

Gasutsläpp och gasexplosion på en krackningsanläggning på ett oljeraffinaderi.

911210 MARS 1991_21

På grund av en läcka på den trycksatta sidan av en luftkylare i krackningsanläggningen inträffade en hastigt tryckfall. Läckan hade uppstått på grund av erosionskorrosion, vilket i sin tur orsakats av en produktionsökning i anläggningen. Nöddåtgärden att sänka trycket aktiverades därför inte. Något senare antändes den utsläppta gasen av okänd källa vilket resulterade i en gasexplosion (VCE) följt av brand. När explosionen inträffat trädde nödsystemet igång och alla relevanta ventiler stängdes. Strömförsörjningen ströps och produktionen stoppades. Räddningstjänst och polis tillkallades.

Effekterna av produktionsökningen hade inte analyserats tillräckligt på grund av en felaktig attityd från ledningens sida gentemot säkerhet.

Inblandade ämnen och mängder

	CAS Nr.	Mängd
brandfarliga gaser väte och C1-C4-kolväten		30 000 kg
mycket brandfarliga vätskor pentan och lätta kolväten		150 000 kg
vätesulfid	7783-06-4	4000 kg
ammoniak	7664-41-7	1500 kg

Skador:

Människor:	24 personer blev lindrigt skadade.
Materiella:	Omfattande skador på byggnader och anläggning. Utanför anläggningen skadades några byggnader och fordon.
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: 1991_021_01

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

Date of Major Occurrence: Time of Major Occurrence

start: 1991-12-10 start: 10:00:00

finish: finish:

Establishment:

name:

address:

industry: 2002 petrochemical, refining, processing

Petrochemical (Hydrocracking 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: 1991_021_01

Accident Types:

release: No explosion: Yes

water contamination: No other: No

fire: Yes

description:

SAFETY SYSTEMS OR OPERATORS INTERVENTION:... see Appendix Short Report / description of accident types

Substance(s) Directly Involved:

toxic: Yes explosive: Yes

ecotoxic: No other: No

flammable: Yes

description:

- Flammable Gases (Hydrogen and C1-C4 Hydrocarbons): amount involved = 30,000 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 during normal operation in the hydrocracker plant of a petrochemical industry. The

component involved in the initial gas release was an air cooler for gas cooling.

Suspected Causes:

plant or equipment: Yes environmental: No

human: No **other:** No

description:

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

Immediate Effects:

material loss: Yes

human deaths: No

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

other: No

ecological harm: No

national heritage loss: No

description:

EFFECTS ON PEOPLE:... see Appendix Short Report / description of immediate effects

Emergency Measures taken:

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

external services: Yes **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: No

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:** 1991_021_01

1 Type of Accident

remarks: Due to a leakage in the high pressure side of an air cooler of the hydrocracker a rapid pressure drop occurred. A little later the released gas ignited due to an unknown ignition source resulting in vapour cloud explosion (code 1307) that w... see Appendix Full Report A / type of accident

2 Dangerous Substances

remarks: The total establishment and the potential directly involved inventories of flammable gases (hydrogen and C1^C4), highly flammable liquids (pentane and light hydrocarbons), hydrogen sulphide and ammonia refer to the amounts released during t... see Appendix Full Report A / dangerous substances

3 Source of Accident

illustration: - not applicable -

remarks: The accident occurred during normal operation in the hydrocracker plant (code 3102) of a petrochemical industry (code 2002). The component involved in the initial gas release was an air cooler (code 4009) for gas cooling.

4 Meteorological Conditions

precipitation none: fog: rain: hail: snow:

No No No No No

wind speed (m/s):

direction (from): East

stability (Pasquill):

ambient temperature (°C):

remarks: High atmospheric pressure. Thermal inversion condition with weak wind from East.

5 Causes of Major Occurrence

main causes

technical / physical 5102 operation: component/machinery failure/malfunction

5104 operation: corrosion/fatigue

- not applicable -

- not applicable -

- not applicable -

human / organizational 5302 organization: management attitude problem

5307 organization: process analysis (inadequate, incorrect)

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

inappropriate)

- not applicable -

- not applicable -

remarks: The leakage was caused by the failure of the air cooler (code 5102) due to erosion/corrosion (code 5104) because of productivity increase of the unit. The effects on the design plant (code 5308) of a productivity increase was not adequately... see Appendix Full Report A / causes of major occurrence

6 Discussion about the Occurrence

- not applicable -

Type of Accident country: FA ident key: 1991_021_01

event:

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

initiating event - not applicable -

associated event - not applicable -

event:

major occurrence 1202 fire: pool fire (burning pool of liquid, contained or uncontained)

initiating event 1307 explosion: VCE (vapour cloud explosion; supersonic wave front)

associated event - not applicable -

Dangerous substances

country: FA ident key: 1991_021_01

a) total establishment inventory

CAS number: 7783-06-4 identity: Hydrogen Sulphide

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): 4

use of substance as: ABNORMAL PRODUCT

b) substance belongs to relevant inventory directly involved: Yes

actual quantity: 4 potential quantity: 4

c) substance belongs to relevant inventory indirectly involved: No

actual quantity: -1 indir_pot_quant: -1

a) total establishment inventory

CAS number: identity: Highly Flammable Liquids

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): 150

use of substance as: NORMAL FINISHED PRODUCT

b) substance belongs to relevant inventory directly involved: Yes

actual quantity: 150 potential quantity: 150

c) substance belongs to relevant inventory indirectly involved: No

actual quantity: -1 indir_pot_quant: -1

a) total establishment inventory

CAS number: identity: Flammable Gases

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): 30

use of substance as: NORMAL FINISHED PRODUCT

b) substance belongs to relevant inventory directly involved: Yes

actual quantity: 30 potential quantity: 30

c) substance belongs to relevant inventory indirectly involved: No

actual quantity: -1 indir_pot_quant: -1

a) total establishment inventory

CAS number: 7664-41-7 identity: Ammonia

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): 1,5

use of substance as: ABNORMAL PRODUCT

b) substance belongs to relevant inventory directly involved: Yes

actual quantity: 1,5 potential quantity: 1,5

c) substance belongs to relevant inventory indirectly involved: No

actual quantity: -1 indir_pot_quant: -1

Source of Accident - Situation country: FA ident key: 1991_021_01

situation

industry

initiating event 2002 petrochemical, refining, processing

associated event - not applicable -

activity/unit

major occurrence 3102 process: chemical continuous reaction

initiating event 3102 process: chemical continuous reaction

associated event - not applicable -

component

major occurrence 4009 heat exchanger (boiler, refrigerator, heating coils, etc.)

initiating event 4009 heat exchanger (boiler, refrigerator, heating coils, etc.)

associated event - not applicable -

B Consequences Full Report

country: FA ident key: 1991_021_01

1 Area concerned

affected

extent of effects installation: Yes

establishment: Yes

off-site; local: Yes

off-site; regional: No

off-site; transboundary: No

illustration of effects - not applicable -

remarks The accident caused damages to some buildings and vehicles outside the establish... 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 24

health monitoring

remarks 24 people (5 were working near the air cooler and were hurt by flying glass piec... see Appendix

Full Report B / people

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 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 DM ECU DM

material losses 9E+07 1200000

response, clean up, restoration

remarks Inside the establishment, the accident caused damages to buildings, parts of the... 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** No Yes No

- **media interest** No No No

- **political interest** No No No

remarks The accident caused damages to some buildings and vehicles outside the establish... see Appendix

7 Discussion of Consequences

C Response Full Report

country: FA **ident key:** 1991_021_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, the follow... see Appendix Full Report C / lesson learned - prevent

measures to mitigate consequences:

- not applicable -

useful references:

- not applicable -

5 Discussion about Response

- not applicable -

Appendices for the FA / 1991_021_01 report

Appendix Short Report / description of accident types:

SAFETY SYSTEMS OR OPERATORS INTERVENTION:

Emergency pressure release (21 bar/minute) was activated. The safety systems operated as foreseen.

ENVIRONMENTAL AND ATMOSPHERIC CONDITIONS:

High atmospheric pressure. Thermal inversion condition with weak wind from East.

ACCIDENT CASE HISTORY DESCRIPTION:

Due to a leakage in the high pressure side of an air cooler of the hydrocracker a rapid pressure drop occurred. The emergency pressure release was therefore not activated. A little later the released gas ignited due to an unknown ignition source resulting in vapour cloud explosion that was followed by a fire.

Appendix Short Report / description of substances involved:

- Flammable Gases (Hydrogen and C1-C4 Hydrocarbons): amount involved = 30,000 kg.
- Highly Flammable Liquids [Pentane and Light Hydrocarbons]: 150,000 kg.
- Hydrogen Sulphide (C.A.S. CODE: 7783-06-4): amount involved = 4,000 kg.
- Ammonia (C.A.S. CODE: 7664-41-7, E.E.C. CODE: 007-001-00-5): amount involved = 1,500 kg.

Appendix Short Report / description of suspected causes:

INITIATING EVENT AND CONSEQUENCES:

Leakage in the high-pressure side of an air cooler of the hydrocracker plant.

CAUSES:

The leakage was caused by the failure of the air cooler due to erosion/corrosion because of productivity increase of the unit. The effects on the design plant of a productivity increase was not adequately analyzed because of a wrong attitude of management towards safety.

Appendix Short Report / description of immediate effects:

EFFECTS ON PEOPLE:

24 people (5 were working near the air cooler and were hurt by flying glass pieces) received light injuries.

MATERIAL LOSS:

Inside the establishment, the accident caused damages to buildings, parts of the plant and some vehicles. The cost of the damages has been estimated in about 90 millions of Deutch Marcs (about 45 MECU). Outside the establishment, the accident damaged some buildings and vehicles. The cost of the damages has been estimated in about 1.2 millions of Deutch Marcs (about 0.6 MECU).

Appendix Short Report / description of emergency measures taken:

INTERNAL TO THE ESTABLISHMENT:

The emergency pressure release was activated. All the connecting pipes to the tank storage were shut-off. Electrical power to the plant was shut-down. Production was halted. The company fire brigade was activated.

EXTERNAL TO THE ESTABLISHMENT:

External fire brigade and police were alerted.

Appendix Short Report / description of immediate lessons learned:

MEASURES TO PREVENT ANY RECURRENCE OF SIMILAR ACCIDENTS:

After the accident, the following measures were established:

- 1- reduction of the outlet speed in the air cooler bundle through installation of outlet nozzles;
- 2- modification of the pipe direction on the outlet side by connecting the outlet nozzles with arc T-stays instead of pipes manifold;
- 3- installation of seats in the inlet chamber of the air-cooler bundle;
- 4- elimination of a 30° bend;
- 5- both the return and outlet chambers as well as the piping on the outlet side will be made of corrosion-proof steel;
- 6- wall thickness measurements of the inlet and outlet piping of the air-cooler to be carried out under scheduling.

Appendix Full Report A / type of accident:

Due to a leakage in the high pressure side of an air cooler of the hydrocracker a rapid pressure drop occurred. A little later the released gas ignited due to an unknown ignition source resulting in vapour cloud explosion (code 1307) that was followed by a fire (code 1202).

Appendix Full Report A / dangerous substances:

The total establishment and the potential directly involved inventories of flammable gases (hydrogen and C1-C4), highly flammable liquids (pentane and light hydrocarbons), hydrogen sulphide and ammonia refer to the amounts released during the accident.

Appendix Full Report A / causes of major occurrence:

The leakage was caused by the failure of the air cooler (code 5102) due to erosion/corrosion (code 5104) because of productivity increase of the unit. The effects on the design plant (code 5308) of a productivity increase was not adequately analyzed (code 5307) because of a wrong attitude of management towards safety (code 5302).

Appendix Full Report B / area concerned - remarks:

The accident caused damages to some buildings and vehicles outside the establishment.

Appendix Full Report B / people:

24 people (5 were working near the air cooler and were hurt by flying glass pieces) received light injuries.

Appendix Full Report B / ecological harm:

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

Appendix Full Report B / material loss:

Inside the establishment, the accident caused damages to buildings, parts of the plant and some vehicles. The cost of the damages has been estimated in about 90 millions of Deutch Marcs (about 45 MECU). Outside the establishment, the accident damaged some buildings and vehicles. The cost of the damages has been estimated in about 1.2 millions of Deutch Marcs (about 0.6 MECU)

Appendix Full Report B / disruption of community life:

The accident caused damages to some buildings and vehicles outside the establishment.

Appendix Full Report C / lesson learned - prevent:

After the accident, the following measures were established:

- 1- reduction of the outlet speed in the air cooler bundle through installation of outlet nozzles;
- 2- modification of the pipe direction on the outlet side by connecting the outlet nozzles with arc T-stays instead of pipes manifold;
- 3- installation of seats in the inlet chamber of the air-cooler bundle;
- 4- elimination of a 30° bend;
- 5- both the return and outlet chambers as well as the piping on the outlet side will be made of corrosion-proof steel;
- 6- wall thickness measurements of the inlet and outlet piping of the air-cooler to be carried out under scheduling.