

Brand i en anläggning för väteperoxidproduktion på en kemikaliefabrik.

920422 MARS 1800_36

Klockan 22:15 fallerade de automatiska reglermekanismerna för flödeskontroll på en av produktionslinjerna. Operatörerna misslyckades med att återfå kontrollen över processen. Resultatet blev att reaktionslösningen kom att passera fram och åter mellan ett oxidations- och ett extraktionssteg. Klockan 23:09 noterades en abrupt temperaturstegring från 70 till 200 grader på mindre än fem minuter, med påföljande trycksättning av den utsatta rörledningen som sprack. Den utsläppta reaktionsblandningen fattade omedelbart eld. Reaktionsblandningen bestod av väteperoxid och organiska lösningsmedel. Företagets interna brandkår fick hjälp av grannföretagets brandkårer och av räddningstjänsten (23:30). Totalt 135 personer var inblandade i släckningsarbetet. Branden var släckt klockan 01:29.

Inblandade ämnen och mängder

	CAS Nr.	Mängd
väteperoxidlösning 40% i närvaro av metalloxider och organiska lösningsmedel	7722-84-1	7000 kg
organiska lösningsmedel		okänt

Skador:

Människor:	En person omkom i samband med explosionen. Två skadades av gasutsläppet.
Materiella:	Två tredjedelar av den ena av två produktionsenheter förstördes. Kostnader för materiella skador och produktionsbortfall uppskattades till 300 miljoner franska Francs,
Miljö/ekologi:	Förorenat släckningsvatten rann ut i en närliggande kanal och två floder. Ingen fiskdöd noterades.
Infrastruktur:	"Då olyckan inträffade orsakade alarmsignalerna på fabriksområdet och de spektakulära effekterna (explosion, rök, lågor) som var synliga från utsidan omotiverat och olämpligt beteende hos den omgivande befolkningen."

Erfarenheter redovisade (Ja/Nej): Ja

Förutom förebyggande åtgärder på anläggningen konstateras också att katastrofberedskapen hos omgivande befolkning måste bli bättre.

Report Profile

Identification of Report:

country: FA ident key: 1800_036_01

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

Date of Major Occurrence: Time of Major Occurrence

start: 1992-04-22 start: 23:00:00

finish: finish:

Establishment:

name:

address:

industry: 2001 general chemicals manufacture

General Chemical (Hydrogen Peroxide Production)

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: 1800_036_01

Accident Types:

release: Yes explosion: Yes

water contamination: Yes other: No

fire: Yes

description:

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

Substance(s) Directly Involved:

toxic: No explosive: Yes

ecotoxic: No other: No

flammable: Yes

description:

- Hydrogen Peroxide Solution [$\leq 40\%$] (C.A.S. CODE: 7722-84-1) in presence of metallic oxides and organic solvents based on derivatives from anthraquinone and cyclohexylene: amount involved in the explosion = 7,000

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 in one of the two hydrogen peroxide production units of a general chemical industry.

Each production unit was composed by: hydrogenation, oxydation and extraction. The units are of the open-air type. The hydrogen perox... see Appendix Short Report / description of immediate sources

Suspected Causes:

plant or equipment: Yes **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: Yes

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:** Yes

mitigation: Yes

description:

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

A Occurrence Full Report

country: FA **ident key:** 1800_036_01

1 Type of Accident

remarks: The decomposition of hydrogen peroxide resulted in the pressurization and the following rupture of the pipeline connecting the oxidizer to the extractor (code 1301). The pipeline rupture was then immediately followed by the fire of the rele... see Appendix Full Report A / type of accident

2 Dangerous Substances

remarks: The organic solvents involved in the accident were based on derivates from anthrachinone and cyclohexylene. The amount of the hydrogen peroxide

solution [$\leq 40\%$] involved in the pipeline rupture includes the metallic

oxides and organic solve... see Appendix Full Report A / dangerous

substances

3 Source of Accident

illustration: - not applicable -

remarks: The accident occurred in one of the two hydrogen peroxide production units

(code 3102) of a general chemical industry (code 2001). Each production unit

was composed by: hydrogenation, oxydation and extraction. The component

involved in the ... 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

5103 operation: loss of process control

5107 operation: unexpected reaction/phase-transition

- 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: The most probable cause for the pipeline rupture (code 5102) was the decomposition (code

5107) of hydrogen peroxide due to the presence of unstabilizing agents in suspension

(metallic particles, rust). The initiating event was the failure o... see Appendix Full

Report A / causes of major occurrence

6 Discussion about the Occurrence

- not applicable -

Type of Accident country: FA ident key: 1800_036_01

event:

major occurrence 1301 explosion: pressure burst (rupture of pressure system)

initiating event - not applicable -

associated event - not applicable -

event:

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

initiating event 1301 explosion: pressure burst (rupture of pressure system)

associated event 1405 other: firewater runoff into water

Dangerous substances

country: FA **ident key:** 1800_036_01

a) total establishment inventory

CAS number: **identity:** Organic Solvents

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

use of substance as: NORMAL FINISHED PRODUCT

b) substance belongs to relevant inventory directly involved: Yes

actual quantity: -1 **potential quantity:** -1

c) substance belongs to relevant inventory indirectly involved: No

actual quantity: -1 **indir_pot_quant:** -1

a) total establishment inventory

CAS number: 7722-84-1 **identity:** Hydrogen Peroxide <= 40%

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): 7

use of substance as: NORMAL FINISHED PRODUCT

b) substance belongs to relevant inventory directly involved: Yes

actual quantity: 7 **potential quantity:** 7

c) substance belongs to relevant inventory indirectly involved: No

actual quantity: -1 **indir_pot_quant:** -1

Source of Accident - Situation **country:** FA **ident key:** 1800_036_01

situation

industry

initiating event 2001 general chemicals manufacture

associated event 2001 general chemicals manufacture

activity/unit

major occurrence 3102 process: chemical continuous reaction

initiating event 3102 process: chemical continuous reaction

associated event 3102 process: chemical continuous reaction

component

major occurrence 4011 general pipework/flanges

initiating event 4011 general pipework/flanges

associated event 4011 general pipework/flanges

B Consequences Full Report

country: FA **ident key:** 1800_036_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 In the Original Report there is no evidence of significant effects outside the e... see Appendix

Full Report B / area concerned - remarks

2 People

establishment popul. emergency personnel off-site population

total at risk 37 101

immediate fatalities 1

subsequent fatalities

hospitalizing injuries 2

other serious injuries

health monitoring

remarks 1 person was killed by the explosion whilst 2 people were injured by the release... 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 Polluted (by organic solvents based on derivatives from anthrachinone and cyclohex... 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 FF ECU FF

material losses 3E+08

response, clean up, restoration

remarks The accident caused the destruction of 25% of the installations (about 1,000 m2)... 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 In the Original Report there is no evidence of significant effects outside the e... see Appendix

7 Discussion of Consequences

Ecological Components involved

country: FA **ident key:** 1800_036_01

type: 6204 freshwater: river

threatened: not applicable **affected:** not applicable

C Response Full Report

country: FA **ident key:** 1800_036_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

The activity of the destroyed ... see Appendix Full Report C / lesson learned - prevent

measures to mitigate consequences:

The activity of the destroyed ... see Appendix Full Report C / lesson learned - mitigate

useful references:

- not applicable -

5 Discussion about Response

- not applicable -

Appendices for the FA / 1800_036_01 report

Appendix Short Report / description of accident types:

SYSTEM ORIGINATING AND OPERATING CONDITIONS:

The component involved in the accident was a pipeline (273mm diameter, 2mm thickness) in stainless steel connecting the oxidizer to the extractor (as shown on page 2 of Annex 1 attached to the Original Report).

ACCIDENT CASE HISTORY DESCRIPTION:

- 22:15: The failure of some automatic control devices of the unit activating the alarms and 20 valves switch to safety position in one of the production chains.

- 22:19: Wrong attempts by the operators to repair the control system without following the required safety procedures caused the complete failure of the automatic control devices. All the remotely controlled devices remained fixed in the position of that moment and some valves, that could have been closed manually, remained opened. As those valves were necessary for the isolation of the various sections of the production chain, the solution passed from the oxydation to the extraction step and back again via the pipeline.

- 23:09: An abrupt increase of temperature (from 70 to 200°C in less than 5 minutes) and pressurisation of the accident section caused the rupture of the connecting pipeline. The pipeline rupture was then immediately followed by the fire of the released solution.

- 23:30: Arrival of first aid and emergency intervention teams.

- 01:29: The fire was extinguished.

Appendix Short Report / description of substances involved:

- Hydrogen Peroxide Solution [$\leq 40\%$] (C.A.S. CODE: 7722-84-1) in presence of metallic oxides and organic solvents based on derivates from anthrachinone and cyclohexylene: amount involved in the explosion = 7,000 Kg.

- Organic Solvents based on derivates from anthrachinone and cyclohexylene with oxygen produced by the decomposition of the hydrogen peroxide solution: amount involved in the fire = not known.

- Organic Solvents based on derivates from anthrachinone and cyclohexylene and hydrogen peroxide mixed with the extinction water: amount involved = about 1,000 m3.

Appendix Short Report / description of immediate sources:

The accident occurred in one of the two hydrogen peroxide production units of a general chemical industry. Each production unit was composed by: hydrogenation, oxydation and extraction. The units are of the open-air type. The hydrogen peroxide plant is the largest in the world, with a production capacity of 100,000 tonnes/year. In Annex N° 1 attached to the Original Report are shown: a photograph of the plant showing the unit where the accident occurred (page 1); a simplified P&I flow diagram showing the pipeline connecting the oxydizer and the extractor (page 2); the map of the area surrounding the factory (page 3).

Appendix Short Report / description of suspected causes:

INITIATING EVENT AND CONSEQUENCES:

The decomposition of hydrogen peroxide resulted in the pressurization and the following rupture of the pipeline connecting the oxidizer to the extractor.

CAUSES:

The most probable cause for the pipeline rupture was the decomposition of hydrogen peroxide (gaseous oxygen formation and temperature/pressure increase) due to the presence of unstabilizing agents in suspension (metallic particles, rust). The initiating event was the failure of the automatic control devices together with a series of human errors during the attempt to repair them. Particularly, the safety procedures followed were not suitable for the event. Furthermore these procedures were not fully applied. Some valves, that could be manually closed, remained opened. As those valves were necessary for the isolation of the various sections of the production chain, the solution passed from the oxydation to the extraction step and back again via the pipeline. The overflowing of the fire extinction water to the natural environment was due to the under-dimensioning of the containment basin designed for this purpose.

Appendix Short Report / description of immediate effects:

EFFECTS ON PEOPLE:

1 person was killed by the explosion whilst 2 people were injured by the release.

MATERIAL LOSS:

The accident caused the destruction of 25% of the installations (about 1,000 m²) that is 2/3 of one of the two production units. The cost of the material damages, together with the production loss, was estimated in about 300 Millions of French Francs.

ECOLOGICAL HARM:

Polluted (by organic solvents based on derivates from anthrachinone and cyclohexylene and hydrogen peroxide) fire extinction water (about 1,000 m³) was released in a nearby channel and two rivers. No mortality of fishes was detected.

COMMUNITY DISRUPTION:

When the accident occurred, the sounding alarms on-site and the spectacular visible external effects (explosion, smoke, flames) caused unjustified and inappropriate behaviour of the surrounding population.

MAP OF THE ACCIDENT AREA AND MAX. DENSITY OF POPULATION:

The map of the area surrounding the factory is shown in page 3 of Annex N° 1 to the Original Report.

Appendix Short Report / description of emergency measures taken:

INTERNAL TO THE ESTABLISHMENT:

The Internal Emergency Plan (Plan d'Urgence Interne [P.O.I]) was activated. 34 firemen of the site were mobilised.

EXTERNAL TO THE ESTABLISHMENT:

101 firemen, of which 15 of a nearby factory, with 35 vehicles were involved in fire fighting operations. 10 m³ of emulsion and 2570 m³ of water were used to extinguish the fire.

Appendix Short Report / description of immediate lessons learned:

EXTERNAL TO THE ESTABLISHMENT

When the accident occurred, the sounding alarms on-site and the spectacular visible external effects (explosion, smoke, flames) caused unjustified and inappropriate behaviour of the surrounding population. The credibility of the brochures about how to behave in case of an accident has to be restored (as shown in Annex N° 2 to the Original Report).

MEASURES TO PREVENT ANY RECURRENCE OF SIMILAR ACCIDENTS:

The activity of the destroyed production chain has been suspended by the inspection authorities and a permission to restart the production will be given only by resubmission of a complete request for operating authorisation. This request has to contain a new safety report taking into account the results of the actual investigations.

As far as the new start-up of the other production unit, the following measures were established by the authorities:

- 1- prevention of hydrogen peroxide back flow to the oxidization section;
- 2- improvement of the automatic control system;
- 3- improvement of operators training and improvement of written procedures.

MEASURES TO MITIGATE THE EFFECTS OF THE ACCIDENT:

As far as the new start-up of the other production unit the increase of the retention basins capacity was required.

Appendix Full Report A / type of accident:

The decomposition of hydrogen peroxide resulted in the pressurization and the following rupture of the pipeline connecting the oxidizer to the extractor (code 1301). The pipeline rupture was then immediately followed by the fire of the released solution (code 1202). Polluted (by organic solvents based on derivates from anthrachinone and cyclohexylene and hydrogen peroxide) fire extinction water was released in a nearby channel and two rivers but no mortality of fishes was detected (code 1405).

Appendix Full Report A / dangerous substances:

The organic solvents involved in the accident were based on derivates from anthrachinone and cyclohexylene. The amount of the hydrogen peroxide solution [$\leq 40\%$] involved in the pipeline rupture includes the metallic oxides and organic solvents. No data are available about the amount of organic solvents involved in the fire and in firewater pollution.

Appendix Full Report A / source of accident - remarks:

The accident occurred in one of the two hydrogen peroxide production units (code 3102) of a general chemical industry (code 2001). Each production unit was composed by: hydrogenation, oxydation and extraction. The component involved in the accident was the pipeline connecting the oxidation to the extraction sections (code 4011). The hydrogen peroxide plant is the largest in the world, with a production capacity of 100,000 tonnes/year.

Appendix Full Report A / causes of major occurrence:

The most probable cause for the pipeline rupture (code 5102) was the decomposition (code 5107) of hydrogen peroxide due to the presence of unstabilizing agents in suspension (metallic particles, rust). The initiating event was the failure of the automatic control devices (code 5103) together with a series of human errors during the attempt to repair them (codes 5401, 5303 and 5304). The overflowing of the fire extinction water was due to the under-dimensioning of the basin (code 5308).

Appendix Full Report B / area concerned - remarks:

In the Original Report there is no evidence of significant effects outside the establishment but the sounding alarms on-site and the spectacular visible external effects (explosion, smoke, flames) caused unjustified and inappropriate behaviour of the surrounding population. Polluted (by organic solvents based on derivates from anthrachinone and cyclohexylene and hydrogen peroxide) fire extinction water was released in a nearby channel and two rivers but no fishes mortality occurred.

Appendix Full Report B / people:

1 person was killed by the explosion whilst 2 people were injured by the release. 34 company firemen and 101 external firemen, of which 15 of a nearby factory, with 35 vehicles were involved in fire fighting operations.

Appendix Full Report B / ecological harm:

Polluted (by organic solvents based on derivates from anthrachinone and cyclohexylene and hydrogen peroxide) fire extinction water (about 1,000 m3) was released in a nearby channel and two rivers but no mortality of fishes was detected.

Appendix Full Report B / material loss:

The accident caused the destruction of 25% of the installations (about 1,000 m2) that is 2/3 of one of the two production units. The cost of the material damages, together with the production loss, was estimated in about 300 Millions of French Francs.

Appendix Full Report B / disruption of community life:

In the Original Report there is no evidence of significant effects outside the establishment but the sounding alarms on-site and the spectacular visible external effects (explosion, smoke, flames) caused unjustified and inappropriate behaviour of the surrounding population.

Appendix Full Report C / lesson learned - prevent:

The activity of the destroyed production chain has been suspended by the inspection authorities and a permission to restart the production will be given only by resubmission of a complete request for operating authorisation. This request has to contain a new safety report taking into account the results of the actual investigations.

As far as the new start-up of the other production unit, the following measures were established by the authorities:

- 1- prevention of hydrogen peroxide back flow to the oxidization section;
- 2- improvement of the automatic control system;
- 3- improvement of operators training and improvement of written procedures.

Appendix Full Report C / lesson learned - mitigate:

The activity of the destroyed production chain has been suspended by the inspection authorities and a permission to restart the production will be given only by resubmission of a complete request for operating authorisation. This request has to contain a new safety report taking into account the results of the actual investigations.

As far as the new start-up of the other production unit the increase of the retention basins capacity was required.