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FACTORY VISIT TO DLF

SEA India arranged factory visit to DLF, IT Park, Manapakkam, Chennai on Saturday, 25th March 2017.

Large number of SEA India members participated in the visit and acquired knowledge on new developments that are being followed in occupational health and safety.

SEA India thank DLF management for accepting and extending all services to the members during the visit.

46th National Safety Day 2017

National Safety Day/week theme of 2017 is

"LEADERSHIP IN SAFETY AND HEALTH ENHANCES BUSINESS SUSTAINABILITY".

SAFETY PLEDGE

"On this Day, I solemnly affirm that I will rededicate myself to the cause of safety, health and protection of environment and will do my best to observe rules, regulations and procedures and develop attitudes and habits conducive for achieving these objectives.

I fully realise that accidents and diseases are a drain on the national economy and may lead to disablement, death, damage to health and property, social suffering and general degradation of environment.

I will do everything possible for the prevention of accidents and occupational diseases and protection of environment in the interest of self, my family, my community and the nation at large".

Inside...

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46TH NATIONAL SAFETY DAY CELEBRATION

Commemorating the 46th National Safety day this year on 6th March, 2017, National Safety Council - Tamilnadu Chapter and the Directorate of Industrial Safety and Health, Government of Tamilnadu jointly organized the Safety day function at the office of The Directorate of Industrial Safety and Health, Royapettah, Chennai.

Our Retired Chief Inspector of Factories Mr. Vasudevan honored our beloved NSC Chairman Mr. Bose, Director of Industrial Safety & Health, Govt. of Tamil Nadu.

Mr. Rajmohan, Secretary, NSC honored Mr. Kaliannan, Senior Additional Director-BOCW, Directorate of Industrial Safety & Health, Govt. of Tamil Nadu. Mr. Baskaran, Vice Chairman honored Mr. Srinivasan Senior Additional Director, Directorate of Industrial Safety & Health, Govt. of Tamil Nadu. After that our Chairman explained the importance of National Safety Day celebration with our members and Directorate of Industrial Safety & Health officials.

After that NSC Office bearers, the Executive Committee members and Directorate of Industrial Safety & Health officials jointly met Dr. Nilofer Kafeel, Hon'ble Minister of Labour and Employment and she was honored by our beloved Chairman Mr. P. Bose in Secretariat. Safety Oath was taken by Dr. Nilofer Kafeel, Hon'ble Minister for Labour and Employment, along with Directorate of Industrial Safety & Health officials and NSC Executive members and office bearers.

Then we met Mrs. B. Jothi Niramalasamy, Additional Secretary, Labour and Employment Department, Government Tamilnadu and she was honoured by our Director Mr. P. Bose.

– Secretary, NSC - Tamilnadu Chapter

ELEVEN TIPS FOR GOOD HOUSEKEEPING

To some people, the word "housekeeping" calls to mind cleaning floors and surfaces, removing dust, and organizing clutter.

But in a work setting, it means much more. Housekeeping is crucial to safe workplaces. It can help prevent injuries and improve productivity and morale, as well as make a good first impression on visitors, according to Cari Gray, safety consultant for the Ohio Bureau of Workers' Compensation. It also can help an employer avoid potential fines for non-compliance of statutory provisions.

The practice extends from traditional offices to industrial workplaces, including factories, warehouses and manufacturing plants that present special challenges such as hazardous materials, combustible dust and other flammables. Experts agree that all workplace safety programs should incorporate housekeeping, and every worker should play a part. In addition, housekeeping should have management's commitment so workers realize its importance. Here are 11 tips for effective workplace housekeeping.

1 PREVENT SLIPS, TRIPS & FALLS

Slips, trips and falls were the second leading cause of nonfatal occupational injuries or illnesses involving days away from work in 2013, according to data from the Bureau of Labor Statistics.

Employers should select adequate flooring (e.g., cement, ceramic tile or another material), as different types of flooring hold up better under certain conditions.

"Things like oils and grease - if you don't use the right kind of cleaning protocols, you'll just spread slipperiness around rather than getting it up and off the floor".

To help prevent slip, trip and fall incidents, the Canadian Center for Occupational Health and Safety recommends the following:

- Report and clean up spills and leaks.
- Keep aisles and exits clear of items.
- Consider installing mirrors and warning signs to help with blind spots.
- Replace worn, ripped or damage of flooring.
- Consider installing anti-slip flooring in areas that can't always be cleaned.
- Use drip pans and guards.

In addition, provide mats, platforms, false floors or "other dry standing places" . Every workplace should be free of projecting nails, splinters, holes and loose boards.

Employers should audit for trip hazards, and encourage workers to focus on the task at hand.

2 FIRE HAZARD ELIMINATION

Employees are responsible for keeping unnecessary combustible materials from accumulating in the work area. Combustible waste should be "stored in covered metal receptacles and disposed off.

The National Safety Council's "Supervisors' Safety Manual" includes these precautionary measures for fire safety:

- Keep combustible materials in the work area only in amounts needed for the job. When they are unneeded, move them to an assigned safe storage area.
- Store quick-burning, flammable materials in designated locations away from ignition sources.
- Avoid contaminating clothes with flammable liquids. Change clothes if contamination occurs.
- Keep passageways and fire doors free of obstructions. Stairwell doors should be kept

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Eleven Tips ....

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closed. Do not store items in stairwells.

- Keep materials at least 18 inches away from automatic sprinklers, fire extinguishers and sprinkler controls. The 18-inch distance is required, but 24 to 36 inches is recommended. Clearance of 3 feet is required between piled material and the ceiling. If stock is piled more than 15 feet high, clearance should be doubled. Check applicable codes, including Life Safety Code, ANSI/NFPA 101-2009.
- Hazards in electrical areas should be reported, and work orders should be issued to fix them.

3 DUST CONTROL

Dust accumulation of more than 1/32 of an inch - or 0.8 millimeters - covering at least 5 percent of a room's surface poses a significant explosion hazard. This dust accumulation is about as thick as a paper clip.

An industrial hygienist should test the workplace for exposures if air quality and dust are a concern for safety or health.

NFPA 654 - a standard on preventing fire and dust explosions - addresses identifying hazard areas, controlling dust and housekeeping. The standard states that vacuuming is the "preferred" method of cleaning. Sweeping and water wash-down are other options. "Blow-downs" using compressed air or steam is allowed for inaccessible or unsafe surfaces.

Industrial vacuums can clean walls, ceilings, machinery and other places.

Dust also can affect equipment's length of life and quality of products.

4 AVOID TRACKING MATERIALS

Work-area mats - which can be cloth or sticky-topped - should be kept clean and maintained. This helps prevent the spread of hazardous materials to other work areas or home.

Check all mats to ensure they are not tripping hazards.

Additionally, separate cleaning protocols may be needed for different areas to prevent cross-contamination. Avoid using the same mop to clean both an oily spill and in another area, for example.

If the materials are toxic, industrial hygiene testing, uniforms and showering facilities might be needed, Employees who work with toxic materials should not wear their work clothes home.

5 PREVENTION OF FALLING OBJECTS

Protections such as a toe board, toe rail or net can help prevent objects from falling and hitting workers or equipment.

Other tips include stacking boxes and materials straight up and down to keep them from falling. Place heavy objects on lower shelves, and keep equipment away from the edges of desks and tables. Also, refrain from stacking objects in areas where workers walk, including aisles.

Keep layout in mind so workers are not exposed to hazards as they walk through areas.

6 CLEAR CLUTTER

A cluttered workplace can lead to ergonomics issues and possible injuries because workers have less space to move.

When an area is cluttered, a cut or laceration injury is very common.

The Ohio Bureau of Workers' Compensation recommends that workers return tools and other materials to storage after using them, and dispose of materials that are no longer needed.

Keep aisles, stairways, emergency exits, electrical panels and doors clear of clutter, and purge untidy

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Eleven Tips ....

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areas. Empty trash receptacles before they overflow.

7 STORE MATERIALS PROPERLY

According to OSHA's Materials Handling, Storage, Use and Disposal Standard (1926.250), storage areas should not have an accumulation of materials that present hazards for tripping, fire, explosion or pests.

Some workers make the mistake of storing ladders or other items inside electrical closets where they can block an electrical panel, creating a fire hazard.

Unused materials and equipment should be stored out of the way of workers. Avoid using workspaces for storage, And remember to put everything back in its proper place.

There's a responsibility to keep the work area in order and return tools to where they belong, The storage space, if readily useable, is designed in such a way where it can be used without stretching too far or lifting heavy loads. They're more likely to use it than if they have to go quite a ways to place something. Or they're going to keep something rather than go back because they have to take the extra time to get it.

8 PPE & TOOLS INSPECTION

Wear basic PPE - such as closed-toe shoes and safety glasses - while performing housekeeping, Determine what type of PPE to don based on the potential risks.

Regularly inspect, clean and fix tools, Remove any damaged tools from the work area.

9 DETERMINE FREQUENCY

All workers should participate in housekeeping, especially in terms of keeping their own work areas tidy, reporting safety hazards and cleaning up spills, if possible.

Every worker does have a role in housekeeping. If they see something is becoming a problem, they need to report it.

Before the end of a shift, workers should inspect and clean their workspaces and remove unused materials. This dedication can reduce time spent cleaning later, experts say.

How much debris or contaminants the workplace releases can help determine the frequency of housekeeping. A company should have a mixture of deep cleaning and more frequent, lighter cleaning that involves sweeping and responding to spills,

10 WRITTEN RULES

Experts agree that housekeeping policies should be put in writing.

Written protocols could specify which cleaners, tools and methods should be used.

Many gaps in the effectiveness of floor cleaning in the operations are normally noticed.

Written protocols and defined training to people are the best practices to overcome the lapses.

11 LONG TERM THINKING

Housekeeping should be more than a one-time initiative - it should continue through monitoring and auditing.

Always Keep records, maintain a regular walkthrough inspection schedule, report hazards and train employees to help sustain housekeeping. ■

COMBUSTIBLE DUSTS

Many employers are unaware of a potential explosive dust hazard in their workplace. By identifying and controlling dust explosion hazards, injuries, deaths, and costly damage can be prevented. Some of the industries that could have a combustible dust hazard include:

- Agriculture
- Chemical
- Forest and furniture products
- Metal processing (e.g. aluminum, magnesium, zinc)
- Organic dust producers or users (e.g. working with fine dusts of candy, dried blood, paper, pulp, soap, spices, starch, sugar, flour, and feed)
- Paper products manufacturers
- Pharmaceuticals
- Plastics
- Producers or users of coal or other carbon dusts
- Recycling operations (e.g. metal, paper, and plastic recycling operations)
- Tire and rubber
- Textile
- Wastewater treatment (Bio solids)
- Wood dust producers

What Makes Combustible Dust an Explosion Hazard?

Combustible dusts become an explosion hazard when they are suspended in the air in the proper concentration in a confined or semi-confined vessel, area, or building. With the oxygen present in the air, all that is needed is an ignition source for an explosion to occur.

Many variables can affect the explosibility of a dust. To fully assess the risk of a dust explosion, it may be necessary to have the materials involved tested by a specialized lab.

Primary and Secondary Dust Explosions

An initial or primary dust explosion can lead to one or more secondary dust explosions within a facility. This can occur when the initial dust explosion in the processing equipment or vessel ruptures the enclosure and ignites settled dust in a nearby area. Such explosions have destroyed buildings, killed large number of people and have injured thousands. In many of these cases, the employers involved were unaware of the hazard.

Catastrophic Fires have occurred with the following kinds of dusts

- Coal dust
- Nylon fiber
- Phenolic Resin dust
- Plastic (polyethylene) dust
- Resin for fiberglass
- Rubber dust

The National Fire Protection Association (NFPA) states, "Any industrial process that reduces a combustible material and some normally noncombustible materials to a finely divided state present a potential for a serious fire or explosion."

Conduct a Hazard Analysis

You may have to seek professional help with the following:

- Recognize that you may have a combustible dust hazard.
- Look for processes that use, consume, or produce fine dusts.
- Look for accumulations of fine dust, including hidden areas (such as inside ductwork or over suspended ceilings).
- Look for ways dusts can become dispersed in the air.
- Look for ignition sources.
- Consider dust collectors, hoppers, and other equipment that can confine a dust cloud.
- Investigate the thermal stability of stored products.

Control - The Main Control Methods

- Prevent dust accumulations.
- Install special electrical equipment in areas with potential for explosive concentrations of combustible dust (Class II locations).
- Select and use industrial trucks properly.
- Implement proper procedures for the maintenance of ovens and process equipment.
- Select and install equipment safety devices.
- Install explosion relief venting devices.
- Design buildings, equipment, and ventilation systems properly (including bonding and grounding).

Safety Management

- Investigate fires and incidents.
- Train employees on Hazard Communication (including combustible dust hazards).
- Implement Process Safety Management. ■

HOW DRONES ARE SAVING LIVES AT INDUSTRIAL JOBSITES?

In industries such as construction, inspection and mining, it is not uncommon for workers to face serious injury - or even death - daily. According to the Occupational Safety and Health Administration (OSHA), 4,836 workers were killed on the job in 2015. On average, that means more than 90 people lost their lives each week on jobsites, or approximately 13 deaths occurred every day.

In addition, workplace injuries and illnesses cost employers in the U.S. almost $1 billion per week in worker's compensation costs alone. These estimates don't include the additional costs that result from lost productivity, staffing replacements and repairs to damaged equipment.

Seeking better ways to inspect jobsites and identify potential hazards before they become dangerous, many companies are increasingly turning to drones and drone mapping to improve overall safety for their workers.

Reducing the Need to Walk in Dangerous Areas

As any site manager is all too aware, most industrial accidents are the result not of falling debris or malfunctioning equipment, but of slips, trips and falls. In fact, falls are the leading cause of death on industrial jobsites and were responsible for 800 OSHA-reported fatalities in 2015. By allowing crews to perform remote inspections with real-time information, drone mapping reduces the need to put boots on the ground in potentially dangerous areas.

One company that is leading the change to improve worker safety with the use of drones is Rogers-O'Brien Construction. "For roofing inspections now, we can go out and fly the drones and get the quality imagery that we need," says Blake Potts, senior virtual design and construction specialist at Rogers-O'Brien Construction. "We're really minimizing the time we've spent inspecting these roofs and putting personnel at risk."

Roof inspections can be very dangerous, as workers are often required to walk atop buildings at extreme heights to check for cracks, leaks and any other potential damage that could require repair. Drones and drone software make it easy to automatically capture aerial imagery for mapping to make measurements and analyze roofs to identify issues in need of fixing - all without ever having to step foot on rooftops. For companies like Roger's-O'Brien, this is having a major impact on jobsite safety by ensuring that workers remain on the ground and out of harm's way unless roof repair is necessary.

Tracking Progress and Forecasting Potential Jobsite Risks

Early identification of safety concerns on jobsites helps minimize safety risks and enables managers to contain environmental hazards before they become costly and dangerous. Project and site managers around the country are putting drones in the air and mapping worksites weekly instead of conducting traditional site inspections on foot. By reducing the time it takes to physically walk sites to inspect earthwork, drainage dikes and other areas of concern for safety, managers can generate real-time site maps more often and with greater detail. Armed with better, more timely information, they can proactively monitor sites and forecast potential issues before disaster strikes.

Making Field Inspection Safer and More Efficient

Construction isn't the only industry to see innovation and increased safety from the use of commercial drones. Another profession that faces a high risk of injury or death from slips and falls is field inspection. From bridges to power lines to cell towers, field inspectors are often required to scale large structures to visually inspect for potential damage in need of repair.

Drones are improving field inspections by making them safer while also making the inspection workflow twice as efficient.

"Everything's about safety in our industry," says Chris Bartlett of ReconnTECH, the technology solutions branch of major field inspection company USIC.

He uses drone mapping to help clients remotely inspect elevated water and cell towers. "Introducing drones increases safety in the workforce by giving our customers tools to perform inspections in a safer manner," he says.

By using drones to visually inspect structures, Bartlett and his team are no longer required to put workers in the air unless they spot

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HOW TO TRANSPORT GAS CYLINDERS SAFELY

Transporting gas cylinders is not safe as other materials since it involves special care and thorough knowledge about the reactive properties of the content of the cylinders and the environmental condition of the transportation route. Professional transporting agencies are supposed to know safe transportation of gas cylinders.

Basic guidelines for transporting gas cylinders safely:

- Try to limit the number of cylinders that are to be transported.
- Ensure the cylinder contents are clearly labeled.
- Ensure the cylinder valve is in the fully closed position.
- Use valve protection caps before moving.
- Use cylinder dollies or other mechanical lifting devices to move the cylinders to the vehicle.
- Never drop the cylinders or allow things to bang into them.
- An open vehicle or trailer is preferred.
- Transporting the cylinders in an upright position is always preferred.
- Secure the cylinders in the vehicle or trailer to prevent movement during transit. ■

How Drones ....

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issues by using the drone's high-resolution camera. This greatly improves productivity in the field because workers no longer need to scale every structure for inspection - allowing them to move more quickly and increase the rate of inspection.

"By using drones … we have increased our field productivity by 50-75 percent," says Bartlett.

Once problems are spotted, inspectors can take aerial images and assess how to safely address the situation should repair be required, dramatically reducing the chance of falls - or fatalities - occurring on the job.

Helping Companies Put Worker Safety First

As drone mapping continues to be adopted across a variety of industries, we can expect to see OSHA figures surrounding jobsite fatalities to plummet. The latest drone models available for manufacturers like DJI, senseFly and Aeryon are well suited for commercial applications on jobsites, and the software available for drone mapping has come a long way in the past few years, opening endless possibilities for improvement to safety and efficiency. Drone data is now being used in almost every country by tens of thousands of professionals in dozens of major industries to make more informed business decisions and increase return on investment.

Companies that are serious about reducing worksite hazards should actively be considering the use of drones and drone mapping software. By keeping workers out of harm's way, drone mapping can ensure companies small and large alike focus on safety first. Drone mapping is an innovative and cost-efficient way to capture information from dangerous areas without the need to put personnel into compromising situations to complete their jobs. ■

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. Below are 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 (Process for Flue gas desulphurisation) removes sulfur dioxide, nitrogen oxides and particulates from flue gases;
- Dry sorbent injection systems that introduce powdered hydrated lime (or other sorbent material) into exhaust ducts to eliminate SO_2 and SO_3 from process emissions.

For a typical coal-fired power station, flue-gas desulfurization (FGD) may remove 90 percent or more of the SO_2 in the flue gases.

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.

FGD chemistry

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 baghouse, 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 may minimize corrosion are: (1) reheating the gases to above their dew point, or (2) using materials of construction and designs that allow equipment to withstand the corrosive conditions. Both alternatives are expensive. Engineers determine which method to use on a site-by-site basis.

Scrubbing with an alkali solid or solution

Schematic design of the absorber of an FGD

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 may be expressed in the simplified dry form as:

$$CaCO_{3(s)} + SO_{2(g)} \rightarrow CaSO_{3(s)} + CO_{2(g)}$$

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

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Flue-gas ....

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the reaction also produces $CaSO_3$ (calcium sulfite) and may be expressed in the simplified dry form as:

$$Ca(OH)_{2(s)} + SO_{2(g)} \rightarrow CaSO_{3(s)} + H_2O_{(l)}$$

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

$$Mg(OH)_2(s) + SO_{2(g)} \rightarrow MgSO_{3(s)} + H_2O_{(l)}$$

To partially offset the cost of the FGD installation, some designs, particularly dry sorbent injection systems, further oxidize the $CaSO_3$ (calcium sulfite) to produce marketable $CaSO_4$-$2H_2O$ (gypsum) that can be of high enough quality to use in wallboard and other products. The process by which this synthetic gypsum is created is also known as forced oxidaton. This technique is also known as **forced oxidation:**

$$CaSO_{3(aq)} + 2H_2O_{(l)} + \tfrac{1}{2}O_{2(g)} \rightarrow CaSO_4 \bullet 2H_2O_{(s)}$$

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:

$$SO_{2(g)} + H_2O_{(l)} + \tfrac{1}{2}O2_{(g)} \rightarrow SO4^{2-}_{(aq)} + 2H+$$

$$HCO_3– + H+ \rightarrow H_2O_{(l)} + CO_{2(g)}$$

In industry caustic (NaOH) is often used to scrub SO_2 producing sodium sulfite:

$$2NaOH_{(aq)} + SO_{2(g)} \rightarrow Na_2SO_{3(aq)} + H_2O$$

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, countercurrently, 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.

FGD scrubbers produce a scaling wastewater that requires treat-ment to meet discharge regulations. However, technological advancements in ion exchange membranes and electrodialysis systems has enabled high efficiency treatment of FGD wastewater to meet recent EPA discharge limits The treatment approach is similar for other highly scaling industrial wastewaters.

Venturi-rod 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 throw away 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.

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.

Spray towers

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

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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 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 ($CaSO_3$) that must be disposed of. Fortunately, calcium sulfite can be oxidized to produce by-product gypsum ($CaSO_4 \bullet 2H_2O$) 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.

Alternative methods of reducing sulfur dioxide emissions

An alternative to removing sulfur from the flue gases after burning is to remove the sulfur from the fuel before or during combustion. Hydrodesulfurization of fuel has been used for treating fuel oils before use. Fluidized bed combustion adds lime to the fuel during combustion. The lime reacts with the SO_2 to form sulfates which become part of the ash. This elemental sulfur is then separated and finally recovered at the end of the process for further usage in, for example, agricultural products. Safety is one of the greatest benefits of this method, as the whole process takes place at atmospheric pressure and ambient temperature. ■

CASE STUDY

CASE STUDY 1:

CHEMICAL BURNS DURING BLENDING OPERATION:

Description of Incident

After carrying out a chemical blending operation, a worker felt severe pain in the fingers of his left hand. As the pain did not subside, he was sent to the hospital for treatment and was warded for one day. He was also given a total of 16 days of medical leave.

Possible Causes and Contributing Factors

Mission

- The blending operation involved a highly corrosive substance, hydrofluoric (HF) acid.

Man

- The worker removed his impervious gloves and replaced them with cotton gloves during the blending operation as he thought that the cotton gloves would provide sufficient protection.

Management

- The management only gave verbal instructions to the workers. There was no documentation of safe work procedures developed for the chemical blending operation.
- There was insufficient training on proper handling of corrosive substances for the worker.
- No supervision was provided to workers handling the corrosive substance.

Recommendations and Learning Points

- Use the correct equipment for storage and handling of corrosive substances. Equipment used for storing or handling corrosive substances must go through a preventive maintenance programme to ensure that the equipment remains fit for use.
- Ensure all chemical containers are labelled clearly. The relevant SDS for each chemical should be made easily available to the workers so that they can quickly identify the hazardous properties of the chemical being handled.
- Provide workers with proper documentation of the safe work procedures specifying the correct PPE (e.g., face shield, chemical protective suits, chemical resistant gloves) to be used during the chemical blending operation. Specifically to this incident, impervious gloves must be provided for basic hand protection and properly fitted for firm grip.
- Organise sufficient training in hazard communication and conduct safety briefings so that workers are fully aware of the hazards and risks associated with the chemical(s) in use.
- Supervise all workers including new workers that are at risk of coming into contact with corrosive substances to ensure proper use and maintenance of appropriate PPE and familiarity with the safe work procedures.
- Provide local exhaust ventilation and/or respiratory protection for the chemical blending operation to prevent or minimise inhalation of toxic and/or corrosive vapours.
- Put in place appropriate spill control measures (e.g., use of secondary containment and availability of suitable absorbents) for immediate response to any spillage during chemical handling.
- Include appropriate first aid treatment guidelines in the safe work procedures and make sure the correct antidote for accidental skin contact with corrosive substances (e.g., calcium gluconate gel for dermal exposure to HF acid) are easily available to the workers.
- Provide SDS to the doctor and/or medical professional attending to the injured worker exposed to the hazardous substance so that the correct treatment could be correctly identified and administered.
- Install signs at worksites to remind workers on the appropriate use of PPE. ■

Causal Analysis

Evaluation of loss	• One worker injured
Type of contact	• Contact with corrosive substance (HF acid)
Immediate cause(s)	• Use of inappropriate PPE (cotton gloves)
Basic cause(s)	• No documented Safe Work Procedures • Lack of training and supervision
Failure of OSHMS	• Process safety information • Operating procedures and safe work practices • Training, awareness and competence • Control of hazardous substances • Emergency preparedness and response (first aid treatment)

ASBESTOS LOBBY PREVAILS AT GENEVA AT THE COST OF WORKERS' HEALTH

An international conference on regulating the production and trade of hazardous industrial chemicals was held at Geneva, Switzerland, between April 24 and May 5. Delegations from signatory nations of the Basel, Stockholm and Rotterdam Conventions participated in wide-ranging discussions on banning or regulating production, trade, and disposal of persistent organic pollutants and other hazardous chemicals.

Leading up to the conventions, trade unions across the world along with environmental groups raised the issue of banning or regulating the trade of Chrysotile Asbestos. Asbestos is still a major killer in the developing world, where its use has not been banned or regulated. WHO estimates that over 100,000 workers die every year due to exposure to asbestos. According to estimates collected by Health Grove, India ranks second in deaths and years lost due to asbestosis. Though the trend is dropping, disproportionately more workers tend to die due to asbestos caused diseases every year. PTRC published a report titled 'India: National Asbestos Profile', which documents the use of asbestos in India, and the health consequences to workers. The report also indicated that nearly 50% of the asbestos use in India is concentrated in Gujarat.

There was a concerted effort once again this year, from trade union groups and environmental groups to include chrysotile asbestos in the list of chemicals that require exporters to obtain 'prior informed consent' from importers before being traded. Yet again, they saw no success, with India and seven other countries opposing the move. While most other opposing members are exporters, India is a major importer of asbestos, with minimal regulation on its use. FirstPost reported in 2014 about the clout and efforts of the asbestos lobby in India in influencing India's policy towards this issue. ■

IN THE NEWS

Thermal plants must meet emission norms: Environment ministry

Sending a strong message to coal-based power plants across the country, the Central environment ministry has made it clear that it will neither dilute the emission norms for thermal power plants, as notified on December 7, 2015, to minimise air pollution, nor relax deadline for implementation of the stricter standards.

"The revised emission standards for thermal power plants were notified with respect to Particulate Matter (PM), Sulphur Dioxide (SO2), Nitrogen Oxide (NOx), Mercury (Hg) and water consumption on December 7, 2015, and shall come into force from December 6, 2017," said environment minister Anil Madhav Dave.

His remarks, in response to a Parliament question in Lok Sabha on Tuesday, will dispel all doubts over the implementation. The minister noted that the assessment in respect to level of implementation would be done only after these standards come into effect.

Besides notifying new emission norms in 2015, the government had taken other steps to clean up the environment in areas adjoining thermal power plants. It included installation of continuous emission/ effluent monitoring systems (CEMS), revised norms for fly ash utilisation, industry specific action plans for critically polluted areas where significant number of thermal power plants are located and development of green belt in surrounding areas.

IN THE NEWS

Thousands join Industrial Safety Rally

Thousands of workers took part in the state level industrial safety rally organised by the directorate of safety and health on Sunday to mark 135 years of the Factory Act and National safety week, which is being observed from March 4 to 11.

The rally began in Nagpur on March 4 and proceeded through Latur and arrived at Nashik on Sunday. The Nashik leg of the event was inaugurated by the city mayor Ashok Murtadak.

The aim of the awareness rally was to emphasise the importance of safety of industrial workers and zero accident in factories. Besides workers, even entrepreneurs from Nashik participated in the event that began from Industrial Training Institute (ITI) ground in Satpur and concluded at NEC in Ambad.

Murtadak said, "The rally is not just about the safety of workers at factories, but they should also return home safely. Apart from safety in factories, workers also follow traffic norms, wear helmets and park vehicles in parking zones. Our objective should be accident free factories."

Joint Director (industrial safety), Nashik division, M S Prabhawale, said, "The office of joint director of safety implements the provisions under the Factory Act. When we probe into accidents in factories, they often occur due to wrong working methods. Therefore, we can't achieve the goal of zero accident in factories by just strictly implementing the Factory Act, we also need to create awareness among the factory workers." The rally began from the grounds of Industrial Training Institute (ITI) in Satpur industrial estate of Maharashtra Industrial Development Corporation (MIDC) and proceeded forward via Satpur and Ambad MIDC areas and finally concluded at the Nashik Engineering Cluster facility at Ambad.

Safety Academy in Telengana State soon, says Home Minister

Labour Minister, Telangana State, Sri Nayini Narsimha Reddy has said that a prestigious 'Safety Academy' would be set up near Hyderabad with the sole objective of spreading awareness about industrial safety and preventing accidents at workplaces.

Industrial accidents

Industrial accidents were a matter of serious concern, he said, adding that the Government would take every initiative to check accidents. The proposed academy would be on the lines of the one in Bengaluru, he said, adding that details would come out shortly.

The World Safety Day was when all concerned resolved to help prevent accidents and pay their respects to those who died in such accidents, he said, apart from remembering the services of those who were injured.

In the year 2015, Mr. Reddy said, 76 people had lost their lives in such accidents across Telangana while 70 were injured.

Source: The Hindu dated 29.4.2017, Hyderabad Edition

SAFETY DAY CELEBRATION BY SEA INDIA ALONG WITH KISHKINTA AMUSEMENT PARK

National Safety day was celebrated on 4th March 2017 by Kishkinta Amusement Park at Chennai.

Senior office bearers of SEA india participated and explained the health and safety aspects to be taken care of in the amusement park.

National Safety Day Pledge was taken by all Kishkinta officials and the gatherings.

Two-day Workshop on "Occupational Health & Safety" organised at Kalasalingam University, Virudhunagar District

Two days workshop on **Recent Trends in Occupational Health and Safety** was conducted at Kalasilingam University, Srivilliputhur on 17th and 18th of February 2017 for the benefit of M.E Industrial safety Engineering candidates. Senior SEA India office bearers participated and discussed various topics on Industrial Safety and Health.

FOR THE KIND ATTENTION OF MEMBERS...

SEA (India) members are requested to send their **current postal address** and **active Email ID (personal)** to us at the earliest to:

seaindiachennai@rediffmail.com / safetyengineersindia@gmail.com

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