

Klorgasläcka på en kemikaliefabrik.

920201 MARS 1992_18

Olyckan inträffade på en anläggning för produktion av organiska klor- och fluorföreningar. Man producerade triklor-trifluoretan genom att reagera koltetraklorid med klor och vattenfri vätefluorid i närvaro av katalysator. Den reaktionsblandning som lämnar reaktorn innehåller både produkt och reaktant och renas i ett antal steg. Två timmar efter uppstart, strax efter 18, upptäcktes en klorgasläcka och stopp av anläggningen sattes igång. Efter en halvtimme hade man satt upp vattengardiner nedvinds läckan. Strax efteråt uppmättes klorhalter på 0,5-1 ppm strax utanför anläggningen. Klockan 19:30 hade läckan lokaliserats, och ytterligare två timmar senare var den tätad. Tio minuter senare, kl 21:45, blåstes faran över. Läckan hade uppstått till följd av korrosion i en rörledning. Man fann att rörledningen hade rostat ungefär 3 gånger fortare än förväntat men kunde inte förklara varför så skett.

Inblandade ämnen och mängder

	CAS Nr.	Mängd
vätefluorid	7664-39-3	1012 kg
klor	7782-50-5	221 kg
väteklorid	7647-01-0	50 kg
triklor-trifluoretan	76-13-1	1070 kg

Skador:

Människor:	6 anställda
Materiella:	Omfattande skador på anläggningens instrumentering till följd av den utsläppta gasens korrosiva egenskaper.
Miljö/ekologi:	Inga effekter rapporterade.
Infrastruktur:	Ungefär 2500 människor stannade inomhus i två timmar, till dess att pläckan tätats och gasen skingrats.

Erfarenheter redovisade (Ja/Nej): Ja.

Kortfattat anges förebyggande åtgärder.

Report Profile

Identification of Report:

country: FA ident key: 1992_018_01

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

Date of Major Occurrence: Time of Major Occurrence

start: 1992-02-01 start: 18:00:00

finish: finish:

Establishment:

name:

address:

industry: 2001 general chemicals manufacture

Organic Chemical (Production of a variety of products including chlorofluorocarbons)

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_018_01

Accident Types:

release: Yes explosion: No

water contamination: No other: No

fire: No

description:

The plant was producing trichloro-trifluoroethane (Arcton 113) by reacting carbon tetrachloride with chlorine and anhydrous hydrogen fluoride in presence of a catalyst. Crude gases leaving the reaction section undergo a series of stripping ... see Appendix Short Report / description of accident types

Substance(s) Directly Involved:

toxic: Yes explosive: No

ecotoxic: Yes other: No

flammable: No

description:

- Hydrogen Fluoride (C.A.S CODE : 7664-39-3, E.E.C. CODE: 009-002-00-6): amount involved = 1,012 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 process plant (for trichloro-trifluoroethane production) of an organic chemical industry that produces a great variety of products including chlorofluorocarbon solvents. The component involved was a 2" monel pipe ... see Appendix Short Report / description of immediate sources

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:** Yes

other: No

ecological harm: No

national heritage loss: No

description:

MATERIAL LOSS:... see Appendix Short Report / description of immediate effects

Emergency Measures taken:

on-site systems: Yes **decontamination:** Yes

external services: Yes **restoration:** No

sheltering: Yes **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:

When the Original Report was prepared, a Prohibition Notice served to prevent the operation of the plant until the investigations have not been completed and any remedial measures (that the investigations showed to be necessary) have fully ... see Appendix Short Report / description of immediate lessons learned

A Occurrence Full Report

country: FA **ident key:** 1992_018_01

1 Type of Accident

remarks: Due to the failure of a 2" monel pipe connecting two vessels, a release of a liquid/vapour mixture under pressure occurred (codes 1101 and 1102). The gas cloud was toxic, containing hydrogen fluoride, chlorine, hydrogen chloride and trichlo... see Appendix Full Report A / type of accident

2 Dangerous Substances

remarks: The total establishment and the potential directly involved inventories of the substances involved refer to the amounts released during the accident.

3 Source of Accident

illustration: - not applicable -

remarks: The accident occurred in a process plant (code 3102) of an organic chemical industry (code 2001). The process plant was manufacturing trichloro-trifluoroethane by reacting carbon tetrachloride with chlorine and anhydrous hydrogen fluoride i... 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): 2

direction (from): SW

stability (Pasquill):

ambient temperature (°C):

remarks: The accident occurred in a dry evening. The wind, from South West, had a speed of about 2.2 m/sec.

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 5307 organization: process analysis (inadequate, incorrect)

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

5314 organization: testing/inspecting/recording (none, inadequate, inappropriate)

- not applicable -

- not applicable -

remarks: The accident occurred due to the failure (code 5102) of a 2" monel pipe connecting the chlorine stripper boiler with the phase separator cooler on a chlorine stripping section downstream the reactors. The failure was caused by internal corr... see Appendix Full Report A / causes of major occurrence

6 Discussion about the Occurrence

- not applicable -

Type of Accident country: FA **ident key:** 1992_018_01

event:

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

initiating event - not applicable -

associated event - not applicable -

Dangerous substances

country: FA ident key: 1992_018_01

a) total establishment inventory

CAS number: 76-13-1 identity: Trichloro-trifluoroethane

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): 1,07

use of substance as: NORMAL FINISHED PRODUCT

b) substance belongs to relevant inventory directly involved: Yes

actual quantity: 1,07 potential quantity: 1,07

c) substance belongs to relevant inventory indirectly involved: No

actual quantity: -1 indir_pot_quant: -1

a) total establishment inventory

CAS number: 7664-39-3 identity: Hydrogen Fluoride

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): 1,012

use of substance as: STARTING MATERIAL

b) substance belongs to relevant inventory directly involved: Yes

actual quantity: 1,012 potential quantity: 1,012

c) substance belongs to relevant inventory indirectly involved: No

actual quantity: -1 indir_pot_quant: -1

a) total establishment inventory

CAS number: 7647-01-0 identity: Hydrogen Chloride

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): 0,05

use of substance as: NORMAL FINISHED PRODUCT

b) substance belongs to relevant inventory directly involved: Yes

actual quantity: 0,05 potential quantity: 0,05

c) substance belongs to relevant inventory indirectly involved: No

actual quantity: -1 indir_pot_quant: -1

a) total establishment inventory

CAS number: 7782-50-5 identity: Chlorine

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): 0,221

use of substance as: STARTING MATERIAL

b) substance belongs to relevant inventory directly involved: Yes

actual quantity: 0,221 potential quantity: 0,221

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_018_01

situation

industry

initiating event 2001 general chemicals manufacture

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 4011 general pipework/flanges

initiating event 4011 general pipework/flanges

associated event - not applicable -

B Consequences Full Report

country: FA ident key: 1992_018_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 A chlorine concentration of 0.5 ppm was detected at 18:38 at a distance of about... see Appendix

Full Report B / area concerned - remarks

2 People

establishment popul. emergency personnel off-site population

total at risk 6 2500

immediate fatalities

subsequent fatalities

hospitalizing injuries

other serious injuries 6 2

health monitoring

remarks 6 people on-site suffered injuries. Two of them suffered minor gassings, 3 minor... 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 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 The accident caused extensive damages to instrumentation on plant due to the cor... 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 Approximately 2,500 people were confined to their homes for about 2 hours.... see Appendix Full R

7 Discussion of Consequences

C Response Full Report

country: FA **ident key:** 1992_018_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

Other similar plants have been... 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 / 1992_018_01 report

Appendix Short Report / description of accident types:

The plant was producing trichloro-trifluoroethane (Arcton 113) by reacting carbon tetrachloride with chlorine and anhydrous hydrogen fluoride in presence of a catalyst. Crude gases leaving the reaction section undergo a series of stripping and separation processes to separate the trichloro-trifluoroethane from by-products and unreacted raw materials. The failed pipe was in this downstream part of the plant. The failure occurred 2 hours after the plant start-up.

The chronology of the accident was as follows:

18:05: the leak was detected by a plant operator and the plant shut-down was initiated;

18:10: the chlorine stripper was isolated from the reactor;

18:30: the pipe was isolated at the cooler inlet and the fire brigade was called;

18:35: water sprays were set up downwind the leak;

18:45: an off-site chlorine concentration of 0.5-1.0 ppm was detected;

18:50: the major off-site emergency plan was activated;

19:30: the emission rate was reduced to half and the source leak was identified;

20:30: the works to clamp the hole in the pipe was initiated;

21:35: the leak was sealed;

21:45: the emergency services were stand down.

Appendix Short Report / description of substances involved:

- Hydrogen Fluoride (C.A.S CODE : 7664-39-3, E.E.C. CODE: 009-002-00-6): amount involved = 1,012 kg.

- Chlorine (C.A.S. CODE : 7782-50-5, E.E.C. CODE: 017-001-00-7): amount involved = 221 kg.

- Hydrogen Chloride (C.A.S. CODE : 7647-01-0, E.E.C. CODE: 017-002-00-2): amount involved = 50 kg.

- Trichloro-trifluoroethane [Arcton 113] (C.A.S. CODE: 76-13-1): amount involved = 1,070 kg.

Appendix Short Report / description of immediate sources:

The accident occurred in a process plant (for trichloro-trifluoroethane production) of an organic chemical industry that produces a great variety of products including chlorofluorocarbon solvents. The component involved was a 2" monel pipe connecting the chlorine stripper boiler and the phase separator cooler of the chlorine stripping section downstream the reactors.

Appendix Short Report / description of suspected causes:

INITIATING EVENT AND CONSEQUENCES:

The failure of the 2" monel pipe connecting the chlorine stripper boiler and the phase separator cooler of the chlorine stripping section allowed the release of liquid/vapour mixture under pressure. The released liquid/vapour mixture was toxic, containing hydrogen fluoride, chlorine, hydrogen chloride and trichloro-trifluoroethane.

CAUSES:

The 2" monel pipe failed due to internal corrosion. The rate of corrosion was about 3 times that expected but the researches and the trials that have been made have not identified the causes of this behaviour. However, underlying causes should have been inadequate process analysis, pipe design and testing procedures.

Appendix Short Report / description of immediate effects:

MATERIAL LOSS:

Extensive damages to the instrumentation on the plant due to the corrosive characteristics of the released gases.

EFFECTS ON PEOPLE:

Inside the establishment 6 (from the Original Report it is not fully clear if 5 or 6 people were injured) people suffered injuries: 2 of them suffered minor gassing, 3 minor hydrogen fluoride burns and 1 banged knee. All were treated at the site medical center. Outside the establishment about 2,500 people, up to 1.5 km from the source of the leak, were confined to their homes for about 2 hours.

1 lady who drove through the cloud with a car was reported to the local hospital with minor eyes irritation. 1 pregnant lady was reported to the the hospital because of concern for the baby but no effects were found.

COMMUNITY DISRUPTION:

About 2,500 people off-site, up to 1.5 km from the source of the leak, were confined to their homes for about 2 hours.

MAP OF THE ACCIDENT AREA:

The extent of the effects is shown on a map attached to the Original Report. In this map, the points where the chlorine measurements had been carried out are highlighted in yellow.

Appendix Short Report / description of emergency measures taken:

INTERNAL TO THE ESTABLISHMENT:

The on-site major emergency plan was activated and the plant was shut-down using control systems. The leak section was isolated and the failed pipe was fitted with a temporary patch. The internal emergency teams were activated and water sprays used to knock down vapours and to dilute the spillage (washed to effluent treatment plant). About thirty appliances were deployed during the accident.

EXTERNAL TO THE ESTABLISHMENT:

The off-site major emergency plan was activated but little action was required as no real off-site effects. Gas detection was carried out in a North East direction from the release point. Approximately 2,500 people were advised to stay in their homes.

Appendix Short Report / description of immediate lessons learned:

When the Original Report was prepared, a Prohibition Notice served to prevent the operation of the plant until the investigations have not been completed and any remedial measures (that the investigations showed to be necessary) have fully implemented. In any case, the plant may not operate again because, due to the Montreal Protocol about the ChloroFluoroCarbons, it has to be closed soon.

MEASURES TO PREVENT ANY RECURRENCE OF SIMILAR ACCIDENTS:

Other similar plants have been checked in order to detect an internal corrosion but none required serious remedial measures. One pipe on another plant had to be monitored regularly for the limited remaining life of the plant itself. Actually, all the "registered" pipeworks (that is all the pipeworks where a major accident hazard could be expected), have to be periodically inspected. In future, all the pipeworks where the consequences of a failure are unacceptable, irrespective of the failure mechanism, will be subjected to inspection procedures.

Appendix Full Report A / type of accident:

Due to the failure of a 2" monel pipe connecting two vessels, a release of a liquid/vapour mixture under pressure occurred (codes 1101 and 1102). The gas cloud was toxic, containing hydrogen fluoride, chlorine, hydrogen chloride and trichloro-trifluoroethane (code 1101).

Appendix Full Report A / source of accident - remarks:

The accident occurred in a process plant (code 3102) of an organic chemical industry (code 2001). The process plant was manufacturing trichloro-trifluoroethane by reacting carbon tetrachloride with chlorine and anhydrous hydrogen fluoride in presence of a catalyst. The system was operating at a pressure of 12 bar and at a temperature of about 90°C. The component involved was a 2" monel pipe (code 4011) connecting two vessels of the stripping/separation section of the plant.

Appendix Full Report A / causes of major occurrence:

The accident occurred due to the failure (code 5102) of a 2" monel pipe connecting the chlorine stripper boiler with the phase separator cooler on a chlorine stripping section downstream the reactors. The failure was caused by internal corrosion (code 5104). The rate of corrosion was about 3 times that expected, and this meant that: the process analysis (code 5307), the design of the pipe (code 5308) and the pipe testing procedure (code 5314) were inadequate.

Appendix Full Report B / area concerned - remarks:

A chlorine concentration of 0.5 ppm was detected at 18:38 at a distance of about 1400 metres from the source of the release. At 18:46 a chlorine concentration of 1 ppm was detected up to 1200 metres from the source. A map showing the extent of these effects is attached to the Original Report. In this map the points where chlorine measurements have been carried out are highlighted in yellow.

Appendix Full Report B / people:

6 people on-site suffered injuries. Two of them suffered minor gassings, 3 minor hydrogen fluoride burns and 1 banged knee. All were treated at the site medical center. About 2,500 people, up to 1.5 km from the leak, were confined to their homes for about 2 hours. One lady who drove through the toxic cloud with her car was reported to the local hospital with minor eye irritation. One pregnant lady was reported to the local hospital because of concern for the baby but no effects were found.

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:

The accident caused extensive damages to instrumentation on plant due to the corrosive characteristics of the released gases but no data are available about the cost of the material losses.

Appendix Full Report B / disruption of community life:

Approximately 2,500 people were confined to their homes for about 2 hours.

Appendix Full Report C / lesson learned - prevent:

Other similar plants have been checked in order to detect an internal corrosion but none required serious remedial measures. One pipe on another plant had to be monitored regularly for the limited remaining life of the plant itself. Actually, all the "registered" pipeworks (that is all the pipeworks where a major accident hazard could be expected), have to be periodically inspected. In future, all the pipeworks where the consequences of a failure are unacceptable, irrespective of the failure mechanism, will be subjected to inspection procedures.