. Both alternatives are expensive, and engineers designing the system determine which method to use on a site-by-site basis.

Scrubbing with a basic solid or solution

SO_2 is an acid gas, and, therefore, the typical sorbent slurries or other materials used to remove the SO_2 from the flue gases are alkaline. The reaction taking place in wet scrubbing using a $CaCO_3$ (limestone) slurry produces $CaSO_3$ (calcium sulfite) and can be expressed as:

$CaCO_3$ (solid) + SO_2 (gas) → $CaSO_3$ (solid) + CO_2 (gas)

When wet scrubbing with a $Ca(OH)_2$ (lime) slurry, the reaction

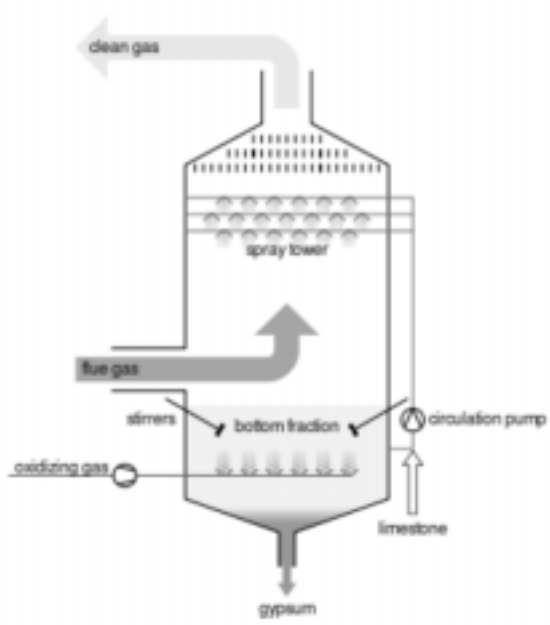
(Contd. on next page)

Flue-gas....

(Contd. from previous page)

also produces $CaSO_3$ (calcium sulfite) and can be expressed as:

$Ca(OH)_2$ (solid) + SO_2 (gas) → $CaSO_3$ (solid) + H_2O (liquid)



Schematic design of the absorber of an FGD

When wet scrubbing with a $Mg(OH)_2$ (magnesium hydroxide) slurry, the reaction produces $MgSO_3$ (magnesium sulfite) and can be expressed as:

$Mg(OH)_2$ (solid) + SO_2 (gas) → $MgSO_3$ (solid) + H_2O (liquid)

To partially offset the cost of the FGD installation, in some designs, the $CaSO_3$ (calcium sulfite) is further oxidized to produce marketable $CaSO_4 - 2H_2O$ (gypsum). This technique is also known as forced oxidation:

$CaSO_3$ (solid) + H_2O (liquid) + $½O_2$ (gas) → $CaSO_4$ (solid) + H_2O

A natural alkaline usable to absorb SO_2 is seawater. The SO_2 is absorbed in the water, and when oxygen is added reacts to form sulfate ions SO_4- and free H+. The surplus of H+ is offset by the carbonates in seawater pushing the carbonate equilibrium to release CO_2 gas:

SO_{2_2}(gas) + H_2O + $½O_2$ (gas)→ SO_4^{-} (solid) + $2H^+$

$HCO_3^- + H+ \rightarrow H_2O + CO_2$ (gas)

Types of wet scrubbers used in FGD

To promote maximum gas-liquid surface area and residence time, a number of wet scrubber designs have been used, including spray towers, venturis, plate towers, and mobile packed beds. Because of scale buildup, plugging, or erosion, which affect FGD dependability and absorber efficiency, the trend is to use simple scrubbers such as spray towers instead of more complicated ones. The configuration of the tower may be vertical or horizontal, and flue gas can flow cocurrently, counter-currently, or crosscurrently with respect to the liquid. The chief drawback of spray towers is that they require a higher liquid-to-gas ratio requirement for equivalent SO_2 removal than other absorber designs.

A few types of Wet Scrubbers are discussed in this article:

1. Venturi- scrubbers

A venturi scrubber is a converging/ diverging section of duct. The converging section accelerates the gas stream to high velocity. When the liquid stream is injected at the throat, which is the point of maximum velocity, the turbulence caused by the high gas velocity atomizes the liquid into small droplets, which creates the surface area necessary for mass transfer to take place. The higher the pressure drop in the venturi, the smaller the droplets and the higher the surface area. The penalty is in power consumption.

For simultaneous removal of SO_2 and fly ash, venturi scrubbers can be used. In fact, many of the industrial sodium-based throwaway systems are venturi scrubbers originally designed to remove particulate matter. These units were slightly modified to inject a sodium-based scrubbing liquor. Although removal of both particles and SO_2 in one vessel can be economic, the problems of high pressure drops and finding a scrubbing medium to remove heavy loadings of fly ash must be considered. However, in cases where the particle concentration is low, such as from oil-fired units, it can be more effective to remove particulate and SO_2 simultaneously.

2. Packed bed scrubbers

A packed scrubber consists of a tower with packing material inside. This packing material can be in the shape of saddles, rings, or some highly specialized shapes designed to maximize contact area between the dirty gas and liquid. Packed towers typically operate at much lower pressure drops than venturi scrubbers and are therefore cheaper to operate. They also typically offer higher SO_2 removal efficiency. The drawback is that they have a greater tendency to plug up if particles are present in excess in the exhaust air stream.

3. Spray towers

A spray tower is the simplest type of scrubber. It consists of a tower

(Contd. on next page)

Flue-gas....

(Contd. from previous page)

with spray nozzles, which generate the droplets for surface contact. Spray towers are typically used when circulating a slurry . The high speed of a venturi would cause erosion problems, while a packed tower would plug up if it tried to circulate a slurry.

Counter-current packed towers are infrequently used because they have a tendency to become plugged by collected particles or to scale when lime or limestone scrubbing slurries are used.

Scrubbing reagent

As explained above, alkaline sorbents are used for scrubbing flue gases to remove SO_2. Depending on the application, the two most important are lime and sodium hydroxide (also known as caustic soda). Lime is typically used on large coal- or oil-fired boilers as found in power plants, as it is very much less expensive than caustic soda. The problem is that it results in a slurry being circulated through the scrubber instead of a solution. This makes it harder on the equipment. A spray tower is typically used for this application. The use of lime results in a slurry of calcium sulfite (CaSO3) that must be disposed of. Fortunately, calcium sulfite can be oxidized to produce by-product gypsum (CaSO4 · 2H2O) which is marketable for use in the building products industry.

Caustic soda is limited to smaller combustion units because it is more expensive than lime, but it has the advantage that it forms a solution rather than a slurry. This makes it easier to operate. It produces a "spent caustic" solution of sodium sulfite/bisulfite (depending on the pH), or sodium sulfate that must be disposed of. This is not a problem in a kraft pulp mill for example, where this can be a source of makeup chemicals to the recovery cycle.

Scrubbing with sodium sulfite solution

It is possible to scrub sulfur dioxide by using a cold solution of sodium sulfite, this forms a sodium hydrogen sulfite solution. By heating this solution it is possible to reverse the reaction to form sulfur dioxide and the sodium sulfite solution. Since the sodium sulfite solution is not consumed, it is called a regenerative treatment. The application of this reaction is also known as the Wellman-Lord process.

In some ways this can be thought of as being similar to the reversible liquid-liquid extraction of an inert gas such as xenon or radon (or some other solute which does not undergo a chemical change during the extraction) from water to another phase. While a chemical change does occur during the extraction of the sulfur dioxide from the gas mixture, it is the case that the extraction equilibrium is shifted by changing the temperature rather than by the use of a chemical reagent.

Gas phase oxidation followed by reaction with ammonia.

A new, emerging flue gas desulfurization technology has been described by the IAEA. It is a radiation technology where an intense beam of electrons is fired into the flue gas, at the same time as ammonia is added to the gas. The Chendu power plant in China started up such a flue gas desulfurization unit on a 100 MW scale in 1998. The Pomorzany power plant in Poland also started up a similar sized unit in 2003 and that plant removes both sulfur and nitrogen oxides. Both plants are reported to be operating successfully. However, the accelerator design principles and manufacturing quality need further improvement for continuous operation in industrial conditions.

No radioactivity is required or created in the process. The electron beam is generated by a device similar to the electron gun in a TV set. This device is called an accelerator. This is an example of a radiation chemistry process where the physical effects of radiation are used to process a substance.

The action of the electron beam is to promote the oxidation of sulfur dioxide to sulfur(VI) compounds. The ammonia reacts with the sulfur compounds thus formed to produce ammonium sulfate, which can be used as a nitrogenous fertilizer. In addition, it can be used to lower the nitrogen oxide content of the flue gas. This method has attained industrial plant scale.

Courtesy: **Wikipedia** ■

INTERNATIONAL LABOUR STANDARDS

International labour standards (conventions and recommendations) and the other instruments on occupational safety and health (codes of practice and guidelines) aim at ensuring and promoting a safe and healthy working environment.

Standards

1. Conventions and Recommendations

International labour standards are legal instruments drawn up by the ILO's constituents (governments, employers and workers) and setting out basic principles and rights at work. They are either conventions, which are legally binding international treaties that may be ratified by member states, or recommendations, which serve as non-binding guidelines. ILO standards on occupational safety and health provide essential tools for governments, employers, and workers to establish sound prevention, reporting and inspection practices and to provide for maximum safety at work. The ILO has adopted more than 40 standards specifically dealing with occupational safety and health. Nearly half of ILO instruments deal directly or indirectly with occupational safety and health issues.

Codes of Practice

Codes of Practice set out practical guidelines for public authorities, employers, workers, enterprises, and specialized occupational safety and health protection bodies (such as enterprise safety committees). They are not legally binding instruments and are not intended to replace the provisions of national laws or regulations, or accepted standards. Codes of Practice provide guidance on safety and health at work in certain economic sectors (e.g. construction, opencast mines, coal mines, iron and steel industries, non-ferrous metals industries, agriculture, ship-building and ship repairing, forestry), on protecting workers against certain hazards (e.g. radiation, lasers, visual display units, chemicals, asbestos, airborne substances), and on certain safety and health measures (e.g. occupational safety and health management systems; ethical guidelines for workers' health surveillance; recording and notification of occupational accidents and diseases; protection of workers' personal data; safety, health and working conditions in the transfer of technology to developing countries).

Guidelines

1. Guidelines on occupational safety and health management systems (ILO-OSH 2001)

These guidelines call for coherent policies to protect workers from occupational hazards and risks while improving productivity. They present practical approaches and tools for establishing, implementing and improving occupational safety and health management systems, with the aim of reducing work-related injuries, ill health, diseases, incidents and deaths.

2. Technical and ethical guidelines for workers' health surveillance (OSH 72)

The purpose of these guidelines is to assist all those who have responsibilities to design, establish, implement and manage workers' health surveillance schemes that will facilitate preventive action towards ensuring a healthy and safe working environment for all.

How Body Reacts to Hot Conditions

Four environmental factors affect the amount of stress a worker faces in a hot work area: temperature, humidity,radiant heat (such as from the sun or a furnace) and wind speed. Individuals with high blood pressure or some heart conditions and people who take diuretics (water pills) may be more sensitive to heat exposure.

The body defends itself from heat through three mechanisms: breathing, sweating, and changing the blood flow. The first reaction is to circulate blood to the skin, which increases skin temperature and allows the body to give off some heat. During heavy work, muscles need more blood flow, which reduces the amount of blood available to flow to the skin and release the heat.

Sweating also helps the body to cool off, but only when the humidity levels are low enough to allow the sweat to evaporate and if water and salts lost through sweating are replaced.

CASE STUDIES

CASE STUDY 1

Freak Surge kills lineman

A 40 year old lineman was electrocuted when power supply resumed unexpectedly while he was attending repair work on a 11KV transformer along with a coworker. The deceased was fixing bolts and nuts in the transformer by sitting on an iron bar. Power supply resumed suddenly, the line man had a severe electric shock and died on the spot while the coworker was thrown off.

It is said that the power supply to the transformer was disconnected and the individual was wearing safety gear. The reason for sudden resumption of power supply is said to be the leakage of current to the transformer from a powerful generator which was working nearby. Though, the actual cause could not be ascertained, it is likely that earthing for maintenance was not effective.

Recommendations:

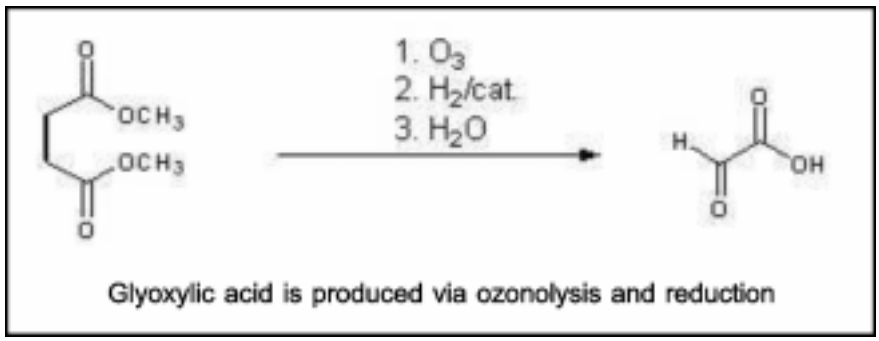
1. Whenever work has to be carried out at high risk area, Risk assessment should be conducted by a competent authority.
2. Permit to work system should be followed scrupulously.
3. Supervision by a qualified and competent personnel should be ensured till the completion of the job.
4. Lockout system should be ensured on both input & output sides of the transformer.
5. Certified and appropriate issue and use of PPE should also be ensured.

CASE STUDY 2

Explosions in a pharmaceutical plant:

The site: The plant is located in a chemical park where about 30 chemical companies are concentrated in order to develop synergy effects in their exploitations, such as easing the exchanges of products, energy etc. The plant produces chemicals and intermediate products for the pharmaceutical industry .

The involved unit: The unit where the accident took place includes two ozonolysis columns that produce



Glyoxylic acid is produced via ozonolysis and reduction

glyoxylic acid from dimethyl maleate, methanol and ozone/ oxygen in various steps.

The process involved in the accident uses ozone at -20°C and 1,7 bars. According to the operator, this process allows producing a higher quality product, thus making it a top-selling product for the company.

The accident: At 10.44 a.m., 2 columns and 2 tanks exploded in the glyoxylic acid unit during a ozonolysis reaction.

This unit contains 2 tanks and 2 columns through which the reaction mix is pumped and put in contact with an O_2/O_3 mixture.

The upper part of the columns are blasted, one column is ripped on 2/ 3rd of its height. The 2 tanks are completely destroyed and their filling (mainly methanol) caught fire. A fireball with a diameter of 80m is formed over the installations.

Firemen from the industrial park and the city arrived on site within a few minutes. The intervention allows the fire not spread to other installations.

Consequences of the accident:

20 workers from the industrial park got injured ; they suffered from burns, bone fractures or bruises due to broken glass.

The part of the installation where the ozonolysis reaction took place (1/4 of the installation) is destroyed. Material damage are significant within a 150 m radius perimeter, mostly due to projections and broken glass. Offices are destroyed in buildings closed to the explosion.

All reactions involving ozone are stopped on the industrial park until the causes of the accident are known.

No environmental damage has been observed outside the chemical site. Most of the chemicals (mainly methanol) burned.

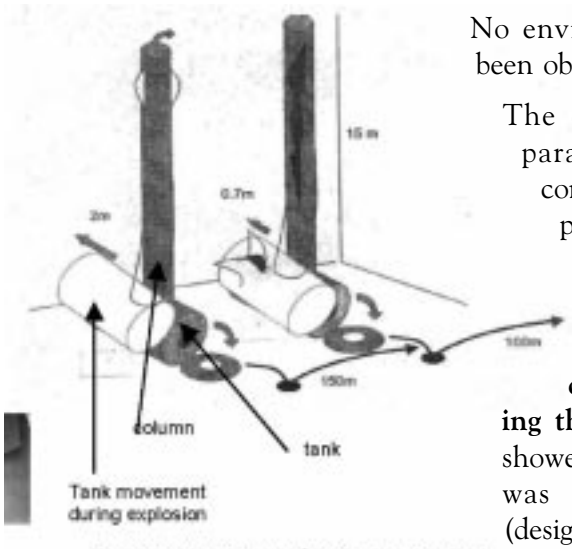
The origin, causes and circumstances surrounding the Accident: The analysis concluded that a leakage (most probably leak on a flange) in a pipe released methanol / peroxide into the insulation material of the column, made of polyurethane. Due to long-lasting high summer temperatures, the methanol (solvent) evaporated, concentrating the peroxide, which

(Contd. on next page)

Case Studies....

(Contd. from previous page)

then self-ignited and decomposed. The rise in temperature was strengthened upon contact with the rusty grid that maintained the insulation material on the column (accelerating the decomposition reaction because of metallic ions of the grid?). The decomposition of the peroxide started the fire, which then spread and caused the explosion of the first column followed by the explosion of the second column (domino effect).



Damaged columns filled with catalyst

Actions taken: Following the accident, the company kept the process unchanged but installed the ozonolysis columns in a separate cold box at -20°C in a separate building with video control. The columns are not isolated anymore, but a leakage indicator system is installed. The reactors are built to resist an explosion and a pressure relief valve is added, as well as additional safety measures such as pressure and temperature measurements.

The Accident, its chronology, effects and consequences:

The accident: Despite the improvements in the process following the above-described accident, two explosions occurred on the same installation at 03:30 a.m. almost one year after, during the re-start of the process.

Consequences of the accident:

The explosions destroyed the devices in the cold box entirely. There was a big crack in the wall. No one got injured and no building got damaged, but a few broken glasses in the surroundings.

No environmental damage have been observed (level 0).

The economic consequences parameter reaches 5 : the company had to re-design the plant and suffered production losses of about 50 million euros.

The Origin, causes and circumstances surrounding the accident: The analysis showed that the safety concept was implemented correctly (design, planning, construction). No explosion trigger was found.

Two hypothesis of the explosions are either the creation and accumulation of foam that ignited upon local heating or hot spots (hot or catalytic particles) or the synthesis of unusual peroxides with following decomposition and ignition.

Other root causes are possible. Any future design would have to be challenged against all the possible scenarios. As a comparison, other ozonolysis users operate their systems at a lower oxygen concentration and mostly with air. Some of them use less or no flammable solvents in addition.

Actions taken: The company involved more than 50 experts from different countries and spend about • 400,000 for the analysis. The company modified the process to implement a reaction with air and inert gas instead of ozone. The local government closed all ozonolysis plants with flammable dilution except for laboratories, until the causes of the accident are clarified.

Lessons Learnt:

The process was neither safe enough nor well controlled. Did the process go through a full safety analysis with identification of physico-chemical and toxicological characteristics of the substances, study of the reaction's criticity, possible secondary reactions, safe operational conditions etc. ?

One positive point is that the safety concept which was implemented after the first explosion was correct. The redesign of the reactor (cold box, leakage indicator system and advanced explosion proof reactor) allowed avoiding any injury during the 2004 explosion.

These accidents also raise the concern of chemical reactions involving (huge) quantities of flammable solvents. The risk of leakage and consequent ignition with important consequences is indeed relatively high and needs to be carefully studied. The question of domino effects should also be mentioned: were they effectively taken into account during the design of facilities?

This accident raises more generally the question of re-starting units after an accident, while root causes are not clearly identified. The re-start has been decided with additional prevention and protection means ("cold box", pressure-proof reactor and safety devices). These measures allowed avoiding any injury but were yet insufficient. ■

IN THE NEWS

NHRC Notice to Jharkhand Government

RANCHI: The National Human Rights Commission (NHRC) has served a show-cause notice to the Jharkhand government for not recommending monetary relief to the kin of 22 workers who died of silicosis in East Singhbhum district during the past few years.

The notice issued by the commission on Tuesday after the state government failed to take proper steps to eradicate silicosis. It is a disease of lungs caused by inhalation of dust containing silica and is prevalent among labourers working in mines and quarries.

The show-cause notice was served to the state chief secretary following a complaint of the Occupational Safety and Health Association of Jharkhand (OSHAJ). The chief secretary has been given eight weeks to respond to the notice.

The NHRC has also asked the government to submit a report about the action taken regarding medical treatment and rehabilitation of workers who have been suffering from silicosis and are alive. OSHAJ secretary general Samit Kumar Carr, who is the complainant, has also been asked to submit a list of silicosis-affected workers to the commission and to the office of the state chief secretary within four weeks.

The press release posted on the commission's website said the directions had come in the wake of material on record indicating that the enforcement agencies of Jharkhand had not taken proper steps for eradication of silicosis caused by inhaling of silica dust resulting in death of these persons.

The complainant in his letter on June 4 had informed the NHRC that 22 persons died of silicosis and the death was certified by International Labour Organization (ILO) and World Health Organization-trained doctors of dust diseases by doing ILO-rating of x-ray plates of ESI Hospital, West Bengal and Mehar Bai Tata Memorial Cancer Hospital, Jamshedpur.

Source: **Times of India**

Two persons arrested

Two men charged with negligence of safety in a fire accident which occurred at , a private power plant, were arrested .

A Safety Officer and an Operation Manager were held and the police filed a case under Sections 285, 287, 337, 338 and 304 (A) of Indian Penal Code based on complaint preferred by one of the injured undergoing treatment at private hospital in Tuticorin. Post mortem was not performed on those who lost their lives in the fire accident. Families of the deceased were demanding compensation for the victims claiming it to have happened due to lack of safety arrangements.

A few political cadres also cited lack of safety arrangements at the plant and sought necessary action. Fire, which broke out at the coal crusher house of the private power plant, claimed the lives of four contract workers and left six others, injured. In the wake of the accident, the deceased fell off the accident site from about 75-metre height to escape. But the victims died not of burns, which was recorded to be of only less percentage, Superintendent of Police said.

Courtesy: **The Hindu**

IN THE NEWS

38 killed in Sivakasi cracker unit blast

Maximum deaths follow second explosion that took rescuers by surprise

Thirty-eight persons, including two women, most of them believed to be villagers who rushed to the site of an explosion at a cracker unit, were killed when a large stock of explosives blew up. Thirty-three persons were wounded and have been admitted to government hospitals in Virudhunagar district and Madurai.

The tragedy took place at Mudalipatti, 13 km from Sivakasi, a region known for frequent accidents in the match and fireworks industries.

Though no bodies were found on the premises of the Fireworks Industries during the initial search by police and revenue officials, the death toll was confirmed after the removal of concrete sheds of at least three working areas flattened in the impact of the explosion. With earthmovers not reaching the site early, rescue work could not be taken up till 6.30 p.m.

The first explosion at the unit, one of the biggest in the region, was reported at 12.20 p.m. Villagers of Mudalipatti and workers of a nearby blue metal crusher unit rushed to the spot. A small posse of police tried to prevent the villagers from entering the unit, but the 500-strong crowd managed to get past the police.

"Unexpectedly, there was a huge explosion around 1 p.m. and the debris that flew across a wide distance injured them seriously," District Revenue Officer, who was at the site, said. Crackers and unfinished goods were seen strewn for more than a half-km radius at the entrance. "A huge stone hit the jeep of the Virudhunagar Tahsildar some 500 metres away from the cracker unit."

Details of the number of workers employed and those present at the time of the incident were not available with officials. Even the police and firemen did not enter the premises for some time on seeing the bodies and the grievous nature of the injuries. Ten fire tenders, including some from Tirunelveli, Tuticorin and Madurai districts, were parked in a serpentine queue outside the unit. The first one entered the unit only at 3.30 p.m. after the entrance was cleared of debris.

Many of the working sheds were damaged as a strong gust of wind fanned the fire. The injured, who were rescued by the villagers, were rushed to the government hospitals.

Courtesy: **The Hindu**

How to avoid electrical shock

When doing electrical work you should practice safety to avoid electrical shock. Here are a couple of things you can do to make sure your safe:

- Shut off power to the circuit you're working on and verify it's off (treat all electrical lines as having power even after shutting off power)
- Wear rubber gloves
- Wear shoes with rubber soles
- Use tools with insulated handles
- Avoid completing circuits with your body
- Keep the area around you dry
- Remove jewelry
- Keep yourself dry
- Wear safety glasses
- If you're using power tools wear ear protection

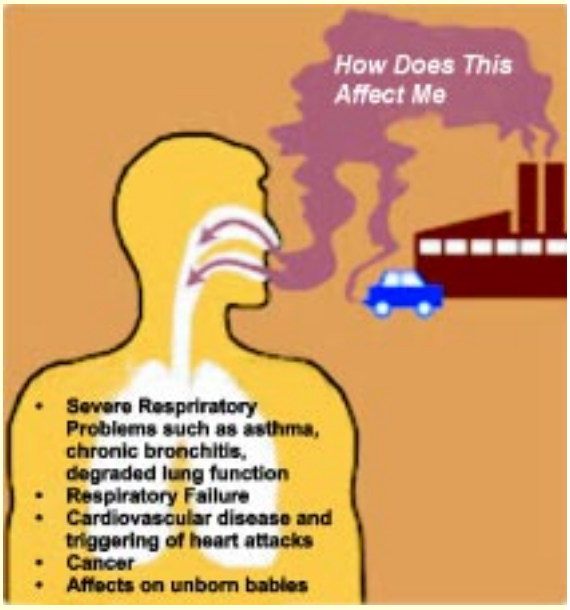
POLLUTION HAZARDS

Pollution hazards can be well understood by newly coined dictum which says that environment is life and pollution is death. Admitted that victim of environmental decay does not die at once which proves it is one of the widely taken slow poisons to weaken the fragile fabric of life. Every year thousands of deaths are reported owing to this menace which has disturbed the green peace of every nation.

If you begin counting number of diseases owing to menace of pollution then half of the total number of maladies would be found because of it. Its worst hit is our immune system and we all know that a weaker immune system is main cause of several fatal diseases because our resistance to these diseases becomes weaker and we fall prey to them.

A person suffering from skin allergy or eyes infection mostly doesn't know the real cause of his or her indisposition owing to lack of awareness on harms of contamination in nature and just narrate the shallow reasons of his illness which are actually secondary reasons and primary reason in most of the cases is one form of pollution or the other.

It is generally said that if people come to know the harms of environmental degradation in its literal sense then most of them might spend half of their life's time in evaluating that if whatever they are using or consuming may harm their health due to being polluted. An ordinary level of awareness is enough to make people realize how can they avoid diseases by protecting themselves from pollution and take full care of their surrounding environment to save it from further decay.



The most fatal diseases which are mostly caused by pollution are lungs cancer, skin cancer, deafness, digestive disorder, bone disorder, coronary disease like angina, blood pressure, and sugar. Some moderate type of illnesses like eyes infection, general allergy, insomnia, hyper tension, memory losses, giddiness etc are also directly or indirectly results of damages to our natural environment.

In Asian countries, diseases due to harming the nature are widely spreading. Lack of medical care is not the only cause of their spread but lack of care to environment is the primary reason that millions of people in Asia and Africa fall prey to menace of pollution. At policy level little work is done in poor states and its repercussions are directly affecting the innocent population of these countries.

Developed nations are lucky to have stringent laws against environmental violations but astronomical industrialization and mechanization of life in rich states has also deprived their citizens the blessings of pure nature and they have to resort to machine based facilities in every aspect of their lives. Eventually they come to know that their aloofness from nature has made them like machines and they don't have such a powerful immune system which should have been like their forefathers had.

Damages to marine life owing to ocean and sea pollution, soil fertility loss due to land degradation and suffocation in air because of industrial and vehicular emissions are also some other major hazards of pollution which can be avoided unless each one of us play his or her role to save environment at every level and do his or her share to keep the mother Earth unaltered as much as possible.

Human Life is a prepaid card, let us give it maximum validity by not polluting the Environment. ■

www.karam.in

KARAM®

knowing your needs better

Providing Long Lasting Safety Solutions

KARAM a brand with a strong manufacturing base, and an exhaustive range of products covering all aspects of protection from "Head to Toe" has over the years became a trusted name in the field of personal protective Equipment. With a comprehensive range of products that are finest in quality (certified as per CE & ISI standards) KARAM seeks to provide complete Safety with ultimate comfort.

CE

ISI

For further details contact below:

KARAM Industries

MARKETING OFFICES

BANGALORE	:	Ph. :080-41661080, Fax :080-22220030,	Mob.:09343090951, e-mail: bangalore@karam.in,	**MUMBAI**	:	Ph. :022-27753553, Fax :022-27753552,	Mob.:09322931191, e-mail: mumbai@karam.in,
CHENNAI	:	Ph. :044-42620314, Fax :044-25382670,	Mob.:09916057538, e-mail: chennai@karam.in,	**KOLKATA**	:	Ph. :033-22375024, Fax :033-22375023,	Mob.:08017066223, e-mail: kolkata@karam.in,
DELHI	:	Ph. :0120-4734400, Fax :0120-2541096,	Mob.:09350550560, e-mail: delhi@karam.in,	**VADODARA**	:	Ph. :0265-3003704, Fax :0265-2416108,	Mob.:09624777669, e-mail: vadodara@karam.in,
HYDERABAD	:	Ph. :040-27807675, Fax :040-40170485,	Mob.:09916057538, e-mail: hyderabad@karam.in,	**RAIPUR**	:	Mob: 09322931191, e-mail: vinods@karam.in	09300074441

CORPORATE OFFICE: D-95, Sector-2, Noida-201301, Delhi NCR, India. e-mail: karam@karam.in