



KOREA OCCUPATIONAL SAFETY & HEALTH AGENCY

INVESTIGATION REPORT

Hydrogen Chloride (HCL) Release in Chemical Plant



Yeosoo, Korea

July, 2005

KEY ISSUES:

- **HCL release from sampling valve**
- **Improper operation of sampling valve**

ABSTRACT

- This report explains the HCL release that occurred on July 16th, 2005 in a chemical plant which produces intermediate pharmaceutical products. The release was arisen due to miss operation of sampling system. In the solvent recovery section, toluene containing HCL went to a vessel to be neutralized by NaOH. Operators check periodically the degree of neutralization by operating sample valve located on the bottom pipelines of the vessel. The accident was occurred due not to close the sample valve. 68 employees were injured by breathing vapor of hydrogen chloride. The key safety issues covered in this report is how to operate the sampling system safety. Recommendations concerning this issue were delivered to whole Korean PSM sites.

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1.0 INTRODUCTION



Figure 1: HCL released sampling valve (3/4", Ball valve)

1.1 BACKGROUND

On July, 2005, HCL was released in a chemical plant which produces intermediated pharmaceutical products, Yeosoo, KOREA. Total 68 employees were injured due to exposure to HCL vapor. 66 out of 68 intoxicated operators came from other factories sitting next to the chemical plant. Because of the serious nature of the incident, the Korea Occupations Safety and Health Agency initiated an incident investigation. The purpose of the investigation was to identify the root causes of the incident and make recommendations to prevent similar incidents.

1.2 INVESTIGATION PROCESS

The KOSHA investigation team conducted an on-site investigation immediately after the incident took place. The scope of the investigation team is to examine and analyze the circumstances of the release to check what happened, and to attempt to determine the cause of the incident.

The team evaluated the process design, operating procedures, maintenance procedures, operating & maintenance record including DCS data, medical records, management of change record and other process management systems to determine their adequacy in controlling the cause of this accident. The ultimate objective of this investigation was to develop recommendations to help prevent similar incidents.

Facts were compiled by examining evidence at the incidents site, conducting interviews and reviewing documentation.

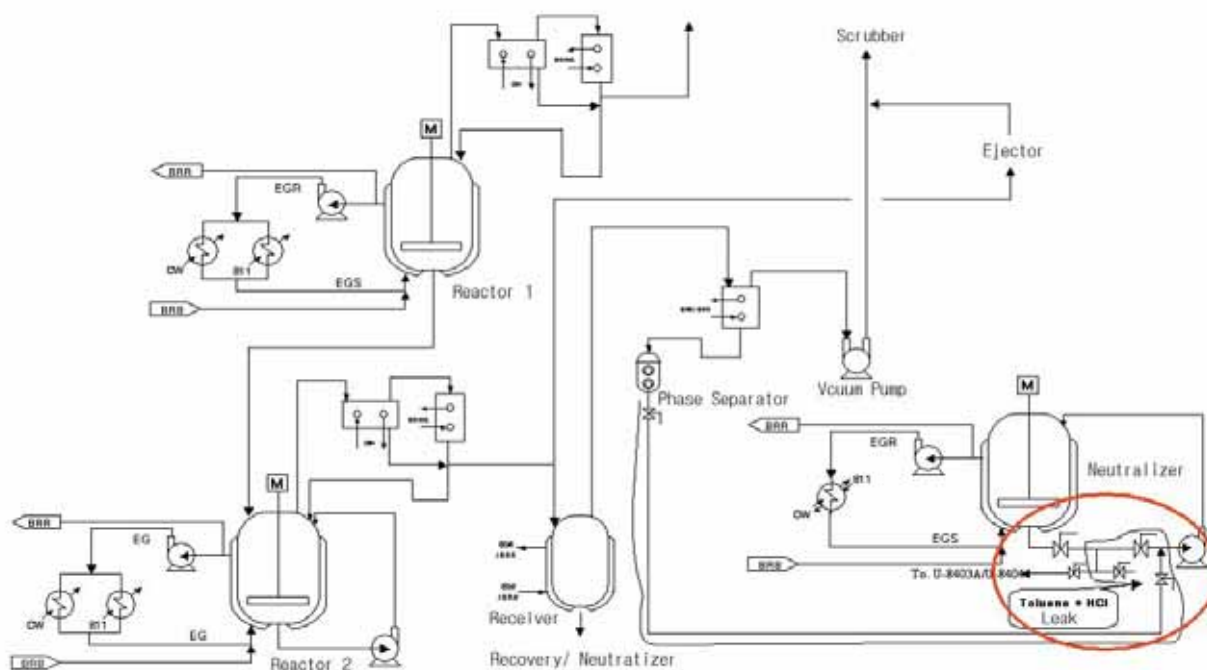


Fig. 2 : Schematic Drawing of incidents

2.0 INCIDENT ANALYSIS

2.1 Description

In the midnight of July, 2005, a release of HCL was occurred in a chemical plant which produces intermediated pharmaceutical product, Yeosoo, KOREA.

The release was arisen due to improper operating of sampling system. In the solvent recovery section, toluene containing hydrogen chloride goes to a vessel to be neutralized by NaOH.

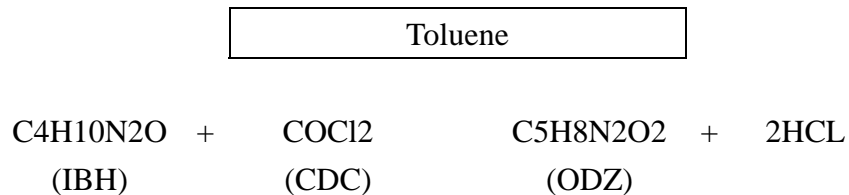
Operator checked periodically the degree of neutralization by operating sample valve located on the bottom pipeline of the vessel. The accident was occurred due not to close the sample valve. Through the opened valve, toluene including HCL was released and intoxicated 68 employees. None of them were seriously injured.



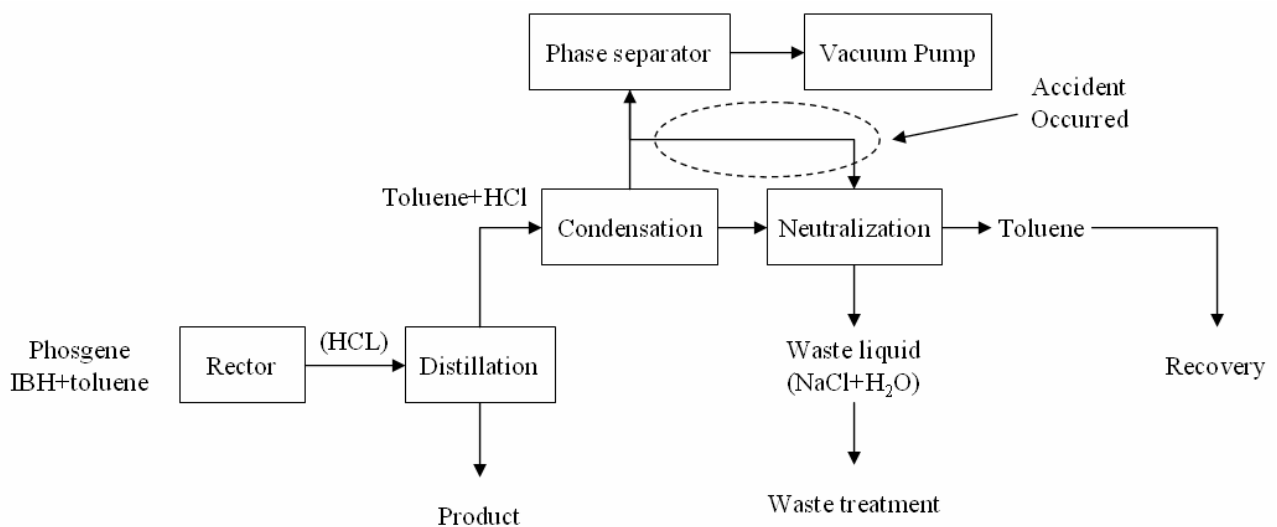
Fig. 3: Phase Separator

2.2 Process Description

1) Reaction Formula



2) Process description



1st reaction

Toluene



After feeding toluene and IBH into Reactor 1, CDC is followed. In the course of reaction, HCL is produced as by product. Un-reacted CDC and part of HCL is eliminated by scrubber continuously. After completion of 1st reaction, the intermediate product is transferred to reactor 2.

2nd reaction and distillation



In the Reactor 2, 2nd reaction and distillation to recover toluene is performed. In the 2nd reaction, HCL is also produced as by product, and dissolved in the toluene

Neutralization

Condensate (toluene + HCL) in the Receiver and Phase separator upstream of vacuum pump goes to Neutralizer, where HCL is to be neutralized by NaOH and toluene is to be recovered.

3.0 Results of Investigation

3.1 Operating status check

As a result of checking DCS data, reaction, distillation and scrubbing were normally processed when accident occurred. It means that release was happened in neutralization area.

3.2 Operator's interview

Operators clearly stated that they sprayed water and NaOH for several minutes when toxic material was released in the bottom of Neutralizer.

3.3 Medical symptoms

In the initial phase of the accident, there were some arguments in deciding the name of released material (CDC or HCL). It is found that CDC can not be transferred to the Neutralizer in normal operating condition. And also, as a result of KOSHA's medical doctor's survey on the condition of patients including sort of smell, edema of the lungs and pneumonia etc., the name of material is declared as HCL.

3.4 Dispersion area HCL release

When we calculated the dispersion area for 10kg HCL by simulation of KOSHA CARM program, the result is very close to the situation of the accident.

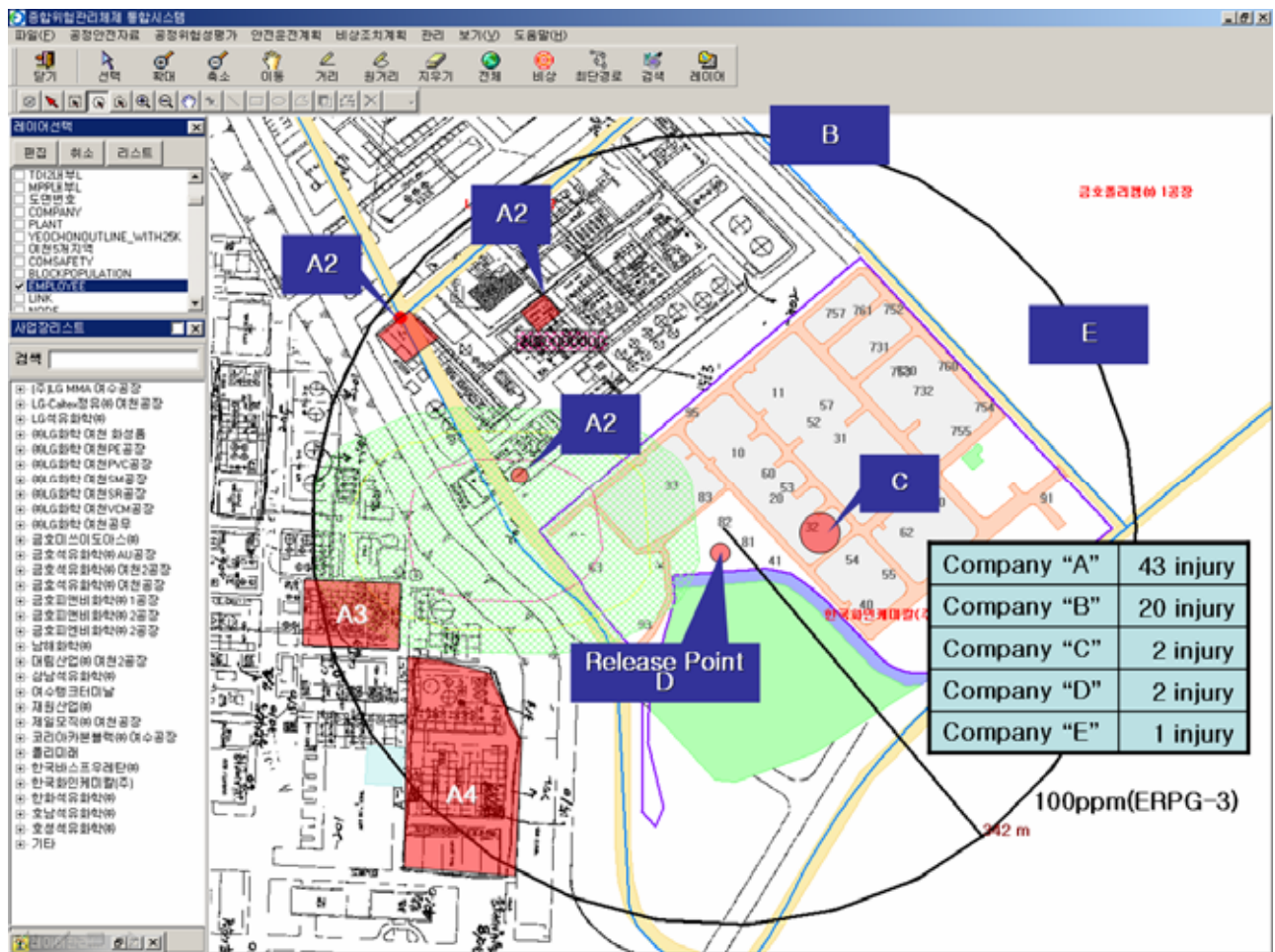


Fig.4. HCL Dispersion Area

4.0 ROOT CAUSE

4.1 Operating procedure not followed

It is normal concept that operator shall make close the valve after sampling. But, in this case the operator did not follow the sampling procedure like checking the on/off status of valve.

4.2 Management of change procedure not implemented

Sampling system under the bottom of neutralized was changed several months before the accident. They did not implement MOC procedure regarding the change of sample valve, etc.

5.0 RECOMMENDATIONS

5.1 Implementation of MOC procedure

When a system is changed, the operations shall be notified and educated on the revisions.

5.2 Check of ON/OFF status

Operators shall check strictly the ON/OFF status of valve after sampling.

5.3 Change of sampling method

The size of sampling valve is to be changed from 3/4" to 3/8", and type of sampling valve is recommend to be changed from plug to needle valves

5.4 Sharing of worst case scenario

Only two out of sixty eights injuries came from the plant where the accident occurred. In this regard, companies sitting close to close as complex type shall share their worst case scenario with neighboring plants. Through this, each company can prepare emergency response plan not only for the accident scenario of their own plant, but also those of close plants.