

LITHUANIAN AMMONIA ACCIDENT, MARCH 20TH 1989

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The results of the failure of a 10,000 ton unpressurised liquid ammonia tank are reported. The ammonia gas released caught fire and ignited a fertilizer store containing 15,000 tons of NPK. The ammonia vapour and fertilizer decomposition products formed a 400 km² contamination zone. There were 7 fatalities and 57 injured.

Keywords - ammonia, fertilizer, storage, fire, tank failure.

The accident took place at the "Azotas" Fertilizer plant, 12 km from Jonova, a town of some 40 000 inhabitants. The plant has 5 000 employees and manufactures mainly fertilizers. Probably it also has military links and is therefore usually closed to foreigners. The plant was built in 1969 and, apart from the accident area made a generally good impression on the visitors. Maintenance however, seemed to be somewhat neglected.

The ammonia tank surrounded by a retention wall of reinforced concrete with thickness of 400 mm and height of 14,1 meters, was situated quite close to a fertilizer factory, where NPK 11-11-11 was produced. This product is strongly self-burning (cigar-burning; 500 mm/h). The product was conveyed by rubber belt to two store houses, 15 000 tons and 20 000 tons capacity. Adjacent to these was also a store house for 20 000 tons ammonium nitrate. All these stores were nearly full at the time of the accident.

The ammonia tank was supplied with ammonia from an ammonia factory, some 600 m from the tank. The tank was of Japanese design and built by Soviet personnel in 1978. It had a capacity of 10 000 tons unpressured liquid ammonia (-33°C) and contained 7 000 tons when the accident occurred. It was equipped with everything necessary for safe operation,

- two ammonia storage cycle piston compressors with the capacity of 323 m³/h, one with electric motor drive and the other one with diesel engine
- two safety valves with capacity of 4 200 m³/h each

- two breathing valves in case of vacuum conditions
- one torch with capacity of 500 kg/h

and a control room from which loading of railway tankers was also supervised. The tank was single walled and surrounded by perlite insulation, kept in place by an outer steel shell for weather protection. External diameter 30,3 m, height 21,3 m and internal diameter 28,9 m, height 19,9 m. The tank rested on a concrete foundation of pillar design, to which the tank was anchored by 36 straps (1400x140x10 mm) fastened to the outside of the cold wall by a welded device and penetrating through the tabletop of the foundation. The straps were fixed in place beneath the "tabletop" by four crossed wings welded to each strap.

Liquid ammonia (-33°C) flows into the tank bottom and is also extracted from the bottom by centrifugal pumps to railway tankers.

The following description of the accident is a summary of the official investigation report, made by the Lithuanian authorities.

On March 20th, one of the compressors in the ammonia plant was in a durable repair and the second was stopped at 10.00 a.m. for a short-term repair. The start-up of the ammonia storage piston compressor for drawing off ammonia gas was delayed because of a difficulty with opening the gate valve in the water delivery line for cooling the compressor. The pressure in the tank was 700 mm water. An operator began the operations of stopping the reception of cold ammonia from the plant and of opening the exhaustion of ammonia gas to the torch. The filling of the railway tankers was stopped.

Between 11.00 to 11.15 a.m. the isothermic tank destroyed itself.

Suddenly the tank opened on one side between wall and bottom and ammonia rushed out through the leak. At the same time the whole tank was dislodged from the foundation and smashed with great force through the surrounding wall of reinforced concrete on the side opposite to the leak. It finally landed about 40 meters from the foundation. The bottom of the tank remained on the foundation.

Devastation around the tank was enormous and liquid ammonia around the fertilizer factory and stores was in places 70 cm deep. Large quantities of ammonia evaporated and suddenly the ammonia gas caught fire and the whole area - control room, fertilizer factory, belt conveyor and loading site - was engulfed in flames. The burning belt conveyor fell down into the fertilizer store containing 15000 tons of NPK 11-11-11 and self-sustaining decomposition was initiated.

The ammonia vapour and the fertilizer decomposition (nitrous fumes) spread up to 35 km forming a contamination zone with an area up to 400 km². At 5 km the cloud had the height of 100 m; at 10 km up to 400 m; and at 20 km up to 800 m.

After 12 hours all the ammonia had evaporated but the fertilizer continued to burn (decompose) for three days evolving great quantities of nitrous fumes.

To protect the operators and employees of the plant, the population of Jonova and adjacent regions, the measures were taken as follows:

- Warning and emergency evacuation of employees from the plant.
- Gradual evacuation of community residents from hazardous areas. In total 32 000 people were evacuated.
- Permanent information for the community.
- Protection of water sources.

The rescue work continued for three days and the official number of fatalities was 7, and 57 injured at the time of my visit (May 1989).

Clearing up and reconstruction had at that time not yet started, but an ammonia tank identical to the one wrecked in the accident was about to be started up. Operation of this tank and the NPK-plant has however been stopped by the Lithuanian authorities.

Causes of the failure according to the official commission of inquiry in USSR:

- 1) The tank did undergo an overpressure.
- 2) This overpressure was due to following events:
 - Delivery of 14 tons "warm" ammonia (+10°C) at the bottom of the tank because of an operating mistake in the ammonia plant.
 - This "warm" ammonia accumulated at the bottom of the tank in the form of "lenses" or a layer of warm unstable ammonia. It did not evaporate at once because of the hydrostatic pressure
 - This layer or these lenses tilted over the surface of the liquid.
 - Then this warm liquid ammonia evaporated to lower its temperature to -33°C.
 - This sudden evaporation caused the overpressure.
- 3) All refrigeration compressors were out of operation.
- 4) Ammonia did caught fire.