Explosion till följd av utsläpp efter en skenanade reaktion på en petrokemisk anläggning.

920525 MARS 1992_19

Under polymerisation av etylen på en petrokemisk anläggning förlorade man kontrollen över en skenande reaktion. Det framgår inte varför reaktionen skenade. Den värmeutvecklande reaktionen resulterade i en tryckökning i kärlet. Detta i sin tur ledde till att reaktionsblandningen släpptes ut, varefter den antändes tämligen omedelbart och exploderade. Det automatiska säkerhetssystemet hann inte gripa in. Tvärtom bidrog det till att ge näring åt explosionen.

Inblandade ämnen och mängder

	CAS Nr.	Mängd
etylen	74-85-1	60 kg
förbränningsprodukter		okänt
kol	7440-44-0	
väte	1333-74-0	
metan	74-82-8	

Skador:

Människor:	Inga.
Materiella:	Skador på anläggningen och angränsande anläggingar.
Miljö/ekologi:	Inga effekter rapporterade.
Infrastruktur:	Inga.

Erfarenheter redovisade (Ja/Nej): Ja

Kortfattat anges förebyggande åtgärder.

Report Profile

Identification of Report:

country: FA **ident key:** 1992_019_01

reported under Seveso I **directive as** major accident **reports:** SHORT+FULL

Date of Major Occurrence: Time of Major Occurrence

start: 1992-05-25 **start:** 03:28:00

finish: 1992-05-25 **finish:** 03:28:00

Establishment:

name:

address:

industry: 2002 petrochemical, refining, processing

Petrochemical (Polyethylene Production Plant)

Seveso II status: not applicable: Yes **art. 6 (notification):** No

art. 7 (MAPP): No

art. 9 (safety report): No

Date of Report:

short: full:

Authority Reporting:

name:

address:

Authority Contact:

rep_cont_name:

rep_cont_phone:

rep_cont_fax:

Additional Comments:

a) - not applicable -

b) - not applicable -

c) - not applicable -

d) - not applicable -

e) - not applicable -

Short Report

country: FA **ident key:** 1992_019_01

Accident Types:

release: Yes **explosion:** Yes

water contamination: No **other:** No

fire: No

description:

As a result of an exothermic runaway decomposition in a 750 litres polymerization reactor, ethylene and its decomposition products were released through the two reactor vent stacks and via the dump valves on the supply lines. The released g... see Appendix Short Report / description of accident types

Substance(s) Directly Involved:

toxic: Yes **explosive:** Yes

ecotoxic: No **other:** No

flammable: Yes

description:

- Ethylene (C.A.S. CODE: 74-85-1, E.E.C. CODE: 601-010-00-3): amount involved in the release = about 60 kg.... see Appendix Short Report / description of substances involved

Immediate Sources of Accident:

storage: No **transfer:** No

process: Yes **other:** No

description:

The accident occurred in a polyethylene plant of a petrochemical industry during the polymerization of ethylene that was carried out in a 750 litres pressurized reactor. The reactor design was 19 years old.

Suspected Causes:

plant or equipment: Yes **environmental:** No

human: No **other:** No

description:

INITIATING EVENTS AND CONSEQUENCES:... see Appendix Short Report / description of suspected causes

Immediate Effects:

material loss: Yes

human deaths: No

human injuries: No **community disruption:** No

other: No

ecological harm: No

national heritage loss: No

description:

MATERIAL LOSS:

The explosion caused structural damages to the surrounding plants but no data are available about their cost.

Emergency Measures taken:

on-site systems: Yes **decontamination:** No

external services: No **restoration:** No

sheltering: No **other:** No

evacuation: No

description:

INTERNAL TO THE ESTABLISHMENT:... see Appendix Short Report / description of emergency measures taken

Immediate Lessons Learned:

prevention: Yes **other:** No

mitigation: Yes

description:

MEASURES TO PREVENT ANY RECURRENCE OF SIMILAR ACCIDENTS:... see Appendix Short Report / description of immediate lessons learned

A Occurrence Full Report

country: FA **ident key:** 1992_019_01

1 Type of Accident

remarks: As a result of an exothermic runaway decomposition (code 1304) in a polymerization reactor, ethylene was released through the two reactor vent stacks and dump valves on the supply line (code 1101). The released gas was ignited (apparently b... see Appendix Full Report A / type of accident

2 Dangerous Substances

remarks: The accident occurred in a 750 litres polymerization reactor. The amount of ethylene in the polymerization reactor and in the product lines to and from it was about 60 kg. Ethylene was released through the two reactor vent stacks together w... see Appendix Full Report A / dangerous substances

3 Source of Accident

illustration: - not applicable -

remarks: The accident occurred in a polyethylene plant (code 3102) of a petrochemical industry (code 2002) during the polymerization of ethylene that was carried out in a 750 litres pressurized reactor (code 4002). The reactor design was 19 years ol... see Appendix Full Report A / source of accident - remarks

4 Meteorological Conditions

precipitation none: fog: rain: hail: snow:

No No No No No

wind speed (m/s):

direction (from):

stability (Pasquill):

ambient temperature (∞C):

remarks: - not applicable -

5 Causes of Major Occurrence

main causes

technical / physical 5106 operation: runaway reaction

- not applicable -

- not applicable -

- not applicable -

- not applicable -

human / organizational 5307 organization: process analysis (inadequate, incorrect)

5308 organization: design of plant/equipment/system (inadequate, inappropriate)

- not applicable -

- not applicable -

- not applicable -

remarks: Ethylene was released from the reactor and supply lines as a result of an exothermic runaway decomposition (code 5106). The released gas was ignited because the automatic water quenching system operated but failed to prevent the aerial igni... see Appendix Full Report A / causes of major occurrence

6 Discussion about the Occurrence

- not applicable -

Type of Accident **country:** FA **ident key:** 1992_019_01

event:

major occurrence 1307 explosion: VCE (vapour cloud explosion; supersonic wave front)

initiating event - not applicable -

associated event - not applicable -

Dangerous substances

country: FA **ident key:** 1992_019_01

a) total establishment inventory

CAS number: 74-82-8 **identity:** Methane

name from Seveso I Directive: - not applicable -

name from Seveso II Directive: - not applicable -

category from Seveso II: - not applicable -

other hazards (1): - not applicable -

other hazards (2): - not applicable -

maximum quantity (tonnes): -1

use of substance as: ABNORMAL PRODUCT

b) substance belongs to relevant inventory directly involved: Yes

actual quantity: -1 **potential quantity:** -1

c) substance belongs to relevant inventory indirectly involved: No

actual quantity: -1 **indir_pot_quant:** -1

a) total establishment inventory

CAS number: 1333-74-0 **identity:** Hydrogen

name from Seveso I Directive: - not applicable -

name from Seveso II Directive: - not applicable -

category from Seveso II: - not applicable -

other hazards (1): - not applicable -

other hazards (2): - not applicable -

maximum quantity (tonnes): -1

use of substance as: ABNORMAL PRODUCT

b) substance belongs to relevant inventory directly involved: Yes

actual quantity: -1 **potential quantity:** -1

c) substance belongs to relevant inventory indirectly involved: No

actual quantity: -1 **indir_pot_quant:** -1

a) total establishment inventory

CAS number: 74-85-1 **identity:** Ethylene

name from Seveso I Directive: - not applicable -

name from Seveso II Directive: - not applicable -

category from Seveso II: - not applicable -

other hazards (1): - not applicable -

other hazards (2): - not applicable -

maximum quantity (tonnes): 0,06

use of substance as: STARTING MATERIAL

b) substance belongs to relevant inventory directly involved: Yes

actual quantity: 0,04 **potential quantity:** 0,06

c) substance belongs to relevant inventory indirectly involved: No

actual quantity: -1 **indir_pot_quant:** -1

a) total establishment inventory

CAS number: 7440-44-0 **identity:** Carbon (particulate)

name from Seveso I Directive: - not applicable -

name from Seveso II Directive: - not applicable -

category from Seveso II: - not applicable -

other hazards (1): - not applicable -

other hazards (2): - not applicable -

maximum quantity (tonnes): -1

use of substance as: ABNORMAL PRODUCT

b) substance belongs to relevant inventory directly involved: Yes

actual quantity: -1 **potential quantity:** -1

c) substance belongs to relevant inventory indirectly involved: No

actual quantity: -1 **indir_pot_quant:** -1

Source of Accident - Situation **country:** FA **ident key:** 1992_019_01

situation

industry

inititating event 2002 petrochemical, refining, processing

associated event - not applicable -

activity/unit

major occurrence 3102 process: chemical continuous reaction

inititating event 3102 process: chemical continuous reaction

associated event - not applicable -

component

major occurrence 4002 reaction vessel; pressurised

inititating event 4002 reaction vessel; pressurised

associated event - not applicable -

B Consequences Full Report

country: FA **ident key:** 1992_019_01

1 Area concerned

affected

extent of effects installation: Yes

establishment: No

off-site; local: No

off-site; regional: No

off-site; transboundary: No

illustration of effects - not applicable -

remarks In the Original Report there is no evidence of significant effects outside the i... see Appendix

Full Report B / area concerned - remarks

2 People

establishment popul. emergency personnel off-site population

total at risk

immediate fatalities

subsequent fatalities

hospitalizing injuries

other serious injuries

health monitoring

remarks No people were injured during the accident.

3 Ecological Harm

pollution/contamination/damage of:

- residential area (covered by toxic cloud) Suspected

- common wild flora/fauna (death or elimination) Suspected

- rare or protected flora/fauna (death or elimination) Suspected

- water catchment areas and supplies for consumption or recreation Suspected

- land (with known potential for long term ecological harm or Suspected

preventing human access or activities)

- marine or fresh water habitat Suspected

- areas of high conservation value or given special protection Suspected

remarks In the Original Report there is no evidence of a significant ecological harms.... see Appendix

Full Report B / ecological harm

4 National Heritage Loss

effects on:

- historical sites not applicable **- historic monuments** not applicable

- historic buildings not applicable **- art treasures** not applicable

remarks No data available.

5 Material Loss

establishment losses off site losses

costs (direct costs to operator) (social costs)

in ECU ECU

material losses

response, clean up, restoration

remarks No data are available about the cost of the structural damages to the surroundin... see Appendix

Full Report B / material loss

6 Disruption of Community Life

establishment/plant evacuated disabled/unoccupiable destroyed

- nearby residences/hotels No No No

- nearby factories/offices/small shops No No No

- schools, hospitals, institutions No No No

- other places of public assembly No No No

interruption of utilities etc. no / yes duration

- gas No

- electricity No

- water No

- sewage treatment works No

- telecommunications No

- main roads No

- railways No

- waterways No

- air transport No

significant public concern none local level national level

- off site populations Yes No No

- media interest No No No

- political interest No No No

remarks In the Original Report there is no evidence of significant effects outside the i... see Appendix

7 Discussion of Consequences

C Response Full Report

country: FA **ident key:** 1992_019_01

1 Emergency Measures

taken - on site - not applicable - - not applicable -

- not applicable - - not applicable -

- not applicable - - not applicable -

- off site - not applicable - - not applicable -

- not applicable - - not applicable -

- not applicable - - not applicable -

still - on site - not applicable - - not applicable -

required

- not applicable - - not applicable -

- not applicable - - not applicable -

- off site - not applicable - - not applicable -

- not applicable - - not applicable -

- not applicable - - not applicable -

continuing contamination or danger

-on site not applicable

-off site not applicable

remarks - not applicable -

2 Seveso II Duties

pre-accident evaluation

Article item not due yet not done done/submitted evaluated

6 notification No No No No

7 policy (MAPP) No No No No

9 safety report No No No No

9, 10, 11 update No No No No

11 internal plan No No No No

11 external plan No No No No

13 informing public No No No No

9, 12 siting policy No No No No

post-accident evaluation

Seveso II duty was actual were actual compared with actual

contingency consequences consequences, the

addressed? addressed? predicted extent was?

Article item

7 policy (MAPP) not applicable not applicable not applicable

9 current safety report not applicable not applicable not applicable

11 internal plan not applicable not applicable not applicable

11 external plan not applicable not applicable not applicable

13 informing public not applicable not applicable not applicable

9, 12 siting policy not applicable not applicable not applicable

evaluation of safety organisation

organisational element element existed did element relate to actual circumstances of

yes / no no / partly / yes adequate?

- written policy objectives No

- specified management No

structure

- specified responsibilities No

- specified working procedures No

- specified procedures for No

assessment/auditing of

management system

- specified procedures for No

review and update of

management policy

- specified general training No

procedures

- specified emergency No

training procedures

evaluation of ecological impact control

organisational element element existed did element relate to actual circumstances of

yes / no no / partly / yes adequate?

- ecological status review No

before incident

- potential ecological No

consequences assessment

- ecological impact review No

after incident

- ecological restoration No

procedures

- subsequent review of No

restoration success

remarks - not applicable -

3 Official Action Taken

legal action

- not applicable -

other official action

- not applicable -

4 Lessons Learned

measures to prevent recurrence

After the accident, it was dec... see Appendix Full Report C / lesson learned - prevent

measures to mitigate consequences:

After the accident, the follow... see Appendix Full Report C / lesson learned - mitigate

useful references:

- not applicable -

5 Discussion about Response

- not applicable -

Appendices for the FA / 1992_019_01 report

Appendix Short Report / description of accident types:

As a result of an exothermic runaway decomposition in a 750 litres polymerization reactor, ethylene and its decomposition products were released through the two reactor vent stacks and via the dump valves on the supply lines. The released gas was ignited (apparently by the hot carbon particles obtained by the decomposition of the ethylene) and an aerial explosion occurred.

Appendix Short Report / description of substances involved:

- Ethylene (C.A.S. CODE: 74-85-1, E.E.C. CODE: 601-010-00-3): amount involved in the release = about 60 kg.

- Ethylene (C.A.S. CODE: 74-85-1, E.E.C. CODE: 601-001-00-3): amount involved in the aerial explosion (together with the decomposition products) = about 60 kg.

No data are available about the amounts of Carbon (C.A.S. CODE: 7440-44-0), Hydrogen (C.A.S. CODE: 1333-74-0, E.E.C. CODE: 001-001-00-9) and Methane (C.A.S. CODE: 74-82-8, E.E.C. CODE: 601-001-00-4) obtained by the decomposition of ethylene and released from the polymerization reactor.

Appendix Short Report / description of suspected causes:

INITIATING EVENTS AND CONSEQUENCES:

During the polymerization on the ethylene in a 750 litres reactor, an exothermic runaway decomposition occurred. The pressure increase resulted in the release of the ethylene and its decomposition products via the two reactor vent stacks and via the dump valves on the supply lines. The released gas was ignited apparently by the hot carbon particles obtained by the decomposition of the ethylene. The ignition of the gas cloud resulted in an aerial explosion.

CAUSES:

The ethylene was released from the reactor and the supply lines as a result of an exothermic runaway decomposition. The released gas was ignited (apparently by the hot carbon particles obtained by the decomposition of the ethylene) because the automatic water quenching system operated but failed to prevent the aerial ignition. This was due to a quenching system design not appropriate. The intervention of automatic isolation valves on the reactor were not fast enough to prevent more unused ethylene entering the reactor and therefore to feed the aerial explosion. Automatic dump valves on the feeding line operated 2 seconds to dump residual ethylene to atmosphere resulting also in feeding the aerial explosion.

Appendix Short Report / description of emergency measures taken:

INTERNAL TO THE ESTABLISHMENT:

The water quenching system automatically operated but it failed to prevent the aerial ignition of the released gas. The intervention of automatic isolation valves on the reactor were not fast enough to prevent more unused ethylene entering the reactor and therefore to feed the aerial explosion. Automatic dump valves on the feeding line operated 2 seconds to dump residual ethylene to atmosphere resulting also in feeding the aerial explosion.

Appendix Short Report / description of immediate lessons learned:

MEASURES TO PREVENT ANY RECURRENCE OF SIMILAR ACCIDENTS:

After the accident, it was decided the reposition the pilot tubes which detect the pressure rise and activate the quenching system in order to speed its response and, therefore, to avoid the ignition of the gas cloud by means of the hot carbon particles.

MEASURES TO MITIGATE THE EFFECTS OF THE ACCIDENT:

After the accident, the following measures were established:

1- to use new smart sensors to speed up the reactor isolation and, therefore, to reduce the amount of gas released;

2- to vent ethylene to a separate, contained system or increase considerably the delay before the automatic dumping of the lines contents.

Appendix Full Report A / type of accident:

As a result of an exothermic runaway decomposition (code 1304) in a polymerization reactor, ethylene was released through the two reactor vent stacks and dump valves on the supply line (code 1101). The released gas was ignited (apparently by hot carbon particles obtained by the decomposition of the ethylene) and an aerial explosion occurred (code 1307).

Appendix Full Report A / dangerous substances:

The accident occurred in a 750 litres polymerization reactor. The amount of ethylene in the polymerization reactor and in the product lines to and from it was about 60 kg. Ethylene was released through the two reactor vent stacks together with the decomposition products (normally carbon, hydrogen and methane) but no data are available about their single amounts. Up to 40 kg of the whole released amount partecipated to the aerial explosion.

Appendix Full Report A / source of accident - remarks:

The accident occurred in a polyethylene plant (code 3102) of a petrochemical industry (code 2002) during the polymerization of ethylene that was carried out in a 750 litres pressurized reactor (code 4002). The reactor design was 19 years old.

Appendix Full Report A / causes of major occurrence:

Ethylene was released from the reactor and supply lines as a result of an exothermic runaway decomposition (code 5106). The released gas was ignited because the automatic water quenching system operated but failed to prevent the aerial ignition due to inadequate system design (code 5308). The intervention of automatic isolation valves (not fast enough) together with dump valves on feeding line caused a further release of ethylene resulting in feeding the aerial explosion (codes 5307 and 5308).

Appendix Full Report B / area concerned - remarks:

In the Original Report there is no evidence of significant effects outside the installation.

Appendix Full Report B / ecological harm:

In the Original Report there is no evidence of a significant ecological harms.

Appendix Full Report B / material loss:

No data are available about the cost of the structural damages to the surrounding plants caused by the explosion.

Appendix Full Report B / disruption of community life:

In the Original Report there is no evidence of significant effects outside the installation.

Appendix Full Report C / lesson learned - prevent:

After the accident, it was decided the reposition the pilot tubes which detect the pressure rise and activate the quenching system in order to speed its response and, therefore, to avoid the ignition of the gas cloud by means of the hot carbon particles.

Appendix Full Report C / lesson learned - mitigate:

After the accident, the following measures were established:

1- to use new smart sensors to speed up the reactor isolation and, therefore, to reduce the amount of gas released;

2- to vent ethylene to a separate, contained system or increase considerably the delay before the automatic dumping of the lines contents.