

Flooding strikes a solvent recycling factory

7 May 2014

Buchères (Aube)

France

Natural hazards

Rising waters

Flood

Response / Emergency

Safety (safe operating mode)

Water damage

THE FACILITIES INVOLVED

The site:



Chemical plant specialised in producing alcohol and recycling solvents, located in Buchères (Aube-10)

Installed approximately 500 metres from the SEINE River in Buchères within the Aube Department, 5 km southeast of the city of Troyes, the company was affiliated with a French sugar manufacturing group possessing several plants across France. The Buchères site was specialised in: producing agricultural alcohol, regenerating alcohols and solvents, distilling vineyard co-products, and drying sewage sludge.

The company had been authorised to store over 22,000 tonnes of flammable liquids, 9,000 tonnes of untreated wastes (including 500 tonnes of methanol), and 13,500 tonnes of treated wastes, in addition to producing 95,000 tonnes/year of regenerated solvents. For this reason, the site, located in a zone primarily dedicated to industrial activities, was ascribed an upper-tier SEVESO classification.

The distillery, which relied on sugar beets, began operations in 1946. An alcohol regeneration activity was set up in 1996 that included workshops for regenerating residual alcohol originating from the perfume industry, pharmaceutical applications and fine chemicals production, along with several dehydration stations. Following the company's 2000 buyout by a French sugar manufacturing group, its solvent regeneration capacity, which represents the site's most important current activity, was expanded. In 2012, the site invested in a 15 MW biomass boiler.

The manufacturing workshop (distillation units) and steam production installations run continuously throughout the year, with some 80 employees; the site's yearly output presently amounts to 400,000 hectolitres of agricultural alcohol and 45,000 tonnes of regenerated solvents, for an annual turnover of roughly €55 million.

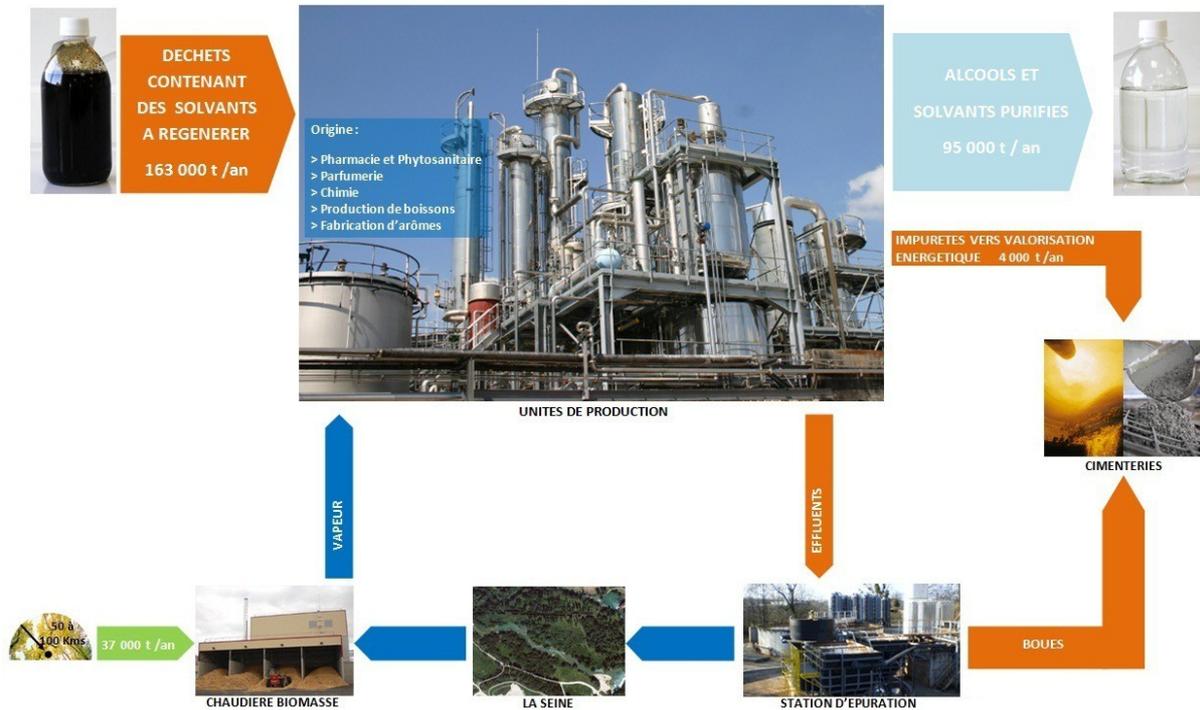
Waste treatment and regeneration: Industrial ecology

The treatment of waste containing solvent is based on physico-chemical processes: distillation, settling, phase separation, filtration, absorption, desorption, redox reactions, neutralisation, pH adjustment, and precipitation.

The primary solvents treated are: ethanol, isopropanol, methanol, ketones, and chlorobenzene.

This activity requires a substantial industrial tool (distillation workshops, loading stations, storage zones, boiler room, control room, analytical laboratory), along with a high-quality and robust organisation. Ultimately, the material reuse process offers these solvents a second life.

REGENERATION DE DECHETS SOLVANTES TRAITEMENT DE DECHETS



Waste treatment and regeneration (ARR operator)

THE FLOOD, ITS CHRONOLOGY, EFFECTS AND CONSEQUENCES

The flood:



Rising SEINE water (ARR)

On 6 May 2013 at 11 am, the Aube Department Prefecture informed the factory operator that subsequent to a period of intense rainfall, the SEINE River was expected to overflow its banks around nightfall. A meeting of the crisis response unit was held at the Prefecture with mayors of the various municipalities concerned. The Prefect requested that each municipality activate its rescue plan, and the mayors decided to adopt all prevention measures necessary to save the population and local companies. At the end of 6 May, Departmental Fire and Emergency Services visited city districts showing the potential for flooding to notify residents.

The operator assembled a crisis unit as of 6 May and activated the facility's internal emergency plan. This state of crisis management would last until 15 May. The objectives assigned this unit were as follows:

- placing the installations in safe operating mode;
- informing all appropriate government agencies;
- notifying mayors and local homeowner associations;
- managing related activities (clients, suppliers, etc.);
- responding to the heavy media attention;
- preparing the logistics for a successful facility restart and resumption of production.



Chemical plant overwhelmed by water
(source: DREAL Champagne-Ardenne)

The operator placed the site in safe operating mode even though the magnitude of the flood that would strike could not be foreseen: utility lines (gas, electricity) turned off, shutdown of the wastewater treatment plant, computer equipment moved to higher ground, sensitive inventories and lorries awaiting delivery removed from the site, evacuation order for a stockpile of wood boards used to fuel the biomass boiler. The storage of hazardous substances (alcohols and solvents) was protected by existing retention walls. All staff were evacuated from the premises.

The rising water reached a peak danger level very quickly (50 cm higher in just a few hours), which required the emergency evacuation of personnel.

Given a location closer to the SEINE than the site itself, the treatment plant was the first facility struck: as of 2 pm, water penetrated inside the electric utility rooms at a height of over 10 cm. Both the plant's biological basins and settlement tanks had been installed on higher ground and remained intact. Water first entered the chemical complex around 4 pm. At 11:30 pm, the facility director decided to shut down the workshops (one by one) depending on the safety margin available relative to the water level. At 1 am, water reached the basin next to the site entrance and flooded this sector; it then surrounded the stockpile of wood boards, which could not be entirely removed for lack of time.

The next morning, on 7 May, the site was totally flooded, with the exception of the biomass storage zone and the barrelling workshop. Water level in the facility was varying between 10 cm and 1.50 m, depending on the specific spot.

The factory operator crisis response unit temporarily banned access to the site given the risk of sewer manhole covers popping up.

The Inspection Authorities for Classified Facilities was first notified at 7:30 am and provided regular updates throughout the event duration.

Organisation of the crisis response planned by the factory operator included an on-call team composed of some 10 staff members, featuring the heads of maintenance, Safety, Health and Environmental (HSE) affairs and production plus the Director. This set-up enabled assessing the efficiency of measures adopted from the time flood waters were announced to monitoring the rising water height and establishing the conditions for factory restart once the waters had subsided.

The Classified Facilities Inspector assigned to oversee the site visited the factory on 9 May and observed, two days after the waters first overflowed, that it was still impossible to access the flooded areas. This "partial" inspection (from outside the fence) also concluded that the most heavily flooded part (up to 1.5 m of water) extended from the cafeteria to the storage platform for harvested wood. This platform itself had sustained less damage, but its access path was completely submerged. Empty barrels had drifted out to the property boundary and ripped apart the fence. These barrels had been recovered by the operator one at a time. Note was made of the presence of a few half-submerged barrels of solvents that nonetheless had not been lifted by the flood water. The inspector returned for a visit on 12 May and recorded that the site was no longer flooded, with 70% of premises being completely dry thanks to the pumping efforts of rescue teams. The operator sought to partially resume site activities the next day, beginning with logistics units (unloading of awaiting tanker lorries) and then restarting the solvent regeneration activity once the treatment plant was operational.



Wood storage at the plant overwhelmed by water
(Source: DREAL Champagne-Ardenne)

Consequences of the accident:

This flooding event affected several companies (ARIA nos. 43787, 43789, 43791) within the Buchères industrial park, where this chemical complex was located, in addition to nearby dwellings. 30 homes were flooded to some extent. Torrents of water and sludge advanced at high flow rates. The geographic territories most adversely affected by this flood were designated natural disaster zones. Hydrocarbon pollution caused by transport firms was also reported. Fields and gardens were not spared. The Prefecture, assisted by a local farmer, decided to build a wall of sandbags to protect the Troyes municipal water pumping station and thereby avoid the entire metropolitan area losing its drinking water supply.



Loading platforms at the neighbouring firm (ARR)

As regards the chemical plant, when the water reached its high point on-site, the levels recorded ranged between 10 cm and 1 m on the premises, and up to 1.5 m on the parking lot.

No chronic or technological accident tied to this installation had occurred; property damage and production losses were estimated at a total of €2 million. No assessment of partial personnel redundancies was offered while the plant was idle.

The shutdown of utility lines served to eliminate all electrical and fire risks, as well as any gas-related hazard.

The large quantity of wood stored on the dedicated platform prevented the full removal of these contents despite the flood warning issued. The woodpile got slightly moved through flotation during the flood period (trunks and boards).

The site's internal roads along the water's path were washed away by the current.

Portions of the fence had to be replaced subsequent to damage by the drifting of empty barrels.

In the various workshops, approximately 150 flooded pump motors were disassembled and shipped to a subcontractor for drying, reconditioning and an ATEX certification (i.e. with no risk of explosion).

The safety data transmission network between storage zones and the control room was down (this network included fire detection, local tank level measurements, and a nitrogen inerting system) and required repairs.

Fire-fighting means remained partially operational: two electric generating sets, including their batteries, were flooded while two other diesel-powered sets stayed dry and thus operational.

Water present in the sludge drying greenhouses, which rose to a height of approx. 40 cm, was pumped and routed to the treatment plant as of 15 May, once the plant had come back online. The operator informed neighbours that the plant's aeration basin (non-submerged) would be reactivated, potentially causing foul odours.

Storage facilities dedicated to flammable liquids and liquid chemicals were protected by retention walls that served to prevent water from flowing towards the tanks (with these retention basins designed to mitigate the consequences of tank leaks). Nonetheless, the presence of water (approx. 15 to 30 cm) inside the oldest basins made it possible to establish that their seals had been breached.

The Prefecture and departmental fire services decided to dig a trench down the middle of the departmental highway leading to the Buchères train station for the purpose of inserting a culvert to drain water that had accumulated at the plant as well as at the neighbouring transport company. In response to the announcement of another flood event by week's end, the Prefect decided on Thursday, 15 May, to build a 400 m long, 3 m wide dyke to protect the district surrounding the train station and adjacent businesses. An earthworks firm was hired and, with the assistance of 20 railway ballast cars, the dyke could be erected in 3 days.



Depiction (in yellow) of the dyke built during this flood episode (ARR operator)

Site activity could partially resume on 13 May (acceptance of cisterns) after an extensive clean-up of flooded zones and the verification/drying of damaged equipment (pumps, motors and transformers). However, since the transmission of safety-related data between storage sites and the control room was not operational, the operator implemented a number of compensatory measures, including the permanent monitoring of tank transfers and manual tank gauging. Both the manufacturing workshops and treatment plant were placed back into service on 15 May.

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:

Dangerous waste released		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Human and labour-related consequences		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Environmental consequences		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Economic consequences		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

The parameters composing these indices and their rating methodology are available at: www.aria.developpement-durable.gouv.fr.

THE ORIGIN, CAUSES AND CIRCUMSTANCES OF THE ACCIDENT

This flood event was caused by heavy rainfall during the previous days. The municipality of Buchères had approved a Flood Risk Prevention Plan in June 2001, given that proximity to the SEINE River in the event of high water levels could flood parcels situated on the Seine's banks. A portion of the chemical plant's site boundary was actually located on a designated non-developable zone according to this Prevention Plan.

According to the operator, the extension of a large flat silo upstream of the site may have triggered flooding at the plant by deviating the watercourse and hindering its natural flow. The most recent reference event, dating back to 1983, had not actually reached the site (beyond the treatment plant closer to the river), at a time the silo had not yet been expanded.

ACTIONS TAKEN

This upper-tier SEVESO-rated chemical complex had been specially monitored throughout the flood episode, notably with the close watch of Classified Facilities inspectors, who were in daily contact with the operator. Two inspections were conducted: in order to authorise the quick resumption of site activity under safe conditions, inspectors proposed measures to compensate for the absence of safety data transmission to the control room. To avoid the risk of overflow around flammable product storage tanks, the operator proceeded with a manual gauging of the tanks several times a day. This gradual restart first focused on three tanks out of the 20 located on-site. The flood served to indicate breaches in the seal on some of the retention facilities for flammable liquid tanks. The more recent retention structures had remained dry, whereas the older ones, exposed to the thrust of water, had flooded from their base (joint ruptures). Classified Facilities inspectors requested that upcoming verifications, in accordance with the approved industrial installation modernisation plan, include specific points on the condition of both basins and blocks, with a ranking of the observed disorders based on available professional guides and an indication of associated repair time constraints. The operator had initiated a comprehensive and detailed expert appraisal of all basins, including an inspection of seals and repair specifications as needed.



Retention basin for an unsealed tank (Source: DREAL Champagne-Ardenne)

LESSONS LEARNT

- The entire set of actors involved were in agreement in highlighting the effective crisis management performed by the plant operator, including communication with State agencies, the media and site neighbours. The drill held within the scope of the External Emergency Plan a few months prior to this event had enabled a rehearsal of these automatic reflexes, thereby underscoring the importance of regularly organising Emergency Plan drills.
- The fact that the plant operator had been informed ahead of time to move the wood board stockpile, coupled with the permanent presence of a watchman, made it possible to significantly limit damage and hence costs. The prevention measures to be adopted once a flood warning has been issued are, in fact, essential (turning off utility lines, closing workshops, shutting down the treatment plant, removing or stowing all inventory capable

of being carried away by floodwaters, raising computer and safety equipment above the water level, securing the storage of flammable and chemical liquids, etc.). These measures could be detailed in the operator's response plan (e.g. a dedicated chapter of the Internal Emergency Plan).

- For this site, an agreement between the Territorial Directorate and the operator had been signed as part of the authorisation granted for the biomass storage platform located in a flood risk zone. This agreement stipulated notifying the operator immediately upon learning of a flood risk so as to evacuate the wood inventory within 48 hours. During this event, the operator had in fact been notified well in advance, which made it possible not only to evacuate a portion of the wood stockpile, but also to very quickly implement appropriate prevention measures and thus mitigate the impacts. More than an agreement to a protocol for notifying operators, regular consultation of the website on flood warnings has been included among the best practices to adopt.
- The retention basin seal defects, which could be identified indirectly through this flood episode, are listed as a verification step in the industrial installation modernisation plan. In 2010, the government enacted a control plan for risks related to ageing industrial installations, pipelines transporting hazardous substances and pressure equipment. This case helps reinforce the need to continue verification actions, by means of site inspections in facilities requiring such authorisations, aimed at compliance with regulatory indications for all equipment targeted by the classified facilities modernisation plan (Ministerial decrees issued on 3rd and 4th October, 2010).
- This event demonstrates that flood risks in an industrial zone must be managed comprehensively, including all relevant sites, in preventing protection measures specific to a given site from exacerbating risks for neighbouring sites.
- Within the scope of revising the Flood Risk Prevention Plan, the operator was working in concert with the Departmental Labour Office to determine the best solution guaranteeing the site's durability and growth. The zone dedicated to sludge drying, which is now being closed, actually offers extra land for the operator. It is important for the site's development that this zone be allowed to accommodate new activities. Along these lines, the operator has commissioned a study by a certified hydrogeological consultant to indicate the improvements to be implemented in order to confine another flood of this magnitude as much as possible within the river's main bed.