iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 11 Issue: IV Month of publication: April 2023

DOI: https://doi.org/10.22214/ijraset.2023.50201

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 11 Issue IV Apr 2023- Available at www.ijraset.com

Hazard and Operability Study of Rotary Drum Dryer in Hazardous Waste Management Industry

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Abstract: The HAZOP study is distinguishing the Hazards related to process, equipment and working methods and evaluate the probability take control measures to protect the workers and company asset. in this project analysand details hazards and Operation failure modes to affect the production and legal requirements. Such as The Atmospheric gas monitoring equipment needs to be installed around the machines to detected LEL and TVOC compounds to eliminate environment concern and Worker's health. the overall purpose of the study to identify the hazards and risks, then remove/minimize the hazards by providing recommendation control measures. And Create danger free zone workplace. In this paper I have used quantitative and quantitative methods used to find the Operation failures and Possible Hazards. I have analyzed and exam pined the work/process locations is has more hazards to work more difficult even though in good housekeeping and preventive measure.

I. INTRODUCTION

A. Company Profile

Greenhouse gases and global warming, the efficient use of non-renewable fossil fuels, toxic residues, water and soil pollution are at the center of environmental issues and public debates. Cost competitiveness, global competition and profitability are all business concerns. The challenge of today's society is to reconcile environmental protection and economic interests. Waste management is a problem in developing and transition countries. In many of the of these countries, waste is discharged into sewers, dumped on company premises or incinerated, dumped illegally in inappropriate locations, or disposed of in landfills that do not meet environmentally sound final disposal requirements.This can contaminate soil, water resources and the atmosphere, leading to a permanent deterioration in the living conditions and health of the surrounding population. Toxic substances and persistent compounds are released into the environment, become widely airborne and can enter the food chain, affecting human and animal health.Green Gene Enviro Protection and Infrastrture Private Limited- Ranipet (GGEPIL) is engaged in the development, operation and maintenance of hazardous waste management infrastructure projects. We are able to co-process waste and hazardous raw materials in cement plants to produce alternative fuels and recover energy and raw materials. This ensures the total destruction of waste and the use of energy by avoiding waste and use of energy by avoiding the waste of energy and resources in any form.Our processes are established, technically tested and legally approved. The Alternative Fuel Resource Facility (AFRF) was established after CTE and received CCA to operate the facility at GEPIL, Lot No. 60, SIPCOT Phase III, Ranipet, Tamil Nadu.

B. Rotary Drum Dryer

rotary dryer consist of a drum several meters long with a diameter of ~2 m, inclined at an angle of 3-4° to the horizontal and rotating on its own axis at a speed of 4-8 revolutions per minute . The drum has internal structures (ribs, vanes, or paddles) that mix and break up the solid sludge particles and help them flow along the drum as they are dried by a stream of hot air circulating along the drum

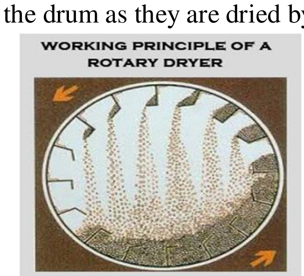

Figure-1.Working Principle of dryer

Rotary drum Dryer at Green Gene Enviro Protection and Infrastructure Private Limited-Ranipet

Figure-2 .Main View of Rotary Dryer

Figure-3. Side View of Rotary Dryer

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C. Major And Critical Equipment

Raw Materials Handling System (RMHS- Belt Conveyors, Crusher, and Storage Yards for Raw Materials storage purposes)
Burner (coal hopper, screening, Coal Storage area)
Rotary dryer feed Charging Equipment (Feeding Conveyor, Crusher)
Rotary dryer shell sealing system, support rollers, Dryer drive system.
Off-gas Handling area - Dust Settling Chamber (Cyclone Separator, Wet scrubber and ID Fan with Chimney etc.
Electrical Panel Room

D. Process Flow Diagram

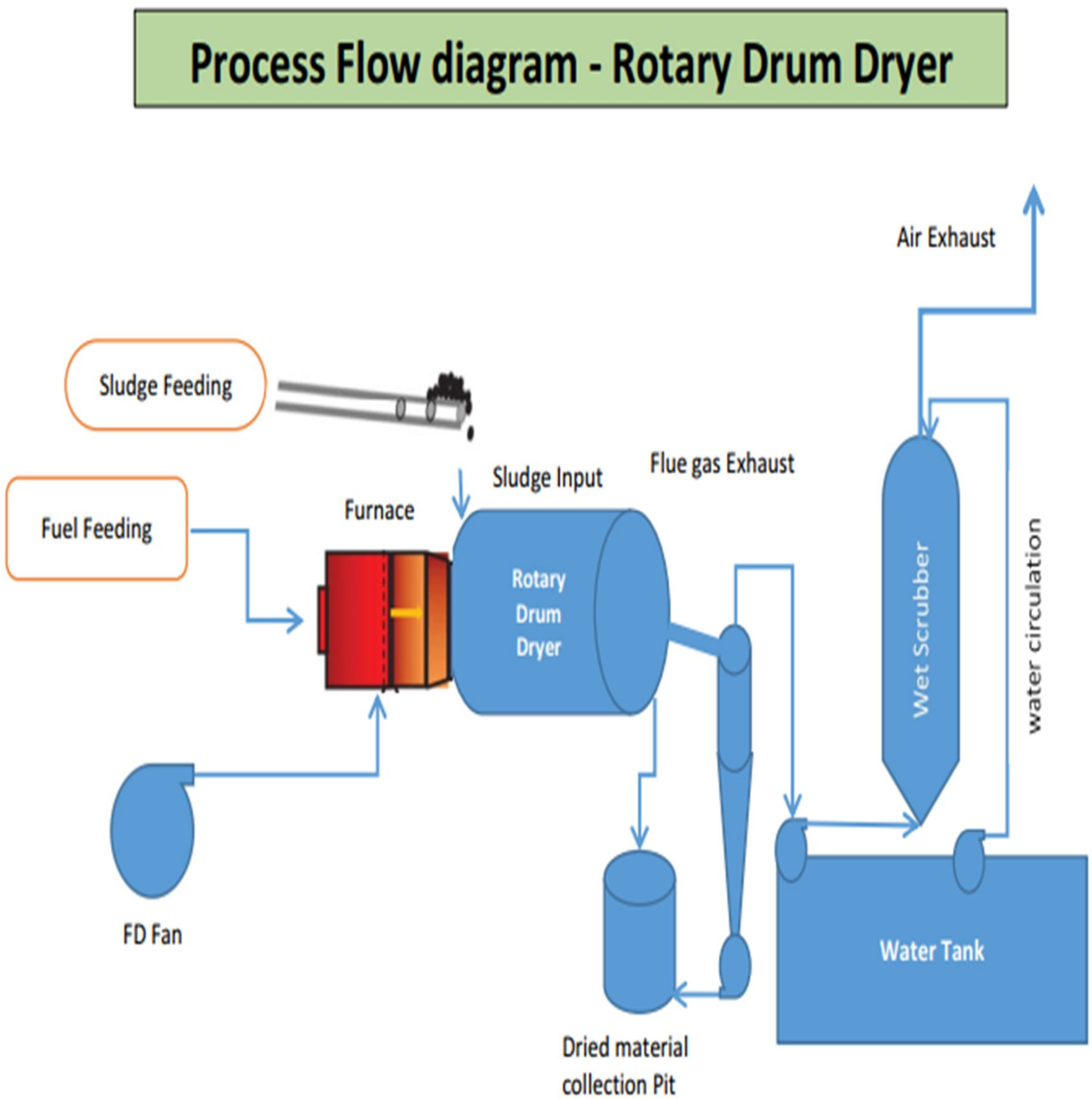

Figure . 4 .Process Flow Diagram

The Bio Sludge Material feed into the rotary dryer through the belt conveyor at the rate of 2MT per Hour. And dried the material inside the dryer with 350 degree Celsius with Minimum holding time. The Hot air used for drying the materials with co current flow condition.The dried material collected at storage pit and then despatch.The flue gas emitted from the process were controlled by wet scrubber.

1) Input Details

Material Qty in MT	CV Kcal/kg	% MOI	% ASH	VOC
2	250	56.31	34.38	6000PPM

2) Output Details

Material Qty in MT	CV Kcal/kg	% MOI	% ASH	VOC
0.1	268.63	1.06	61.14	0 PPM

II. HAZOP STUDY

A. What is HAZOP?

Hazard and Operability (HAZOP) is a systematic approach to identifying potential problems that can be discovered by reviewing design safety and examining existing processes and operations in the chemical, pharmaceutical, oil & gas, and nuclear industries.

B. What is the purpose of HAZOP?

HAZOP, also known as HAZOP testing or HAZOP analysis, is a method of process hazard analysis (PHA) recognized by the OSHA Standard for Process Safety Management (PSM). It is a form of risk management with the aim of recognizing, evaluating and controlling dangers and risks in complex processes.It includes highly hazardous chemicals that, if handled and handled improperly, can cause serious injury to workers and widespread damage to company property and reputation. Help the organization meet:
potential threats in running a business;
past accidents with probable catastrophic consequences;
human-controlled factors; AND
Consequences of the ineffectiveness of the control measures applied, taking into account the extent of possible risks to health and safety.

C. HAZOP Rules

The basic concept of hazard and functional research is to write a comprehensive description of the process and examine each part to determine what deviations from design intent may occur and what the causes and consequences may be. This is done systematically through the use of suitable keywords.

D. HAZOP Study Scope

HAZOP (Hazard & Operaability) study is designed to identify plant hazards and identify operational problems that, while not hazardous, may affect the plant's ability to achieve planned productivity. A hazard assessment is carried out to determine the existing hazard, the consequences that may arise from the hazards, the likelihood of events that would lead to an accident with such consequences, and the likelihood that the safety, damage control and warning systems operate, identify emergencies and plan to evaluate the performance of the property and eliminate or limit the impact
HAZOP requirements:
Process flow diagrams
Detailed description of the process
purity of materials Process
Operations and Safety Manual
maintenance schedules and history.

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III. METHODOLOGY

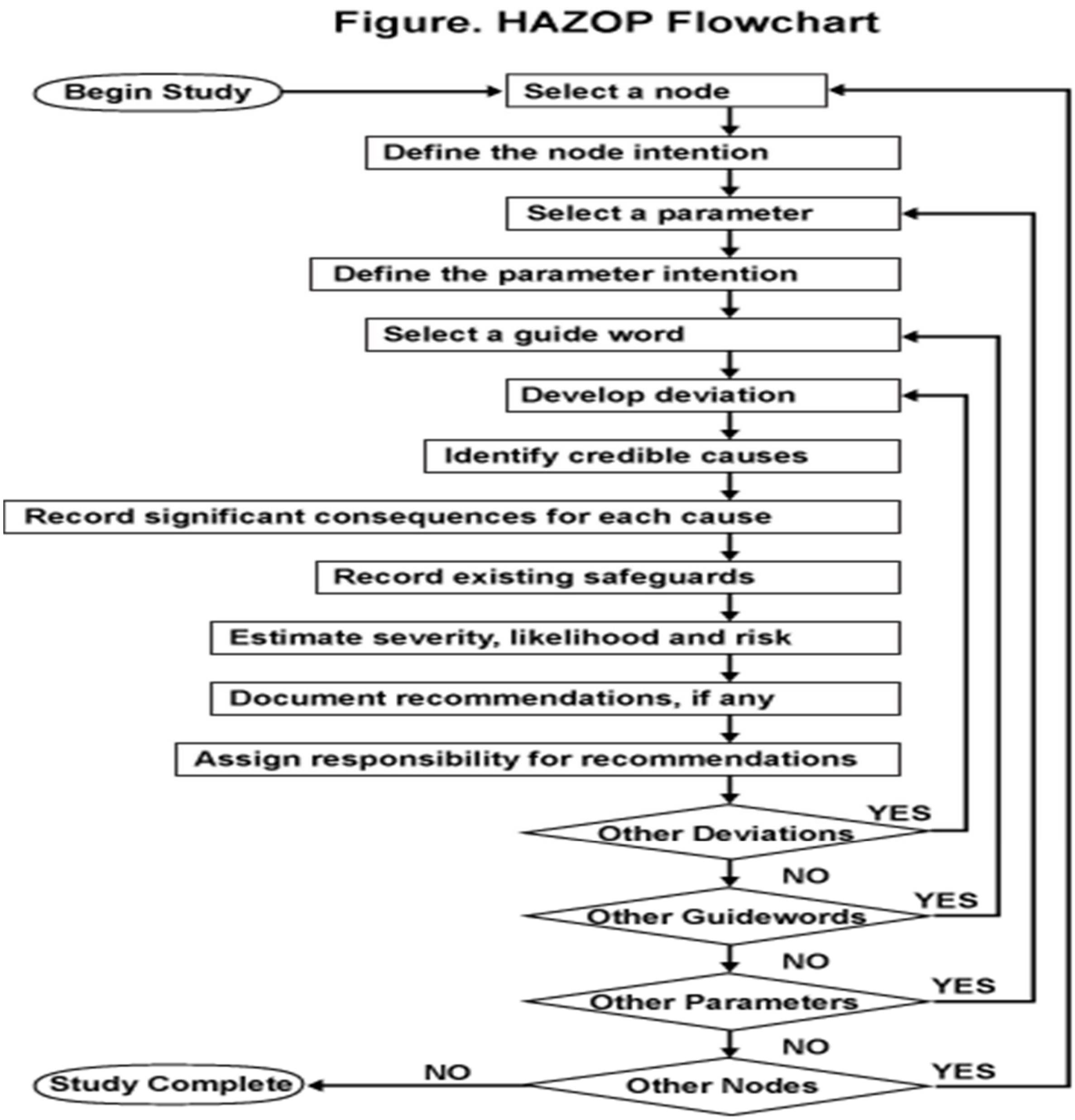

Figure-5. HAZOP Flow chart

A. HAZOP procedure

The HAZOP worksheet discussed during the HAZOP confrontation included the following details:

Guide word
Parameter
Deviation
Causes
Consequences
Safeguards
Recommend actions
Remarks

B. Guide Word

keyword gives the team a starting point for identifying problems. Using a long list of keywords is important to get the most out of your HAZOP study. The HAZOP checklist should be used as a journal to identify hazards that may have been overlooked during the brainstorming session. For each threat, the root cause, consequences and any protection measures already implemented in the project are identified.

C. Parameters

A parameter is an aspect of a process that describes it physically, chemically, or in terms of what is happening.

D. Deviation

A deviation is defined as an unjustified/undesirable change in a parameter. A gap is created by combining a parameter and a guide word.

E. Causes

The original cause must be determined for each hazard in order to be able to determine appropriate protective measures for the causal events.

F. Consequences

In assigning a consequence level to the hazards, the HAZOP team considered the following factors:

- Current status of the safety and control concept
- Physical conditions and work environment
- Educational level, experience, skills, education, etc. Staff of the institution

G. Safeguards

The study identified the existing design safeguards for each hazard. Security types typically include:

- Preventive measures to prevent the occurrence of the cause of the event
- Investigative security, the aim of which is to improve the response time to an event
- Protections aimed at protecting against an escalation of the impact and which are always applied, regardless of whether the event occurs or not
- Mitigation aimed at reducing the severity of the consequences of an escalation, activated according to the cause of the event and the consequences of the escalation

H. Actions / recommendations

The method identifies the causes of deviations from the design intent by using keywords.The ultimate impacts are then identified and recorded without reference to existing mitigations (examples of mitigations are plant design, control systems and procedures). The consequences are then compared to the safeguards and the HAZOP team then decides if the current safeguards are appropriate. If the team deems them insufficient, it is recommended to consider or add other guarantees.

The HAZOP study was based on a series of P&I diagrams for the sections to be inspected. (A copy of the P&I charts used in the study is included in Appendix I.)The following backup documents were also used during the HAZOP session

I. HAZOP registration:

Study interviews are recorded in journals. Information is stored in log card columns as follows:

Words
Parameters
Deviations
Causes
Consequences
Safeguards
Recommendations

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J. Guide words used in HAZOP Study

GUIDE WORD	MEANING
NO	Negation of the design intent (e.g., no flow when there should be; no pressure when there should be
LESS	Less of a physical property than there should be —qualitative decrease (e.g., lower flow rate than there should be)
MORE	More of a physical property than there should be —qualitative increase
PART OF	Composition of the system (stream) is different than it should be—qualitative decrease (e.g., less of one component)
AS WELL AS	More components present than there should be —qualitative increase (e.g., extra phase or impurities present)
REVERSE	Logical opposite of the design intent (e.g., reverse flow)
OTHER THAN	Complete substitution (e.g., transfer of a material other than the material intended; transfer of a material to a location other than intended)

Figure-6. Guide Words

IV. HAZOP WORKSHEETS

Table.1 -HAZAOP worksheets

Plant: Solid Section	Process Section: Solar drying area
Node:-	Phase:-
Process Line/Equipment: Coal feeding to Furnace through conveyor	Date & Time:

Guide word	Deviation	Immediate Causes	Consequences	Existing Safe guard	Risk Level	Recommended Action	Remarks
More	More Coal inside burner	Loading of coal in higher amount due to worker error	1.Due to overloading conveyor motor became too Hot and make fire 2.Accumulation of Bio waste in shaft and conveyor idler make conveyor belt became damaged 3.Spillage of waste from conveyor make slippery floor, that is leads to Injury 4.Clinker formation due to High Pressure and Temperature inside burner 5.Materials jam inside roller if difficult to run the operation	Pull Chord Switch Available	High	Flow meter, Fire Fighting Equipment to be placed near Dryer	-

Less	Less coal Inside burner	Loading of coal in less amount due to worker error	1.Production loss delay due to Low Temperature and pressure 2.Rotary dryer MOC degradation due to Empty load Heat	Feed limit switches available	Medium	Flow meter, Fire Fighting Equipment to be placed near Dryer	
		Slide valve in Hopper partially closed					
		Materials Spillage from conveyor					
		Raw Materials available in low					
No	No Coal	No coal Available	1.Affect productivity	Feed limit switches available	Medium	Flow meter, Fire Fighting Equipment to be placed near Dryer	
		Slide valve in Hopper full closed					

V. RESULTS AND RECOMMENDATION

From the HAZAOP studied the following recommendation have been made

- Installation of LEL and TVOC gas detector and its connected with Flameproof control panel monitors and alarm.

A. Design

Fixed gas detection systems are required to detect and alarm elevated levels of all airborne volatile organic compounds as specified in "NFPA 325M" for related combustible gas groups. The system must be designed to allow rapid response to an emergency situation and to prevent unauthorized system bypass or alarm reset. The design should allow each gas detector (sensor) to be accurately and efficiently tested or calibrated at regular intervals. System design must provide a way to test each detector without shutting down the entire system or causing accidental equipment shutdown, per ANSI/ISA-12.13.02 - 2003 (IEC 61779-6 Mod.).A system consists of one or more detectors linked to a control unit or logic system to provide audible and visual alarms in the field and in monitored control buildings. The system should not be used to automatically initiate shutdowns of process equipment. Fire detection and control shall not be incorporated into a gas detection system

B. Environmental Conditions

Each part of the sensor system, alarms and associated electronics is designed to operate in the environment for its particular application and location.

C. System Description

1) General

Continuous ambient air monitoring for the presence of volatile organic compounds, sulfides, or combustible gases in designated areas shall be accomplished by a gas detection system that includes: detectors and housings (detector housings); logic or control unit; transmission cable connector; Visual and audible alarms in control buildings, at detector positions and at access doors to unmanned positions.

2) Detector Selection

Detectors (sensors) must use elements resistant to poison. Diffusion adsorption type semiconductor detectors are used for continuous monitoring of hydrogen sulfide. Sensor response should not be affected by changes in ambient temperature. The Catalytic Diffusion Detectors are preferred for continuous monitoring of combustible gases. The use of open path infrared detectors requires prior approval from the head of the proposing organization and the Inspector General, Division of Process Equipment, Division of Process and Control Systems.

The specific or predominant gas to be detected at the designated location is identified and the detector is calibrated for that gas.If more than one combustible gas is present in a given location, set the detector calibration for the most difficult (least sensitive) component to detect. The combustible gas used for calibration must comply with CSA under the following conditions: For instruments designed specifically for methane detection or for general combustible gas detection, methane must be used to calibrate LEL sensors, up to Instruments for general purpose detection of combustible gases other than methane, propane gas can be used to calibrate the LEL sensor for instruments intended to detect a specific combustible gas or vapor other than methane, use the actual gas recommended by the manufacturer. Calibrated range for fixed detectors should be: 0 to 4000 PPM - Volatile Organic Compounds in Air detectors should be used, which have an emitter positioned with the sensing element. The transmitted signal must be linear between 0 and 22 mA according to the following requirements: Detector Error/Open Circuit Alarm (0-4mA DC)Sensor Overload/Calibration Mode Alarm (0-4mADC)analog output signal (4-20mA DC)signal out of range alarm (above 20mA DC)Alternatively, the detector transmitter output can use optional digital communication protocols such as Mod bus RTU, HART, ASCII or Foundation Field bus where available. The above alarm requirements also apply when signals other than 0-22mA are used. Detectors must include a built-in linear scale or digital readout, or a temporary connector for calibrating the detector. The detectors are equipped with intelligent microprocessor-based fault diagnosis and calibration functions. The calibration should be non-invasive, ie can be carried out without opening the sensor/transmitter housing detectors must have non-interactive null and span settings Infrared Hydrogen Sulfide and Combustible Gas Point Detectors shall have automatic temperature compensation for changes in ambient temperature and humidity. The detectors are shielded against RF and EMI according to IEC 61000-4-3, Level 3 (at a power level of 10 V/m). Detectors should also be fitted with sunscreens if site conditions require it. Specify specific detectors to be installed in high temperature gas turbine chambers with remote calibration equipment.

3) Detector Sitting

The need for and specific location of fixed detectors should be assessed on a case-by-case basis in accordance with ISA-RP92.0.02, Part II - 1998. Detection should be based on protection against specific local hazards and not general area protection of drying. Detectors should normally be placed near identifiable single points of potential release where there is a significant risk of VOC, hydrogen sulfide or combustible gas leakage, such as: B. fuel pump and compressor seals, valves, etc.For liquid hydrocarbons, combustible gas detection should only be used for potential sources of flammable liquid release with an effective vapor pressure of at least 200 kPa (abs) (29 psia) at 54 °C.

4) Installation Of The Gas Sensor

gas detectors require regular maintenance. Accessibility should be considered when choosing the installation site, and maintenance platforms should be placed where they are needed. Do not expose gas detectors to strong infrared radiation or fumes. Gas detectors should be installed as late as possible during construction to avoid welding and paint damage. However, setup and stabilization must be performed before using any gases or liquids that the detectors are designed to measure. Stabilization time is 2-4 days or more depending on sensor type and temperature unless otherwise noted. Bypass all relay controls during stabilization. To protect the gas detector from dirt and moisture, mount the housing with the sensor cover facing down. Wiring should also be done from below for the same reasons. When cabling is routed from above in cramped situations, the gland must be properly sealed. When installing a gas detector or making any electrical changes to the gas detection system, power must be removed to avoid damage. The gas detector should be mounted close to the potential leak for quick response, however, the density of the gas should be considered when determining the mounting height. When monitoring heavier-than-air gases, gas detectors should be mounted 30-50 cm off the floor. There is therefore sufficient space between the gas detector and the floor for maintenance of the gas detector and floor cleaning. If there is a possibility of mechanical damage, a protective cover must be fitted around the sensor. When monitoring lighter-than-air gases, gas detectors should be mounted on or near the ceiling. If the density of the gas to be measured is approximately that of air, gas detectors should be mounted at breathing height. Install a splash guard in areas where detectors will be exposed to water. A heated enclosure may be required if the detector is used outside of normal operating temperature and/or humidity. The detectors are designed to detect gases and solvents based on alarm limits. These devices require regular maintenance and testing to ensure proper operation. A full calibration should be performed at least once a year and more frequent testing. The website's security statement indicates the correct test range. The test gas pressure at the gas inlet of the detector must be within ±10% of the nominal atmospheric pressure. The concentration of the calibration and test gases must not exceed the flow rate of the detector. For volatile gases, the concentration should be between 0 and 4000 PPM. Too high a gas concentration can damage the sensor element. Make sure that the gas flow through the calibration adapter is not obstructed. Contact your dealer for most calibration gases.

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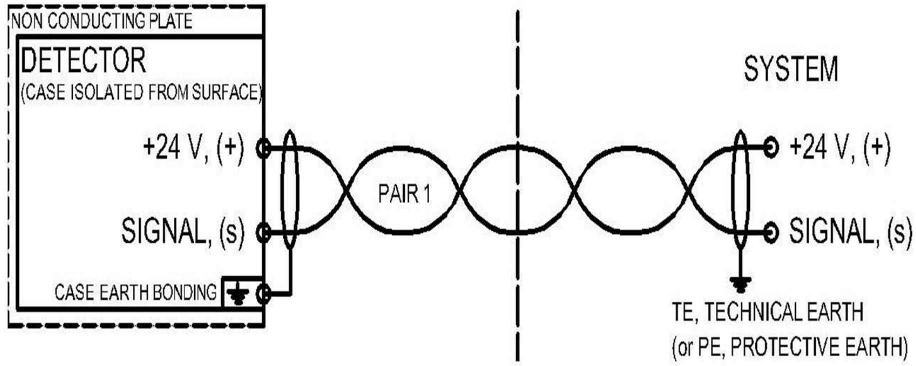

Figure .7- .Recommended cabling for 2-wire connection when gas detector casing is isolated from surface using non conducting plate.

- Provision of fire Fighting equipment.

Table-2- List of installed Fire Extinguisher in Rotary Drum Dryer

S.NO	PROPOSED LOCATION	TYPE OF FIRE EXTINGUISHER	CAPACITY	QTY
1	Near Furnace Area	ABC	06 Kg	02
2	Conveyor Feed Area	ABC & Mechanical Foam	06 Kg & 50 Liters	02
3	Electrical Panel Room	Carbon Di Oxide	09 Kg	01
4	Near Roller Area	ABC	06 Kg	01
5	Unloading Area	ABC	06 Kg	01

- Provision of Ventilation fan for exhaust removal or fresh air ingress. - 2nos
- Additional hose reel(25 x 30 mtrs) - 1no near coal storage area.
- Additional sand bucket storage near the furnace area.
- Provision of clear Entry and emergency exit area and pathways.

Note: Selection And Installation Of Gas Detectors, Fire Fighting Equipment are per Indian Standards.

VI. CONCLUSION

In conclusion, where particulate solid materials are being dried in industrial process equipment, the potential for fires and explosions exists. An understanding of the conditions necessary for these events to be initiated is essential to effectively manage the risk. Monitoring of LEL, VOC, and CO to detect the onset of combustion can be effective in preventing fires in drying systems. Good bonding and grounding practices also are essential where conductive components are present inside of the drying equipment. Explosion prevention and protection systems may need to be installed where suspensions of Sludge or dustsAs we come to conclusion from the project report such as hazard and operability of rotary drum dryer analysis detailed and possible risk outcomes from the drying process in fire and explosion, toxic gas release to environment. The most suitable recommendation are implemented like fire extinguisher installation, gas detectors installation, Fire hose reel installation, placement of fire buckets with sand and provision related to emergency exits. From this installation of fire safety equipment we protect the process, equipment and men near working and also increase the company valuation and reputation. We further planning to implementation of automatic fire sprinkler system, Fire suppression system to be installed at rotary drum dryer. And seclude to provide training include standard operating procedure, emergency preparedness and procedure and fire fighting training

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