



KOREA OCCUPATIONAL SAFETY & HEALTH AGENCY

INVESTIGATION REPORT

Explosion in HDPE Plant



Yeosoo, Korea

October, 2003

KEY ISSUES:

- **Released N-Hexane to Cause VCE**
- **Implementing MOC Strictly**

ABSTRACT

This report explains the explosion that occurred on October, 2003 in a HDPE Plant, Yeosoo, Korea. The accident was a release of N-Hexane from the HDPE reactor. One operator was killed and seven others were seriously wounded. Block valve at the lower PE reactor was opened by mistake before inline strainer was not reinstalled ,after detaching for cleaning. Recommendations concerning this issue were delivered to said Plant.

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1.0 INTRODUCTION

On October, 2003, 10" remote on-off valve in the suction side of 2nd slurry cooler pump was opened and N-Hexane was released and vapor cloud explosion was occurred in a HDPE plant, Yeosoo, Korea . One operator was killed and seven others were wounded

In order to clean the strainer in the suction pipe of 2nd slurry cooler pump located in the bottom side of HDPE Reactor, the slurry cooler pump was stopped and the 10" remote on-off valve was closed and then the strainer was dismantled.

Main cause is block valve at the lower PE reactor was opened by mistake before inline strainer was not reinstalled, after detaching for cleaning



Fig. 1 HDPE Unit after Explosion

1.1 Incident Description

- Date of accident : October , 2003
- Accident type : Fire and explosion
- Accident consequences :

- Injuries : 7 peoples
- Fatality : 1 people

- Accident description

In order to clean the strainer in the suction pipe of 2nd slurry cooler pump located in the bottom side of HDPE Reactor, the slurry cooler pump was stopped and the 10” remote on-off valve was closed and then the strainer was dismantled.

On October, 2003, 10” remote on-off valve in the suction side of 2nd slurry cooler pump was opened and N-Hexane was released and vapor cloud explosion was occurred.

Block valve at the lower PE reactor was opened by mistake before inline strainer was not reinstalled , after detaching for cleaning

- Work status
 - October , 2003
 - 12:10 : 2ND Slurry cooler pump stopped
 - 15:40 : strainer spool(10”) dismantled
 - 17:00 : Completion of strainer cleaning work
 - 17:15~17:40 : Dinner
 - 17:59:22 : Remote on-off valve opened without cleaned strainer insert
 - 18:03:13 :
 - Occurrence of vapor cloud explosion
 - Occurrence of fire following the VCE
 - Two product storage silos which were 70 m isolated from the fire place were caught fire by radiation heat
 - 21:10 : Completion of fire extinguish



Fig. 2 Strainer location at Reactor Bottom

2.0 SYSTEM ANALYSIS

2.1 HDPE PROCESS

The HDPE plant was built in 1996. The plant can produce about 100,000 HDPE product with two polymerizing reactors.

Property of N-hexane

Formular	M.W.	Boiling point()	Flash point()	Autoignition()	Explosion limit
$\text{CH}_3(\text{CH}_2)_4\text{CH}_3$	86	68.7	- 21.7	225	1.2~7.7%

2nd polymerizer operation status

Reactor cap(m3)	Operation Level(5)	Operation temp()	Operation press(kg/cm2)	Ingredient
120	50	85	4	380g(PE)/I(Hexane)

2.2 HDPE UNIT

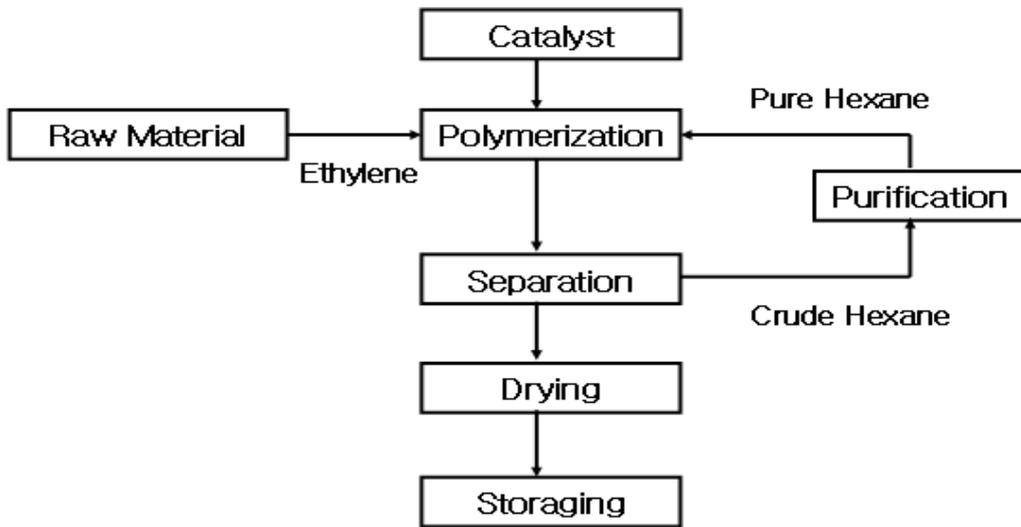


Fig. 3 HDPE Process Flow Chart

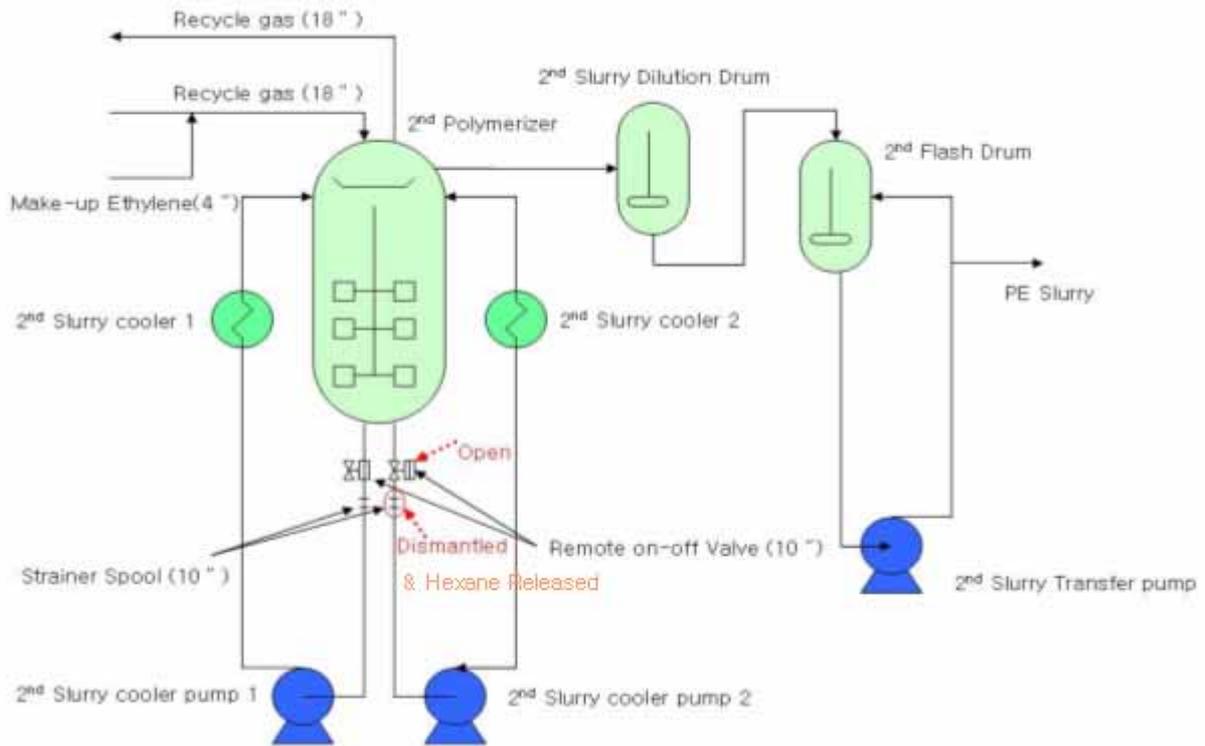


Fig. 4 HDPE Reactor Flow Diagram

3.0 INCIDENT ANALYSIS

3.1 Cause of release

- After 2nd slurry cooler pump was stopped with the 10” remote on-off valve opened, the open/close lever switch for 10” remote on-off valve should be manipulated to the closed position in the local. However, this lever switch was not manipulated to the closed position and also in the control room, someone might manipulated open/close switch to the open position.
- After manipulate open/close switch to the open position in the control room, then the open/close lever switch for 10” remote on-off valve was manipulated to the opened position in the local.
 - 10” remote on-off valve was designed to be opened if the open signal from the control room and local is exist. Also the 10” remote on-off valve is opened when the local lever switch is positioned open position and the open signal is exist from the control room.

3.2 Ignition sources

- Static electricity generated by releasing of N-hexane, PE slurry, hydrogen etc. from the 2nd polymerizer through the 10” remote on-off valve
- Electric spark generated from non-explosion proof electric equipments in the non-hazardous area might be act as a ignition sources during the dispersion of N-hexane vapor cloud
- Hot surface of pipe or equipment using steam etc. might be act as a ignition sources

4.0 Result of Investigation

- Implementation of management of change(MOC):

The change or modification made in the field shall be reflected in the related P & ID, operation procedures, etc. and based on these up-dated process information the hazard analysis for the changed or modified process and/or equipment shall be performed.

- Mechanical local lever switch for 10” remote on-off valve shall be changed to the electric type switch or something else so that the open position will be changed to the close position automatically when shutdown the 2nd polymerizer or 2nd slurry cooler pump.
- * When the 10” remote on-off valve is opened, the valve position shall be indicated “open”, reversely when the 10” remote on-off valve is closed then the valve position shall be indicated “close”.

5.0 ROOT CAUSE

5.1 Mismanagement of MOC

- With regard to the additional installation of inline strainer in the suction of cooler pump, the MOC including risk assessment, design of control logic, checking operating procedure and operator training was not properly done.

6.0 RECOMMENDATIONS

6.1 Technical Issues

- o Manual shut off valve to be installed in the upstream of strainer.
- o To install spare strainer which can make Hexane circulation without interruption
- o To change the manual local switch to electric type which make the shut-off valve closed automatically when the slurry pump is off.

6.2 Management Issues

- o To implement the MOC procedure more strictly.
- o To update the drawings, procedure and data as built
- o To improve the operator capabilities by strengthening operation & maintenance training