

Gasexplosion på en fabrik för produktion av cellulosa acetat.

910113 MARS 1991_30

Olyckan inträffade i en process för återvinning av aceton på en fabrik för produktion av cellulosa acetat. Vid reparationsarbete uppstod en läcka och lösningsmedelsångor släppte ut. Dessa antändes av en gnista från ett svetsarbete i närheten. Lågan slog back följde ångorna tillbaka in i rörledningen där en explosion uppstod. Anläggningen skadades allvarligt. 10 personer fick föras till sjukhus. Anläggningen utrymdes. Ingen brand uppstod efter explosion. Räddningstjänst och polis tillkallades.

Inblandade ämnen och mängder

	CAS Nr.	Mängd
aceton	67-64-1	3 kg

Skador:

Människor:	10 personer fördes till sjukhus med skador från explosionen.
Materiella:	Omfattande skador på återvinningsanläggningen och omgivande byggnader. Fönster krossades upp till 100 m bort.
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_030_01

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

Date of Major Occurrence: Time of Major Occurrence

start: 1991-01-13 start: 11:00:00

finish: finish:

Establishment:

name:

address:

industry: 2001 general chemicals manufacture

Organic Chemical (Cellulose Acetate and Related Products Manufacturing)

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_030_01

Accident Types:

release: Yes **explosion:** Yes

water contamination: No **other:** No

fire: No

description:

During repair works on a disabled vessel connected by T-piece to an intercircuit duct, a vapours leak from a blanking plate (not gas-tight fit) occurred. Since an electric arc welding was in progress, the vapours leak was ignited by a spark... see Appendix Short Report / description of accident types

Substance(s) Directly Involved:

toxic: No **explosive:** Yes

ecotoxic: No **other:** No

flammable: Yes

description:

- Acetone (C.A.S. CODE: 67-64-1, E.E.C. CODE: 606-001-02-8): amount involved = 3 kg.

Immediate Sources of Accident:

storage: No **transfer:** No

process: Yes **other:** No

description:

The accident occurred in a solvent recovery plant processing acetone of an industry manufacturing cellulose acetate and related products. The recovery plant consisted of 4 separate (but inter-related) adsorber vessels operating as a two ads... see Appendix Short Report / description of immediate sources

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: 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: Yes

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 MITIGATE THE EFFECTS OF THE ACCIDENT:... see Appendix Short Report / description of immediate lessons learned

A Occurrence Full Report

country: FA **ident key:** 1991_030_01

1 Type of Accident

remarks: During repair works on a disabled vessel connected by T-piece to an intercircuit duct, a vapours leak from a blanking plate (not gas-tight fit) occurred (code 1101). Since an electric arc welding was in progress, the vapours leak was ignite... see Appendix Full Report A / type of accident

2 Dangerous Substances

remarks: The total establishment and the potential directly involved inventories of acetone refer to the amount involved in the explosion.

3 Source of Accident

illustration: - not applicable -

remarks: The accident occurred in a solvent recovery plant processing acetone (code 3104) of an industry manufacturing cellulose acetate and related products (code 2001). The vapour leak occurred from a flange (4011). The leak, ignited by a spark, p... 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 5102 operation: component/machinery failure/malfunction

- not applicable -

- not applicable -

- not applicable -

- not applicable -

human / organizational 5302 organization: management attitude problem

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

5307 organization: process analysis (inadequate, incorrect)

- not applicable -

- not applicable -

remarks: The vapours leak occurred because the isolation of the disabled vessels to the

intercircuit duct was made by means of a blanketing plate not gas-tight fit. The

composition of vapours stream in the intercircuit duct was assumed to be safe fr... see

Appendix Full Report A / causes of major occurrence

6 Discussion about the Occurrence

- not applicable -

Type of Accident country: FA ident key: 1991_030_01

event:

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

initiating event 1101 release: gas/vapour/mist/etc release to air

associated event - not applicable -

Dangerous substances

country: FA ident key: 1991_030_01

a) total establishment inventory

CAS number: 67-64-1 **identity:** Acetone

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): 0,003

use of substance as: STARTING MATERIAL

b) substance belongs to relevant inventory directly involved: Yes

actual quantity: 0,003 **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: 1991_030_01

situation

industry

initiating event 2001 general chemicals manufacture

associated event - not applicable -

activity/unit

major occurrence 3104 process: physical operations (mixing, melting crystallizing, etc.)

initiating event 3104 process: physical operations (mixing, melting crystallizing, etc.)

associated event - not applicable -

component

major occurrence 4007 machinery/equipment (pump, filter, column separator, mixer, etc.)

initiating event 4011 general pipework/flanges

associated event - not applicable -

B Consequences Full Report

country: FA ident key: 1991_030_01

1 Area concerned

affected

extent of effects installation: Yes

establishment: Yes

off-site; local: No

off-site; regional: No

off-site; transboundary: No

illustration of effects - not applicable -

remarks The explosion caused major structural damages to the recovery plant and enclosin... see Appendix

Full Report B / area concerned - remarks

2 People

establishment popul. emergency personnel off-site population

total at risk 12 50

immediate fatalities

subsequent fatalities

hospitalizing injuries 10

other serious injuries

health monitoring

remarks 10 people were hospitalized due to the injuries caused by the explosion. About 5... 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 ECU

material losses

response, clean up, restoration

remarks The explosion caused major structural damages to the recovery plant and enclosin... 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 e... see Appendix

7 Discussion of Consequences

C Response Full Report

country: FA **ident key:** 1991_030_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

Explosion situation only aros... see Appendix Full Report C / lesson learned - prevent

measures to mitigate consequences:

The area surrounding the recov... see Appendix Full Report C / lesson learned - mitigate

useful references:

- not applicable -

5 Discussion about Response

- not applicable -

Appendices for the FA / 1991_030_01 report

Appendix Short Report / description of accident types:

During repair works on a disabled vessel connected by T-piece to an intercircuit duct, a vapours leak from a blanking plate (not gas-tight fit) occurred. Since an electric arc welding was in progress, the vapours leak was ignited by a spark and the flame propagated back inside duct causing an explosion. The explosion caused major damages to the recovery plant and injured ten people. No fires occurred in the plant following the explosion. Explosion situation only arose because plant was operating in an unusual way which will not be repeated because plant to be rebuilt in such a way to return to service as a normal four adsorber system.

Appendix Short Report / description of immediate sources:

The accident occurred in a solvent recovery plant processing acetone of an industry manufacturing cellulose acetate and related products. The recovery plant consisted of 4 separate (but inter-related) adsorber vessels operating as a two adsorber system. Acetone was then desorbed by steam and recovered in a condenser for final distillation. The air/vapours stream from condenser system passed to atmosphere by way of 50" mild steel duct which ran around the plant and passed the ends of the adsorber vessels.

Appendix Short Report / description of suspected causes:

INITIATING EVENTS AND CONSEQUENCES:

The vapours leak from flange (blanked) at the outlet of a disabled adsorber vessel was ignited by a spark from welding. The flame propagated back inside the intercircuit duct causing an explosion that damaged the recovery plant and injured ten people.

CAUSES:

The vapours leak occurred because the isolation of the disabled vessel to the intercircuit duct was made by means of a blanketing plate not gas-tight fit. Management failed to recognize the composition of vapours stream in the intercircuit duct when planning revised operating procedures and, therefore, they were inadequate for repair operations on the adsorption vessels.

Appendix Short Report / description of immediate effects:

EFFECTS ON PEOPLE:

10 people were hospitalized due to the injuries caused by the explosion.

MATERIAL LOSS:

The explosion caused major structural damages to the recovery plant and enclosing buildings. Windows were broken up to 100 metres from the point where the explosion occurred. No data are available about the cost of the damages.

Appendix Short Report / description of emergency measures taken:

INTERNAL TO THE ESTABLISHMENT:

The recovery plant was shut-down and evacuated. The factory fire brigade attended.

EXTERNAL SERVICES:

Fifty rescue people (police, ambulance and county fire brigade) attended.

Appendix Short Report / description of immediate lessons learned:

MEASURES TO MITIGATE THE EFFECTS OF THE ACCIDENT:

The area surrounding the recovery plant had sealed-off until the structure was made safe and the debris removed (including the asbestos-cement cladding sheets).

MEASURES TO PREVENT ANY RECURRENCE FOR SIMILAR ACCIDENTS:

Explosion situation only arose because plant was operating in an unusual way which will not be repeated because plant to be rebuilt in such a way to return to service as a normal four adsorber system.

After the accident, the following measures were established:

- HAZOP study of plant prior to rebuilding;
- re-routing "incondensable" stream from condensers into the incoming SLA duct;
- increased awareness of possible presence of flammable concentrations in parts of the ductwork system under operating conditions;
- steam desuper heating of adsorbers;
- reversion to original design of carbon-bed mesh;
- revised carbon charging techniques (and increased supervision);
- improved instrumentation and alarm systems;
- Revised Safe Operating Procedures and retraining of operatives;
- Provision of a water flooding system in the adsorbers;
- Revision of arrangements for carrying out modifications included in site objectives

for 1992/93.

Appendix Full Report A / type of accident:

During repair works on a disabled vessel connected by T-piece to an intercircuit duct, a vapours leak from a blanking plate (not gas-tight fit) occurred (code 1101). Since an electric arc welding was in progress, the vapours leak was ignited by a spark and the flame propagated back inside the duct causing an explosion (code 1307).

Appendix Full Report A / source of accident - remarks:

The accident occurred in a solvent recovery plant processing acetone (code 3104) of an industry manufacturing cellulose acetate and related products (code 2001). The vapour leak occurred from a flange (4011). The leak, ignited by a spark, propagated back inside duct and connected items causing an explosion (code 4007). The accident occurred during the repair works that were in progress on a separate adsorber vessel of the solvent recovery plant.

Appendix Full Report A / causes of major occurrence:

The vapours leak occurred because the isolation of the disabled vessels to the intercircuit duct was made by means of a blanketing plate not gas-tight fit. The composition of vapours stream in the intercircuit duct was assumed to be safe from the management without a specific process analysis (codes 5302 and 5307) and, therefore, the procedures to be followed during the repair of the adsorption vessels were inadequate (code 5303).

Appendix Full Report B / area concerned - remarks:

The explosion caused major structural damages to the recovery plant and enclosing buildings. Windows were broken up to 100 metres from the point where the explosion occurred. In the Original Report there is no evidence of significant effects outside the establishment.

Appendix Full Report B / people:

10 people were hospitalized due to the injuries caused by the explosion. About 50 people of police, ambulance and county fire brigade attended.

Appendix Full Report B / ecological harm:

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

Appendix Full Report B / material loss:

The explosion caused major structural damages to the recovery plant and enclosing buildings. Windows were broken up to 100 metres from the point where the explosion occurred. The area surrounding the recovery plant had sealed-off until the structure was made safe and the debris removed (including the asbestos-cement cladding sheets). No data are available about the cost of these material losses.

Appendix Full Report B / disruption of community life:

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

Appendix Full Report C / lesson learned - prevent:

Explosion situation only arose because plant was operating in an unusual way which will not be repeated because plant to be rebuilt in such a way to return to service as a normal four adsorber system.

After the accident, the following measures were established:

- HAZOP study of plant prior to rebuilding;
- re-routing "incondensible" stream from condensers into the incoming SLA duct;
- increased awareness of possible presence of flammable concentrations in parts of the ductwork system under operating conditions;
- steam desuper heating of adsorbers;
- reversion to original design of carbon-bed mesh;
- revised carbon charging techniques (and increased supervision);
- improved instrumentation and alarm systems;
- Revised Safe Operating Procedures and retraining of operatives;
- Provision of a water flooding system in the adsorbers;
- Revision of arrangements for carrying out modifications included in site objectives

for 1992/93.

Appendix Full Report C / lesson learned - mitigate:

The area surrounding the recovery plant was sealed-off until the structure was made safe and the debris removed (including the asbestos-cement cladding sheets).