

FINAL REPORT



ACCIDENT DESCRIPTION

CAUSES OF THE ACCIDENT

RECOMMENDATIONS

Accident Occurred On: 09/13/2010

INCIDENT DESCRIPTION

On September 13, 2010, a large explosion and fire occurred in high density polyethylene production unit at a petrochemical company and led to one fatality, multiple injuries and extensive damages to the unit.

In this plant, ethylene gas is polymerized in the catalytic reactors. Each reactor has a volume of about 90 cubic meters, which is filled with hexane solvent, ethylene gas and catalyst. The polymerization process is performed at design temperature and pressure, and finally high-density polyethylene polymer is produced. In other sections of the unit, these polymer chains are being converted into granules and transported to the consumer market.

The gas mixture exits from the reactor top and after being cooled in a heat exchanger, it enters the separation drum. In this drum, gas and liquid are being separated from each other. liquid and gas are returned to the reactor by a pump and blowers.

This plant was scheduled for startup procedure after implementing the capacity increase project in September 2010. For pre-commissioning and testing of the piping, the operating group pressurized the unite with nitrogen. During the pressure test, it was determined that the gas return line from the blower to one of the reactors was leaking and one section of the pipe needed replacement.

Because it was not possible to start up the unit before replacing this part, the management and operation team decided to perform the pre-commissioning activities including calibration of the instrument. One of the instruments that was tested was the level gauge of the reactor. To calibrate the level gauge, the reactor should be filled with liquid; however, because the defective section of the reactor outlet pipe was removed, the operators decided to isolate that outlet by blind spade and issued the work permit for insulation. The maintenance team inserted spade between the relevant flanges as well.

The injection of hexane to the reactor was started at 16:15. After about 2 hours, by increasing the pressure inside the reactor, a leak was observed around the flange that

Accident Occurred On: 09/13/2010

was blinded by the inserted spade. The operation team diagnosed that the leakage can be stopped by applying more torque on the bolts. After fixing the leak, the filling operation continued and the reactor was filled up to a 78% of its volume and pressure up to 4.5 bar according to the instructions. The calibration procedure was completed at about 21:38 and the level gauge of the reactor was calibrated by the instrumentation team. The maintenance activities were temporarily suspended until 22 because of shift change time. At 21:53, the level gauge showed a sudden reduction in the liquid level and the pressure gauge showed a sudden decrease in pressure. The decrease was rapid in 100 seconds when the hexane level dropped to 50% and also the pressure dropped to 1.6 bar. Less than three minutes later, a loud explosion was heard.

After the fire announcement by the operation team, the firefighters immediately arrived at the scene and started the firefighting operation. The fire spread to all floors of the units and their facilities. The firefighters started cooling the environment and sprayed the foam. The fire in the upper floors was controlled after a while but the flames in the lower floors and below the reactor became severe and continued for hours due to the multiplicity and number of the equipment. The cause of the fire at the bottom of the reactor was a hexane leakage from one of its valves. Firefighters contained the fire at 2 am. The extinguishing operation completed at 17:55 in the next day as they let hexane inventory to be burnt completely.

In this accident, a worker who was performing construction work nearby, was fatally injured and died and four other workers were injured. Fortunately, explosion and fire occurred at the time of shift change which reduced the fatalities.

CAUSES OF THE ACCIDENT

The HDPE unit has a section in which equipment and pipes have interior glass wall. For isolating the flanges, two Teflon spades are inserted on both side of a steel spade flange. On the day of accident, the person who was inserting the spades between the relevant flanges used only one Teflon spade flange instead of two. Maybe because of

Accident Occurred On: 09/13/2010

much more weight of the steel type, he didn't insert the steel spade into flange. However, the Teflon spades flange were just allowed to be used in a certain part of the unit simultaneously by steel one.



Figure 1. Teflon spade flange instead of steel type

The unit operator did not monitor the performance of the person properly. Since the handle of spade flange was placed incorrectly upwards; therefore, the unit operator couldn't realize that the spade flange was of Teflon type.

The reactor pressure was high and resulted the hexane flowing into this pipe and accumulated behind the Teflon spade flange. The hexane solvent with a pressure more than 4.5 bar ruptured the Teflon plate and flowed to the blower and then to the condenser and finally reached to the disconnected point in the pipeline.

Due to large 16" pipe, a large volume of hexane liquid was spilled to the unit space and floors in a few seconds and began to evaporate. Before any reaction of the board staff, an explosive gas cloud was formed quickly in 3 minutes and reached to a source of spark or heated surface and exploded.

Accident Occurred On: 09/13/2010

The heat generated at the bottom of the reactor caused some Teflon valves seats to melt, resulting in fire expansion, so that the jet fire generated have caused further damages and destructions to the sensitive equipment.

RECOMMENDATIONS

- A pre-startup safety review (PSSR) should be implemented in the operating units, before initial commissioning, whenever the unit has been out of service for a long time, or when major changes are occurred.
- Following up exactly the procedure for process valve insulation.
- Avoiding unnecessary project activities at the time of startup.
- Use of experienced and skilled contractors for maintenance activities.
- Improving the level of discipline among units through exchange of information between shifts, the careful monitoring of the activities carried out on the site especially in sensitive times such as startup as one of the principles of PSM safety management.