FIRE RISK ANALYSIS IN THE PAINT SHOP OF AN AUTOMOBILE INDUSTRY

Final Year Project Report

Submitted by

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RITWIZA PHUKAN

Table of Contents

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

In most of the industries, fire imposes the greatest threat both in terms of financial loss as well as loss to life and property. The presence of combustible materials, their physical arrangement, the likelihood of ignition and the necessary amount of heat required are the factors on which the risk of fire depends upon. It is widely recognized that solvents and paints play an important in many areas of automobile industry. This project concentrates on the causes of fire and explosion inside the paint shop section of an automobile industry. Thus it considers how fire risk is affected by the storage and handling of flammable substances in the workplace and the effectiveness of the existing measures. This pilot study shows a gap analysis between the existing control measures and the required IS/OSHA/NFPA standards for fire and explosion safety while working with paints and solvents. It focuses on solvents and thinners that are highly flammable and makes the area a high risk zone.

***Keywords*:** Fire and Explosion, Flammable solvents, Fire risk analysis

Chapter 1

INTRODUCTION

1.1 Background

In most of the industries, fire imposes the greatest threat both in terms of financial loss as well as loss to life and property. The presence of combustible materials, their physical arrangement, the likelihood of ignition and the necessary amount of heat required are the factors on which the risk of fire depends upon. Fire protection measures also influence the risk of fire to a great extent. It is widely recognized that chemicals (solvents and paints) play an important and productive role in many areas of industrial activity. The application of paints and other similar coatings, whether by spraying, dipping or other processes, can present fire or explosion hazards. These results not only from the solvent vapors that are emitted but also from mixed paint deposits which may be liable to spontaneous combustion from subsequent drying or baking processes. The term "solvents" refers to liquid organic chemicals used to dissolve solid materials. Solvents can be made from natural sources such as turpentine and the citrus solvents, but most are derived from petroleum or other synthetic sources. Solvents are used widely because they dissolve materials like resins and plastics, and because they evaporate quickly and cleanly. There are no "safe" solvents. All solvents, natural or synthetic, are toxic. Contact either with liquid solvents or inhalations of the vapors they emit into the air are hazardous.

Most organic solvents are generally combustible under the right conditions. Exceptions include those that are heavily halogenated. There are certain criteria that have to be met before ignition will occur.

1. For a vapor ignition, the air and vapor must be present within certain concentrations and an ignition source present.

2. For a liquid fire sufficient air and high enough temperature have to be present to ignite the liquid. The temperature may be from the ignition source such as a static spark or from the liquid itself being above its auto-ignition temperature.

Two properties which affect a solvent's capacity to cause fire and explosions are evaporation rate and flash point. In general, the higher a solvent's evaporation rate, the faster it evaporates and the more readily it can create explosive or flammable air/vapor mixtures. All, solvents, flammable or not, should be isolated from sources of heat, sparks, flame, and static electricity. The products used by the paint department require special storage protocols so that they do not become a danger to those working with them, to those working near them or to the general public. Use of flammable materials in spray painting (e.g. organic solvents), increases the risk of fire and explosion because of the amount of solvent vapor in the air. For a liquid fire sufficient air and high enough temperature have to be present to ignite the liquid. The temperature may be from the ignition source such as a static spark or from the liquid itself being above its auto-ignition temperature.

This report concentrates on the causes of fire and explosion inside the paint shop section of an automobile industry. Thus it considers how fire risk is affected by the storage and handling of flammable substances in the workplace and the effectiveness of the existing measures. This pilot study shows a gap analysis between the existing control measures and the required IS/OSHA/NFPA standards for fire and explosion safety while working with paints and solvents. It focuses on solvents and thinners that are highly flammable and makes the area a high risk zone.

1.2 Scope of Work

- The areas considered in the study were the paint storage area, the paint kitchen, the rag/tag area and the painting area the paint baking oven and the CO_2 bank.
- Flammable substances considered in the study were flammable solvents such as thinner and primer and the paint which was used for painting the automobile parts.
- The study concentrated on storage and handling of paints and solvents in the workplace and control of ignition sources.
- The study was limited to Escorts Agri Machinery Plant -2 Farmtrac

1.3 Objectives:

- Review the effectiveness of current control measures on fire safety for paints and solvents in the workplace.
- Carry out a gap analysis between the existing fire control measures and control measures stated in the IS and OHSAS standards.

Chapter 2

Literature Survey

The following literature review on Fire Risk Analysis in the Paint Shop of Escorts Agri Machinery includes the current knowledge on substantial findings, as well as theoretical and methodological contributions to fire risk analysis in the paint shop of an automobile industry. The table below describes the objective and key findings of the papers that are considered in carrying out the following project.

Table 2.1 Literature Survey

Author's Name	Title of paper	Objectives	Key Findings
Dillon Consulting Ltd. 2011	"*Paint Department: Health and Safety Guidelines"*	To identify the precautionary measures that should be taken to ensure that the release of these vapors are minimized and do not accumulate while the products are in storage.	Solvents and thinners are incompatible with oxidizing agents; as oxidizing agents increase the risk of fire if they come into contact with flammable materials. Therefore, thinners and solvents should be stored away from agents such as peroxides.
Monona Rossol October 10, 1995	*"Data Sheet: SOLVENTS"*	To provide guidelines on the use of solvents and the hazards associated with different types	All solvents should be isolated from sources of heat, sparks, flame and static electricity

		of solvents.	
Occupational Safety and Health Act 1984 and Occupational Safety and Health Regulation 1996		The act prevents occupational injuries and diseases, also places certain duties on employers, employees, self-employed persons, manufacturers, designers, importers and suppliers. Occupational Safety and Health Regulation 1996 define specific requirements related to a particular hazard or a particular type of work.	Use of flammable materials in spray painting (e.g. organic solvents), increases the risk of fire and explosion because of the amount of solvent vapor in the air.
Solvents Industry Association 10/2007	*"Flammable Solvents and the Hazard of Static Electricity"*	To identify the factors responsible to cause fire while using solvents.	For a liquid fire sufficient air and high enough temperature have to be present to ignite the liquid. The temperature may be from the ignition source such as a static spark or from the liquid itself being above its

			auto-ignition temperature.
W S Atkins Consultants Limited 2002	*"Fire risk Assessment for Workplace containing Flammable Substances"*	• Review the effectiveness of current guidance on fire safety for flammable substances in the workplace. • Provide a proposal for a risk assessment method for assessing the hazards to workplaces resulting from the storage of flammable substances	Fire risk is affected by the handling and storage of flammable substances in the workplace, and by the control of ignition sources.
Zurich Management Services Limited 2011	"*Paint Spraying and Other Painting Processes- Fire Safety"*	To Provide guidance on the risk control measures which should be taken during paint spraying and other painting processes.	The application of paints and other similar coatings, whether by spraying, dipping or other process, can present fire hazard.

Chapter 3

MATERIALS AND METHODS

3.1METHODOLOGY

- Understanding the various processes carried out in the paint shop of Escorts Agri Machinery.
- Identifying regions with high risk of fire hazard.
- Identifying the existing control measures in place.
- Comparing the existing measures with the OSHA, NFPA and IS standards

3.2 PROCESS DESCRIPTION

Table3. 1: Process Description of the paint shop

Process No.	Process Description	Purpose of the Process
1.	**Parts Loading:** bare sheet metal components coming from vendor applied with rust preventive are loaded on hangers	To take the components through various stages involved in painting
2.	**Predegrease:** spray stage having chemical of alkaline nature maintained at a temperature of 50-60degree Centigrade. The chemicals used are namely TPB-1 and TPA-1	For removal of rust preventive oil from the component applied at vendor end
3.	**Degrease:** dip and spray stage having chemical of alkaline nature and maintained at temperature of 50-60degree centigrade. The chemicals used are namely TPB-1 and TPA-1	For effective removal of rust preventive oil from the component
4.	**Water Rinse 1:** dip and spray stage with normal industrial water maintained at room temperature	For removal and washing of the degreasing chemical from the component

5.	**Water Rinse 2:** dip and spray stage with normal industrial water maintained at room temperature	For effective washing of the component to remove the degreasing chemical
6.	**Surface Condition:** dip and spray stage with chemical of alkaline nature maintained at a room temperature. The chemical used is namely GNZS	It prepares the component surface for phosphate chemical coating
7.	**Phosphating:** dip and spray stage with chemical of acidic nature maintained at a temperature of 47-50degree centigrade. The chemicals used are namely 3004R & 3004M	Deposits the phosphate layer on the component surface which makes the surface smooth and prevents rust formation
8.	**Water Rinse 3:** spray stage with normal industrial water maintained at room temperature	It removes the sludge formed during the reaction of the component with Phosphating chemical from the surface of the component
9.	**Water Rinse 4:** dip and spray stage with demineralized water of conductivity 0-10µ maintained at room temperature	For effective washing of the component and lowering the conductivity of the water on the component
10.	**Water Rinse 5:** dip and spray stage with demineralized water of conductivity 0-10µ maintained at room temperature	For effective cleaning of the component and further lowering of the conductivity of water settled on the component as high conductivity water will make the CED primer rupture.
11.	**DM Rinse Spray:** spray stage with demineralized water of conductivity 0-10µ maintained at room temperature	For effective cleaning and lowering the component conductivity before it enters the CED primer bath

12.	**CED Bath(cathodic electrode position)-** dip stage with CED primer paint(acidic in nature with ph 6±0.3) maintained at a temperature of 28-30 degree centigrade and supplied with a voltage of 415V through rectifier. The chemical form of CED primer is F1, F2, Additive- M and Additive- S	It provides the coating of the CED primer on to the component by means of electric current by making the component as cathode and paint as anode
13.	**Ultra Filtration:** spray stage acidic in nature maintained at room temperature	For washing the excess CED paint from the component.
14.	**Ultra filtration:** dip and spray stage acidic in nature maintained at room temperature	For effective removing of the CED paint from the component
15.	**DM Rinse:** dip stage with demineralized water of conductivity 0-10µ maintained at room temperature	For effective washing of the component for removal of excess paint
16.	**Fresh D I Spray:** spray stage with demineralized water of conductivity 0-10µ maintained at room temperature.	For curing the CED paint
17.	**Baking Oven:** over maintained at a temperature of 175±5degree centigrade.	For covering the joints of the component to prevent rust formation at the joints
18.	**Sealer Application Stage:** sealer filled guns with no air trapping	CED coated component may contain fine CED dust or marks on the component which has to be removed before top coat application
19.	**Sanding and Buffing:** emery paper and the buffer paper	Sealer applied at the component joints needs to be cured so that it does not comes out and also to dry off the components before paint application

20.	**Sealer and Drying Off Oven:** oven maintained at a temperature of 90±10deg centigrade	Sealer applied at the component joints needs to be cured so that it does not come out and also dry off the components before paint application
21.	**Tag Rag:** made of fine cotton and polyester cloth of high strength fibers	To completely clean the component surface before paint application
22.	**Primer Application:** applying coating of primer	Primer is applied on the CED coated component to prepare the surface for painting and for proper adhesion
23.	**Paint Application:** Paint used is TSA	For preventing the component against rust and most important for imparting aesthetic look to the component
24.	**Baking Oven:** oven maintained at a temperature of 140±10deg centigrade	For paint curing
25.	**Unloading and Inspection**	Inspection is done for checking the desired parameters such as gloss, DFT etc.

3.3 THINNER AS A CLEANING AGENT

According to **MSDS 130029**, Thinner is used as a cleaning solvent. OSHA Regulatory classifies this material as hazardous under OSHA Regulations.

- The major ingredient of thinner is Methoxy –propyl Acetate.

- **Section 3** of the MSDS indicates thinner to be highly combustible liquid and vapor.

- **Section 5** illustrates the firefighting measures of thinner as follows:

    - **Flash Point**: 114º F or 45.5ºC
    - **Explosive Limit**: Lower: 1.5%, Upper: 7.0%
    - **Auto ignition Temperature**: 670ºF or 354ºC
    - **OSHA Flammability Class**: Combustible Liquid- Class II.
    - **Hazardous Products of Combustion**: May form toxic and corrosive gases: carbon dioxide, carbon monoxide and various hydrocarbons.
    - **Fire and Explosion Hazards**: Vapors are heavier than air and may travel along the ground or may be moved by ventilation and ignited by pilot lights, other flames, sparks, heaters, smoking, electric motors, static discharge, or other ignition sources at locations distant from material handling point.
    - **Extinguishing media used**: Regular foam, carbon dioxide, dry chemical.
    - **Fire Fighting Instructions:** Water may be used to keep fire-exposed containers cool until fire is out.
    - **NFPA Rating:** Health - 0, Flammability - 2, Reactivity – 0

- **Section 6** describes the accidental release measures as follows:

- In case of spill, eliminate all sources of ignition such as flares, flames including pilot lights, and electrical sparks. Ventilate the area. Wear PPE. Avoid breathing vapors. Collect with an inert absorbant and dispose of properly.

- **Section 7** illustrates the handling and storage of thinner as:
  - **Handling**: All hazard precautions given in the data sheet must be observed. Avoid contact with eyes, skin and clothing. Wash thoroughly after handling. Use only with adequate ventilation. Do not breathe vapors or spray mist. Do not take internally. Close container after each use. **Keep out of reach of children.**
  - **Storage:** Store material in a cool, well-ventilated area. For maximum product quality, avoid prolonged storage at temperatures above 75°F (25°C). Do not use or store near heat, sparks, or open flame. Keep container tightly closed. Avoid contact with incompatible materials.

- **Section 9** demonstrates the physical and chemical properties of thinner

Table 3.2: Chemical Properties of Thinner

PROPERTY	STANDARD CONDITION	PROPERTY	STANDARD CONDITION
Boiling Point:	284 - 302 °F/ 140 - 150 °C	**Vapor Density:**	Heavier than air.
Specific Gravity / Density:	0.969/ 8.08 lbs/gal	**Percent Volatiles by weight:**	100 %
Evaporation Rate:	Slower than ethyl ether.	**Physical State:**	Liquid
Melting Point:	Not Available	**pH:**	Neutral
Odor:	Sharp, aromatic odor.	**Solubility:**	19.8g/100ml
Vapor Pressure:	3.7 mmHg @ 68 °F / 20 °C	**Appearance:**	Clear Liquid
Octanol/Water Partition Coefficient:	3.6	**VOC (as packaged-less exempts and water):**	8.08 lbs/gal or 969 g/L
VHAP Content by weight (as packaged):		0%	

Chapter 4

RESULTS AND DISCUSSION

The existing measures in the high risk zones of the paint shop were identified. The requirements as per OSHA and Indian Standards were studied for each individual high risk zone in the paint shop and it was observed that the company has abided by this rules and regulations.

4.1 Raw Materials used in the paint shop and the existing control measures

Table 4.1 Raw Materials and Existing Control Measures in the Paint Shop of Escorts Agri-Machinery

PARAMETERS	PAINT STORAGE	PAINT KITCHEN	RAG/TAG AREA	PAINTING BOOTH	PAINT BAKING OVEN	CO_2 Bank
Raw Materials	Flammable paints, Thinner	Flammable paints, Thinner	Thinner	Thinner, Flammable paints	Flammable paint fumes	CO_2, PNG lines
RISK	Fire hazard due to storage of flammable paint and thinner	**1.** Fire due to flammable paint and thinner. **2.** Fire due	Fire due to Thinner	**1**. Fire due to storage of thinner inside the paint booth 2. Fire due to	Fire and explosion hazard due to explosive and	Fire due to bursting of PNG lines

		to mobile phones inside the paint kitchen		flammable paints and fumes	flammable paint fumes	
CONTROLS	**1.** Open flames and smoking shall not be permitted in flammable or combustible liquid storage areas. **2.** Fire protection system like carbon dioxide, water spray is provided	**1**.Fire Extinguishers, no smoking area, flame proof lightening, CO_2 flooding system 2. Prohibition of mobile phones. 3. Proper grounding to prevent static electricity	**1**.Fire Extinguishers, no smoking area, flame proof lightening, CO_2 flooding system, Prohibition of mobile phones. 2. Proper grounding to prevent static electricity	**1.** Limited quantity is being stored. Flame proof fittings, no smoking area, mobile prohibition, restricted entry, CO_2 flooding system. 2. Fire extinguisher, no smoking area. 3.Proper grounding to prevent static electricity	Flame proof lightening, CO_2 flooding system, trained and experience person, safety caution displayed.	Safety valves, Isolation Valves, Fire tender and fire-extinguisher

4.2 Requirements as per OSHA 29CFR 1910.106

Table 4.2 Requirements in the high risk zones as per OSHA 29CFR 1910.106

Sl. no.	PAINT STORAGE	PAINT KITCHEN	RAG/TAG AREA	PAINTING BOOTH	PAINT BAKING OVEN	CO_2 BANK
1.	Suitable fire control devices, such as small hose or portable fire extinguishers, shall be available at locations where flammable or combustible liquids are stored.	Suitable fire control devices, such as small hose or portable fire extinguishers, shall be available at locations where flammable or combustible liquids are stored.	Flammable liquids shall be kept in covered containers when not actually in use. Where flammable or combustible liquids are used or handled, except in closed containers, means shall be provided to	A mechanical exhaust ventilation system designed to provide for a complete change of air within the room at least six times per hour.	Prior to the furnace heating system startup, provision shall be made for the removal of all flammable vapors and gases that have entered the heating chambers during the shutdown	Automatic detection equipment shall be approved, installed and maintained in accordance with 1910.164.

			dispose promptly and safely of leakage or spills.		period.	
2.	At least one portable fire extinguisher having a rating of not less than 12-B units shall be located: **a.** outside of, but not more than 10 feet from, the door opening into any room used for storage; and **b.** not less than	At least one portable fire extinguisher having a rating of not less than 12-B units shall be located: **a.** outside of, but not more than 10 feet from, the door opening into any room used for storage; and **b.** not less than	Fire protection system shall be sprinkler, water spray, carbon dioxide, or other system.	Fire protection system shall be present such as CO_2 flooding system, sprinkler system.	Regulators, relief valves and switches shall be vented to an approved location.	At least one manual station is provided for discharge activation of each fixed extinguishing system.

	10 feet, nor more than 25 feet, from any Class I or Class II liquid storage area located outside of a storage room but inside a building.	10 feet, nor more than 25 feet, from any Class I or Class II liquid storage area located outside of a storage room but inside a building.				
3.	Open flames and smoking shall not be permitted in flammable or combustible liquid storage areas.	Open flames and smoking shall not be permitted in flammable or combustible liquid storage areas.	Open flames and smoking shall not be permitted.	Any electrically isolated section of metallic piping or equipment shall be bonded or grounded to prevent hazardous accumulation of	Heating elements must be securely fastened.	Provide automatic actuation of total flooding systems by means of an approved fire detection device installed and interconnected

				static electricity. All nonmetallic equipment and piping where an ignitable mixture could be present shall be given special consideration		with a pre-discharge employee alarm system.
4.	Materials which react with water shall not be stored in the same room with flammable or combustible liquids.	Materials which react with water shall not be stored in the same room with flammable or combustible liquids.				Systems installed in the presence of corrosive atmospheres are constructed of non-corrosive material or otherwise protected

						against corrosion.
5.	Fire protection system shall be sprinkler, water spray, carbon dioxide, or other system.	Fire protection system shall be sprinkler, water spray, carbon dioxide, or other system.				Assure that the weight and pressure of refillable containers is checked at least semi-annually. If the container shows a loss in net content or weight of more than 5 percent, or a loss in pressure of more than 10 percent, it shall be subjected to maintenance.

6.	Every inside storage room shall be provided with either a gravity or a mechanical exhaust ventilation system designed to provide for a complete change of air within the room at least six times per hour.	Every inside storage room shall be provided with either a gravity or a mechanical exhaust ventilation system designed to provide for a complete change of air within the room at least six times per hour. .				
7.	Any electrically isolated section of metallic piping or equipment shall	Any electrically isolated section of metallic piping or equipment shall				All fire protection systems must have pipes and fittings that are

	be bonded or grounded to prevent hazardous accumulation of static electricity. All nonmetallic equipment and piping where an ignitable mixture could be present shall be given special consideration.	be bonded or grounded to prevent hazardous accumulation of static electricity. All nonmetallic equipment and piping where an ignitable mixture could be present shall be given special consideration.				suitable for the expected temperature extremes with good corrosion resistance properties.

4.3 Requirements as per IS Standard 9109:2000

Table 4.3 Requirements as per IS Standard 9109:2000

Sl. no.	PAINT STORAGE	PAINT KITCHEN	RAG/TAG AREA	PAINTING BOOTH	PAINT BAKING OVEN
1.	Paint containers shall be supported either by resting on the ground or on masonry supports. Wood or steel supports without fire-proofing shall not be permitted.	Paint containers shall be supported either by resting on the ground or on masonry supports. Wood or steel supports without fire-proofing shall not be permitted.	No open flames, naked lights, smoking electric or gas cutting and welding equipment shall be permitted near the area.	There shall be no open flame, spark producing devices, or heated surface having a temperature sufficient to ignite vapors in any vapor area.	Oven shall be constantly watched during the process. An excess temperature alarm shall be provided to attract attention of persons to manually control the situation.

2.	All containers shall be suitably earthed to dissipate static charge.	All containers shall be suitably earthed to dissipate static charge.	The area shall be fully illuminated.	All containers shall be suitably earthed to dissipate static charge.	Safe operating temperature shall not be exceeded. An automatic control shall be provided to ensure against excessive temperature. Such a system shall be interlocked with a device to shut off the heating medium.
3.	The containers' vents shall be provided with flame arrestors or pressure-	The containers' vents shall be provided with flame arrestors or pressure-	A suitable automatic fire detection and alarm system directly	No open flames, naked lights, smoking electric or gas cutting and	First aid fire appliances shall be properly maintained, checked, tested

	vacuum vent.	vacuum vent.	connected to a central control room shall be provided.	welding equipment shall be permitted near the area.	and refilled as specified in IS 2190 and proper records maintained.
4.	No open flames, naked lights, smoking electric or gas cutting and welding equipment shall be permitted near the storage area	No open flames, naked lights, smoking electric or gas cutting and welding equipment shall be permitted near the area	No Smoking' sign written in large letters on a background of contrasting colors shall be conspicuously displayed in the vicinity of the processing, tank farm and storage area.	The area shall be fully illuminated as indicated below: Godowns 70, Grinding, mixing, 200 places, lux milling, heating.	

5.	The area shall be fully illuminated as indicated below: Godowns 70 lux;	The area shall be fully illuminated as indicated below: Godowns 70, Grinding, mixing, 200 places. lux milling, heating.	All containers shall be suitably earthed to dissipate static charge.	No Smoking' sign written in large letters on a background of contrasting colors shall be conspicuously displayed in the vicinity of the processing, tank farm and storage area.	
6.	For high fire risk areas, especially those which remain unattended for considerable periods, a suitable automatic fire detection and	For high fire risk areas, especially those which remain unattended for considerable periods, a suitable automatic fire detection and	All electrical installations shall be in accordance with IS 1646. All lighting fittings and switches shall be of the enclosed type.	All electrical installations shall be in accordance with IS 1646. All lighting fittings and switches shall be of the enclosed type.	

	alarm system directly connected to a central control room shall be provided.	alarm system directly connected to a central control room shall be provided.			

4.4 Requirements as per IS: 7969-1975

Table4.4 Requirements as per IS: 7969-1975

Sl. no.	PAINT STORAGE	PAINT KITCHEN	RAG/TAG AREA	PAINTING BOOTH
1.	Paints, varnishes, lacquers, thinners and other flammable materials shall be kept m a properly sealed or closed containers. The container shall be kept in a well-ventilated location, free from excessive heat, smoke, sparks or flame.	Paints, varnishes, lacquers, thinners and other flammable materials shall be kept in properly sealed or closed containers. The container shall be kept in a well-ventilated location, free from excessive heat, smoke, sparks or flame.	Paint scrapings and paint-saturated rags and debris shall be removed daily from the premises and, preferably, destroyed by burning at a safe place.	When electric lights, switches or electrical equipment are necessary, they shall be of explosion proof design.

2.	Paint materials in quantities other than required for daily use shall be kept stocked under regular storage place.	Paint materials in quantities other than required for daily use shall be kept stocked under regular storage place.	When electric lights, switches or electrical equipment are necessary, they shall be of explosion proof design	No smoke or open flame, exposed heating elements, or other sources of ignition of any kind shall be permitted in areas or rooms where spray painting is being done.
3.	When electric lights, switches or electrical equipment are necessary, they shall be of explosion proof design.	When electric lights, switches or electrical equipment are necessary, they shall be of explosion proof design.		When painting is done in confined spaces where flammable or explosive vapors may develop, any necessary heat shall be provided through ductwork remote from the source of flame.

4.5 Requirements for CO_2 Bank as per IS 15528: 2004

- Piping shall be designed in accordance with IS 15493 to deliver the required rate of application at each nozzle.
- The extinguishing media used shall be carbon dioxide complying with the requirements of IS 15222.

Some of the controls are shown in the following photographs:

Fig 4.1: CO_2 Flooding System

Fig 4.2: CO_2 control panel

Fig 4.3: Pilot cylinders for paint kitchen

Fig 4.4: Static Charge Disposer

Fig 4.5: Safety Sign Board

Fig 4.6: How to use an extinguisher

Fig 4.7: Description on CO_2 flooding system

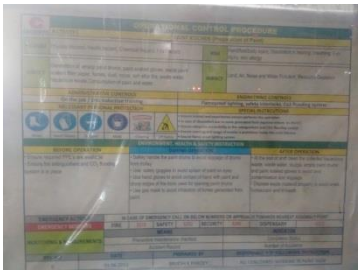

Fig 4.8: OCP of Escorts in disp

Chapter 5

SUMMARY and CONCLUSION

5.1 SUMMARY

The organization has taken utmost care to abide by the above regulations. The safety measures which are in place in addition to the above controls are:

- In the organization, the paint baking oven has an electrical panel with interlock system. The interlock system maintains the temperature of the oven. If the temperature goes higher than the actual temperature, it will cut off the supply the hot air from the PNG gas pipes and will reduce the temperature and thus preventing fire and explosion.
- the CO_2 bank operates as follows:
  - The areas are fitted with three smoke detectors. If there is smoke inside the area, at least two of the smoke detectors should send a signal to the electrical panel for the CO_2 flooding system to be activated. Once the signal reaches the panel, the electrical panel sends signals to the pilot cylinders which in turn pressurizes the CO_2 cylinders and through the pipes as well as discharge holes CO_2 gas is released and thus fire is extinguished. In case of small fires, portable cylinders are kept at appropriate places along with sand buckets for extinguishing the fire. The fire department periodically checks the CO_2 cylinders and keeps a track of the pressure inside them.
- Safety sign boards have been placed on all high risk zones such as no use of mobile phones inside the paint booth, paint kitchen etc.
- Static charge disposer has been placed near the doors of paint booth, rag/tag area, paint kitchen etc. to prevent electrocution.
- Safety shoes must be worn inside the paint shop.
- No smoking sign boards are kept in all the places in the high risk zone.
- Mock drills are being carried out once in a month and all the workers are made aware about the Do’s and Don’ts when there is a fire.

- The sprinklers are yet to be installed inside the paint shop.
- Flame proof lightening is provided in all the areas such as the paint kitchen, paint storage area, rag/tag area etc.

5.2 CONCLUSION

An organization's asset is its workforce, the property it deals with and the surrounding environment. The standards have been formulated by various regulatory boards so as to have zero accidents and hence no loss of life, no property loss and no environmental effect. It is mandatory to abide by these regulations so as to achieve a 100% profit both in terms of production and safety. This work tried to make a gap analysis between the existing safety measures and that recommended by various regulatory bodies. The automobile industry taken into consideration has in no means sacrificed to follow the safety norms and as can be clearly seen has taken safety as an utmost important aspect along with its production interest. The organization has put up all the necessary sign boards which are to be followed to prevent fire. The workforce is being trained time and again on how to follow the safety norms and what should be done when a fire outbreaks. Thus, Escorts Agri Machinery has proved itself that it does not compromise with the safety of its employees, its surrounding environment and its property and goes hand in hand with the latest safety norms.

Chapter 6

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