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SAFETY AND FIRE FIGHTING IN REFINERIES AND FERTILIZER PLANTS[1/]

by

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SUMMARY

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[illegible] REFINERIES AND FERTILIZER PLANTS—

SUMMARY

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J. Mariappan*

Petroleum Refineries and Fertilizer plants are highly specialised industries. Both petroleum Refineries and Fertilisers are vital for economical development of the nations. The Safety and Fire Fighting in these industries with large investments and costly equipments poses many problems which differ from those found in other industrial plants. Costly mistakes have been repeated in different Refineries and Fertilizers before specific cause of a fire and explosion become widely known and the appropriate remedy have widely applied. The world wide research programme on these fields are playing a big part in speeding up the process of investigation and the production of code of safe practices. In the field of industrial safety and fire protection the National Safety Council, America and National Fire Protection Association are playing a big role.

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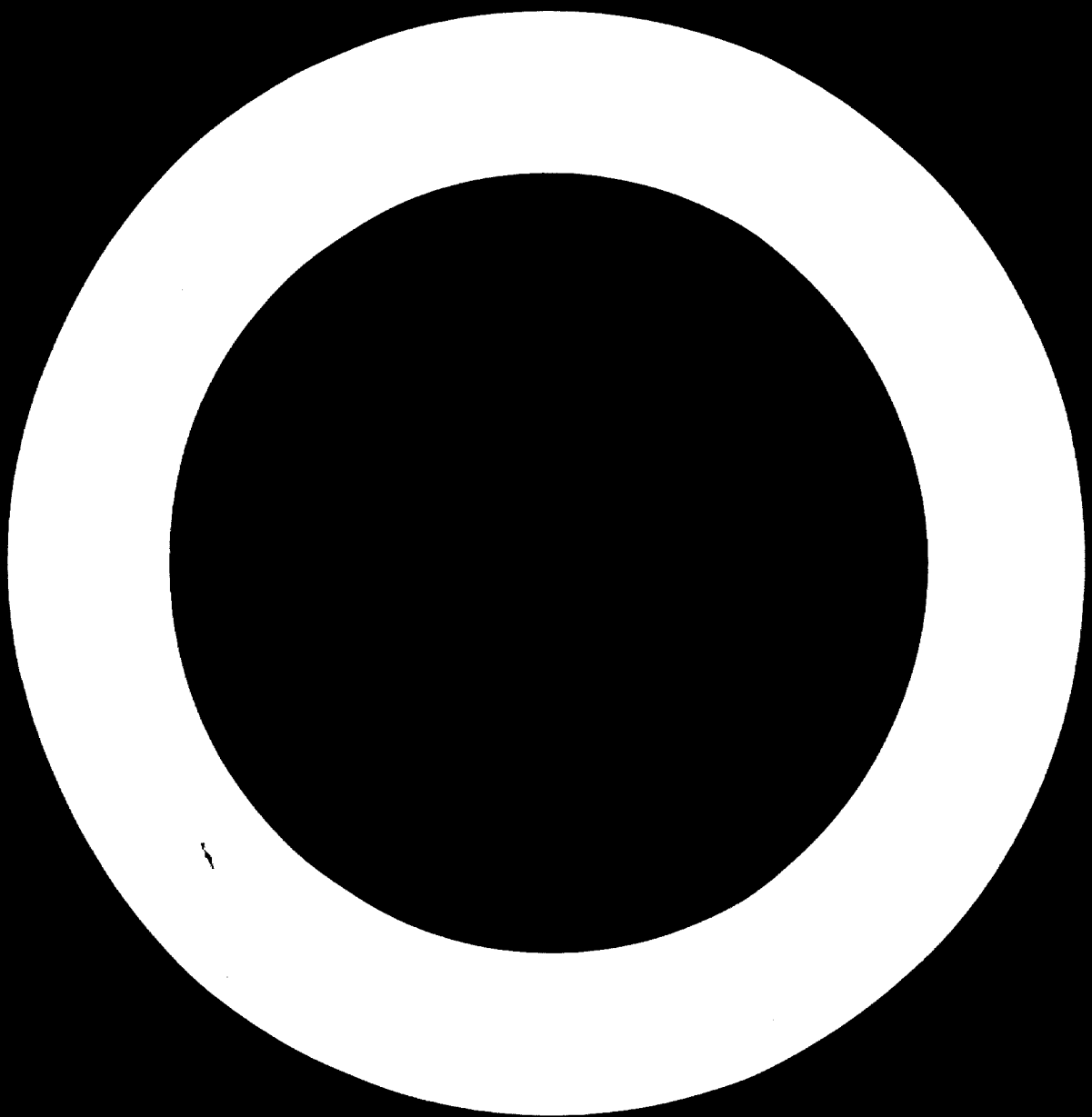


PHILOSOPHY OF SAFETY:

Elimination of industrial accidents are vital to public interest. Accidents produces economic and social loss, impair individual and group productivity, cause inefficiency and retard advancement of standard of living. It has been well said that "An injury prevented is a benefaction, an injury compensated is an apology". Safety of workmen is the responsibility of management with active co-operation of employees.

The enlightened industrial management in Refineries and Fertilizers had accepted this responsibility for preventing accidents in these industries.

Refineries and Fertilizer industries have developed many safety standards and established that engineering could prevent accidents; Safety could be sold to employees through education, and that Safety rules could be established and enforced. Apart from engineering, education and enforcement is the most important factor which influence safety in creating enthusiasm among employees. Therefore, continued effort to maintain interest in safety is very important.

TRAINING:

Effective training should be given to both supervisors and workmen. Workmen should wear personal protective equipments such as Safety Hats, Safety shoes and Safety Goggles and Respiratory protection such as gas masks, air line masks etc. Toxic materials such as Tetra ethyle Lead and H_2S have to be carefully handled. Smoking is restricted in Refineries and Fertilizers to limited areas only. Work permit systems for Hot work and cold work, excavation permits, vessel entry permits must be obtained by maintenance men before any maintenance work is undertaken in process units. Accident prevention basically depends on the desire of the workmen to work safely. Therefore continued interest in safety should be maintained by introducing Award Schemes, Safety Contests, Essay writing on Safety, good house keeping competition, issue of Safety News Letters periodically and sending Birth day greeting cards to the workmen on their birthday.

GENERAL FIRE PRECAUTIONS:

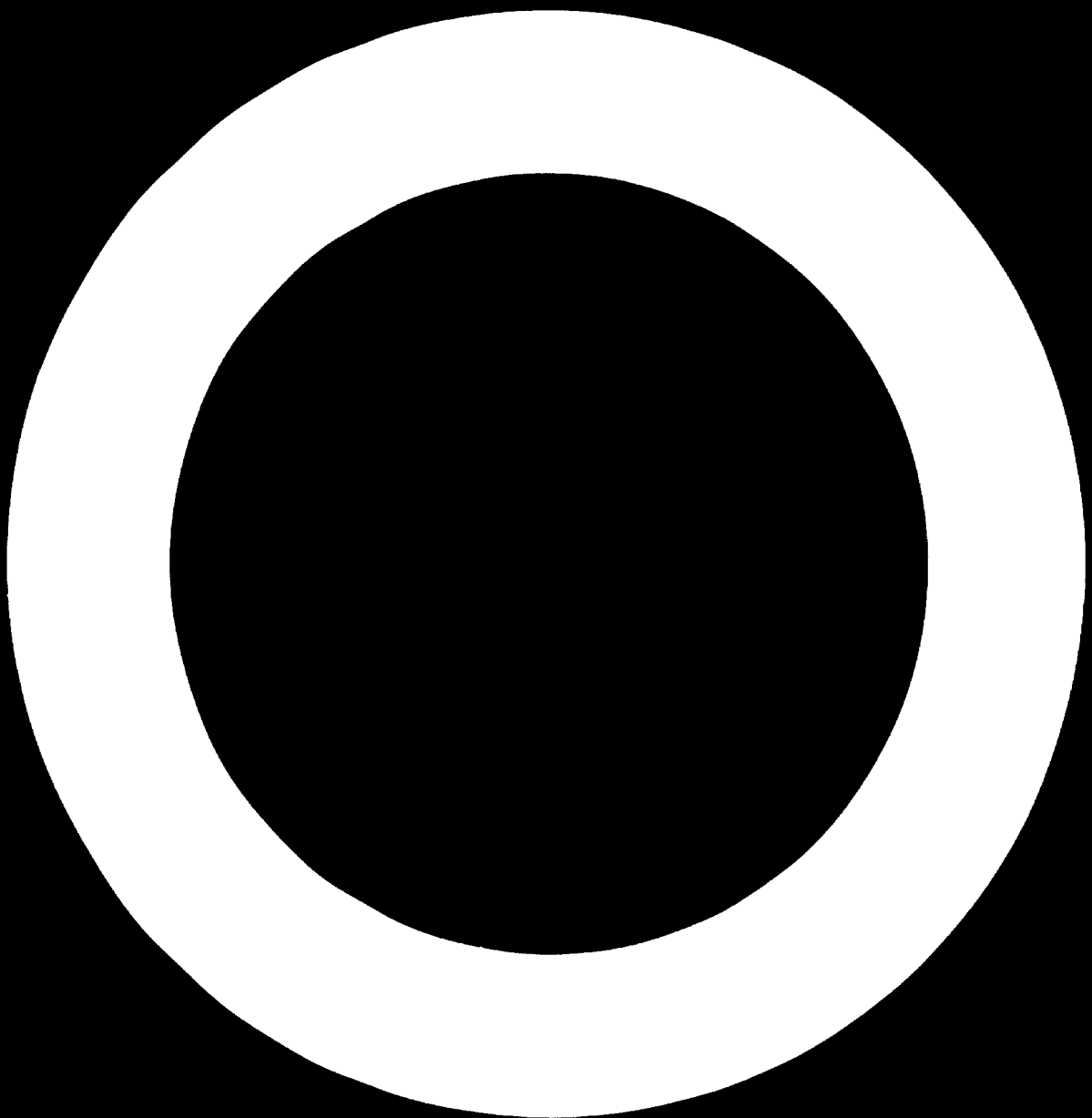
The entire plant personnel should be trained in Fire Protection and Fire Extinction. This training programme should include class-room instructions and live fire practices. Refresher course should be conducted periodcally to gain confidence so that, they could fight fires confidently when actual fire situations arises. Mutual aids between

nearby industries should be planned so that in an emergency help could be mobilised. This again emphasizes that fire fighting equipments should be of one standard. Pre-pressurised fire water mains should run around the process and storage areas and hydrants should be located at an interval of not more than 30 metres. Where fire risks are imminent, turret nozzles should also be placed. Suitable and adequate quantity of chemicals such as Mechanical and Chemical foam compound, dry chemical powders should be stocked. Their strength should also be tested periodically since prolonged storage may weeken the extinguishing properties of these chemicals. Portable and wheeled First Aids, Fire fighting equipments should be deployed in the plants for prompt killing of fire in the incipient stage itself. Where equipments are operating at higher temperatures and pressures, steam lances should be provided to smother fires without causing any thermal snocks and rupture of operating equipments. Close proximaty fire suits and fire blankets should also be provided at important locations to enable easy approach to otherwise unapproacheable places to close down valves to cut off supplies feeding fires. Mock fire practices should be conducted at intervals to keep the fire crew alert to fire situations. The plant personnel should also be knowledgeable in first aid to injured and first aid training must also be included in the training programme.

The plants should have preprepared disaster plans and civil Defence measures so that, they could be put into operation in an emergency. The personnel should be frequently refreshed on the emergency shut down procedures. Fire booster pumps should have alternate source of supply so that when power outage occurs they could be operated. Apart from the electrical driven pumps, at the design stage itself, planning should provide desiel driven fire pumps. An adequate storage of water for fire fighting should be available with appropriate drainage facilities.

CONCLUSIONS:

If proper safety and fire precautions are not observed the resulting mishap may be detrimental to the progress of these industries. It should be realised that accident and fire prevention is not a one time job but a continuous one.



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INTRODUCTION

Petroleum Refineries and Fertilizer plants are highly specialised industries, are vital for economical development of a nation. The safety and fire protection in these industries with large investments and costly equipment pose many problems which differ from those found in other industrial plants. Costly mistakes have been repeated in different Refineries and Fertilizer plants before specific causes of a fire and explosion become widely known and the appropriate remedies are widely applied. The world wide research programme on these fields play a big part in speeding up the process of investigation and the production of a code of safe practices. In the field of industrial safety and fire protection the National Safety Council, America and the National Fire Protection Association are playing a big role.

I. PHILOSOPHY OF SAFETY

Elimination of industrial accidents is vital to public interest. Accidents produce economic and social loss, impair individual and group productivity, cause inefficiency and retard advancement of the standard of living. It has been well said that "An injury prevented is a benefaction, an injury compensated an apology". Safety of workmen is the responsibility of management but active co-operation of employees is necessary.

The enlightened industrial management in Refineries and Fertilizers had accepted this responsibility for preventing accidents in these industries. Refineries and Fertilizer industries have developed many safety standards and established that, engineering could prevent accidents. The concept of Safety could be sold to employees through education, and Safety rules could be established and enforced. Apart from engineering, education and enforcement are the most important factors which influence safety in creating enthusiesm among employees. Continued effert to maintain interest in safety is therefore very important.

1. TRAINING

Training is one way of influencing human behaviour. Therefore, all employees should be given intensive class room training, in accident prevention principles based on their jobs, before they are sent to the actual work spots.

As a first step in this direction, supervisors should be given effective training because the immediate responsibility of preventing accidents is that of the supervisor, not because it has been arbitrarily assigned to him, but because accident prevention and production control are closely associated supervisory functions. They should be taught the elements of an accident, unsafe acts, unsafe conditions and accident investigation methods. The training course should include the basic needs of the worker, off-the job safety, workmen health and industrial hygiene, use of personal protective equipments, gas masks, industrial house keeping and fire prevention and control. The training should be repeated from time to time for new supervisors and also for the prospective supervisors. The supervisors training would produce - an increased understanding of safety, acceptance of responsibility for the prevention of accidents and greater interest in supervisory functions.

2. TRAINING OF NEW EMPLOYEES

On commencement of the new assignment, an employee should know the company's safety policy. Generally in the Refineries and Fertilizer plants certain safety rules are treated as conditions of employment such as wearing of safety helmets, safety shoes, boiler suits and wearing of goggles etc. The new employees should be issued with company's safety hand book.

3. SAFETY PRACTICES

The undermentioned general safety rules followed in Refineries hold good for Fertilizer plants also:

(a) Use of Safety Hats: Workmen should wear Safety Hats whenever they work within battery limits of the plants and also at places where the sign boards "HARD HAT AREA" are displayed.

During turn-around of operating units, all employees should wear their safety hats. This would prevent injuries from falling bodies from lofty heights. Many serious accidents have been averted by the use of safety hats.

(b) Use of eye protection: Where acids, alkalies, other chemicals and irritating gases are encountered, safety goggles should be worn by the workmen. As a matter of fact employees working in these areas should keep their goggles readily fixed on to their safety hats. Safety showers and eye wash fountains are available throughout the Refineries and Fertilizer plants for immediate washing down of any accidental spills of acids and chemicals.

(c) Respiratory protection: Appropriate type of gas canister masks and closed/open circuit self contained breathing apparatus are to be used whenever workmen enter into a confined and gaseous atmosphere. Refineries and Fertilizer plants provide a number of gas masks, air line masks etc. Most commonly used are MSA gas canister for acid alkali handling and for total protection such as Scott Air Pak etc. The employees should be thoroughly trained in the use of various types of gas masks. Dry runs should be conducted periodically to refresh the employees in the proper use of these life saving equipments.

(d) Safety Shoes: Refineries and Fertilizer plants provide safety shoes at subsidised rates to the employees. They generally have a concealed steel toe cap. They protect the employees from crushed foot injuries and ensure sound footing on the work spot.

(e) Smoking: Smoking is permitted in the Refineries and Fertilizer plants only in certain specified areas. Match boxes are not allowed to be carried inside the Refineries. Explosion proof lighters are provided in the smoking booths. Smoking outside the specified areas is forbidden.

(f) House Keeping: Good house keeping is a 'must' in these industries. Oil rags may give rise to spontaneous combustion.

they should be placed in covered metal containers. Oil and chemical spills must be washed promptly to help prevent slipping hazard and falls.

(g). Work permit system: No mechanical work should be carried out on operating equipment until authorisation is obtained from the manufacturing department in the form of a work permit. This system not only safe guards the workmen but also the operating equipment. Further the work permit system ensures that the manufacturing department has determined as safe to perform the designated job. Two kinds of work permits are generally issued - one for hot work and another for cold work. The permit issuing authority ensures isolating and depressuring of equipment, cleaning the area of oil and other combustible materials, covering hot lines, sewere man holes etc. They conduct gas tests with explosive meters to determine the explosive range of hydrocarbons before issue of hot work permit. The maintenance workmen must ensure all precautions stipulated in the permit are complied with and restrict the work to that particular equipment covered by the permit.

(h). Vessel Entry Permit: Before entering into any enclosed premises such as tanks, drums, towers, furnaces, sewers and other places which may contain gases or vapours, vessel entry permit must be obtained.

Validity and limitation of permits: Work permits are valid for the date and time specified in the permit. If the work has to be continued after the eight hours shift, the permit should be renewed after satisfying, that the conditions prior to the issue of permit have not been altered. If necessary, gas test is to be conducted before renewing the permit.

(i) Road cutting and Excavation permit: Road cutting in a Refinery and Fertilizer plant should be covered with a permit signed by the general engineering department to ensure the electrical cables and underground piping are not cut and damaged. Fire department should also be informed so that they can plan rerouting the fire truck for responding to any unforeseen emergencies. "Road Closed" sign board should be displayed whenever any road is closed.

(d) Maintaining interest in Safety: It is necessary to maintain interest in safety, because even with optimum working conditions accident prevention basically depends upon the desire of people to work safely. In order to maintain interest in safety in refineries and fertilizer plants, many plans have been introduced. Few of them are:

(i) Safety Committee Meeting: Safety Committee consists (a) Management Safety Committee (b) Departmental or Area Safety Committee for each operating area. In the area committee meetings, workmen and supervisors discuss various points on safety. Minutes of these meetings are circulated among departments for corrective actions. Where financial sanction to implement a suggestion is warranted the management safety committee presided over by the Chief Executive accords necessary sanctions. This system makes the top managements committed to safety of the plant and workmen.

Apart from discussion type meeting, the area committee should conduct inspection type of meeting also. The committee members must go round the plants to observe for maintaining a safe work environment and noting down the unsafe actions of workmen.

(ii) Safety Contests: As a part of maintaining interest among employees, safety contests should be conducted periodically and awards given to employees. Slogan, limerick, poster and essay competitions and house keeping competitions should also be conducted periodically. Safety Week celebrations, issue of safety news letters, sending birth day greetings to employees by the Safety Department are few schemes to maintain interest in safety. Mini posters in the monthly pay packets, display of safety posters and accidents statistics board at important locations would also help workmen to sustain interest in safety. The National Safety Council of America had set up four levels of awards to provide recognition for every good safety record of a plant. In order of merit the awards are (1) Award of Honour (2) Award of Merit (3) Certification of Commendation and (4) President's Letter.

The governments in certain countries have plans to award to industries (1) which had worked for longest accident free period (2) Who had reduced frequency rate of accident and (3) For percentage reduction in severity rate of accidents. They help

maintain a healthy competition to improve the safety performance among industries.

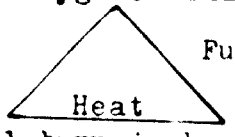
It is suggested that ILO should also introduce award schemes to stimulate safety ideas from among the workmen, seperately for different industries. The UNIDO should also consider awards to industries of the member nations to improve overall safety in different industries.

II. FIRE PREVENTION

Fire is a major hazard in the Refineries and Fertilizer plants. The best time to fight the fire is before it starts. It is an established cold fact that in most Refineries fire and Fertilizer fires are due to the failure of employees to comply with approved procedures and recognised safe practices and standards.

1. ANATOMY OF FIRE

Fire is a chemical reaction between and one or more elements to produce heat and light. Ordinary fire results from the combination of fuel, heat and oxygen. This is represented by a Triangle



When an element that will burn is heated to certain critical temperature called its "ignition temperature" it will ignite and continue to burn as long as there is fuel, temperature and continued supply of oxygen. Present studies in analysing the anatomy of fire reveal that the fuel molecules appear to combine with oxygen in a series of successive intermediate stages called branched chain reaction in arriving at the end product of combustion. It is these intermediate stages which are responsible for evolution of flames. The chain reactions are inhibited by the application of Dry Chemical Powder and the most effective Dry Powder is the Potassium Bicarbonite, because of its large size of Potassium Ion.

2. FIRE TRAINING PROGRAMME

Every employee in the Refinery has to be exposed to the effective pre employment fire training. Such training programme

should include class room instructions demonstration of various fire fighting equipments and appliances followed by live fire practices. Refresher courses should be conducted at periodical intervals on a phased programme to cover all the employees. Tactical exercises simulating emergency situations should be conducted at frequent intervals.

3. FIRE PROTECTION

Up-to-date operating procedures and instructions should be available in written form at the control room of each plant. On the job training and class room instructions on start up, shut-down and operating procedures should be on a continuous basis to cover new operators and refresher courses should be conducted for experienced operators. Permit to work procedure should be clearly established in written form and kept up-to-date. Periodic reviews of all operating and maintenance procedures are necessary to ensure that safe practices are followed and the lessons learned from experience are not lost. Regular plant visits by the operating personnel and also by a competent fire and safety auditing team are necessary for reviewing the adequacy of fire prevention, safe operations and plant standards. The fire safety audit team might be composed of a process engineer, fire prevention officer, safety adviser and possibly an industrial hygienist. Whenever any additional installation of new equipments or alteration of existing equipments are made, fire protection facilities must be taken into consideration.

4. FIRE FIGHTING

Successful fire fighting results from the systematic application of planned procedures. At all important locations, fire fighting procedures should be written and displayed permanently. In areas where there are number of industries conveniently situated it is a general policy to organise a mutual assistance scheme. Any serious fire situations will invariably involve, calling in for assistance from the public fire services and the fire units from nearby plants. Periodical combined tactical exercises between the nearby industries should be conducted. The mutual ....

assistance scheme will lead to increase efficiency by ensuring that more men and material are available at a short notice in those first vital 10 to 15 mts. to combat an emergency. In this scheme there is also a strong economical incentive , sources of man power and equipment , also fire fighting chemical supplies are pooled and the burden can be equally shared at a much smaller capital out-lay on fire fighting.

Prevention of fire spreads generally determines the success of extinguishing efforts. Proper placement of fire hydrants and turretnozzles is important to both control and extinguishment of fire. Adequate drainage of fire area assures against blazing oil, flooding to other unaffected areas. Blanketing pools of oil with foam will also guard against fire spread.

5. USE OF DRY CHEMICAL FOR FIRE FIGHTING

Dry chemicals should be used to replace foam as a first aid fire fighting medium because of its quick extinguishing action. Application of dry chemical to hydrocarbon fires should be very quick and the rate of application would have to be about 0.14 pounds/second per square foot and about 1 minute supply would have to be available. However, dry powder has a limited application and in its present form cannot replace chemical or mechanical foam when dealing with major fires involving low flash point stocks. It must be understood, that the continued existenceof flame in a given situation of hydrocarbon fires depend upon a chain reaction from one burning molecule to the other and the effect of using dry powder in its very fine form is to interrupt this chain reaction by the application to the atmosphere of myriads of fine particles of powder which prevents any further oxygen combining with flammable material or substances.

6. USE OF WATER ON PETROLEUM FIRE

Water has the highest specific heat of any known substance which gives remarkable cooling properties. Water should be used in the fine form of spray or fog for controlling oil fires and for preventing spread of fire from one place to another. Water can also be used as a curtain to prevent fire spread. In general water is ineffective as an extinguishing means on fires fed by

gases or vapoures from low flash stocks. However water is used to cool the containers. Water is used in Refineries and Fertilizer plants to cool or protect buildings, structures, pipe bands, equipments and tanks etc. from heat or flame impingement. A dense spray of water may also be used as barrier between flame and fire fighter to permit closer approach for closing a valve and to shut off flow of fuel feeding the fire. Water can also be used to stop bottom leaks of tanks. Adding water may float the oil above the level of the tank. This method is used to stop the flow of oil feeding and otherwise uncontrolable fire. The rate of water flow must match the rate of leakage. Once the bottom water level has been established, in case of oil leak from a open end pipe or valve fed at a pressure lower than the fire water nozzle pressure, it is possible to stop the escape of fuel by directing a hose stream into the opening till such time other steps are taken to stop the leak.

7. USE OF FOAM ON PETROLEUM FIRES:

It is necessary to maintain in Refineries large stock of foam compound to deal with large fires involving low flash stocks. The foam application ensures quick covering of the entire surface of the burning liquid and reduces the vapour formation to mix up in the oxygen and continue the combustion. Gentle application of foam avoids splashing of the burning liquid and spreading the fire. Foam can be used on a flammable liquid spill for covering to prevent possible fires. Foam should not be used on electrical fires since foam is nothing but an areated water. Effort to extinguish with the foam compound should not be attempted as there is only little chance of success if sufficient quantity of foam compound is not available for atleast 90 minutes application at the rate of one gallen of solution per minute per each 10 square feet of surface area.

8. EXTINGUISHING PETROLEUM FIRE:

There are three conventional methods of extinguishing the fire:

(i) Elimination of the fuel supply - Starvation method:

This is being done by operational procedures such as depressuring systems, blowing down a complete unit, pumping out tanks, closing pipe lines, valves and rerouting the flow.

(ii) Prevention of air from combining with fuel - Smothering method:

This is being done by diluting the air with an inert material to reduce the oxygen content by CO_2 or dry powder chemicals or by steam. Wet sacks or asbestos blankets could be used for fires in open containers, tank vents and tanker vehicles dome openings.

(iii) Elimination of heat - Cooling method:
This could be done by quenching and cutting off the flames where ever necessary.

(iv) The fourth method is by inhibition of chain carriers. Fire Anatomy of fire - II-1.

2. Inorganic Solid Fires

These fires are extinguished principally by fuel removal by operational means to reduce pressure, introducing steam and depressurising of unit involved. The small fires can be extinguished by dry chemical powder or steam. water in the form of spray can be applied on large area or intense fires that threaten damage to supporting structures and adjacent equipments.

(a) Transfer line and exchanger fires: Steam should be applied to the point of leakage. If the fire could not be extinguished by the use of dry chemical, water is to be sprayed to the area of leakage. Surrounding area should be cooled by applying water spray. Flow should be rerouted if possible.

(b) Trench and Pit fires: Foam is to be applied to this type of fires. Dry chemical is also effective. Water spray to prevent damage to nearby equipment should be continued.

(c) Pump and Compressor fires: Affected equipment should be taken out of service and isolated. Check if it is possible to drain or depressure the line from a remote control. Steam or dry chemical should be used to extinguish the fire. Spray water till the pump or the compressor is stopped.

(d) Furnace fires: Shut-down the units, cut the flames, steam to be cut into the tubes to protect the coils. Open snuffing steam into the furnace box. Do not use foam.

(e) Tank fires: 1. Cone roof tanks:- If fixed foam pourers are available, introduce foam immediately. For any reason if foam could not be used, protect the tank shell with cooling water.

Foam should be introduced into the tank by portable towers and maintain recommended delivery rate of foam. The rate of application of foam is one gallen per minute for every 10 square feet of oil surface. Avoid water jets into the tank as it would destroy the foam blanket and possibly cause boil over. Water is to be applied to the tanks down wind of the tank on fire.

. . Floating Roof Tanks: - On small seal fires, dry chemical extinguishers should be used to put out the fire. Water fog can be used to cool the exposed metal to avoid reflash. Cooling water should be applied to the shell.

(f) Tank Vent Fires: Fire at the tank vent can be extinguished by smothering with dry chemical, CO_2 or wet blankets.

(g) LPG Fires: It is very important to avoid endangering human life in the event of fire involving LPG equipment or serious leakage of LPG without a fire. If escaping gas is not on fire, close the leaking valve. Water spray should be used to disperse vapour. If thegas is on fire, do not extinguish unless leakage has been stopped. Apply cooling water to equipments exposed to heat. If the shut off valve is on fire, firemen with water fog and close proximity fire suits should be engaged to close the valve under the cover of the water fog. Dry chemicals are effective in extinguishing LPG fire.

10. PYROPHORIC - A SOURCE OF FIRE

The fuel gas contain varying percentage of hydrogen sulphide which cause pyrophoric iron sulphide deposite on the walls of the fuel gas linee and vessels. The pyrophoric deposits in these gae lines and vessele will ignite spontaneously when exposed to air. It is therefore important that, air should be excluded from fuel gas line. Pyrophoric iron should always be kept wet and finally disposed of by burning. Carbon Monoxide conversion catalyst after exposure to reducing gases under operating conditions, become pyrophoric and must not be exposed to oxygen or air and wetted to prevent rapid oxidation.

11. WATER AS A SOURCE OF DANGER

water as a source of danger to process unit has been present throughout the entire history of petroleum refining. This is true

because water will vaporize and expand in volume 1,600 times when it contacts hot oil at atmospheric pressure. This will cause violent surge in pressure and equipment will suffer considerable damage such as upset trays, warped pots and possible rupture. There is also possibility of water entering into the process system through leaking condensers, coolers, steam reboilers etc. There is very little a process man can do in advance concerning this contigency, but he should be cognizant of the fact whether water will flow to hydrocarbon or hydrocarbon to water in the event of such leak.

III. INDUSTRIAL TOXICOLOGY

1. TETRAETHYL LEAD $(C_2H_5)_4$ PB: It is the main constituent of anti-knock compound blended with gasoline and is most toxic and poisonous when it gets into the body and affects the nervous and circulatory system. TEL blending operators, laboratory personnel, gasoline tank cleaning maintenance crew come in contact with the leaded gasoline. This toxic compound absorption takes place through respiratory tract, alimentary tract and skin contact. The blending plant personnel should therefore scrupulously observe manufacturers safety recommendations. The management should provide protective equipment such as canister gas masks, air line apparatus, oxygen gas masks, white hand gloves and gum-boots. Critical supervision of workmen in order to ensure proper use of personnel protective equipment as well as complete compliance with recommended safepractices are essential. Strict attention to house keeping and all matters of hygiene and social amenities enforced by disciplinary measures are essential in the protection of personnel exposed to this hazard. A high level of efficient supervision is all important, to protect the workmen for all effects of this toxic and deady material. Evidence of lead absorption in the workmen concerned may be taken as proof of failure to follow the safety recommendations. Sludge containing TEL should be disposed of either by burning or by burying. The operators doing blending should be subjected to periodical medical check up to determine the lead poisoning.

2. HYDROGEN SULPHIDE

This is one of the most dangerous material, Refinery workmen are exposed to. It is an extremely toxic gas and therefore, every effort must be made to keep this material confined and to prevent its inhalation by workmen because of low allowable concentration of 20 parts per million exposure during an eight hour day. When hydrogen sulphide is inhaled accidentally, the sense of smell is rapidly deaded with the result an individual may inhale larger amount without being aware that he is inhaling the deadly gas. This gas is to be respected since it is a strange killer and always proper respiratory equipments should be worn by the workmen when encountering this gas. Whenever maintenance workmen open up any equipment of hydrogen sulphide gas service, they should wear respiratory protection.

3. AMMONIA

The liquid ammonia vapourises at 33.3°C at atmospheric pressure, hence it can freeze on any part of the body on contact. Vaccum may be created in vessels containing ammonia gas, when water is put into these vessels as ammonia has tremendous affinity for water and rapidly disolves in it.

Ammonia irritates and damages skin and mucous membrane, cause swelling in the throat and inflammation in the lungs with severe pain. Ammonia in the eye has caused blindness. The gas is fatal if breathed in strong concentration. Anhydrous ammonia can react with mercury under certain conditions, to form explosive compounds. Instruments containing mercury should not be used in ammonia service. Ammonia produces violent reactions when in contact with commercial acids.

Ammonia is flammable - flammability limits being 15 to 28 percent by valume. The major hazard is accidental release of this gas. In case of burns or serious exposure of eyes, it should be washed promptly with plenty of water and medical aid is to be saught. When opening pipes or vessels where the material is expected, breathing apparatus such as canister gas mask or self contained

breathing apparatus, rubber gloves and goggles must be used. Medicinal liquid paraffin or Dermatex ointment supplied by M/s. Siebe Gormen & Co. should be applied when skin has been attacked by Ammonia fumes.

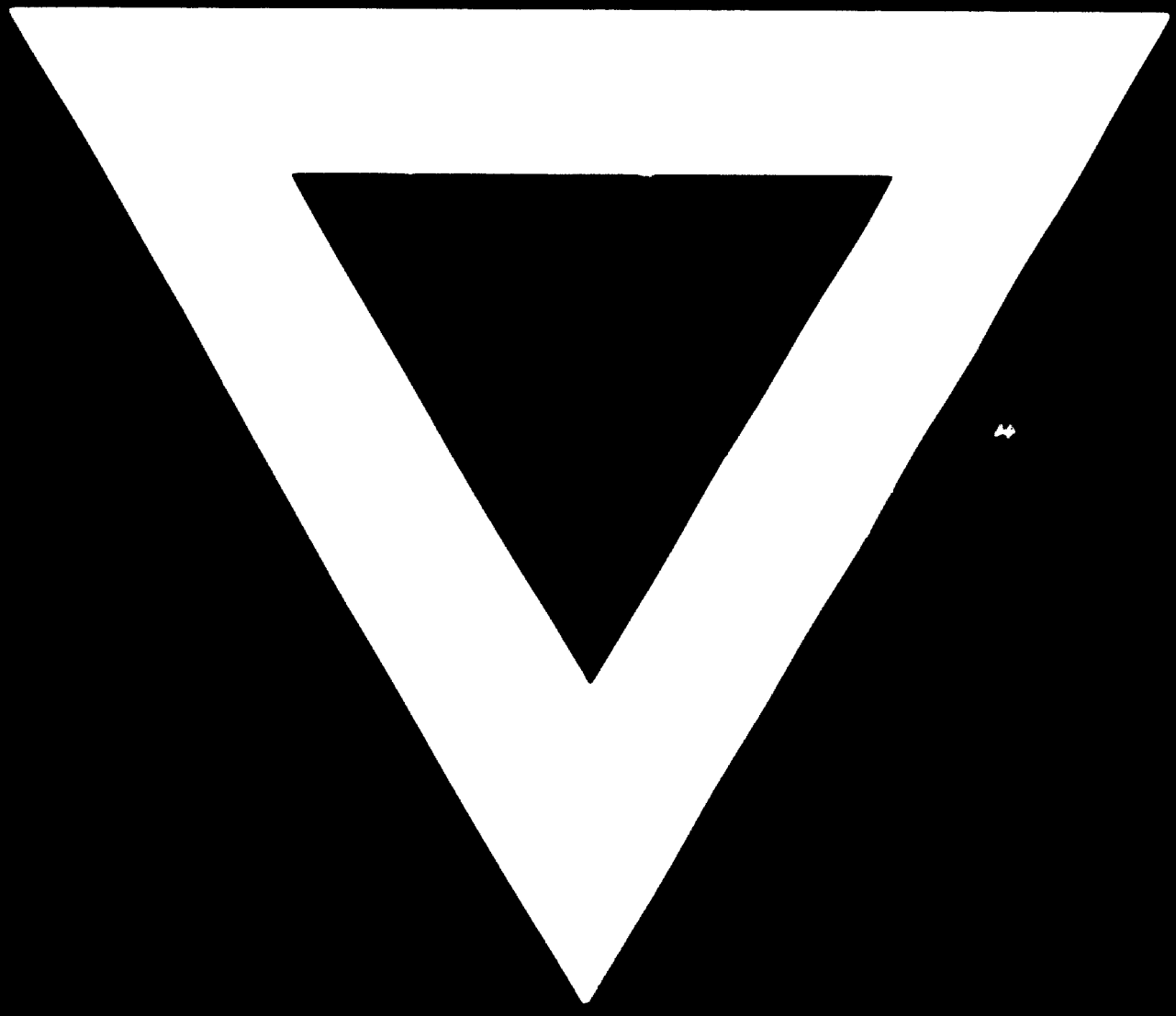
4. AROMATIC HYDROCARBONS

Aromatic hydrocarbons such as benzene, Toluene and xylene are used in these industries continuously. They are systemic poisons. Inhalation of high concentration of benzene vapours, for example, for few minutes can result in acute poisoning. Self contained breathing apparatus should be used by workmen when these gases are encountered.

CONCLUSION

The biggest safety hazard is the inconsiderate careless or unthinking individual. The Refinery and Fertilizer plants situations are not different. It is a cold fact that by far the majority of accidents are not caused by mechanical failure but by human error. Regardless how complex a industrial machine is, it is merely a tool in the hands of the man who operates it. It can only do what the operator makes it to do or permits it to do. Therefore, the careful worker is the best worker in an industry.

If proper safety and fire precautions are not observed, the resulting mishap may be detrimental to the progress of these industries. It should be realised that accident and fire prevention is not a one time job but a continuous one for the progress of these industries.



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