SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM NAGAR, KATTANKULATHUR-603 203.

DEPARTMENT OF MECHANICAL ENGINEERING

IS3267 INDUSTRIAL SAFETY LABORATORY-II

ACADEMIC YEAR 2024-2025

IS3267 INDUSTRIAL SAFETY LABORATORY – II L T P C 0 0 4 2

OBJECTIVES :

1. To provide opportunity to operate the equipment to acquire practical knowledge.

2. To know the various PPEs and software.

3. To carry out experiments to find out the environmental parameters.

4. To assess the impact of sensitivity of chemicals on explosion.

5. To run the software to assess the consequence effects of major accidents.

FRICTION TEST 9

Explosive materials like barium nitrate, white powder, amorces composition etc.

IMPACT TEST 9

Explosive materials like barium nitrate, white powder, amerce composition etc. Burst strength test of packaging materials like paper bags, corrugated cartoons, wood etc.

EXHAUST GAS MEASUREMENT AND ANALYSIS 9

Measurement of SOx, NOx, COx, hydrocarbons.

ENVIRONMENTAL PARAMETER MEASUREMENT 9

Air sampling analysis

TRAINING IN USAGE AND SKILL DEVELOPMENT 3

Road safety signals and symbols First-Aid training

STATIC CHARGE TESTING 2

On plastic, rubber, ferrous and non-ferrous materials.

ELECTRICAL SAFETY 2

Insulation resistance for motors and cablesEstimation of earth resistance,Earth continuity test

SOFTWARE USAGE 2

Dispersion modeling of various highly dangerous chemicals using ALOHA software

Total: 45 Periods

Equipment's Required:

1. Friction tester : 1No

2. Impact tester : 1No

3. Exhaust gas analyser : 1 No

4. High volume sampler : 1 No

5. First aid kid : 1No

6. Static charge tester : 1 No

7. Earth continuity tester : 1 No

8. Earth resistance meter : 1 No

9. Software : ALOHA,CAMEO

OUTCOMES:

The students will be able to

1. Analyze and run the various equipment to ensure safety environment in the industry.

2. Helpful to measure the particulate matter and assess the impact of air pollution.

3. Conduct experiments to find out various environmental parameters.

4. Use personal protective equipment independently.

5. Recognize the use of software to predict the real situations on major accidents.

CO - PO and CO - PSO MAPPING

IS3267	PROGRAM OUTCOMES					PSO's		
	1	2	3	4	5	1	2	3
CO1	1	-	-	-	-	-	-	-
CO2	-	-	-	-	1	1	-	-
CO3	-	1	-	1	-	-	-	-
CO4	-	-	1	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-
Average	1	1	1	1	1	1	-	-

1- low, 2-medium, 3-high

FRICTION TESTER

Aim:
To measure the Friction force required to ignite the given Particles.

Apparatus Required:
Friction Test apparatus, Different Weights

Procedure:

1) Place the materials in the setup plate.
2) Place the weight in the top of the taper plate.
3) Note down the weight of the plate.
4) Note down the time taken to travel.
5) Calculate the Friction force using the given formula.
6) Monitor the material for ignition.
7) Continue the procedure till the material got ignited.
8) Note down the force at which the material got ignited.
9) That is the Friction force of the material.

Formula:
Friction Force = Weight x $(\tan\alpha - (h/(gt^2 \sin\alpha\cos\alpha)))$ Newtons
Where,
$\alpha = 30°$, h= 0.2 meters
t = Time taken to travel
g =9.81

Tabulation:

Sl.No Weight Applied	Time Taken (t)	Friction Force	Ignition Status

Result:
The Friction force required to ignite the given material was calculated.

IMPACT TEST

Aim:
To measure the Impact force on the material for getting fired.

Apparatus Required:
Impact Test apparatus, Samples

Procedure:

1) Place the material in the impact tester.
2) Place the weight in the column.
3) Raise the weight from the lower point and drop.
4) Increase the dropping height gradually till the material got fired.
5) Note the reading.
6) Calculate the force for the material got fired.

Formula:
Impact Force – Wight X Distance Kg-cm

Tabulation:

Sl.No	Weight in Kg Height in cm	Impact Force	Fired Yes/No

Result:
The Impact force was measured.

EXHAUST GAS ANALYSIS OF AIR POLLUTANTS

AIM:

Themeasuring exhaust gas emissions in a two-wheeler using an exhaust gas analyzer is to assess the levels of harmful pollutants, such as carbon monoxide (CO), hydrocarbons (HC), and nitrogen oxides (NOx), emitted by the vehicle.

Exhaust Gas analyzer

An exhaust gas analyzer is a device used to measure the composition of gases emitted from the exhaust of an internal combustion engine, such as those in vehicles. It helps in determining the levels of pollutants like carbon monoxide (CO), hydrocarbons (HC), nitrogen oxides (NOx), and oxygen (O2). This information is crucial for ensuring compliance with emission standards, diagnosing engine problems, and optimizing fuel efficiency.

PROCEDURES:

- Ensure the two-wheeler is parked in a well-ventilated area.
- Make sure the engine is at operating temperature.
- Place the exhaust gas analyzer probe into the exhaust pipe of the two-wheeler.
- Connect the analyzer to its power source and switch it on.
- Calibrate the exhaust gas analyzer according to the manufacturer's instructions.
- This typically involves zeroing the analyzer
- And ensuring it's properly calibrated for accurate readings.
- Start the engine and let it idle.
- Allow the engine to stabilize for a few minutes.
- Place the probe securely into the exhaust pipe, ensuring a tight seal.
- Once stabilized, record the exhaust gas emissions readings displayed on the analyzer.
- Measure the levels of carbon monoxide (CO), hydrocarbons (HC), and oxygen (O2).
- Note any other pollutants measured by the analyzer, depending on its capabilities.
- Compare the measured emissions levels with regulatory standards or manufacturer specifications.
- Identify any pollutants exceeding permissible limits.
- Based on the analysis, make necessary adjustments to the engine or exhaust system to reduce emissions.
- Perform routine maintenance on the two-wheeler to ensure optimal performance and minimal emissions.
- Periodically repeat the emissions testing to ensure ongoing compliance and monitor the effectiveness of any adjustments made.

READINGS:

Time	CO(%)	Hexane In PPM	Propane in PPM	CO2(%)	O2(%)	NOX

CONCLUSION :

The measuring exhaust gas emissions in a two-wheeler using an exhaust gas analyzer is to measured and assessed the levels of harmful pollutants, such as carbon monoxide (CO), hydrocarbons (HC), and nitrogen oxides (NOx), emitted by the vehicle.

HIGH VOLUME SAMPLER

Aim:

Sampling of Particulate matter (PM10) in ambient air and the determination of its concentration.

Method:

Gravimetric Method

Principle:

Air with dust enters the sampler through circular inlet and passed through the impactor where all particles size more than 10 microns are removed. Particles equal or less than 10 micron passed through impactor. Design of impactor has been done for a cut off at 10 micron at flow rate 2.3 m3/hr. Particles greater than 10 microns hit on greased metallic surface and remains on the surface while dust less than 10 microns follow trajectory and reach to pre weighted filter paper where it accumulated. Accumulated dust on filter paper is obtained by weight difference while total volume of air sampled is given by difference of final and initial DG reading. PM10 dust concentration calculated simply by dividing weight of dust by volume of air passed through filters.

Instrument/Equipment:

1. Analytical balance
2. Sampler : Combo PM10 and PM2.5 Sampler with size selective inlet for PM10 and automatic volumetric flow control
3. Filter Jacket
4. Calibrated flow-measuring device to control the airflow at 16.67 l/min

Absorbing Media: Filter Media – A Glass fibre filter of 47 mm size.

Procedures:

1. Filter inspection: Inspect the filter for pin holes using a light table.
2. Loose particles should be removed with a soft brush. Apply the filter identification number or a code to the filter if it is not a numbered.
3. Condition the filter in conditioning room maintained within 20-30° C and 40-50% relative humidity or in an airtight desiccator for 24 hours.
4. Take initial weight of the filter paper (Wi) before sampling.
5. Place the filter paper in the sampling system securely and tighten the screws of the bracket.
6. Note down the initial dry gas meter reading and time.
7. Start the sampler and adjust flow rate as per guidelines.
8. At the end stop the pump, note down final dry gas meter reading and time.
9. Remove filter cassette from the filter holder and store in filter carrier immediately and transfer it to desiccators as early as possible.
10. Condition the filter after sampling in conditioning room maintained within 20 30° C and 40-50% relative humidity or in an airtight desiccator for 24 hours.
11. Take final weight of the filter paper (Wf)

Calculation:

Concentration of PM_{10} in µg/m3

$$PM_{10} = (Wf\text{-}Wi) \times 10^6/V$$

Where:

Wi : Initial mass of the conditioned filter before sample collection (gm)
Wf : Final mass of the conditioned filter after sample collection (gm)
106 : Unit conversion factor for grams (gm) to micrograms (µg)
V : Volume of air sampled (m^3)
[V= Final Dry Gas Meter Reading – Initial Dry Gas Meter Reading]

Result I :

The concentration of PM_{10} in ambient air is _____.

STUDY OF FIRST AID

Introduction

It is often very difficult to render medical care to victims of injuries, occurring at industrial environment, construction area etc. The nature of injuries and infliction may vary widely. This may lead to grave complication and can some times be fatal. It is therefore necessary to render aid to the victims as soon as possible on the spot itself and send them for further treatments to hospital. Often proper and prompt first aid will be the most essential saving factor. Every management should feed knowledge of first aid methods and facilities to a good number of personnel in the organization. First Aid boxes, First aid room are to provided as per the requirement.

Objectives

"First Aid is the immediate and temporary care given to the victim of an accident or sudden illness by a bystander until effective medical aid arrives".

Training:

The first aiders must be given sufficient training atleast in the following:

1. To determine the nature and severity of injuries.
2. To take urgent steps to control disturbances of heart action and breathing
3. To stop external bleeding
4. To bandage wounds
5. To immobilize injured body parts in case of fractures
6. To lift the victims properly
7. To remove the cloths of the victims
8. To shift the victims to the ambulance
9. To handle the victims properly
10. To utilize the materials available in a skilled way at the work site
11. To handle emergy situation when the affected persons are more.

First aid Box

Regardless of the number of employees there must be atleast one first aid box on site. Every first aider or occupational first aider should have easy access to first aid equipment and provision shall be made for every employee to have reasonably rapid access to first aid box. Each box shall be placed in clearly identified and readily accessible location and contain a sufficient quantity and suitable first aid materials and nothing else. Boxes are to be checked frequently to ensure that they are fully stocked and all items are in a useable condition. Sufficient qualities of each item should always be available in every first aid room. The first aid box or cupboard should protect the contents from dampness and dust and be clearly marked with a white cross, in red back ground. First aid equipment like stretcher in sufficient numbers may be kept in the first aid room in tip top conditions for use at any moment. De dusting at the time of usage is not safe for the victims movement.

Technique

If the casualty is not breathing and if there is no improvement after six inflations by exhaled air resuscitation or other method of artificial resuscitation used, then closed chest cardiac massage combined with mouth to mouth (or to nose) resuscitation should be commenced. (Silvester method of respiratory resuscitation – chest pressure arm lift method – can be combined with external cardiac resuscitation)

The casualty must be on his back on a hard surface. The first aider feels quickly for the lower end of the sternum and places the ball of the hand on it, with the second hand covering the first. After each inflation of the lungs, the first aider has to apply six to eight sharp presses at the rate of one per second.

Closed chest cardiac massage combined with mouth to mouth (or to nose)

First aid treatment of eye injury

Eye is a most delicate organ and even a slight injury is liable to be followed by unpleasant complications. Therefore all cases need medical attention.

First Aid Treatment of Fainting

Sudden, temporary loss of consciousness owing to rapidly developing anaemia of the brain is a frequent complication of various injuries. Fainting occurs with strong emotional strain and with pain caused by clumsy manipulations during bandaging or shifting or jolting during transportation.

When the patient faints, he suddenly turns pale, loses consciousness and does not respond to such external stimuli as calls or pricks. The pulse accelerates and weakens, the pupils are dilated and when fainting is deep do not respond to light.

Remove the victim from crowds or a stuffy atmosphere. The victim should be laid flat on his back with his head lower than his feet and his clothings loosened so as to provide a free circulation of air. He may be allowed to sniff of smelling salt. Water should be sprinkled on the face. Artificial respiration can be applied.

Conclusion:

First aid is the care given to the victim by the available person nearby till medical assistance is got. Person with qualification and training can give first aid treatment. The first one hour after accident is the very vital period. The treatment given within one hour after the accident is the golden hour of treatment. The important golden rules of first aid is "Do first things first, quickly, quietly and without fuss or panic and speaking encouraging words to the victim."

STATIC CHARGE TEST

Aim:
To measure the Static voltage in the environment or an object.

Apparatus Required:
Static Meter

Procedure:

1) Switch on the power in the static meter.
2) Set zero value.
3) Keep the meter where you want to test.
4) Press the red button to measure
5) Measure in the different places and in objects.
6) Tabulate the reading.

Tabulation:

Sl.No	Name of the place/object	Static Voltage

Result:
The static voltage was measured and recorded

EARTH CONTINUITY TESTER

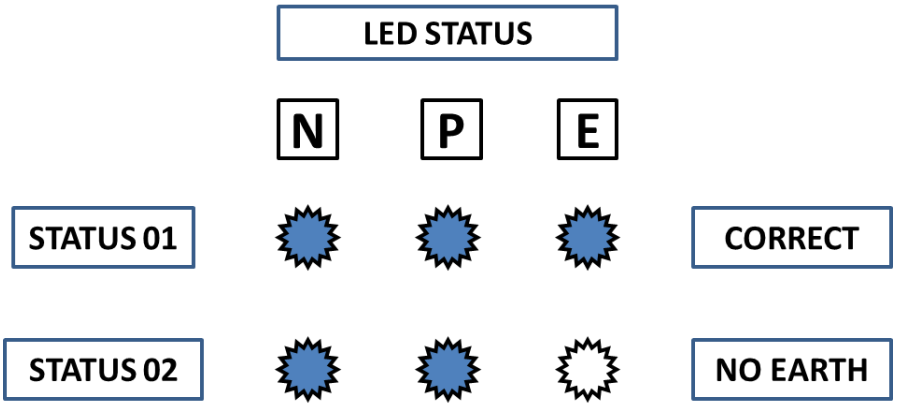
Aim:

To ensure that electrical circuits connected to the Earth are properly grounded and verify the integrity of the grounding system to prevent electrical hazards and ensure safety.

Apparatus Required:

Socket Earth Tester

Status of the Continuity tester:



Procedure:

- Connect the socket earth tester plug into the near live plug socket
- Switch ON the power plug
- Ensure the status 01
- Switch of the live power plug.
- Disconnect the earth connection (Green Wire)
- Ensure the status 02

Result:

Electrical circuits connected to the Earth are properly grounded is ensured. The integrity of the grounding system is also verified.

EARTH RESISTANCE METER

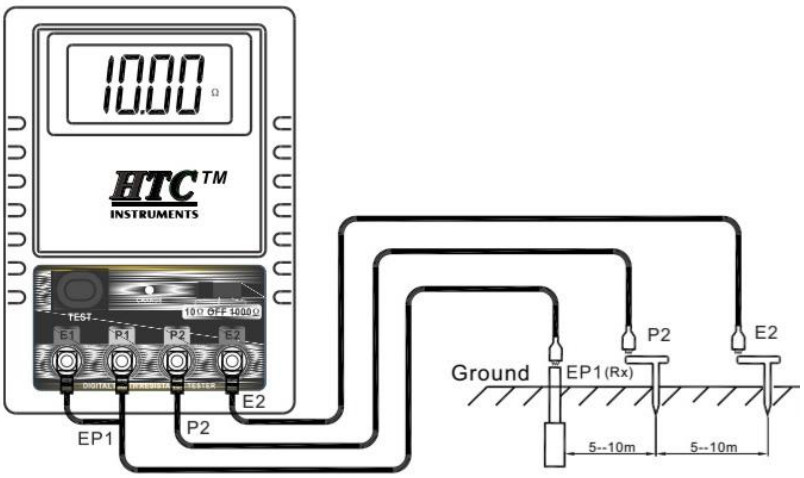
Aim:

To measure earth resistance in an earth pit is to assess the effectiveness of the grounding system in providing a low-resistance path for fault currents to dissipate safely into the earth.

Apparatus required:

DET 99 Digital Earth Resistance Meter

Procedure:



- Read the manufactures Instructions
- Install the tworeference (auxiliary) electrodes near the distance of 5m from earth pit.
- Connect the different colored test leads to the instrument terminal EP1 (E1 and P1 in parallel)to earth pit electrode, P2 to auxiliary electrode 01 and E2 to auxiliary electrode 2.
- Set the function switch in 10 0r 1000 and press the test switch to do the measurement.
- Note down the resistance readings

Table:

S No	Earth pit no	Earth Pit Resistance

Result:

Earth pit ideally should be a low resistance value, indicating efficient grounding and safe dissipation of fault currents to prevent electrical hazards.

SIMULATION & MODELING OF POOL FIRE BY USING ALOHA SOFTWARE

Aim:

To simulate and model a pool fire using ALOHA software to assess the potential impact on surrounding areas and populations.

Procedures

Define scenario

In a small industrial park outside Baton Rouge, Louisiana, a 500-gallon, 4-foot-diameter, vertical tank

contains liquid benzene. On June 20, 2016, at 10:30 p.m. local time, a security guard discovers that liquid is leaking out of the tank through a 6-inch circular hole located 10 inches above the bottom of the tank. He also sees that the liquid is flowing onto a paved area in the industrial park. The guard thinks that the tank has just been filled that evening.

The temperature on scene is 80°F, with the wind from the southwest at 7 miles per hour (as measured at

a height of 10 meters by a fixed meteorological tower at the site). The sky is more than half covered by clouds and the humidity is about 75 percent. A thunderstorm is approaching from the southwest. There is no low-level inversion. There are very few buildings in the industrial park and a large grassy field is located to the northeast of the industrial park.

The Local Emergency Planning Committee has requested that on-scene responders use ERPG-2 concentrations to define the toxic endpoints in their analysis of benzene hazards.

In this example scenario, you'll determine:

1. Distance to the ERPG-2 level if the puddle evaporates and forms a toxic vapor cloud.
2. Thermal radiation threat if a lightning strike ignites the puddle and forms a pool fire.

Parameters:

Define the parameters of the pool fire scenario you want to model. This includes specifying the location, size, and characteristics of the pool fire, such as the type of fuel involved and the weather conditions.

Input data:

Input the necessary data into ALOHA, including information about the physical properties of the fuel, the terrain, and any nearby structures or populations that could be affected by the fire.

Run the simulation:

Run the simulation in ALOHA to model the behavior of the pool fire over time. The software will calculate the dispersion of smoke, heat, and other hazardous substances released by the fire, taking into account factors such as wind speed and direction.

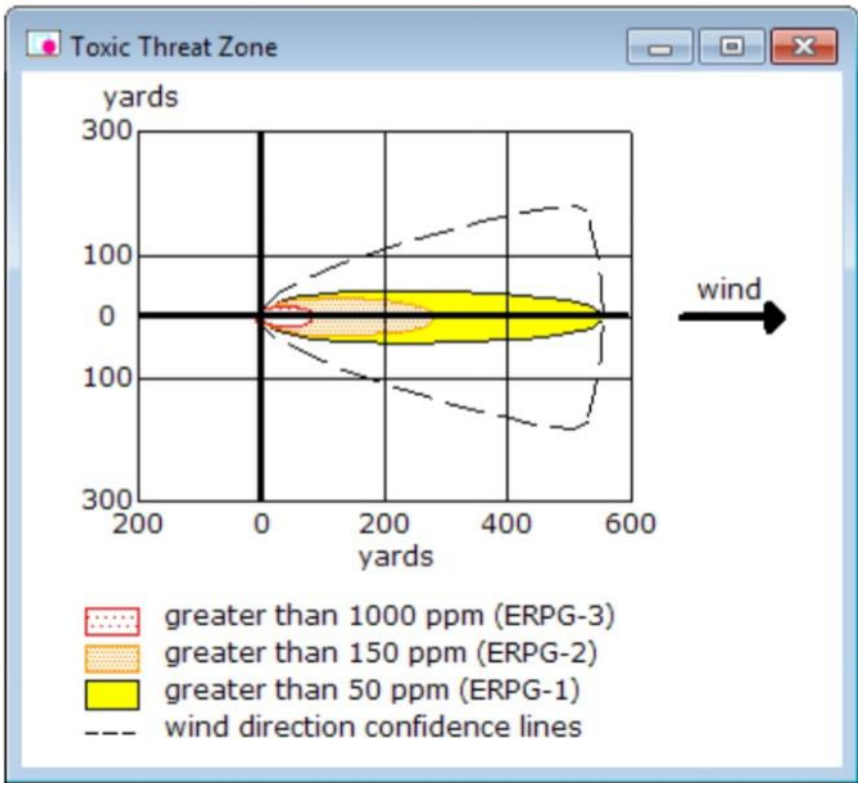
Analyze results:

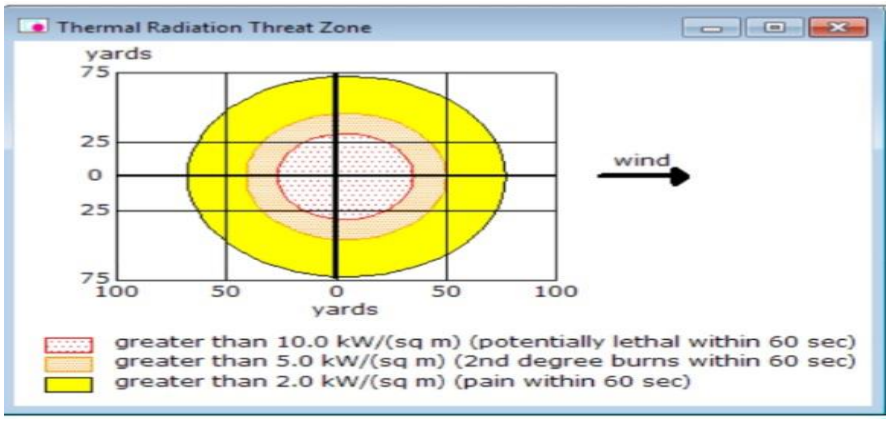
Analyze the results of the simulation to assess the potential impact of the pool fire on surrounding areas and populations. This may include evaluating the extent of smoke plumes, the concentration of hazardous substances in the air, and the potential for thermal radiation exposure.

Refine and iterate:

If necessary, refine the parameters of the simulation and run additional iterations to further analyze the potential impacts of the pool fire and explore different scenarios.

Scenario	Toxic Dispersion	Pool Fire
Threat Modulated	Toxicity	Thermal Radiation
Red Threat Zone	82 Yards	36 Yards
Orange Threat Zone	281 Yards	50 Yards
Yellow Threat Zone	561 Yards	77 Yards





Conclusion:

The simulation and modeling of the pool fire using ALOHA software provide valuable insights into the potential risks and impacts associated with such an event. By accurately predicting the behavior of the fire and its effects on the surrounding environment, emergency responders and decision-makers can better prepare for and respond to similar incidents, ultimately reducing the potential for harm to people, property, and the environment.