

Klorutsläpp på en klorfabrik för produktion av klororganiska föreningar.

890606 MARS 1989_15

Olyckan inträffade vid underhållsarbete på en värmare i elektrolytisk industri. Man sökte tömma värmaren på rester av flytande klor genom att leda över mängden i en tank. På grund av otillräckliga instruktioner gjordes inte reningen tillräckligt noggrant varför det fortfarande fanns klor i värmaren efter avslutat arbete. När det upptäcktes sökte man blåsa ut resterande klor med tryckluft. Tryckluften öppnade en ventil och klor strömmade genom den ut i process luftsystemet. Efter 25 minuter noterades klorutsläpp. Ungefär klockan 8 på morgonen, tre timmar senare, förklarade räddningstjänsten faran över.

Inblandade ämnen och mängder

	CAS Nr.	Mängd
klor	7782-50-5	högst 55 kg

Skador:

Människor: Inga.
Materiella: Inga.
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: 1989_015_01

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

Date of Major Occurrence: Time of Major Occurrence

start: 1989-06-06 start: 04:45:00

finish: finish:

Establishment:

name:

address:

industry: 2001 general chemicals manufacture

Electrolytic (Production of Organo-halogen and Salts for Industrial and Consumptive Use)

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:** 1989_015_01

Accident Types:

release: Yes **explosion:** No

water contamination: No **other:** No

fire: No

description:

ACCIDENT CASE HISTORY DESCRIPTION:... see Appendix Short Report / description of accident types

Substance(s) Directly Involved:

toxic: Yes **explosive:** No

ecotoxic: No **other:** No

flammable: No

description:

- Chlorine (C.A.S. CODE: 7782-50-5, E.E.C. CODE: 017-001-00-7): amount involved = impossible to estimate an accurate value. The whole amount involved was 40 litres of liquid chlorine (about 55 kg) but the amount released into the environmen... 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 the maintenance of a heater in the chlorine transfer circuit of an electrolytic industry for the production of organo-halogens and salts mainly for industrial use (some for consumptive use).

The maintenance cons... see Appendix Short Report / description of immediate sources

Suspected Causes:

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

human: Yes **other:** No

description:

CAUSES:... see Appendix Short Report / description of suspected causes

Immediate Effects:

material loss: No

human deaths: No

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

other: Yes

ecological harm: No

national heritage loss: No

description:

OTHER:... see Appendix Short Report / description of immediate effects

Emergency Measures taken:

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

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:

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:** 1989_015_01

1 Type of Accident

remarks: During maintenance, an attempt was made to free a heater in the chlorine

transfer circuit from residual liquid chlorine by introducing pressurized

air. Owing to an operator error, the residual liquid chlorine evaporated and

entered into the... see Appendix Full Report A / type of accident

2 Dangerous Substances

remarks: It had been impossible to evaluate an accurate value of the amount of

chlorine released during the accident. The total establishment inventory of

chlorine refers to the potential amount involved in the accident (40 litres

of liquid chlorine... see Appendix Full Report A / dangerous substances

3 Source of Accident

illustration: - not applicable -

remarks: The accident occurred during the maintenance of a heater (codes 3104 and

4009) in the chlorine transfer circuit of an electrolytic industry (code 2001) for the production of organo-halogens and salts mainly for industrial use (some for cons... see Appendix Full Report A / source of accident - remarks

4 Meteorological Conditions

precipitation none: fog: rain: hail: snow:

Yes No No No No

wind speed (m/s):

direction (from): E/S-E

stability (Pasquill): E

ambient temperature (°C):

remarks: When the chlorine release occurred, the Pasquill Atmospheric Stability Class was E or F, hardly any wind. The wind's direction was East/South-East. No rainfall.

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)

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

5401 person: operator error

- not applicable -

remarks: Due to the inadequacy of written maintenance procedures (code 5303) and to insufficient training of the personnel (code 5304), an error was made by the operator (code 5401) during the maintenance of the chlorine transfer circuit (an attempt... see Appendix Full Report A / causes of major occurrence

6 Discussion about the Occurrence

- not applicable -

Type of Accident country: FA ident key: 1989_015_01

event:

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

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

associated event - not applicable -

Dangerous substances

country: FA ident key: 1989_015_01

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): 0,055

use of substance as: NORMAL FINISHED PRODUCT

b) substance belongs to relevant inventory directly involved: Yes

actual quantity: 0,035 potential quantity: 0,055

c) substance belongs to relevant inventory indirectly involved: No

actual quantity: -1 indir_pot_quant: -1

Source of Accident - Situation country: FA ident key: 1989_015_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 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: 1989_015_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 When the chlorine sensors detected the presence of gas in the area, phases 0 (in... 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 data are available about the number of people (inside and outside the establi... 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 No significant material losses occurred because a complete plant shut-down was a... 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 When the chlorine sensors detected the presence of gas in the area, phases 0 (in... see Appendix

7 Discussion of Consequences

C Response Full Report

country: FA ident key: 1989_015_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 / 1989_015_01 report

Appendix Short Report / description of accident types:

ACCIDENT CASE HISTORY DESCRIPTION:

The accident occurred during maintenance in the chlorine transfer circuit. The accident case history was as followed:

- 03:20 Production stopped.

- 04:00 Clearing of tank V-2500 (see diagram N⁻ 2 attached to the Original Report) from liquid chlorine (pumped into buffer tanks).

- 04:30 The remaining liquid chlorine in the heater section was (supposed to be) released to tank V-2504 (see diagram N⁻ 2). After the accident it was concluded that this step must have been executed in a too short period of time and only a partial boil-off of liquid chlorine resulted. So this section was still containing some liquid chlorine which was heated to about 80 °C.

- 04:45 An attempt was made to free the heater section E-2504 (see diagram N⁻ 2) from (residual) chlorine by the introduction of pressurized air. The presence of a one-way valve may not have been recognized (see diagram N⁻ 2). It resulted in chlorine inlet into the process air system. Process air system (7 bara) was responsible for chlorine distribution and emission in about 12 different sites on the plant. Therefore, chlorine emission occurred via several in- and outdoors sources.

- 04:55 Chlorine detectors (limited to shipping and compression areas) intervened (chlorine concentrations up to 0.8 ppm during the accident) resulting in the automatic cut off of the equipment.
- 05:00 The air supply to the heater was manually closed (although the cause of chlorine leakage was not known, possible chlorine sources were blocked in). After, the remaining contents of the heater section was fed to a chlorine destruction unit.
- 05:25 Supervisor activated chlorine alarm (phase 0 according to the emergency plan: internal warning to personnel, external warning to local police).
- 06:00 Shift change (the night-crew remained several hours until the situation became clear). Due to the specific (weather and emission) conditions, there was no significant dispersion.
- 06:55 Supervisor activated chlorine alarm phase 1 (possible nuisance outside the plant).
- 07:30 Several complaints from the neighbourhood (about 10) recorded. Local police activated alarm phase 2 (annoyance, no danger).
- 07:45 Municipal fire brigade brought the alarm phase back to 1. At about 08:14 again to phase 0.
- 08:30 All warnings were deleted by the safety division of AKZO plant.

Appendix Short Report / description of substances involved:

- Chlorine (C.A.S. CODE: 7782-50-5, E.E.C. CODE: 017-001-00-7): amount involved = impossible to estimate an accurate value. The whole amount involved was 40 litres of liquid chlorine (about 55 kg) but the amount released into the environment had been estimated to be 25 litres (approximately 35 kg) or somewhat less over a period of 1² hours.

Appendix Short Report / description of immediate sources:

The accident occurred during the maintenance of a heater in the chlorine transfer circuit of an electrolytic industry for the production of organo-halogens and salts mainly for industrial use (some for consumptive use). The maintenance consisted in an attempt to free a heater in the transfer circuit from residual liquid chlorine by introducing pressurized air. The factory was in an industrial area with dense population at distances over 400 metres. Two diagrams are attached to the Original Report. Diagram N° 1 shows the process air system schematically. Diagram N° 2 shows how it was possible to block in liquid chlorine in the heater section (no relief valve was provided).

Appendix Short Report / description of suspected causes:

CAUSES:

Due to the inadequacy of written maintenance procedures and to the insufficient training of personnel, an error was made by an operator during the maintenance of the chlorine transfer circuit (an attempt was made to free a heater in the circuit from residual liquid chlorine by introducing pressurized air but that procedure had been executed in a too short period of time). It caused the evaporation of the liquid chlorine and its entering into the process air system. In addition, the design of the heater circuit was not correct (it was possible, by mistake, to block in liquid chlorine).

Appendix Short Report / description of immediate effects:

OTHER:

No significant material losses occurred because a complete plant shut-down was already scheduled and no corrosion occurred in the process air system (dry air).

Appendix Short Report / description of emergency measures taken:

INTERNAL TO THE ESTABLISHMENT:

When the chlorine sensors detected the presence of gas in the area, an automatic cut-off of the equipment occurred and the air supply to the heater was manually closed (although the cause of chlorine leakage was not known, possible sources were blocked in). After, the remaining contents of the heater was fed to a chlorine destruction unit. Supervisor activated chlorine-alarm (phase 0 of the emergency plan [internal warning of the personnel and external warning to local police] and then phase 1 [possible nuisance outside the plant]). Measurements were carried out outside the buildings but chlorine concentration in air was less than 0.2 ppm. A waterscreen was set up down wind from the plant by the company fire brigade (in cooperation with the municipal firebrigade).

EXTERNAL TO THE ESTABLISHMENT:

Supervisor activated phases 0 and 1 of emergency plan (warning of emergency services, i.e. municipal and other authorities). Several complaints (about 10) from the neighbourhood were recorded by the police which activated phase 2 of the emergency plan (annoyance, no danger). Measurements by the municipal/regional fire brigades were carried out outside the establishment but chlorine concentration in air was less than 0.2 ppm. Gradually, municipal fire brigade brought the alarm phase back to 1 and, then, to 0. At 08:30, all warnings were deleted by the safety division of AKZO plant.

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- better training of personnel;
- 2- preparation of written maintenance procedures.

Two diagrams are attached to the Original Report. Diagram N° 1 shows the process air system schematically. Diagram N° 2 shows how it was possible to block in liquid chlorine in the heater section (no relief valve was provided). When the Original Report was prepared, there were no indications that changes in the installation will be made in order to avoid to block in liquid chlorine in the heater section.

Appendix Full Report A / type of accident:

During maintenance, an attempt was made to free a heater in the chlorine transfer circuit from residual liquid chlorine by introducing pressurized air. Owing to an operator error, the residual liquid chlorine evaporated and entered into the process air system. From this system, it leaked from various point in the factory also causing a nuisance in the neighbourhood (code 1101).

Appendix Full Report A / dangerous substances:

It had been impossible to evaluate an accurate value of the amount of chlorine released during the accident. The total establishment inventory of chlorine refers to the potential amount involved in the accident (40 litres of liquid chlorine, about 55 Kg) that had been estimated. The actual amount of chlorine released into the environment had been estimated in about 25 litres (35 Kg), over a period of 1^h2 hours.

Appendix Full Report A / source of accident - remarks:

The accident occurred during the maintenance of a heater (codes 3104 and 4009) in the chlorine transfer circuit of an electrolytic industry (code 2001) for the production of organo-halogens and salts mainly for industrial use (some for consumptive use). The maintenance consisted in an attempt to free a heater in the transfer circuit from residual liquid chlorine by introducing pressurized air. The factory was in an industrial area with dense population at distances over 400 metres.

Appendix Full Report A / causes of major occurrence:

Due to the inadequacy of written maintenance procedures (code 5303) and to insufficient training of the personnel (code 5304), an error was made by the operator (code 5401) during the maintenance of the chlorine transfer circuit (an attempt was made to free a heater in the circuit from residual liquid chlorine but that procedure had been executed in a too short time period). The design of the heater circuit was not correct (it was possible, by mistake, to block in liquid chlorine [code 5308]).

Appendix Full Report B / area concerned - remarks:

When the chlorine sensors detected the presence of gas in the area, phases 0 (internal warning of the personnel and external warning to local police) and, after, 1 (possible nuisance outside the plant) of the emergency plan were activated. Several complaints (about 10) from the neighborhood were recorded by the police which activated phase 2 (annoyance, no danger). Measurements by fire brigades were carried out but chlorine in air was less than 0.2 ppm outside the establishment.

Appendix Full Report B / people:

No data are available about the number of people (inside and outside the establishment) affected by the accident. Anyway, no people were injured by the chlorine release.

Appendix Full Report B / ecological harm:

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

Appendix Full Report B / material loss:

No significant material losses occurred because a complete plant shut-down was already scheduled and no corrosion occurred in the process air system (dry air).

Appendix Full Report B / disruption of community life:

When the chlorine sensors detected the presence of gas in the area, phases 0 (internal warning of the personnel and external warning to local police) and, after, 1 (possible nuisance outside the plant) of the emergency plan were activated. Several complaints (about 10) from the neighborhood were recorded by the police which activated phase 2 (annoyance, no danger). Measurements by fire brigades were carried out but chlorine in air was less than 0.2 ppm outside the establishment.

Appendix Full Report C / lesson learned - prevent:

After the accident, the following measures were established:

- 1- better training of personnel;
- 2- preparation of written maintenance procedures.

Two diagrams are attached to the Original Report. Diagram N^o 1 shows the process air system schematically. Diagram N^o 2 shows how it was possible to block in liquid chlorine in the heater section (no relief valve was provided). When the Original Report was prepared, there were no indications that changes in the installation will be made in order to avoid to block in liquid chlorine in the heater section.