

Explosion på en uppskalningsanläggning vid en kemikaliefabrik.

890628 MARS 1989_12

Olyckan inträffade på en uppskalningsanläggning vid vakuumdestillation av en nitro-imidazol vid 100°C. Företaget var angeläget om att kontrollera de eventuella riskerna för explosion med en råvara som innehöll en nitro-grupp. Emellertid hade inga explosionstester genomförts innan uppskalningsförsöket. Processoperatören hällde 154 kg av substansen i en 450 l reaktor och satte termostaten på 100°C. Vätskenivån befann sig under temperaturproben varför termostateringen inte fungerade. Operatören såg en gul rök stiga upp ur reaktorn och skyndade ut från rummet. Inom 2 sekunder hördes två explosioner tätt inpå varandra.

Uppskalningsanläggningens tak blåstes bort och reaktorns lock sköts som en missil ut genom taket. Det landade 30 m bort. Resten av reaktorn rasade genom golvet och landade våningen under. Fönster krossades upp till 30 m bort. Splitter flög 60 m omkring. Företagets interna brandkår bekämpade småbränder som utbröt med handhållen släckningsutrustning. Röken från explosionen drev långsamt mot en närbelägen by men skingrades innan den nådde fram. Två närliggande fabriker utrymdes. Räddningstjänsten övervakade situationen i två timmar till dess att farana ansågs över.

Inblandade ämnen och mängder

	CAS Nr.	Mängd
1-metyl-2-formyl-1-nitroimidazol	4750-57-6	154 kg
acetone	67-64-1	10 kg

Skador:

Människor:	Två närliggande fabriker utrymdes.
Materiella:	Omfattande skador på anläggningen. Utanför anläggningen uppstod skador på hustak, och på bilar på en parkering i närheten.
Miljö/ekologi:	Inga effekter rapporterade.
Infrastruktur:	Trafiken i närheten spärrades av.

Erfarenheter redovisade (Ja/Nej):

Kortfattat anges förebyggande åtgärder.

Report Profile

Identification of Report:

country: FA ident key: 1989_012_01

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

Date of Major Occurrence: Time of Major Occurrence

start: 1989-06-28 start: 16:00:00

finish: finish:

Establishment:

name:

address:

industry: 2004 pesticides, pharmaceuticals, other fine chemicals

Pharmaceutical (Manufacturing bulk fine chemicals)

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_012_01

Accident Types:

release: Yes explosion: Yes

water contamination: No other: No

fire: Yes

description:

The explosion demolished the dividing walls between the pilot plant and the laboratory and the main process area causing extensive damages to equipment therein. The roof of the pilot plant was destroyed.... see Appendix Short Report / description of accident types

Substance(s) Directly Involved:

toxic: No explosive: Yes

ecotoxic: No other: No

flammable: Yes

description:

- 1-Methyl-2-Formyl-1-Nitro-imidazole (C.A.S. CODE:4750-57-6): amount involved = 154 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 during the distillation of a crude nitro-imidazole compound at 100°C under vacuum in a pilot-plant (laboratory trials had shown that under those conditions was possible to obtain a pure product).

The process operator a... see Appendix Short Report / description of immediate sources

Suspected Causes:

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

human: No **other:** No

description:

CAUSES:... 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:

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: Yes **other:** No

evacuation: Yes

description:

INTERNAL TO THE ESTABLISHMENT:... see Appendix Short Report / description of emergency measures taken

Immediate Lessons Learned:

prevention: Yes **other:** No

mitigation: 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_012_01

1 Type of Accident

remarks: During the distillation, at pilot-plant scale, of a crude nitro-imidazole compound at 100°C under vacuum, 2 successive explosions occurred due to the instability of the chemical substance (code 1306). The explosions were followed by a fire ... see Appendix Full Report A / type of accident

2 Dangerous Substances

remarks: The total establishment and the potential directly involved inventories of 1-methyl-2-formyl-1-nitro-imidazole refer to the amount involved in the

accident. The total establishment and the potential directly involved inventories of acetone ... see Appendix Full Report A / dangerous substances

3 Source of Accident

illustration: - not applicable -

remarks: The accident occurred during the distillation (code 3104) of a crude nitro-imidazole compound in a pilot-plant of a pharmaceutical industry (code 2004). The distillation was carried out at 100°C and under vacuum in a 450 litres reactor (cod... 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):

stability (Pasquill):

ambient temperature (°C):

remarks: The day was dry with calm conditions.

5 Causes of Major Occurrence

main causes

technical / physical 5106 operation: runaway reaction

- not applicable -

- not applicable -

- not applicable -

- not applicable -

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

- not applicable -

- not applicable -

- not applicable -

- not applicable -

remarks: The explosion was caused by the decomposition of 1-methyl-2-formyl-1-nitro-imidazole due to the heating (code 5106). The distillation of the crude product at 100°C under vacuum had shown by laboratory trials to yield pure product but, in a ... see Appendix Full Report A / causes of major occurrence

6 Discussion about the Occurrence

- not applicable -

Type of Accident country: FA ident key: 1989_012_01

event:

major occurrence 1306 explosion: explosive decomposition (of unstable material)

initiating event 1306 explosion: explosive decomposition (of unstable material)

associated event - not applicable -

Dangerous substances

country: FA ident key: 1989_012_01

a) total establishment inventory

CAS number: identity: Smoke

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: ABNORMAL PRODUCT

b) substance belongs to relevant inventory directly involved: No

actual quantity: -1 potential quantity: -1

c) substance belongs to relevant inventory indirectly involved: Yes

actual quantity: -1 indir_pot_quant: -1

a) total establishment inventory

CAS number: 4750-57-6 identity: Methyl-formyl-nitro-imidazole

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): 0,154

use of substance as: STARTING MATERIAL

b) substance belongs to relevant inventory directly involved: Yes

actual quantity: 0,154 potential quantity: 0,154

c) substance belongs to relevant inventory indirectly involved: No

actual quantity: -1 indir_pot_quant: -1

a) total establishment inventory

CAS number: 67-64-1 identity: Acetone

name from Seveso I Directive: - not applicable -

name from Seveso II Directive: - not applicable -

category from Seveso II: - not applicable -

other hazards (1): - not applicable -

other hazards (2): - not applicable -

maximum quantity (tonnes): 0,16

use of substance as: STARTING MATERIAL

b) substance belongs to relevant inventory directly involved: Yes

actual quantity: 0,01 potential quantity: 0,16

c) substance belongs to relevant inventory indirectly involved: Yes

actual quantity: 0,01 indir_pot_quant: 0,16

Source of Accident - Situation country: FA ident key: 1989_012_01

situation

industry

initiating event 2004 pesticides, pharmaceuticals, other fine chemicals

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 4001 reaction vessel; non-pressurised

initiating event 4001 reaction vessel; non-pressurised

associated event - not applicable -

B Consequences Full Report

country: FA ident key: 1989_012_01

1 Area concerned

affected

extent of effects installation: Yes

establishment: Yes

off-site; local: Suspected

off-site; regional: No

off-site; transboundary: No

illustration of effects - not applicable -

remarks The extents of the effects are shown on a map attached to the Original Report. N... see Appendix

Full Report B / area concerned - remarks

2 People

establishment popul. emergency personnel off-site population

total at risk 90 300

immediate fatalities

subsequent fatalities

hospitalizing injuries 1

other serious injuries 1

health monitoring

remarks 2 people were slightly injured by the explosion: one person working in the adjac... 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. The... 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 Irish Pounds ECU Irish Pounds

material losses 500000

response, clean up, restoration

remarks Extensive damages to plant and internal/external walls. Around the pilot plant 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 Yes 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 Yes No

- **political interest** No No No

remarks No significant overpressures were observed off-site but the windows of the house... see Appendix

7 Discussion of Consequences

C Response Full Report

country: FA **ident key:** 1989_012_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 company has discontinued r... 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_012_01 report

Appendix Short Report / description of accident types:

The explosion demolished the dividing walls between the pilot plant and the laboratory and the main process area causing extensive damages to equipment therein. The roof of the pilot plant was destroyed.

The factory is in an industrial estate on basically level ground. The day was dry with calm conditions. Smoke from the fires drifted towards the nearby Shannon town about 2 km away.

The 450 l glass lined reactor was built in 1979 by Balfour and Company Ltd., Leven, Fife, Scotland according to B.S. 1500. It was tested and certified by Lloyds in 1980 and installed in Sifa in 1980. The reactor was used for chemical reactions at atmospheric pressure or distillations under vacuum over a range of temperatures. On July 28, 154 kg of crude 1-methyl-2-formyl 1-nitroimidazole were loaded in the reactor and heated with heating medium at 100°C, with the intention of dropping the hot liquid into 20 litres glass distillation bowls. These bowls would then be used in the pilot plant distillation unit. Distillation of the crude product at 100°C under vacuum had shown by laboratory trials to yield pure product. When the solid lumps of crude product were almost dissolved, the reactor's agitator was turned on. Shortly afterwards the mixture began to boil up. A yellow fume began to emerge from the closed man-hole. The pilot plant operator exit quickly and within seconds 2 successive explosions were heard. Process plant on both the first floor and ground floor pilot plant was severely damaged. The roof of the pilot plant was blown off. The internal walls between the pilot plant and laboratory and the process area were blown down. External walls were severely damaged and two window frames were blown out. Glass windows were shattered up to 30 m away. Missiles from the pilot plant were projected up to 60 m away. The head of the process reactor was projected through the roof and landed about 30 m away while the bottom portion was projected from the first floor area down to the ground floor area and embedded in the floor. One person working in the adjacent main production area received shoulder injuries resulting from a fall. Another person suffered a slight cut and shock. Although there was no damage off-site the sound of the explosion was heard some distance away. In the town of Shannon 2 km away windows were shaken and the noise caused considerable public concern.

Appendix Short Report / description of substances involved:

- 1-Methyl-2-Formyl-1-Nitro-imidazole (C.A.S. CODE:4750-57-6): amount involved = 154 Kg.

- Acetone (C.A.S. CODE: 67-64-1, E.E.C. CODE: 606-001-02-8): amount involved = about 10 kg (little amount as most of the contents of the two nearby reactors, 100 litres volumetric capacity each, containing acetone was not lost).

Appendix Short Report / description of immediate sources:

The accident occurred during the distillation of a crude nitro-imidazole compound at 100°C under vacuum in a pilot-plant (laboratory trials had shown that under those conditions was possible to obtain a pure product). The process operator added 154 kg of substance into a 450 litres reactor and set the temperature of heating medium (glycol/water mixture) at 100°C at control panel and turned on heating medium circulation pump to reactor's jacket. The solid was almost melted after 4 hours and then the

operator turned on the reactor's agitator and continued the heating to finish the melting of the solid.

Appendix Short Report / description of suspected causes:

CAUSES:

The explosion occurred during the heating of 1-methyl-2-formyl-1-nitroimidazole at 100°C in a closed reactor under vacuum. The explosion was caused by the decomposition of the product due to the heating. As the liquid level in the reactor was below the temperature probe, its exact temperature was unknown. It was thought that it was below 100°C of the heating medium in the reactor's jacket. The company was concerned about the potential explosive properties of the compound due to the presence of a nitro group and recognised the need for explosivity tests. At the time of the explosion they had not done these tests. The material was an intermediate and no health and safety information was available. The substance was still at pilot plant trials stage and the company intended to compile the relevant data if the process developed to full production scale.

Appendix Short Report / description of immediate effects:

EFFECTS ON PEOPLE:

2 people were slightly injured by the explosion.

MATERIAL LOSS:

Extensive damages to plant and internal/external walls. Around the pilot plant also roof damages and some glass damages to windows of the main building and to cars in the company car park. The cost of the damages has been estimated in about 500,000 Irish Pounds (about 0.65 MECU).

COMMUNITY DISRUPTION:

The smoke from the fire and the explosion drifted slowly (calm day) towards the nearby town of Shannon. It slowly dispersed over a number of hours. No smoke monitoring was carried out but the public was concerned. The manufacturer allayed the public's fears by stating on national radio and TV that the smoke was not toxic.

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

The extents of the effects are shown on a map attached to the Original Report. Only industrial population in the adjacent area. No significant overpressures were observed off-site. Glass breakage was confined to a 30 m radius within the site. The windows of houses in the town 2 Km away shook (blast effects compared to 2.5 kg TNT equivalent approximately).

Appendix Short Report / description of emergency measures taken:

INTERNAL TO THE ESTABLISHMENT:

When the explosion occurred all personnel went to the assembly area in accordance with the site's emergency plan. The company fire crew equipped with breathing apparatuses, put out small fires. They were aided by the local fire emergency services.

EXTERNAL TO THE ESTABLISHMENT:

Approximately 35 policemen closed off the access road to the factory. Three units of the local fire brigade arrived on the scene and found that the fire was under control. Approximately 5 fire brigade personnel aided the company fire crew in the pilot plant area. One fire brigade crew remained on-site for two hours until the "all clear" was given. The policemen evacuated two nearby factory units. Total number of people evacuated was approximately 300. The smoke from the fire and the explosion drifted slowly (calm day) towards the nearby town of Shannon. It slowly dispersed over a number of hours. No smoke monitoring was carried out but the public was concerned. The manufacturer allayed the public's fears by stating on national radio and TV that the smoke was not toxic.

Appendix Short Report / description of immediate lessons learned:

MEASURES TO PREVENT ANY RECURRENCE OF SIMILAR ACCIDENTS:

The company has discontinued research and development work for the foreseeable future and have to concentrate their activities on existing processes. The hazard evaluation of these processes is being reviewed prior to recommencement of each in turn. If the company reintroduces research and development work on new processes it will be done only after that a satisfactory programme is put in place to ensure an adequate hazard evaluation at each stage.

Appendix Full Report A / type of accident:

During the distillation, at pilot-plant scale, of a crude nitro-imidazole compound at 100°C under vacuum, 2 successive explosions occurred due to the instability of the chemical substance (code 1306). The explosions were followed by a fire in the plant area (code 1202). The smoke from the fire and the explosions drifted slowly towards a nearby town, causing public concern but it was not toxic (code 1401).

Appendix Full Report A / dangerous substances:

The total establishment and the potential directly involved inventories of 1-methyl-2-formyl-1-nitro-imidazole refer to the amount involved in the accident. The total establishment and the potential directly involved inventories of acetone refer to the whole volumetric capacity of the two reactors near to the pilot reactor. Only a fraction of the acetone contained in the two reactors was released from damaged flanges and burnt.

Appendix Full Report A / source of accident - remarks:

The accident occurred during the distillation (code 3104) of a crude nitro-imidazole compound in a pilot-plant of a pharmaceutical industry (code 2004). The distillation was carried out at 100°C and under vacuum in a 450 litres reactor (code 4001) containing 154 Kg of 1-methyl-2-formyl-1-nitro-imidazole. The factory is in an industrial estate on basically level ground. The lay-out of the establishment is shown on a map attached to the Original Report.

Appendix Full Report A / causes of major occurrence:

The explosion was caused by the decomposition of 1-methyl-2-formyl-1-nitro-imidazole due to the heating (code 5106). The distillation of the crude product at 100°C under vacuum had shown by laboratory trials to yield pure product but, in a pilot-plant scale, the heating caused its decomposition and the following explosion. It was probably caused by laboratory analysis procedures not correctly followed (5303).

Appendix Full Report B / area concerned - remarks:

The extents of the effects are shown on a map attached to the Original Report. No significant overpressures were observed off-site. The windows of the houses in the town

2 Km away shook (blast effects compared to 2.5 Kg TNT equivalent approximately). The smoke from the fire and the explosion drifted slowly (calm day) towards the nearby town of Shannon and dispersed over a number of hours. No smoke monitoring was carried out but the public was concerned.

Appendix Full Report B / people:

2 people were slightly injured by the explosion: one person working in the adjacent main production area received shoulder injuries resulting from a fall; another person suffered a slight cut and shock.

Appendix Full Report B / ecological harm:

In the Original Report there is no evidence of significant ecological harms. The smoke from the fire and explosions was not toxic.

Appendix Full Report B / material loss:

Extensive damages to plant and internal/external walls. Around the pilot plant also roof damages and some glass damages to windows of the main building and to cars in the company car park. The amount of the damages has been estimated in about 500,000 Irish Pounds (about 0.65 MECU).

Appendix Full Report B / disruption of community life:

No significant overpressures were observed off-site but the windows of the houses in the town 2 Km away shook. The smoke from the fire and the explosion drifted slowly (calm day) towards the nearby town of Shannon and dispersed over a number of hours. No smoke monitoring was carried out but the public was concerned. The manufacturers allayed the public's fears by stating on national radio and TV that the smoke was not toxic. The policemen evacuated two nearby factory units.

Appendix Full Report C / lesson learned - prevent:

The company has discontinued research and development work for the foreseeable future and have to concentrate their activities on existing processes. The hazard evaluation of these processes is being reviewed prior to recommencement of each in turn. If the company reintroduces research and development work on new processes it will be done only after that a satisfactory programme is put in place to ensure an adequate hazard evaluation at each stage.