Leak on a pipe conveying MTBE
October 2004
Stein Port - The Netherlands

Petrochemistry
Soil pollution
Water table pollution
Construction defect
Welding
Human factor
Late detection

THE INSTALLATIONS IN QUESTION

The site:

The 800-ha petrochemical complex near the port includes roughly ten different plants that produce approximately fifty or so chemical products, including methyl-tertio-butyl-ether (MTBE), benzene, toluene, ethylbenzene and xylene (BTEX).

The concerned installation:

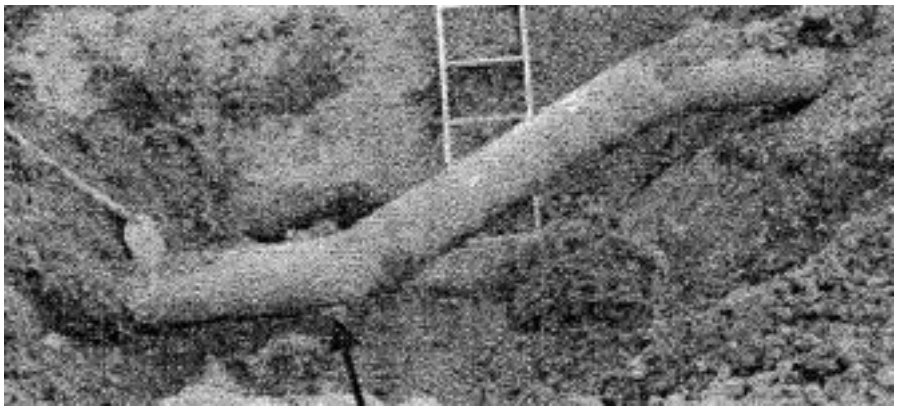
A 10" (254 mm) diameter pipe used to transfer various products from the production facilities to the port's loading/unloading zone runs along the Juliana canal, also near the Meuse. Built in 1976 and designed to withstand a pressure up to 25 bar, the pipeline is operated at a service pressure of 2 bar.

THE ACCIDENT, ITS BEHAVIOUR, EFFECTS AND CONSEQUENCES

The accident:

In October 2004, inconsistencies in the material balance between the MTBE sent by the production unit and that received at the port lead to an in-depth inspection on the transfer pipe. The inquiry revealed that 2,500 t (3,000 m³) of MTBE had been released through a crack in the pipe.

Despite annual inspections, the leak appeared to have existed for a number of years; the leak's initially low flow rate most likely increased progressively due to soil movements.



Portion of damaged pipeline
Source: VROM-Inspectie (The Netherlands)

In April 2005, even though soil and water table decontamination measures had been undertaken in the contaminated zone (see below), hydrocarbon pollution was detected in a pumping well at a drinking water facility 30 km downstream and which supplies 300,000 people. The pollution of Meuse was characterised by the presence of 5 µg/l of MTBE.

The investigations undertaken indicated that the pollution originated near the Stein port where nearly 200 m x 800 m of MTBE (300 mg/l) was detected above the water table, between the site's accident zone and the river. The transfer of MTBE from the pollution pocket to the river was evaluated between 50 and 100 kg/day. The Meuse is primarily supplied by rainfall, and thus its flow rate is highly variable (10 m³/s to 2,500 m³/s), as well as the observed level of MTBE pollution.

The consequences:

The release of 2,500 t of MTBE, responsible for the pollution of the water table and the Meuse, created a risk for:

- drinking water,
- aquatic life,
- swimming,
- agriculture and animal husbandry.

The cost of the decontamination and cleanup measures undertaken immediately following detection of the leak and implemented for several years was evaluated at more than 6 M€.

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 that oversees the application of the 'SEVESO' directive, considering the available information, the accident can be characterised by the following 4 indices.

The parameters that comprise these indices and the corresponding rating method are available at the following address: http://www.aria.ecologie.gouv.fr .

The Seveso Directive classifies MTBE as an "easily flammable liquid" with a threshold of 50,000 t; the 2,500 t released by the leak thus represent 5% of this threshold. The "dangerous materials released" index is thus level 3 (parameter Q1).

As the accident polluted at least 30 km of river (parameter Env14) and 16 ha of soil and water table pollution (parameter Env13) requiring decontamination, the "environmental consequences" index is at least equal to 4.

As the cost of the decontamination measures was estimated at more than 6 M€ (parameter €18), the "economic consequences" index is greater than or equal to 5.

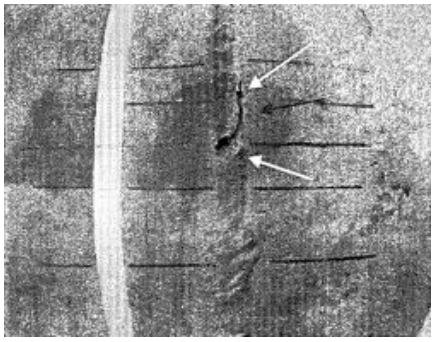
ORIGIN, CAUSES AND CIRCUMSTANCES OF THE ACCIDENT

A crack on a pipe weld resulted in the MTBE leak. This defect resulted from multiple failures during the construction of the pipeline.

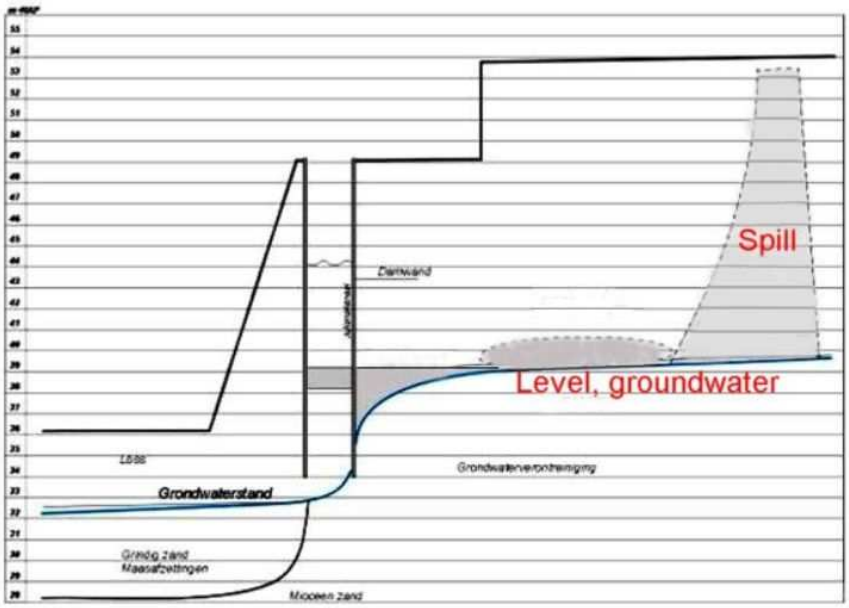
In 1976, construction began on each side of the project to save time. A difference of 70 cm in height between the two sections thus required the addition of an improvised S-shaped junction. Poor adjustment of this part required a 1.5 cm gap to be plugged by welding.

The welding of this junction part, poorly performed and left unchecked, caused the pipe to crack. The crack, the appearance of which remains difficult to establish, most certainly widened over time, notably due to ground motion.

The transfer of pollution from the leak zone to the Meuse, despite the presence of a 15-m deep reinforced steel dike (forming the Juliana canal) can be attributed to the presence of a strong water table current flowing through the Meuse gravel bed (see photo below).



Crack on the weld
Source: VROM-Inspectie (The Netherlands)



POLLUTION TRANSFER DIAGRAM
Sources: VROM-Inspectie (The Netherlands)

ACTIONS TAKEN

Following the detection of the pollution in October 2004, the pipeline was repaired and several methods were used to treat the site's polluted zone:

- removal of polluted soil,
- pumping of the supernatant MTBE above the water table,
- injection of air into the water table and treatment of the return vent air.

Furthermore, to prevent the pollution from spreading, the steel structure of the Juliana canal dike was reinforced up to 15 m in depth, i.e. below the level of the water level.

Following detection of the pollution in the Meuse in April 2005, the treatment program was extended to the zone located between the site and the river in late 2005 and brought up to full steam in early 2006.

Due to the absence of the pre-existing MTBE concentration limit values in the underground and surface water, strong pressure by the public authorities and opinion were required for the operator to implement these cleanup measures.

LESSONS LEARNT

A variety of lessons were learnt from this accident:

- in terms of regulations, the limit concentration values in underground and surface water for well-defined chemical products enable rehabilitation measures to be more easily imposed on operators responsible for causing pollution,
- technically speaking, due to their level of precision (1%), output control systems do not allow a leak of this type to be detected (low output, long duration, etc),
- the accident can be attributed to a series of certain number of organisational and human failures which could have been avoided:

- poor organisation of the canal construction project lead to improvise a solution to connect the 2 sections of pipe,
- poor welding and non-inspection of this junction,
- yearly inspection inefficient to detect the leak,
- underestimation of the risks and insufficient action taken when the pollution was detected, assuming that the pollution would not spread given the low solubility of MTBE.