

AN OVERVIEW ON THE MAJOR OIL FIRE DRILL IN FACT-PETROCHEMICAL DIVISION

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SYNOPSIS

FACT Petrochemical Division, a Production Unit of Fertilisers and Chemicals Travancore Ltd. is a major accident hazard unit. The mock drills that has become a statutory requirement under Onsite Emergency Plan started losing its seriousness as the incidents considered were imaginary. This matter came up through the safety committee of the company and it was decided to conduct a major real fire drill making use of imported fire entry suits and other modern fire fighting equipments. The paper describes the back ground information on Petrochemical Division like hazard potential, fire prevention, protection and fighting facilities. The objectives, preparations and benefits of the real fire mock drill conducted are also described.

INTRODUCTION

FACT Petrochemical Division is a Production Unit of The Fertilisers And Chemicals Travancore Limited, Udyogamandal and is one of the major chemical complexes in our country having a capacity to produce 50,000 TPA Caprolactam and 2,25,000 TPA Ammonium Sulphate. Caprolactam ($C_6H_{10}ONH$) is used for the manufacture of Nylon-6. Nylon-6 is used in the manufacture of tyre cord, synthetic fabrics, plastic, bristles, film, coatings, synthetic leather and plasticisers.

Like other Chemical and Petrochemical industries, here also large quantities of flammable and toxic liquids and gases are dealt with. The processes employed involve working at extreme temperatures and pressures which speak of hazard potential. Although the emergency may be caused by a number of different factors like plant failure, human error, windstorm, lightning or earthquake, it will normally manifest itself in three basic forms namely fire, explosion or toxic release.

Based on On-site Emergency Plan, mock drills have been conducted every six months. Incidents being imaginary, they lacked seriousness, though a statutory requirement. The idea

of a real Fire Drill and conducting it with existing capabilities under On-site Emergency Plan came up in the Safety Committee of the division. As this will boost the morale of the employees, management and public, the Fire/Safety Department organised a major oil fire drill.

PROCESS EMPLOYED IN FACT-PETROCHEMICAL DIVISION

FACT's Caprolactam Project envisages production of 50,000 TPA of Caprolactam and 2,25,000 TPA Ammonium Sulphate (as 40% solution). Soda ash and Nitric Acid are also obtained as by-products. The Caprolactam Unit comprises of three main sections, waste recovery and effluent treatment plants, utilities and offsite facilities, as listed below:

- (i) Anone Preparation Section
- (ii) Hyam Preparation Section
- (iii) Lactam Preparation, Flaking and Bagging
- (iv) Waste Recovery and Effluent Treatment Plants
- (v) Utilities and Offsite facilities

The hazardous processes employed in the plant are:

- (a) Anone Plant
 - (i) Benzene Hydrogenation
 - (ii) Cyclohexane Oxidation
 - (iii) Anol Dehydrogenation
 - (iv) Saponification
- (b) Hyam Plant
 - (i) Ammonia Oxidation
 - (ii) Ammonium Nitrate Preparation
 - (iii) HADSA Preparation
 - (iv) Hydrolysis of HADSA
 - (v) Neutralisation
- (c) Lactam Plant
 - (i) Saponification
 - (ii) Beckmann's Rearrangement of Oxime
 - (iii) Neutralisation
 - (iv) Ion Exchange
 - (v) Hydrogenation

RAW MATERIALS AND OPERATING SUPPLIES

- (a) Raw materials
 - (i) Benzene
 - (ii) Synthesis Gas
 - (iii) Caustic Soda
 - (iv) Carbon Dioxide
 - (v) Sulphur Dioxide
 - (vi) Oleum
 - (vii) Ammonia
- (b) Intermediates
 - (i) Cyclohexane
 - (ii) Cyclohexanone
 - (iii) Cyclohexanol
 - (iv) Hyam Sulphate
- (c) Operating Supplies
 - (i) Hydrochloric Acid
 - (ii) Sulphuric Acid
 - (iii) Phosphoric Acid
 - (iv) Polyelectrolyte
 - (v) Hydrazine
 - (vi) Cooling Water Treatment Chemicals
 - (vii) Chlorine
 - (viii) Trisodium Phosphate
 - (ix) Thermal Oil, etc.
 - (x) Fuel Additives
- (d) Fuels
 - (i) Furnace Oil / LSHS
 - (ii) Liquefied Petroleum Gas (LPG)

STORAGE OF RAW MATERIALS/INTERMEDIATES AND PRODUCTS UNDER MSIHC RULES 1989

As per the Gazette Notification No.707 Part II Section 3, sub Section (ii) published on Nov. 27 1989 (The Manufacture, Storage and Import of Hazardous Chemicals Rules 1989), the chemicals used and handled in our works are listed below, showing threshold quantities.

SL. NO.	CHEMICALS	THRESHOLD QUANTITY (MT)	IN-PLANT CAPACITY (MT)
1.	BENZENE	1000	2230
2.	AMMONIA	50	5000
3.	LPG	15	66
4.	CYCLOHEXANE	1000	1150
5	CYCLOHEXANONE	25	1400
6	OLEUM (23% SO ₃)	15 (SO ₃)	300 (70 MT SO ₃)

FIRE FIGHTING FACILITIES

FIRE PREVENTION, PROTECTION AND FIRE FIGHTING

Petrochemical Fire Station is located near the main gate of the Petrochemical Division and is manned round the clock on a 3-shift rotation basis by a trained fire fighting crew. The fire station is provided with Crash Fire Tenders, Ambulance, Emergency Vehicle, Emergency Stores and a Control room with an advanced Fire Alarm System. The Fire Water Pump House is located at the extreme end of the Main Tank Farm and is manned round the clock.

ORGANISATION

* Chief Engineer (Fire & Safety)	- 1
* Assistant Manager (Fire Service)	- 1
* Senior Fire Inspectors	- 4
* Fire Inspectors/Fire Hydrant Operators	- 8
* Senior Firemen	- 12
* Firemen	- 8
* Driver-Cum-Pump Operators	- 4
* Drivers (Ambulance)	- 3
* General Helpers	- 4

APPLIANCES

(a) Combined Water-Foam Tender	- 2
(b) Emergency Vehicle with Trolley	- 1
(c) Trolley mounted Water/Foam Monitor	- 1

- (d) Portable Fire Pump - 1
- (e) Portable Fire Extinguishers (different types) - 500 Nos.
- (f) Stock of AFFF & Protein based Foam - 10,000 Lts.
- (g) DCP - 1500 Kg.

FIXED FIRE PROTECTION SYSTEM

The following Tanks containing highly flammable fluids are provided with automatic Sprinkler Systems.

- (i) 3 Nos. LPG Bullet and Hydrogen Buffer Drum.
- (ii) Cyclohexane Storage Tank
- (iii) Benzenic Lactam and Benzene Day Tank
- (iv) Light Residue and Heavy Residue Storage Tanks.

Fixed Foam Systems are provided for the following Storage Tanks.

- (i) Main Benzene Storage Tanks
- (ii) Extraction Effluent Tank

Semi-automatic Water Spray Systems are provided in the following areas.

- (i) LPG Unloading Platform
- (ii) Benzene Unloading Platform.

Automatic Halon Extinguishing Systems are provided in the following areas.

- (i) Central Control room
- (ii) Empty Bag Storage

WATER FACILITIES

Fire Hydrant System

The Fire Hydrant System is designed considering the hazard potential of the Petrochemical Division. The Hydrant is an automatic pressure main system, for which the water is drawn from the Periyar River. The system consists of 4 Nos. Vertical Turbine Pump Sets driven by Kirloskar Cummins Diesel Engines and a small horizontal electrically driven Jockey Pump to make up the system pressure when there are small leaks in the landing valves, water monitor, stop-valve glands and hence avoid the unnecessary starting of the main Pump Sets. Automatic starting is provided for the main pumps when pressure in the header drops.

- (a) Hydrants single Headed - 101 Nos.
- (b) Hydrants double Headed - 14 Nos.
- (c) Fire Escape Hydrants - 9 Nos.
- (d) Monitors - 12 Nos.

The Fire Hydrant System is extended to cover the new Ammonia Project also.

SAFETY EQUIPMENTS AND PERSONAL PROTECTIVE EQUIPMENTS IN USE

SAFETY EQUIPMENTS

- (i) Explosive Meters
- (ii) Oxygen Indicator
- (iii) Gas Detectors
- (iv) Sound Level Meters

PERSONAL PROTECTIVE EQUIPMENTS IN USE (IMPORTED) ARE:

- (i) Breathing Apparatus Sets : 45 Min. duration
30 Min. duration
- (ii) Gas Masks for : Ammonia
Organic Vapour
Acid Gases
Benzene
Nitrogen Oxides
Sulphur Dioxide
- (iii) Chemical Protection Suit with B.A. Set inside
- (iv) Fire Entry Suit (Isotemp. glass coated heat protection clothing model 2000)
- (v) Fire Proximity Suit.

FIRE ENTRY SUIT (ISOTEMP HEAT PROTECTION CLOTHING)

Specification : ISOTEMP glass coated heat protection clothing model 2000;
To be used with B.A. Sets; and consists of Jacket with hook,
removable helmet and replaceable window, trousers,
five finger gloves, heat protection boots.
Wegiht: 10700 gms.

- Manufacturer : PreUssag; Feuerschutz
Federal Republic of Germany
- Application : The Suit provides greatest protection against flames and heat.
It is possible to walk through flames for rescue purposes and
Shutting of valves.
- Approvals : From specialised organisations from Germany, Holland, USSR
and USA.

TROLLY MOUNTED WATER FOAM MONITOR

This consists of Gun Metal Foam-Water Monitor dual Nozzle, single quick change over valve, 0-6% Foam liquid metering valve, Foam discharge 21,500 LPM and water discharge 3,500 LPM at 7 Kg/cm², range of Foam 50 meters and 63 meters, Pick-up tube, mounted on 2 wheeled Tractor fabricated on mild steel channels, solid beam axle, heavy duty elliptical spring, over run brakes, rear light traffic indicator, adjustable drop legs, towing arrangements with 600 litres capacity stainless steel Foam Storage Tank, rectangular with 3 mm plate thickness duly fitted with filter cap with strainer, breather valve, inspection man-hole with cover, drain valve and collecting header with 4 Nos. 2 1/2 " non-return instantaneous male coupling. The basic Foam-Water Monitor is (dual) approved by TAC.

DETAILS OF LIVE FIRE DRILL

OBJECTIVES OF LIVE FIRE DRILL

- (a) To train the Fire Crew in using Fire Proximity/Fire Entry Suit along with Breathing Apparatus Sets quickly and properly. Create confidence in them to meet major fire situations.
- (b) To test the efficiency of Fire Fighting Appliances and Extinguishing media.
- (c) To create confidence in employees, management and public with regard to capabilities under On-site Emergency Plan.
- (d) To demonstrate the performance of Trolley mounted Water Monitor by fighting a major fire.

PREPARATIONS FOR LIVE FIRE DRILL

- (a) Made a brick lined and plastered pit of size 2M x 2M x 1M and made Mock Storage Tank around it using black polythene sheet and bamboo poles.
- (b) Trained Firemen in the wearing of Fire Entry Suit with B.A. Sets and extinguishing small fires.

- (c) Kept a Fire Engine with full Fire Crew as standby.
- (d) The pit was half filled with water, added LSHS 600 Litres, Diesel 300 Litres, put Cotton wastes and finally poured few litres of Benzene to give an impression that a Benzene Tank is under fire.
- (e) Theoretical calculations on radiation heat was made and a safe distance arrived at was 15 M and visitors were allowed to sit beyond 15 M radius and at identified location. The maximum height that the flame would reach was calculated as 7.5 M.
- (f) Seating arrangements were made for employees, Senior Managers, Public and specially invited guests from Kerala State Fire Force and were briefed about the activities before the Drill.

CRITIC MEETING

A Critic meeting was held after the Drill. Sri. Ravindran Pillai, Director of Fire Force, Kerala was on the Chair. In his remarks he expressed that the purpose of the drill was fully met with. Sri. Ravindran Pillai appreciated the efforts and said that such efforts improve the morale of the employees and public together.

Minor problems experienced by the Firemen who did the rescue operation was also noted seriously. The observations made by the fire crew are given below:

Shri. Antony, Senior Fireman:

“Having practiced the wearing and activities with the imported Fire Suit, I was confident to carry out the activities in the major real Fire Drill. I did not feel any radiation heat beyond bearable limit. When the Coat was removed after the Drill, skin on one hand got mild burns by coming in contact with the outer part of the suit”. (The coat was removed before cooling down properly).

Shri. Nazar, Senior Fireman:

“I had learned to wear the suit properly by taking training and trials. As the hand piece is a separate piece, I felt radiation heat on hands”.

Mr. O.T. Varghese, Asst. Manager (Fire Service):

“This was the major live Fire Drill we carried out in FACT-Petrochemical Division with full support and co-operation from management, employees and public. This gives us confidence to tackle major fires. The success of this has boosted up the morale of the employees and public as well by witnessing the emergency preparedness in FACT-Petrochemical Division”.

CONCLUSION

The real fire mock drill described in the paper reveals the magnitude of the operations. The success of this drill really motivated the fire crew, employees, management and the public.