Explosion of a road tanker
April 27th 1993
Sorgues – [Vaucluse]
France

Projections
Chimicals
Phytosanitary products
Dinoseb
Temporary storage
Organisation
Procedures
Incorrect intervention
Decomposition
Thermal run-away
Material damage

THE INSTALLATIONS CONCERNED

The site

The company specialises in the production of nitrate based explosives such as T.N.T., P.E.N.T. hexogen, octogen and composite explosives .

The know-how acquired during the conduct of nitrating reactions progressively incited the company to diversify its activities to include the production of additives for fuel, agrochemicals, pharmaceuticals and cosmetics. A specialised subsidiary operates the production units for phytosanitary products.

At the time of the accident, the Sorgues site was covered by article 5 of the “Seveso” directive for an activity of secondary importance from the standpoint of the total risks presented, the production of sodium picramate.

The nitrating reactions generate a large quantity of polluted residual acids which were formerly released into the sewers. In 1994, 98 % of the used acids were treated for recycling in production or sold. The accident concerned the storage of residual acids awaiting treatment.

THE ACCIDENT, THE SEQUENCE OF EVENTS, EFFECTS AND CONSEQUENCES

The accident

On February 19th the production unit for phytosanitary products was in full production of DNBP (dynoseb). It was then that one of the enamelled basins in the residual acids storage park started to leak; the treatment workshop was halted for 4 days for repairs. The storage autonomy having dropped to 2.5 days’ production, the operator rented 3 tanker lorries to srore the acids temporarily and thus to avoid the need to halt production.

On February 23rd, the 3 lorries arrived on the site. Their 30 m³ tanks were heat insulated, fitted with cooling gauges (not put into service) and a gas vent which was kept closed. On 24th February, lorry n°1 was filled with residual acid from the production of DNBP then, on February 26th, lorry 2 was half filled. These lorries were emptied and cleaned out on March 9th and 11th.

On March 19th the operator starts production of a precursor product for phytosanitary products, DNTCBB (dinitro 2-6 tertiobutyl 4 chlorobenzene), by nitration of the TBCB with a mixture of concentrated nitric acid and oleum.

Another enamelled basin storing 85% sulphuric acid then also sprung a leak, requiring a further stoppage of the treatment workshop for 5 days. The storage autonomy for residual acids corresponding to 4 days for this production the 3 hired lorries, which had not been returned were put back into service and a further 3 lorries were hired.

On March 23rd, lorry n°2 was initially filled with residual aci d from the production DNTCBB.

Between March 25th and April 8th, the other rented lorries were filled. In particular, lorry n°1 (another wagon having served during the preceding production run) was filled on March 25th and then emptied on April 21st.

On April 27th, lorry n°2 had not yet been emptied of its residual content composed of 25.9% sulphuric acid with 26.1% nitric acid, with impurities representing 7.6 ppm of dichloromethane and 2 220 ppm of organic matter. The lorry was parked close to the treatment facility at 250m from the Southern end of the plant's enclosure. A very light breeze was blowing from the North, the cloud ceiling was low, the atmosphere humid but with no rain and the temperature was 21°C.

13h30: nitrous vapour escaped from the manhole in the tank. The alert was given. Fire-hoses were positioned to cool the heat-insulated envelope and a water curtain created down-wind to bring down the cloud. The manager of the security department of the site, an operator and two firemen were standing at 25m downwind.

14h30: the gaseous release had not weakened, the POI (plant emergency plan) was implemented in the form of a "routine alert" and the Avignon fire brigade and the neighbouring factories were alerted.

14h52: a cloud of nitrous vapour 30m high and 180m long had formed. It was at this point that the tank exploded, projecting an aerosol of acid and products of reaction, as well a large amount of metallic debris.

15h00: the hosing was increased and neutralising products (carbonates) were spread over the ground. Part of this partly neutralised mixture reached the OUVEZE river.

17h00: two workers from an outside company working in the neighbourhood of the Southern end of the plant enclosure complained of prickling in the eyes. They were treated in the guardhouse.

18h00: end of the intervention.

The consequences

The tank had split along the entire length of the upper longitudinal welding. 13 pieces of metal debris were found in a radius of nearly 200m, one of which was a fragment of the envelope (30 kg) at 67 m and a stem (3 kg) at 195 m.

The acid aerosol projected by the explosion had been expelled over a considerable distance; in particular, it discoloured a distillation column at 135m from the wagon without, however, interrupting its operations.

Two employees of an outside company, working close to the Southern end of the enclosure, complained of prickling in the eyes and were treated at the guard-post. There was no damage to other companies or to the environment. The absence of human consequences was almost miraculous:

- Before the explosion and during the escape of the nitrous vapours, a security staff member had climbed onto the wagon to attempt to unbolt the manhole,
- At the moment of the explosion, the members of the security personnel placed at 25m downwind were not hit by any of the liquids or solids thrown up.

Part of the effluents, partly neutralised, reached the Ouvèze river.

Material damage was evaluated at 0.36 MF. (or 0.05 M€).

European scale of industrial accidents

Using the scoring rules of the 18 parameters on the scale formalised in February 1994 by the Committee of Competent Authorities of the Member States in the application of the 'SEVESO' directive, the accident can be characterised by the following 4 indices, taking into account the available information.

The parameters comprising these indices and the corresponding method of scoring can be found at the following address: http://www.aria.ecologie.gouv.fr

Among the various Seveso substances involved, only the nitric acid released represented 2.7% of the corresponding Seveso threshold (200 t - oxidant), which is the equivalent to level 3 on the index of "dangerous substances released" according to the Q1 parameter (Q1 including from 1 % et 10 %).

The H5 parameter of the index "human and social consequences" is scored at 1: 2 sub-contractors suffered from irritation in the eyes (H5 covering 1 – 5 injured employees).

The Env12 parameter of the "environmental consequences" index is scored at 1 by default, as the volume of water polluted was not measured.

THE ORIGIN, CAUSES AND CIRCUMSTANCES OF THE ACCIDENT

Investigations carried out following the accident revealed the presence of dinoseb (DNBP) deposits in the destroyed tank. Tests showed that at ambient temperature and in adiabatic conditions, a reaction of decomposition of the dinoseb started after 15 days of contact with residual acids from the production of DNCTBB, and emitted nitrous vapours. Furthermore, the reaction accelerated rapidly as from temperatures of 30 °C.

Analyses conducted on the acid residues recovered from the tank wagon showed:

- HNO_3: 26.1 %
- H_2SO_4: 25.9 %
- NO_2: 0.18 %
- COT: 2 230 ppm
- Dichloro-1,2 ethane : 7.6 ppm

A slow decomposing reaction occurred between the acids and the traces of dinoseb present during the storage period (1 month) followed by the pressure increase within the sealed and heat-insulated wagon.

MEASURES TAKEN

Immediate measures:

The Regional Directorate for Industry, Research and the Environment (DRIRE) made sure that measures were taken the same day to prevent similar accidents occurring in two other wagons containing the same acids:

- Opening of the manholes to avoid pressure build-up and to avoid exothermic reactions,
- Cooling of the acids by water circulation from cooling points,
- Measurements of the temperature during every security round, every 45 min.

Internal measures:

The operator took the following measures:

- Purchase of an enamelled tank to provide a rapid solution in the event of any incident during the treatment of "old" acids (200 KF),
- In-depth study of the storage and treatment possibilities for "old" acids in relation to the production programmes,
- Maximum avoidance of storage in wagons or, where this was inevitable:
    - ensuring their cleanliness by means of internal inspection,
    - cooling and checking them once filled,
    - planning a ventilation point protected against the entry of water, to allow airing.

The incident gave rise to no penal proceedings. A study of the dangers relating to all activities on the site was updated and led to the reinforcement of all instructions imposed covering all activities.

THE LESSONS LEARNED

The recourse to mobile temporary storage without retaining basins was not authorised and the storage and re-treatment activities for used acids had not been the subject of any study of the dangers.

The absence of any internal evaluation procedure covering the risks of temporary storage and the absence of external consultation, at the origin of the accident, led the operator to commit a series of mistakes and acts of negligence: useless hosing of the heat-insulated wagons (the fixed reservoirs were not heat-insulated)) failure to survey the temperatures, the sealing of the manholes and the gas vent (the fixed reservoirs had a vent) the non-use of the sprinkler system which was available, the absence of a retaining basin and the absence of an adequate quality control system for the cleaning of the wagons….