

Natural triggering event:

Extended period of intense cold

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Rupture of a benzene pipeline

16 February 2012

Martigues (Bouches-du-Rhône)

France



THE ACCIDENT AND ITS CONSEQUENCES

A leak occurred at 2:50 pm on an insulated benzene pipeline supplying an oil terminal. Approximately 4 m³ of product spread over the ground. The internal emergency plan at the oil depot was activated, entailing: port closure, personnel evacuated to shelters, water curtains and foam blankets deployed, plus recordings of benzene concentration in the environment. The leak was plugged using a hose clamp. 50 m³ of product remained inside the pipeline. Over the following days, other leaks were detected, each triggering an emergency plan response. Ultimately, a concrete sarcophagus was installed around the damaged section and the pipeline could be properly drained.

No human consequences ensued thanks to the efficient response of emergency crews and prevailing northerly winds, which diluted the product as it was evaporating into the air. Fouled earth in the zone was subsequently excavated.

ORIGIN / CAUSES

The freezing of benzene, which solidifies below 5°, caused this accident. The pipeline had been idle for 18 days and the system to maintain a constant temperature proved ineffective. The product froze during an intense cold wave and wound up contracting. Over an inclined pipeline stretch, some product filled the space freed during contraction; during the thawing period, the pipeline broke as a result of exposure to excessive pressure. This incident was attributed to the solidification of benzene in zones where the alignment had not been plotted (i.e. crossings via nozzles running beneath roads). These “plugs” created pipe segments isolated from vacuum relief valves, which experienced pressure rises due to a combination of two phenomena: a benzene volume increase during melting, and thermal expansion of the liquid benzene.

ACTIONS TAKEN

A metallurgical appraisal of the failed pipe sections was conducted, in conjunction with building a model to describe the phenomenon of benzene freezing in the pipeline, in order to confirm the mechanism responsible for these leaks. Moreover, the site operator undertook the following steps:

- revise and improve the temperature maintenance system during freezing periods;
- study the feasibility of introducing recirculation on the line or draining the pipe;
- design a device to allow verifying at all times that heaters are indeed operational.

LESSONS LEARNT

These events, triggered by widespread and unfavourable climatic variations, have demonstrated the importance of:

- re-evaluating risks related to the consequences of benzene solidification;
- implementing both remedial and preventive measures to cope with extended periods of intense freezing;
- verifying the use of appropriate techniques for maintaining temperature (e.g. insulation, plotters, temperature probes).