Explosion och påföljande kemikalieutsläpp från fabrik i metallindustrin.

970128

Vid en anläggning för produktion av titanvitt (TiO_2) skulle en fyrtums ångrörledning rensas. Man anbringade en gjutjärnsventil för ändan av röret och började spola det med vatten. I röret fanns depåer av $TiCl_4$ och $AlCl_3$.Den snabba reaktionen mellan dessa depåer och vattnet ledde till en explosionsartad tryckökning. Röret höll men p.g.a. tryckstegringen pressades vatten och vattenånga tillbaka mot ventilen som sprack under trycket. En anställd träffades av splitter från ventilen och omkom av skadorna. Ytterligare tre personer i närheten skadades då blandningen av vattenånga och kemikalier svepte in dem.

Inblandade ämnen och mängder

	CAS Nr.	Mängd
ämnen		

Skador:

Människor:	En person omkom, och tre skadades allvarligt.
Materiella:	Anläggningen skadades.
Miljö/ekologi:	Inga effekter rapporterade.
Infrastruktur:	Inga effekter.

Erfarenheter redovisade (Ja/Nej): Ja

Mycket kortfattat anges förebyggande åtgärder

Report Profile

Identification of Report:

country: FA **ident key:** 1800_113_01

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

Date of Major Occurrence: Time of Major Occurrence

start: 28/01/1997 **start:** 12:00:00

finish: 28/01/1997 **finish:** 12:00:00

Establishment:

name:

address:

industry: 2011 metal refining and processing (includes foundries, electrochemical refining,

plating, etc.)

refining TiO2

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) A four inch vapour pipeline was flushed with water. In the pipe deposits of "Ticle", TiCl4 and AlCl3. The rapid reaction between TiCl4 and/or AlCl3 and water caused a fast pressure rise and violent trembling of the pipe. The speed of pressu... see Appendix Profile Text a

b) - not applicable -

c) - not applicable -

d) - not applicable -

e) - not applicable -

Short Report

country: FA **ident key:** 1800_113_01

Accident Types:

release: Yes **explosion:** Yes

water contamination: No **other:** No

fire: No

description:

physical explosion / pipe whip

Substance(s) Directly Involved:

toxic: No **explosive:** No

ecotoxic: No **other:** Yes

flammable: No

description:

TiCl4 and water

Immediate Sources of Accident:

storage: No **transfer:** No

process: No **other:** Yes

description:

cleaning activity

Suspected Causes:

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

human: Yes **other:** No

description:

unsafe design of installation, working method unsafe

Immediate Effects:

material loss: No

human deaths: Yes

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

other: No

ecological harm: No

national heritage loss: No

description:

1 death, 3 perons injured

Emergency Measures taken:

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

external services: Yes **restoration:** No

sheltering: No **other:** No

evacuation: Yes

description:

alarm phase

Immediate Lessons Learned:

prevention: No **other:** Yes

mitigation: No

description:

installation altered, working method changed.

A Occurrence Full Report

country: FA **ident key:** 1800_113_01

1 Type of Accident

remarks: - not applicable -

2 Dangerous Substances

remarks: - not applicable -

3 Source of Accident

illustration: Vapour recovery system used for cleaning purposes. It was used to provide a

vessel to be cleaned with water.

remarks: tube rupture during cleaning operations. The pipeline fracktured because of

rapid chemical reactions inside. Leading to reaction forces and the pipe

whip.

4 Meteorological Conditions

precipitation none: fog: rain: hail: snow:

No Yes 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 5101 operation: vessel/container/containment-equipment failure

- not applicable -

- not applicable -

- not applicable -

- not applicable -

human / organizational 5301 organization: management organization inadequate

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

unclear)

5307 organization: process analysis (inadequate, incorrect)

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

inappropriate)

- not applicable -

remarks: The vent system (a four inche pipeline of about 240 feet long) was used to clean a vessel.

The purpose of the vessel was to ad AlCl3 to the process. The vessel had to be cleaned

with water because of problems in the normal process. The vess... see Appendix Full Report

A / causes of major occurrence

6 Discussion about the Occurrence

- not applicable -

Type of Accident **country:** FA **ident key:** 1800_113_01

event:

major occurrence 1303 explosion: rapid phase-transition explosion (rapid change of state)

initiating event 1999 other: other

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

Dangerous substances

country: FA **ident key:** 1800_113_01

a) total establishment inventory

CAS number: 7782-50-5 **identity:**

name from Seveso I Directive: Chlorine

name from Seveso II Directive: Chlorine

category from Seveso II: toxic

other hazards (1): - not applicable -

other hazards (2): - not applicable -

maximum quantity (tonnes): 0

use of substance as: on-site intermediate

b) substance belongs to relevant inventory directly involved: No

actual quantity: 0 **potential quantity:** 0

c) substance belongs to relevant inventory indirectly involved: No

actual quantity: 0 **indir_pot_quant:** 0

a) total establishment inventory

CAS number: 13463-67-7 **identity:** TiO2

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

use of substance as: normal finished product

b) substance belongs to relevant inventory directly involved: No

actual quantity: 0 **potential quantity:** 0

c) substance belongs to relevant inventory indirectly involved: No

actual quantity: 0 **indir_pot_quant:** 0

a) total establishment inventory

CAS number: 7446-70-0 **identity:** AlCl3

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

use of substance as: on-site intermediate

b) substance belongs to relevant inventory directly involved: Yes

actual quantity: 0 **potential quantity:** 0

c) substance belongs to relevant inventory indirectly involved: Yes

actual quantity: 0 **indir_pot_quant:** 0

a) total establishment inventory

CAS number: 7550-45-0 **identity:** TiCl4

name from Seveso I Directive: - not applicable -

name from Seveso II Directive: - not applicable -

category from Seveso II: oxidising

other hazards (1): - not applicable -

other hazards (2): - not applicable -

maximum quantity (tonnes): 1

use of substance as: on-site intermediate

b) substance belongs to relevant inventory directly involved: Yes

actual quantity: 0 **potential quantity:** 0

c) substance belongs to relevant inventory indirectly involved: Yes

actual quantity: 0 **indir_pot_quant:** 0

Source of Accident - Situation **country:** FA **ident key:** 1800_113_01

situation

industry

inititating event - not applicable -

associated event - not applicable -

activity/unit

major occurrence 3999 other: other

inititating event - not applicable -

associated event - not applicable -

component

major occurrence 4011 general pipework/flanges

inititating event - not applicable -

associated event - not applicable -

B Consequences Full Report

country: FA **ident key:** 1800_113_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 loss of containment, local exit vapour cloud

remarks - not applicable -

2 People

establishment popul. emergency personnel off-site population

total at risk 200 25 0

immediate fatalities 1 0 0

subsequent fatalities 0 0 0

hospitalizing injuries 3 0 0

other serious injuries 0 0 0

health monitoring 0 0 0

remarks one fatality was due to hit by the Saunders valve, 3 men were seriously injured ... see Appendix

Full Report B / people

3 Ecological Harm

pollution/contamination/damage of:

- residential area (covered by toxic cloud) not applicable

- common wild flora/fauna (death or elimination) not applicable

- rare or protected flora/fauna (death or elimination) not applicable

- water catchment areas and supplies for consumption or recreation not applicable

- land (with known potential for long term ecological harm or not applicable

preventing human access or activities)

- marine or fresh water habitat not applicable

- areas of high conservation value or given special protection not applicable

remarks - not applicable -

4 National Heritage Loss

effects on:

- historical sites not applicable **- historic monuments** not applicable

- historic buildings not applicable **- art treasures** not applicable

remarks - not applicable -

5 Material Loss

establishment losses off site losses

costs (direct costs to operator) (social costs)

in ECU HFL ECU HFL

material losses 460000 1000000 0 0

response, clean up, restoration 460000 1000000 0 0

remarks - not applicable -

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 Yes

- political interest No Yes No

remarks - not applicable -

7 Discussion of Consequences

- not applicable -

C Response Full Report

country: FA **ident key:** 1800_113_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

Process safety analysis needs ... see Appendix Full Report C / lesson learned - prevent

measures to mitigate consequences:

none

useful references:

none

5 Discussion about Response

- not applicable -

Appendices for the FA / 1800_113_01 report

Appendix Profile Text a:

A four inch vapour pipeline was flushed with water. In the pipe deposits of "Ticle", TiCl4 and AlCl3. The rapid reaction between TiCl4 and/or AlCl3 and water caused a fast pressure rise and violent trembling of the pipe. The speed of pressure accumulation is estimated to have been of a magnitude comparable to an explosion. The maximum pressure however did not exeed the dynamic burst pressure of the vent line. The fast pressure built up took place in the part of the line that was completely filled with water. The pressure was transmitted in all directions. The pressure wave was directly transmitted through the water to the end of de pipeline. Here a cast iron Saunder valve had been mounted temporarily to let the water in the pipe line. The sudden pressure rise caused the cast iron valve housing to fail (in a brittle mode). Parts of the housing hit the deadly injured victim. Because of the failure of the valve housing trust of water, expelled at a high speed, induced strong reaction forces in the pipe. The end of the pipe line was also not properly supported, in fact is was completely lose because of the mounting of the Saunders valve. So released reaction forces (pipe whip), destroyed the pipeline.On several places the pipe was dammaged (sheer fractures in circumferential direction). Besides the dead victim three other people were severly injured bij the accid comming out of the pipeline.

Appendix Full Report A / causes of major occurrence:

The vent system (a four inche pipeline of about 240 feet long) was used to clean a vessel. The purpose of the vessel was to ad AlCl3 to the process. The vessel had to be cleaned with water because of problems in the normal process. The vessel was situated at a level of about 60 feet high. In order to ad water to the vessel the pipeline was used. At ground level the pipe was disconnected and a cast iron Saunders valve was attached. The fire water system was attached to the Saunders valve. Not very well known was the fact that in the pipeline were quantities of AlCl3 and TiCl4 as a deposit. The water and the deposit caused rapid reactions. The rapid pressure rise had the force of an explosion, but the pressure itself did not exceed the burst pressure of the pipe. This is proved because of the fact that longitudinal cracks did not develop. The fast pressure was transmitted in all directions. As mentioned before the pipe resisted the pressure in curcumferential and of course also in longitudinal directions. But the pressure (probably a pressure wave) was directly transmitted through the water to the end, where the Saunders valve was situated, in almost completely closed position. The presure wave resulted in a brittle failure of the Saunders valve housing. As a result of the thrust of the water and the vapour, expelled at a high speed, induces strong reaction forces on the pipe, resulting in a pipe whip and so destroying the pipeline in several parts.

Appendix Full Report B / people:

one fatality was due to hit by the Saunders valve, 3 men were seriously injured due to exposion of vapour cloud (VCE)

Appendix Full Report C / lesson learned - prevent:

Process safety analysis needs more attention, also in the case of procedures like cleaning