

Explosion på en kemikaliefabrik.

911105 MARS 1991_06

Olyckan inträffade i samband med svetsarbete på en lagertank med formaldehyd. Tanken var till 2/3-delar fylld med 37%-ig formaldehyd. Svetsning på utansidan av tanken ovanför vätskeytan överhettade ångan inne i tanken som antändes och exploderade. Företagets interna brnackår ryckte in tillsammans med två helikoptrar. Skadade fördes bort och det kontaminerade området spärrades av.

Inblandade ämnen och mängder

	CAS Nr.	Mängd
formaldehyd 37%	50-00-0	312 ton

Skador:

Människor: 2 personer omkom och 10 skadades av explosionen.
Materiella: Anläggningen skadades svårt. Fönster krossades utanför fabriksområdet.
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_006_01

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

Date of Major Occurrence: Time of Major Occurrence

start: 1991-11-05 start:

finish: finish:

Establishment:

name:

address:

industry: 2001 general chemicals manufacture

Organic Chemical (Process Plants and Storage Areas)

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_006_01

Accident Types:

release: Yes **explosion:** Yes

water contamination: No **other:** No

fire: No

description:

SYSTEM ORIGINATING AND OPERATING CONDITIONS:... see Appendix Short Report / description of accident types

Substance(s) Directly Involved:

toxic: Yes **explosive:** Yes

ecotoxic: No **other:** No

flammable: Yes

description:

- Formaldehyde [37% solution] (C.A.S. CODE: 50-00-0, E.E.C. CODE: 605-001-01-2): amount involved = 312,000 Kg.

Immediate Sources of Accident:

storage: Yes **transfer:** No

process: Yes **other:** No

description:

The accident occurred during maintenance of a formaldehyde storage tank in an organic chemical industry. The storage tank was filled 2/3 with formaldehyde (37% solution).

Suspected Causes:

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

human: Yes **other:** No

description:

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

Immediate Effects:

material loss: Yes

human deaths: Yes

human injuries: Yes **community disruption:** Yes

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:** Yes

sheltering: No **other:** No

evacuation: Yes

description:

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

Immediate Lessons Learned:

prevention: Yes **other:** Yes

mitigation: No

description:

EXTERNAL TO THE ESTABLISHMENT... see Appendix Short Report / description of immediate lessons learned

A Occurrence Full Report

country: FA **ident key:** 1991_006_01

1 Type of Accident

remarks: A welding process (manual electrode welding) took place on the outside of the wall of a storage tank which was filled 2/3 with formaldehyde 37% solution. The welding operation over the level of the liquid phase in the storage tank overheated... see Appendix Full Report A / type of accident

2 Dangerous Substances

remarks: The total establishment and the potential directly involved inventories of formaldehyde (37% solution) refer to the amount involved in the accident. From the Original Report it is not fully clear if formaldehyde is a starting material or not... see Appendix Full Report A / dangerous substances

3 Source of Accident

illustration: - not applicable -

remarks: The accident occurred during maintenance of a formaldehyde storage tank (codes 3201 and 4003) in an organic chemical industry (code 2001). The storage tank was filled 2/3 with formaldehyde (37% solution).

4 Meteorological Conditions

precipitation none: fog: rain: hail: snow:

No No No No No

wind speed (m/s): 8

direction (from): wEST

stability (Pasquill):

ambient temperature (∞C): 7

remarks: Temperature = 6.8°C. Air humidity = 83%. Ambient pressure = 983.6 hPa. Western wind = 8 m/sec.

5 Causes of Major Occurrence

main causes

technical / physical - not applicable -

- not applicable -

- not applicable -

- not applicable -

- not applicable -

human / organizational 5303 organization: organized procedures (none, inadequate, inappropriate, unclear)

5304 organization: training/instruction (none, inadequate, inappropriate)

5305 organization: supervision (none, inadequate, inappropriate)

5401 person: operator error

- not applicable -

remarks: The explosive air/formaldehyde vapours mixture in the storage tank ignited due to heat transfer supplied by a welding process. The heat was supplied to the gas phase by mistake during the welding operation (codes 5303, 5304, 5305 and 5401).

6 Discussion about the Occurrence

- not applicable -

Type of Accident country: FA ident key: 1991_006_01

event:

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

initiating event - not applicable -

associated event - not applicable -

event:

major occurrence 1101 release: gas/vapour/mist/etc release to air

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

associated event - not applicable -

Dangerous substances

country: FA ident key: 1991_006_01

a) total establishment inventory

CAS number: 50-00-0 **identity:** Formaldehyde 37% Solution

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): 312

use of substance as: NORMAL FINISHED PRODUCT

b) substance belongs to relevant inventory directly involved: Yes

actual quantity: 312 **potential quantity:** 312

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_006_01

situation

industry

initiating event 2001 general chemicals manufacture

associated event - not applicable -

activity/unit

major occurrence 3201 storage: process-associated (stockholding, etc. on-site of manufacture)

initiating event 3201 storage: process-associated (stockholding, etc. on-site of manufacture)

associated event - not applicable -

component

major occurrence 4003 container; non-pressurised (hopper, tank, drum, bag, etc.)

initiating event 4003 container; non-pressurised (hopper, tank, drum, bag, etc.)

associated event - not applicable -

B Consequences Full Report

country: FA ident key: 1991_006_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 Outside the establishment the explosion caused the breakage of windows.... see Appendix Full

Report B / area concerned - remarks

2 People

establishment popul. emergency personnel off-site population

total at risk

immediate fatalities 2

subsequent fatalities

hospitalizing injuries 10

other serious injuries

health monitoring

remarks Inside the establishment 2 people were killed and 10 injured by the explosion.... 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 730000 180000

response, clean up, restoration

remarks Inside the establishment, the explosion caused extensive damages to the storage ... 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 Outside the establishment the explosion caused the breakage of windows.... see Appendix Full Repo

7 Discussion of Consequences

C Response Full Report

country: FA **ident key:** 1991_006_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 followi... see Appendix Full Report C / lesson learned - prevent

measures to mitigate consequences:

Broken windows were repaired.

useful references:

- not applicable -

5 Discussion about Response

- not applicable -

Appendices for the FA / 1991_006_01 report

Appendix Short Report / description of accident types:

SYSTEM ORIGINATING AND OPERATING CONDITIONS:

Normal operation parameters during filling of the tank.

SAFETY SYSTEMS OR OPERATORS INTERVENTION:

The level indicator with alarm for full tank condition was operative.

ENVIRONMENTAL AND ATMOSPHERIC CONDITIONS:

Temperature = 6.8°C. Air humidity = 83%. Ambient pressure = 983.6 hPa. Western wind = 8 m/sec.

ACCIDENT CASE HISTORY DESCRIPTION:

A welding process (manual electrode welding) took place on the outside of the wall of a storage tank which was filled 2/3 with formaldehyde (37% solution). The welding operation over the level of the liquid phase in the storage tank overheated the gas causing the explosion of the mixture air/formaldehyde and the vapours's release into the environment.

Appendix Short Report / description of suspected causes:

INITIATING EVENT AND CONSEQUENCES:

Welding work (manual electrode welding) on the outside storage tank wall.

CAUSES:

The explosive air/formaldehyde vapours mixture in the storage tank ignited due to heat transfer supplied by a welding process. The heat was supplied to the gas phase by

mistake during the welding operation.

Appendix Short Report / description of immediate effects:

EFFECTS ON PEOPLE:

Inside the establishment 2 people were killed and 10 injured by the explosion.

MATERIAL LOSS:

Inside the establishment, the explosion caused extensive damages to the storage tank and accessories (the tank was declared out of use). The cost of the damages has been estimated in about 730,000 Deutch Marcs. Outside the establishment, the explosion caused the breakage of windows. The cost of the damages has been estimated in about 180,000 Deutch Marcs.

COMMUNITY DISRUPTION:

Outside the establishment the explosion caused the breakage of windows.

Appendix Short Report / description of emergency measures taken:

INTERNAL TO THE ESTABLISHMENT:

The plant fire brigade and 2 helicopters were activated. Wounded people were evacuated. The contaminated area was fenced. The released formaldehyde was collected in order to avoid its spreading. The contaminated soil was removed. Analytical controls for the waste water were carried out. The contaminated area was cleaned.

Appendix Short Report / description of immediate lessons learned:

EXTERNAL TO THE ESTABLISHMENT

Broken windows were repaired.

MEASURES TO PREVENT ANY RECURRENCE OF SIMILAR ACCIDENTS:

After the accident the following measures were established:

- 1- the storage temperature to be decreased;
- 2- the revision of the fire and explosion certificate;
- 3- measures to match the state of the art in matter of safety;
- 4- in the future, welding works may be performed only under an expert supervision;
- 5- equipping of the storage tank with hermetic sealed pumps and leakage-proof fittings.

Appendix Full Report A / type of accident:

A welding process (manual electrode welding) took place on the outside of the wall of a storage tank which was filled 2/3 with formaldehyde 37% solution. The welding operation over the level of the liquid phase in the storage tank overheated the gas causing the explosion (code 1307) of the mixture air/formaldehyde and the vapours's release into the environment (code 1101).

Appendix Full Report A / dangerous substances:

The total establishment and the potential directly involved inventories of formaldehyde (37% solution) refer to the amount involved in the accident. From the Original Report it is not fully clear if formaldehyde is a staring material or not.

Appendix Full Report B / area concerned - remarks:

Outside the establishment the explosion caused the breakage of windows.

Appendix Full Report B / people:

Inside the establishment 2 people were killed and 10 injured by the explosion.

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 explosion caused extensive damages to the storage tank and accessories (the tank was declared out of use). The cost of the damages has been estimated in about 730,000 Deutch Marcs. Outside the establishment, the explosion caused the breakage of windows. The cost of the damages has been estimated in about 180,000 Deutch Marcs.

Appendix Full Report B / disruption of community life:

Outside the establishment the explosion caused the breakage of windows.

Appendix Full Report C / lesson learned - prevent:

After the accident the following measures were established:

- 1- the storage temperature to be decreased;
- 2- the revision of the fire and explosion certificate;

- 3- measures to match the state of the art in matter of safety;
- 4- in the future, welding works may be performed only under an expert supervision;
- 5- equipping of the storage tank with hermetic sealed pumps and leakage-proof fittings.