Pollution of the Rhone River by phenol

26th February, 1993

Roussillon (Isère)

France

Phenol
Sensors / Redundancy
Loading-unloading (station)
Maintenance / repairs
Training
Organisation / Procedures

THE FACILITIES INVOLVED

The site:

Located 50 km from Lyon, the site extended over 2 km and encompassed a land area of 97 ha spread across 3 municipalities. The plant employed a workforce of 1,700 and comprised 4 major production "lines" (phenol and by-products, acetic acids and by-products, "silicones" (methylchlorosilanes and siloxanes), and methionine), along with several other intermediate production lines for organic synthesis (dimethyl sulfoxide - DMS, nitric acid, etc.) and catalysts (Raney nickel).

Like many chemical installations, the plant had since the 1970's gradually adopted a policy of reducing chronic discharges at the source and controlling accidental pollution risks. The preventive treatment of accidental pollution incidents included an online monitoring of aqueous discharges, in addition to retention capacities set up at the level of storage zones and some production workshops. This monitoring action had been planned in order to notify technicians as soon as possible and enhance response efficiency during abnormal discharge events. The corresponding controls were designed on 3 levels:

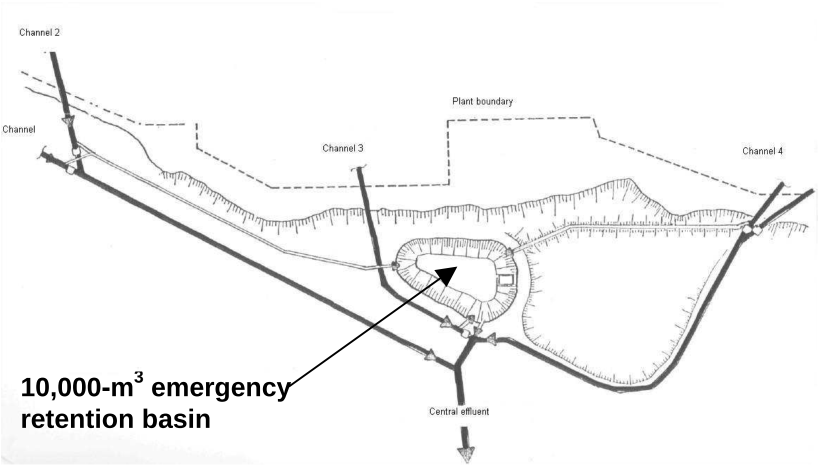
- Level 1 (workshop): In order to monitor their facilities, technicians tracked the recordings of various parameters (flow rates, level measurements, temperatures, etc.). Alarms and automated safety mechanisms were also designed for the most sensitive parameters. Discharges at workshop outlets were continuously tested by means of ancillary devices: flow meters, TOC meters, pH meters, phenol meters, conductivity meters, and explosive detectors. The readings from these devices were relayed to the control room.
- Level 2 (trunk sewers): The plant made use of 4 distinct channels, to which several workshops had been connected. These channels had all been fitted with flow meters, TOC meters, pH meters and temperature recorders. Any unmonitored effluent leaving the workshop could thus be detected.
- Level 3 (central effluent equal to 8,000 m^3/hr): This level was equipped with the same devices as the main channels (see Level 2), along with a phenol meter, a conductivity meter and a redox meter.

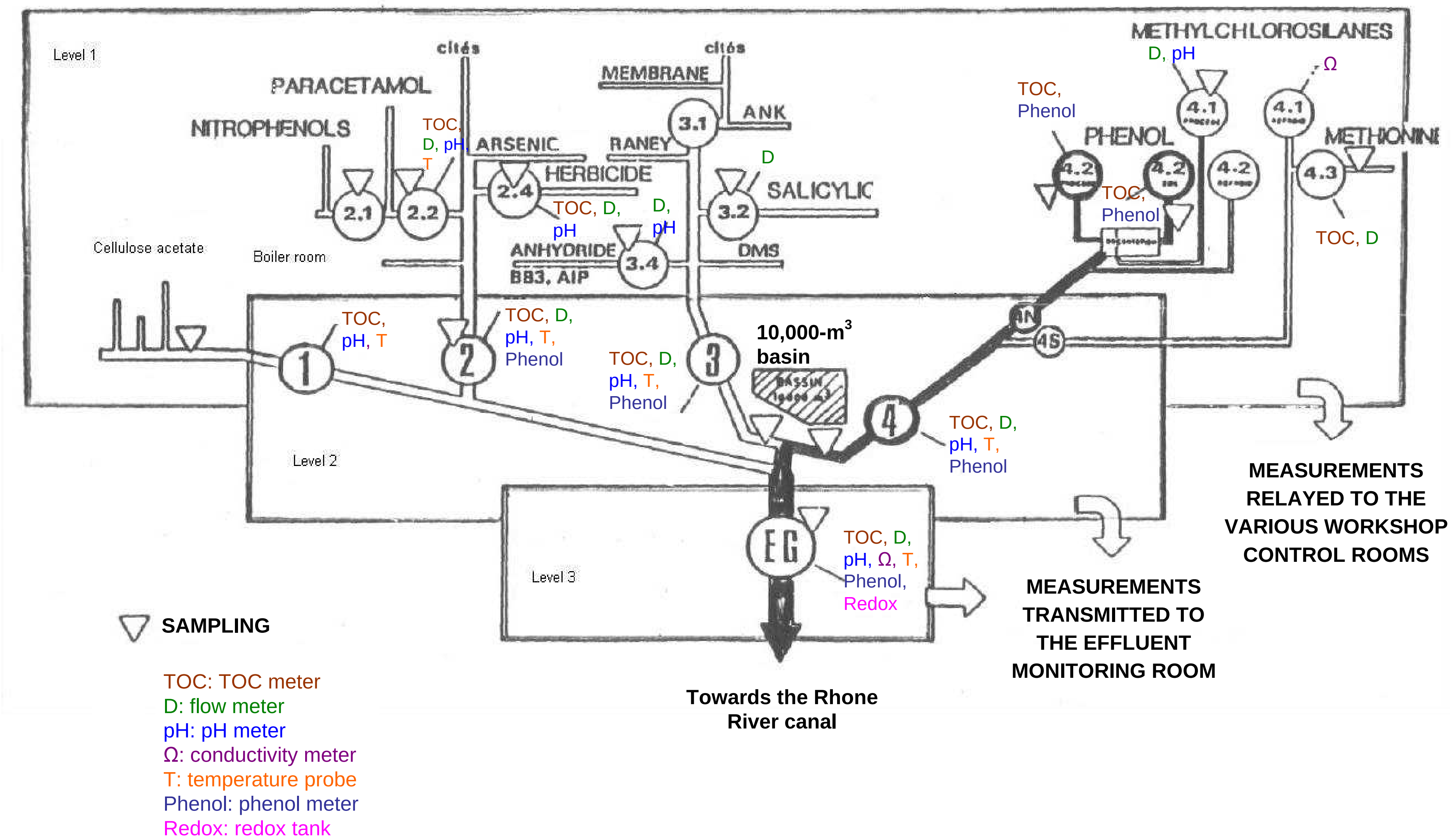
The Level 2 and 3 measurements were electronically transmitted to a centralized supervisor's office, adjoining the permanent control laboratory. Laboratory personnel, alerted by sound and light alarms, were required to relay information by phone to all potentially concerned workshops, requesting they conduct a search for the discharge source and proceed with all pertinent repairs. Given the fear of major impacts occurring to the natural environment, the entire discharge contents of the identified branch were rerouted and stored in an emergency, 10,000-m^3 capacity retention basin (see summary diagram on the next page).

The specific unit involved:

The unit responsible for the accident was synthesizing phenol; its installation included a lorry transfer station, with a retention facility present throughout. This retention basin however had already been filled with 10 m^3 of water originating from application of the "defrost" procedures specific to the lorry transfer station.

Wastewater from the phenol workshop was being released into Channel no. 4.





ONLINE AQUEOUS EFFLUENT MONITORING (SOURCE: SITE OPERATOR)

THE ACCIDENT, ITS CHRONOLOGY, EFFECTS AND CONSEQUENCES

The accident:

On 25th February, 1993, a technician was assigned to fill a lorry with phenol. He initiated the necessary steps but failed to position the loading arm. The transfer station had been equipped with 3 detectors, but all were defective and did not indicate the faulty connection.

Once the transfer operation had begun, the technician noticed the incident and stopped the transfer pump. He proceeded to wash the lorry with the help of a warehouse employee; 1.3 tonnes of phenol spilled into the retention basin attached to the transfer station (which already contained 10 m^3 of water). Due to a lack of training and information provided to technicians, this incident was not reported up the hierarchy, and the presence of phenol in the retention basin was held to a minimum.

At 7 am the next morning, another warehouse employee, who had not been informed of the incident, drained the retention basin into Channel 4, without any preliminary analysis of the effluent; this type of control had in fact not been included as part of the drainage protocol.

TOC detection at the level of Channel 4 displayed 600 ppm. Subsequent to a production incident, the TOC meter positioned at the phenol workshop outlet also detected a concentration (10 ppm) during this period. The phenol meter placed at the retention outlet on the transfer station, despite its defective operations, still showed a small phenol content (30 ppm). In making a poor interpretation of the contrasting values output by detectors and no doubt in overlooking the incident that had occurred the previous day, control room technicians attributed the pollution in Channel 4 to the phenol workshop. At 8:10 am, they isolated this workshop's discharges by closing a stop valve and diverting water (from the workshop phenol + loading station) to the emergency basin.

The TOC meter on Channel 4, which had been operating continuously, was only able to record one measurement every 10 min. Located downstream of the phenol workshop shut-off valve, this meter stopped relaying warnings as of 8:30 am since the water was being diverted to the emergency basin. The stop valve was then reopened and closed again 15 min later following a new TOC warning.

Drainage of the retention pit associated with the transfer station was completed at 9:30 am; of the 1.3 tonnes of phenol routed to the transfer station retention basin, 300 kg had been collected in the emergency basin while the other 1,000 kg would have been discharged into the Rhone.

Consequences of this accident:

The Rhone was definitely exposed to pollution, but the exact impacts on the river's flora and fauna were not known. It's possible that this pollution exhibited a "delayed effect", in contributing to the death of 5 tonnes of fish, as observed 4 months later around Saint-Pierre-de-Bœuf, though here again the exact cause remained unexplained (ARIA 4476).

The European scale of industrial accidents

By applying the rating rules applicable to the 18 parameters of the scale officially adopted in February 1994 by the Member States' Competent Authority Committee for implementing the '*SEVESO*' directive on handling hazardous substances, and in light of information available, this accident can be characterised by the four following indices:

The parameters composing these indices and their corresponding rating protocol are available from the following Website: http://www.aria.developpement-durable.gouv.fr.

1.3 tonnes of phenol were released, hence the hazardous substances released parameter reached level "2".

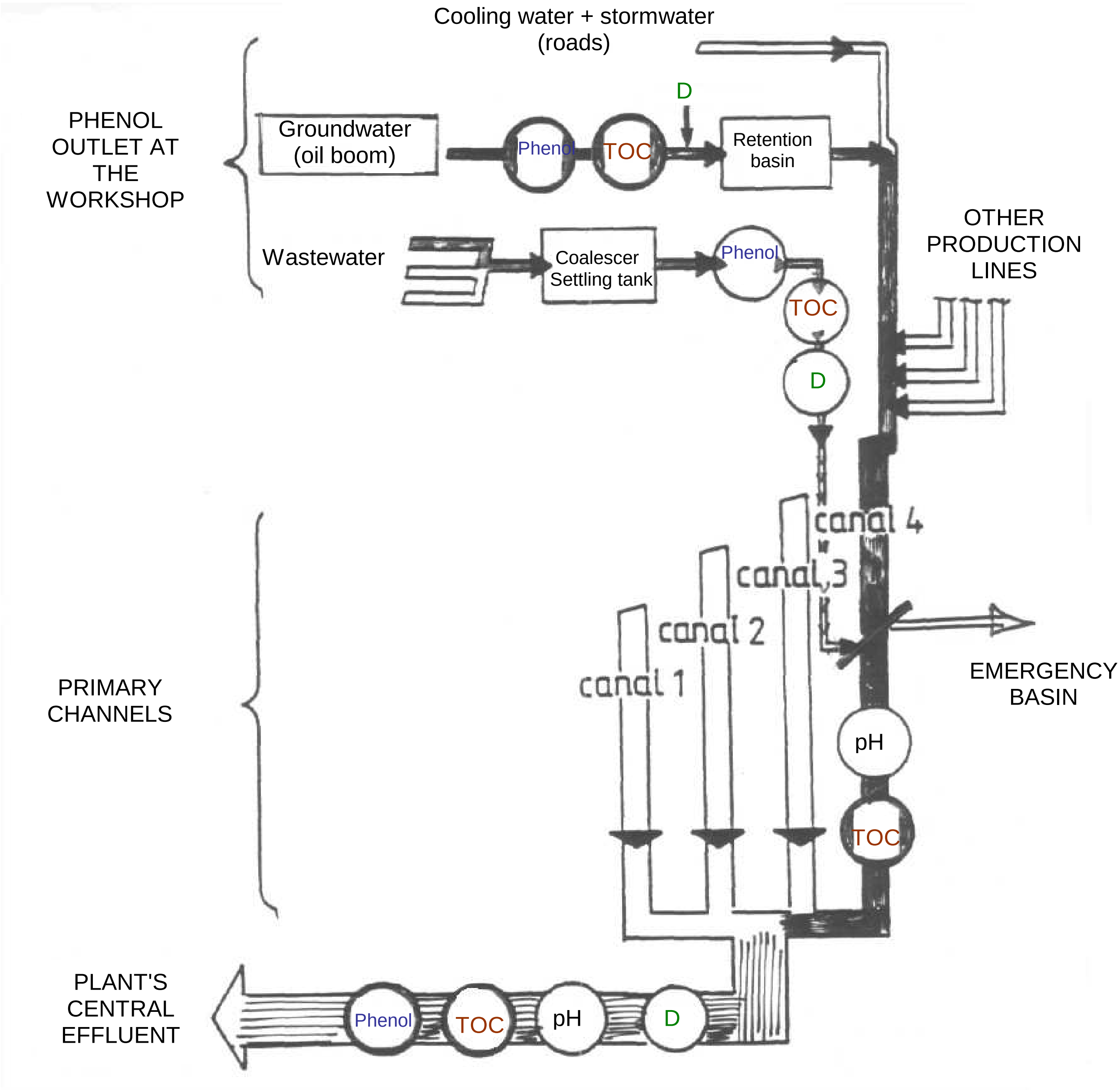
The human and social consequences parameter was not scored due to a lack of sufficient information.

The environmental consequences parameter was rated level "1" as a default value (given the presence of surface water pollution, though without any precise quantification).

The economic consequences parameter could not be assigned a score, again due to insufficient information.

THE ORIGIN, CAUSES AND CIRCUMSTANCES SURROUNDING THIS ACCIDENT

The discharge of toxic materials into the Rhone River stemmed from a combination of technical and organizational deficiencies: faulty and/or poorly positioned detectors; lack of internal information circulation on incidents; inadequate personnel training; absence of comprehensive procedures and guidelines, especially regarding the degraded mode of operations (poor interpretations by technicians of erroneous data, etc.).



TOC: TOC meter
D: flow meter
pH: pH meter
Ω: conductivity meter
T: temperature probe
Phenol: phenol meter
Redox: redox tank

ACTIONS TAKEN

The facility operator repaired the faulty detection equipment on the lorry transfer stations and proceeded to equip the corresponding railcar devices. The TOC meter controlling Channel 4 effluent was moved to a different spot.

A training programme dedicated to warehouse staff was initiated, and new procedures were specifically drafted for drainage operations, including an indication of the relevant risks as well as a set of instructions in the event the effluent control room alarm was activated.

LESSONS LEARNT

This accident underscores the importance to be ascribed to risk mitigation during all production stages, from loading sequences at the beginning to transfer and other packaging phases at the end. It also highlights the need for high-level maintenance and regular testing of all safety devices (detectors, transmitters and actuators). Moreover, the sensors used to improve safety must remain independent of the sensors that facilitate industrial processes, and their respective positions need to be carefully chosen.

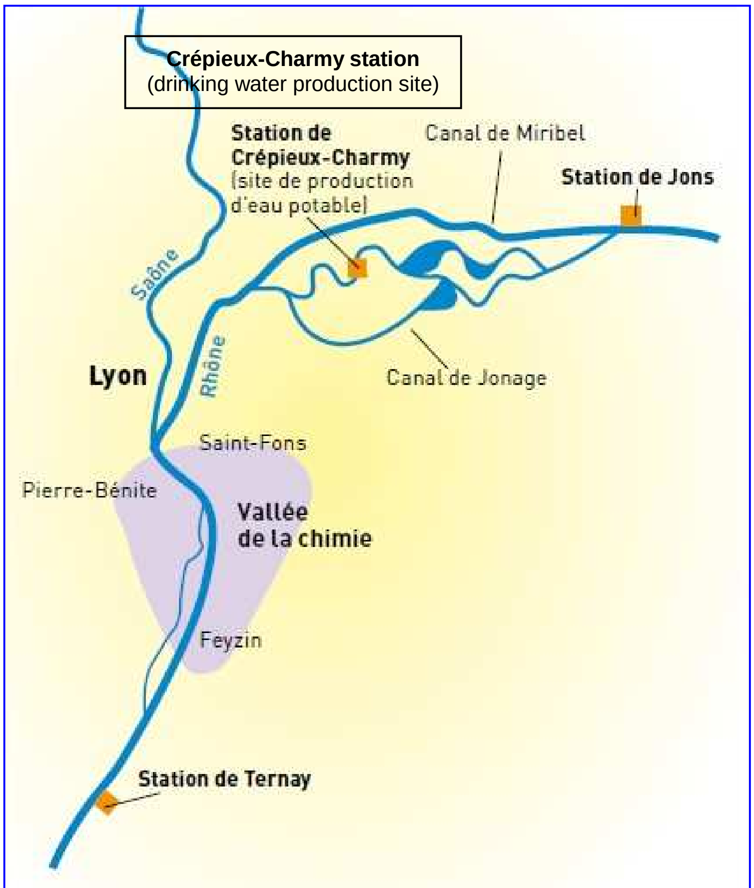
The sharing of feedback internally, coupled with effective communication among teams (transfer of information, data on near-accidents, difficulties encountered, etc.), is a key element of any risk management system designed to detect deficiencies and anomalies as early as possible in order to introduce remedial measures.

A clear set of procedures and instructions, along with a well-trained technical staff, proves critical to properly operating an installation; these items encompass: safety training, process supervision (analyses of situations in a degraded mode), and guidelines to follow in cases of emergency.

Subsequent to several pollution incidents occurring in the Rhone during 1993, the Departmental Prefect commissioned the WATER Group with the SPIRAL organization (acronym of the Permanent Secretariat for the Prevention of Industrial Pollution and Risks within the Lyon Metropolitan Area) to set up an automated alarm and monitoring system for the river's water quality downstream of the metropolitan area, with the aim of preventing pollution and quickly implementing the measures necessary to protect water sources (drinking water extraction, irrigation, industrial water), as well as sensitive ecological zones and recreational areas.

The station located in Ternay continuously measures some 15 physicochemical parameters, including several heavy metals; it also features a hydrocarbon detector and a test (with fishes) quality meter to act as a biological system warning.

A data validation procedure along with an on-call service had been instituted for cases when an alarm threshold is exceeded, for the purpose of informing the relevant bodies and authorities. An alert protocol served to codify all of the targeted actions. Each partner was provided direct and permanent access to analytical data on an ongoing basis.



Le dispositif d'alerte, de surveillance et de suivi de la qualité des eaux du Rhône dans l'agglomération lyonnaise.

Source d'après G. Boudin, BURGEAP/Camaly – Étude des stations d'alerte et de surveillance de la qualité des eaux de surface dans l'agglomération lyonnaise.

The warning, monitoring and tracking system dedicated to Rhone River water quality within the Lyon Metropolitan Area

Source extracted from G. Boudin, BURGEAP/Camaly - Study of the surface water quality warning and monitoring station in the Lyon Metropolitan Area.