

Chlorine leak in a gas packaging facility

27th October 1999

Chalon-sur-Saône (Saône et Loire)

France

Compressed gas
Chlorine
Organisation /
Management of
modifications
Procedures
Risk analysis
Pressurised equipment

THE FACILITIES INVOLVED

The site:

The site is a storage, conditioning and unloading centre for gases primarily used in the high-technology electronics industry (the manufacture of semi-conductors). The gases used at the site are grouped into four categories :

- √ hydrides (silane, arsine, phosphine, diborane,...),
- √ corrosives (chlorine, hydrogen chloride,...),
- √ fluorinated gases (hexafluoroethane, tetrafluoromethane,...)
- √ organometallic gases (trimethylgallium, trimethylaluminium,...) which are only stored.

A fifth category is stored in greater quantities: oxide gases (nitric oxide, carbon monoxide...).

The establishment is located approximately 1,500 m from the city centre and employs 48 persons. The plant operates under the SEVESO directive for its arsine and phosphine storage facilities.

The chlorine depot forms the subject of a special autorisation (prefectorial order of July 27th 1999 - section 1138-2).

The involved unit:

The workshop in question is used to condition corrosive gases.

THE ACCIDENT, ITS CHRONOLOGY, EFFECTS AND CONSEQUENCES

The accident:

At approximately 9:40 am, during a chlorine conditioning operation to a "daughter" cylinder (B10), a leak occurred on the "mother" cylinder allowing approximately 4kg of chlorine to escape. The workshop's toxic alarm was triggered immediately. The operator sounded the alarm, closed the valves on both cylinders and, with the leak continuing, left the workshop. The five other operators secured their workstations and also left the premises.

The fire brigade was notified initially at 9:51 am and a second time by two neighbouring companies which were alerted by the smell of chlorine. The P.O.I ("Plan d'Organisation Interne", internal contingency plan) was initiated. The leaking cylinder was transported to a containment facility designed for this purpose. As the room was not completely hermetic, the cylinder was then transported to an isolated sector of the establishment. The remaining gas was purged in a sodium carbonate bath.

The P.P.I. ("Plan Particulier d'Intervention", emergency response plan) was initiated at around 10:50 am, then the P.P.I. and P.O.I. were lifted at around 11:40 am. The operator was hospitalised for observation and was released rapidly with a clean bill of health.

Consequences of the accident:

The technician was slightly injured. The leak had no significant effect on the surrounding population nor the environment. The workshop upgrade operations total approximately 8 MF.

The European scale of industrial accidents

By applying the rating rules applicable to the 18 parameters of the scale officially adopted in February 1994 by the Member States' Competent Authority Committee for implementing the 'SEVESO II' directive on handling hazardous substances, and in light of the information available, this accident can be characterised by the four following indices:

Dangerous materials released			<input type="checkbox"/>				
Human and social consequences			<input type="checkbox"/>				
Environmental consequences		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Economic consequences		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

The parameters composing these indices and their corresponding rating protocol are available from the following Website: <http://www.aria.developpement-durable.gouv.fr>

The overall score of the "Hazardous materials released" index was assigned a "1", given that the quantity of chlorine released into the environment remained less than 0.1% of the SEVESO threshold (parameter Q1).

Since a technician had to be hospitalised (albeit for less than 24 hours), the "Human and social consequences" index was rated a "1".

No environmental consequences were detected; the corresponding index therefore remained at "0".

Moreover, the "Economic consequences" index also posted a "0" score, as no damage was reported (safety improvements are not included as a European scale parameter).

THE ORIGIN, CAUSES AND CIRCUMSTANCES SURROUNDING THE ACCIDENT

The "mother" cylinder is emptied by reheating the cylinder using a sleeve equipped with an electrical resistance, while the "daughter" cylinder is cooled by a system circulating a coolant. A 3kw heating sleeve had been ordered to replace the 1kW sleeve in order to increase the shop's productivity. It was being used for the first time and the temperature probe was not correctly positioned to ensure good contact with the cylinder. The "mother" cylinder was fitted with a safety plug which opens at 75°C. The excessive and uncontrolled heating of the cylinder raised the temperature of the valve to such a point that the fuse melted. The design of the exhaust hood did not allow it to draw off a leak of such magnitude and its ventilation system was not designed to neutralize the exhausted gases.

ACTIONS TAKEN

The manufacturer undertook the following measures: use of the new sleeve was suspended, distribution of a reminder concerning the management of procedure modifications, and extensive reflective thinking as to the packaging procedures, the ventilation of the workshop and its treatment were reviewed.

Suspension of the plant's activity was not proposed due to the limited consequences of the accident, the operator's control of the situation and the corrective measures proposed. However, the safety study was insufficient as it did account neither for the cylinders equipped with the safety plug nor for the iron-chlorine combustion above 120°C.

The inspectorate proposes that the operator be asked to thoroughly update the safety study and to reinforce requirements to avoid a new leak, such as the installation of a gas extraction system slaved to the detection system, treatment of the gases extracted by a scrubbing system having at least 99% yield, and verification and retesting of the confinement facility.

LESSONS LEARNT

This accident highlights that the modification project (a new, more powerful heating sleeve) was not adequately analysed to evaluate the consequences. Accidents are often due to the implementation of a poorly controlled modification.

The accident occurred even though the company had a procedure that recommends a modification project to be validated by someone other than the person proposing it (generally by the line supervisor or a member of functional management). The implementation of a reliable procedure for managing modifications is important, with a new safety study if necessary.

Thought must also be given to the conditions for triggering the emergency response plan (P.P.I.).