

Gas oven explosion

April, 1st, 2003

Geleen

The Netherlands

Chemistry
Restarting
Maintenance
Human factor
Organisation
Procedures
Competitiveness
Victims
Property damage

THE INSTALLATIONS IN QUESTION



Photo : R. D.

Chemelot site is situated in the south of the Netherlands, in the province Limburg, just north of Maastricht. It is the second largest chemical complex in the Netherlands. Chemelot consists of several production plants, producing plastics, as well as several base chemicals for the production of plastics, medicine and other products.

On the site several companies are active among which a former state owned mining company, nowadays a privately owned company which produces basic chemicals, medicine, food products and products such as high strength fibres like Dynema. The accident happened in a plant which is part of this company. This plant consists of a large industrial gas oven, fuelled by natural gas and residual gasses from other plants on the site. These residual gasses are contaminated and therefore have to be filtered before use. These filters have to be cleaned regularly, which means shutting down the oven and restarting it after cleaning the filters. This plant produces melamine.

THE ACCIDENT, ITS BEHAVIOUR, ITS EFFECTS AND CONSEQUENCES

The accident

Shutting down and restarting the oven is a lengthy process in which the oven has to cool down, before it can be restarted. Restarting has to be done gradually, starting with the pilot burners, after which the main burners can be started.

On restarting the oven filled with a combustible mixture of gas and air, which was *probably ignited by an errant spark from a ventilator started by an operator.*

The explosion caused the lid of the oven, on which a maintenance crew was working, to be blown off. The lid fell down in the oven, together with the crew who were standing on it.




Photo : R. D.

The consequences :

At *the moment of the accident* three people carried out maintenance work on top of the lid of the oven. The temperature in the oven was still 350°C and all three were killed tragically.

European scale of industrial accidents

By applying the rating rules of the 18 parameters of the scale made official in February 1994 by the Committee of Competent Authorities of the Member States which oversees the application of the 'SEVESO' directive, the accident can be characterized by the following 4 indexes, based on the information available.

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

The parameters which compose these indexes and the corresponding rating method are indicated in the appendix hereto and are available at the following address: <http://www.aria.ecologie.gouv.fr/>

By default, parameter Q1 is given a rating of 1 as the quantity gas involved is unknown.

As the effects of the explosion had not been characterised and windows were broken at distances less than 300 m, parameter Q2 was given a rating of 1.

The overall "dangerous materials released" rating is thus 1.

The level of the human and social index is 3 because 3 workers were killed.

The level of the economic consequences index is 3 because damages to the installations and production losses are estimated at several millions of euros.

ORIGIN, CAUSES AND CIRCUMSTANCES OF THE ACCIDENT

Safety has three components :

- The first is the '**hardware**' consisting of machines, ancillaries, pipes etc., in this case the oven itself with pipes, valves, burners, ventilators, electric appliances, the switchboard etc.
- The second component is the '**software**' consisting of measures, rules and regulations regarding the safe operation of machines and plants.
- The third and last component is the **human factor**, the people operating the switchboard and their behaviour.

The behavioural elements are the crucial factor in this case, as they often are.

As said before, stopping and restarting the oven was a lengthy procedure, taking about 24 hours. During that period production at the plant was halted, causing substantial production losses. In order to shorten the cut off time, the operators of the plant devised a faster procedure to restart the oven, thereby ignoring safety procedures prescribed.

This faster procedure, which was employed before, resulted in filling the oven with a stoichiometric (explosive) mixture of gas and air. This explosive mix was ignited, probably by a freak spark coming from an electric ventilator started moments before the explosion, by an operator.

In analysing the sequence of events, it becomes clear that the fast track procedure employed in this case, resulted in bypassing the safety precautions, applied to prevent the oven filling with an explosive mixture of gas and air. It becomes clear that the explosion *probably* happened because of the ventilator, which provided the spark for the ignition, but that the roots of the accident are lying deeper.

The underlying cause consists in the use of the fast track procedure employed to restart the oven. This procedure was designed to by-pass safety measures prescribed in order to safeguard the safe restart of the oven. By doing so, explicit safety instructions were ignored.

However the root cause can be found when analysing this event. Analysing the root cause, is necessary to understand the operators, the people who run the plant and were trying to restart the oven as quickly as possible. Of course they were well-trained and experienced professionals, knowing their plant and the oven inside out, otherwise they would not have been able to devise a fast track procedure to restart the oven. Of course they were not irresponsible, incompetent, or consciously taking the risks they were taking. Nor were they undisciplined thrill seekers. On the contrary, they meant to be responsible professionals, trying to do their job properly and to a professional standard, thereby bearing in mind the primary goal of the company; to produce as much, as fast as possible, at the lowest possible costs.

It was this aim that was predominant in their decision to restart the oven using a faster procedure than prescribed. In this, their actions were in keeping with the result driven culture of the company involved, which puts economic aims first and consequently safety at a second best. A quote from one of the company's directors testifies this. In a safety audit the company scored 55%, which according to the director in case is sufficient to pass your exam at school!

The fast track starting procedure had been employed before, in that instance with good result. The accident survey revealed that in that case, neither beforehand nor afterwards, did the management of the plant check the procedure. By not checking the procedure, the quick restart of the oven was implicitly accepted by the management as good practice. So understandably the operators saw no reason not to use the fast procedure again.

As we now see, the result driven culture of the company, which puts economic results first en safety second best, supported by actions of the company's management, or rather as in this case by the lack of action in the form of control, resulted in the dangerous fast track starting procedure devised by the operators of the plant.

The conclusion is therefore that on the basic level the root cause of the accident is to be found in the company's culture.

LESSONS LEARNED

This accident underscores that in order to obtain a high level of safety, the company's management must be permanently committed to going beyond simply posting safety-related "slogans" on the wall and spouting empty speeches. The consideration of human behaviour is also a crucial step in this approach.