Fire in a plant specialising in processing recycled elastomer waste

02 February 2022

JOUÉ-SUR-ERDRE (Loire-Atlantique)

FRANCE

Fire
Miscellaneous equipment (Heater)
Oil
Storage

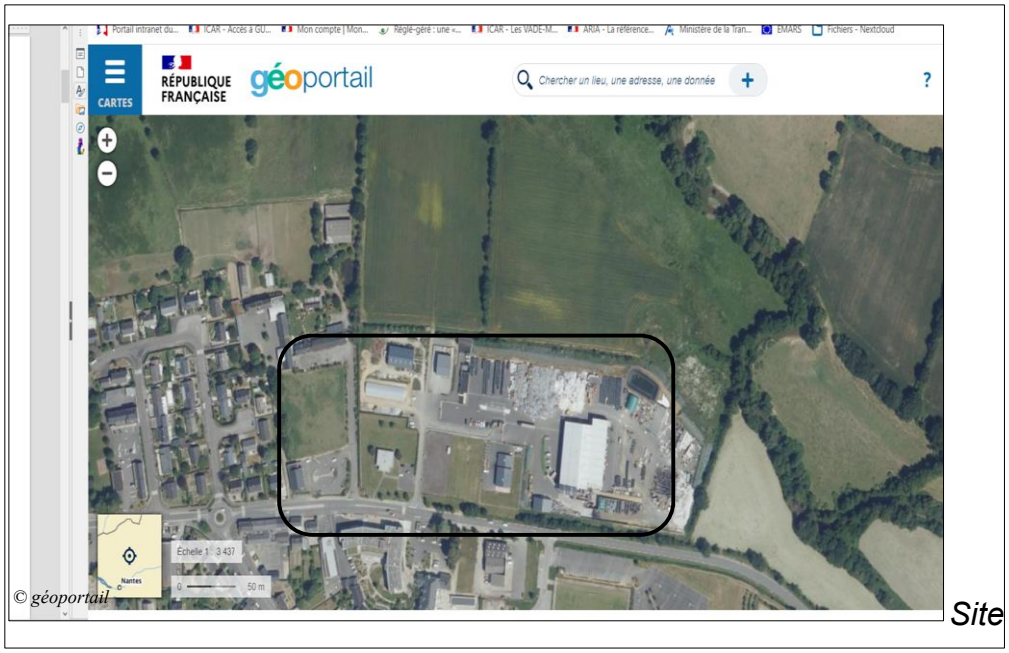
THE FACILITIES

The site:

The company specialises in transforming recycled elastomer waste (latex, butyl, tyres, etc.). The products it manufactures are intended for animal welfare and comfort. The site has been subject to declaration since 26 March 2014 for the following sections:

- 1158 B2: 15 t of methylene diphenyl diisocyanate (MDI) resins;
- 2661 2b: 9 t/production day of plastic materials;
- 2662 3: 500 m³;
- 2791-2: 9 t/day.

The site is located in an industrial area on the outskirts of the town and is surrounded by farms. The plant consists of three production lines, including a vulcanisation line that has been operating since 2021.



Site

The unit:

The fire originated on the vulcanisation line. This line is designed for a production capacity of 3 t per day, operating in three 8-hour shifts. On the day of the fire, the production was 900 kg per day, operating on a single 8-hour shift.

Preparation of the vulcanisation moulds requires them to be preheated to 180 °C. This operation begins at 3:30 a.m. with the start-up of the oil-powered heater. This equipment is maintained at regular intervals and was installed on the site by its manufacturer. The system operates at a service pressure of 4 to 7 bar. The oil tank contains 370 litres of oil, some of which was contained in the supply hoses and heating plates.

THE ACCIDENT, ITS CHRONOLOGY, EFFECTS AND CONSEQUENCES

The accident:

At 8 a.m., an operator arrived and noticed an orange glow in the vulcanising unit. The heater was on fire. As this zone was not equipped with a fire detection system, the operator triggered the fire alarm and began extinguishing the fire with a fire hose reel. He stopped trying to extinguish the fire when he noticed that the fire was burning oil, and his action was spreading the fire. The room has a natural slope towards the west side of the building. The fire had begun to spread outside the building via a stream of flaming oil. The stock of finished products and machines being assembled caught fire. The spreading fire generated dense black smoke that could be seen for kilometres. Smoke dispersion was low due to a thermal inversion phenomenon that blocked the smoke at an altitude of 150 m. At the time of the accident, the wind speed from West-Northwest was low (2 to 3 m/s). The fire was brought under control at 3:30 p.m. and declared extinguished on 5 February. The firefighting water was collected in the site's retention pond. A 240 m³ storage bladder was set up the day following the fire to ensure that all the effluents were managed and to allow the retention pond to be partially emptied.

The consequences:

The site suffered significant damage:

- the stock of finished products (approximately 13,500 sheets of elastomer, i.e. 345 t) and machines pending assembly were destroyed by the fire, generating more than 316 t of waste disposed of in a non-hazardous waste storage facility;
- loss of the 10 t travelling crane;
- the vulcanisation line remained out of operation for 10 months;
- part of the structure and the building's entire roof and cladding were destroyed;
- the adjoining building was damaged (the partition between the two buildings and the roof were affected).

One positive factor in the fire was a slight easterly breeze which blew the smoke towards an uninhabited area and did not feed the development of the fire. The fire's extent and consequences demonstrate the danger of using oil in processes. These phenomena were presented in the synthesis document "Involvement of oil in industrial incidents and accidents. 2016-2020" produced by BARPI.

European scale of industrial accidents:

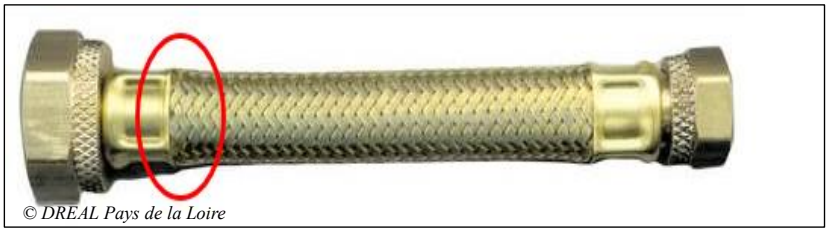
By applying the rating rules applicable to the 18 parameters of the scale officially adopted in February 1994 by the Member States' Competent Authority Committee for implementing the 'SEVESO' Directive and in light of the available information, the accident can be characterised by the following 4 indexes:

- Dangerous materials released
- Human and social consequences
- Environmental consequences
- Economic consequences

The parameters composing these indices and the rating method are available here. The consequences known during the preparation of this sheet are economic and environmental in nature. The first assessment evaluated the damage at €2.8 million. This represents the loss of the production line and the stock of finished products.
The responsiveness of the employees made it possible to limit the fire spreading to other buildings by using three fire hose reels. The action by the fire brigade made it possible to protect everyone and ensure the continuity of the company's activity. The environmental and air monitoring analyses showed no significant impact. This event is classified as an accident.

THE ORIGIN, CAUSES, AND CIRCUMSTANCES SURROUNDING THE ACCIDENT

The origin of the accident, as determined by the experts, was a rupture of the heater's oil supply hose. This was due to the flexible part of the hose "coming loose" from the rigid part which includes the rotating fastening nut (see the picture below for illustration).



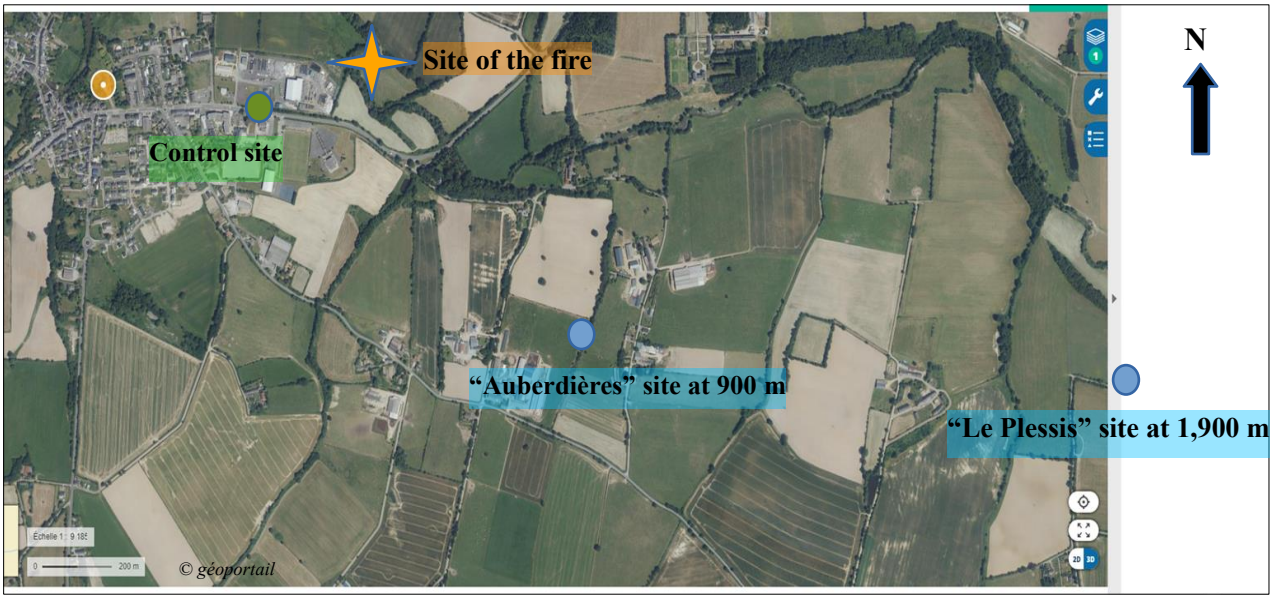
The oil used is a special high-quality oil for heat transfer and thermal regulation. The oil ignited between 7:45 and 8 a.m., as the first employees did not notice any fire beforehand. To obtain CE certification, the regulations of the Machinery Directive require that the fire risk be reduced while taking the three principles of the fire triangle into account. This means implementing preventive and protective measures to prevent the fire from breaking out or spreading. If these actions are not feasible, confinement, fire detection and extinguishing measures must be taken. In this case, this new heater did not have a retention tank or fire detection. The firefighting means were ill-adapted to the stock of oil, which played a significant role in the development of this incident.

ACTIONS TAKEN

When the fire broke out, the inspection team went to the site to implement use of canisters. This made it possible to install this equipment in conjunction with the fire brigade at the outbreak of fire. It should be noted that in October 2020, a partnership was established between the departmental firefighting and emergency response service (SDIS 44) and the Air Quality Monitoring Association for the Pays de la Loire Region for the deployment of canisters during fires.

The measurements were carried out over periods ranging from 30 minutes to 4 hours based on the following scheme:

- a control site (an 'EPHAD' assisted living facility) located 200 m to the south-west not impacted by the smoke;
- eight measurement sites located downwind between 0 and 6 km to the east of the establishment near inhabited areas.



Ready-to-use canister
© AIR Pays de la Loire

The pollutants analysed were mainly Chlorinated Volatile Organic Compounds (Cl-VOCs) and BTEX (Benzene, Toluene, Ethylbenzene and Xylene). 55 gaseous species were also identified. Canister sampling does not allow for the analysis of particulate matter on which certain pollutants such as PAHs (Polycyclic Aromatic Hydrocarbons), dioxins and furans can be attached.

The overall results were as follows:

– chlorinated VOCs were not identified as their concentrations were below the detection threshold (< 1 µg/m³);

– a decrease by a factor of 2 to 20 in BTEX on the sites at 900 m and 1,900 m away, respectively (see Appendix 1);

– environmental matrix analysis (firefighting water, foodstuffs, plants, soils and soot) confirmed there was no impact of fumes on the environment. No concentration exceeded the limit values for discharge into the natural environment.

At the same time, the operator studied the possibility of treating the firefighting water contained in the retention pond before discharging it into the natural environment. A mobile pre-treatment installation was therefore set up on site (with a decanter, sand filter and activated carbon filter). The first test was conducted on 16 March to determine whether the pre-treated effluents were compatible with discharge into the natural environment. In light of the results obtained, it was decided to authorise the discharge of the water contained in the 240 m³ temporary storage bladder and the pond (i.e. approximately 500 m³ in all).

LESSONS LEARNT

BARPI: a reminder of the general rules of fire risk management:

This significant accident provides an opportunity to review the fundamentals of fire safety. First, the nature of the combustible material must guide the choice of the appropriate protective equipment. Using unsuitable extinguishing equipment will endanger the person using it and worsen the situation. The spread of a fire can be limited or avoided by passive safety equipment such as firewalls. In this case, class F fire extinguishers would have limited the spread and development of the fire.

In the risk analysis of an installation, it is essential to ensure that the fire safety resources are appropriately adapted to fire, whatever its origin. The table below illustrates the resources that can be used at the onset of a fire and from which the selection must be made.

Fire classes	Pictogram	Combustible material	Extinguishing agents
A		Fire where the fuel is ordinary solid materials, slow combustion without flames or rapid combustion with open flames (Solid/non-melting synthetic materials such as paper, wood, textile, cardboard, etc.).	Water spray fire extinguishers Foam fire extinguishers ABC powder extinguishers
B		Flames produced by liquid or flammable liquefiable solids. So-called "grease fire", which burns without a braze. (hydrocarbons, solvents, gasoline, alcohols, greases, oils, paints, etc.).	Extinguisher type: water extinguishers with additive (AB), powder (BC), gas (CO2), or foam
C		Flammable gas fire	BC powder extinguishers Closing the supply valve is also an extinguishing operation
D		Metal fires (sodium, magnesium, **aluminium**, etc.). Such fires are particularly dangerous as they give off oxygen in contact with water, leading to a high risk of explosion.	Special extinguishing agents (special powders consisting of graphite, sodium carbonate, sodium chloride, etc.)
Electrical fire		Flaming fire on live electrical equipment represents a real danger as it involves an electrocution hazard for the individual trying to extinguish the fire.	Gas extinguisher (CO2)
F		Animal or vegetable grease and oil fires.	Water additive or foam extinguishers. For cooking appliances, fire blankets are also a means of extinguishing

To conclude, in terms of fire safety equipment, it is essential to recall the principles of fire prevention developed by French regulations, which are based on three points:

- limit the outbreak and spread of fire;
- allow people to evacuate safely;
- facilitate operations by the emergency services.

By taking action in a way that takes account of these principles, it is possible to control fire risk. Examples include installing a fire detection or sprinkler system in specific areas or conducting fire drills to allow operators and emergency services to ensure the equipment and procedures are working.

Specific lessons:

In addition to these general lessons, the operator has also set up the following action plan:

- initiation of the process to regularise its administrative situation (the site is required to register its operations) to analyse the improvements to be made in terms of site safety;
- purchase of a new heater from a different manufacturer;
- raising awareness of the risks and consequences of fires and continued first-aid training for staff;
- in areas of high combustible potential, increase in the number of islands with separation of storage areas to limit the risk of propagation to the finished product and raw materials storage area using concrete blocks, as required;
- updating of the formal risk assessment document (DUERP) regarding fire hazards;
- implementation of an incident register to identify recurring problems that may result in a disaster;
- limit the spread of fire between buildings, possibly by installing a firewall;
- identification of equipment presenting a risk of spillage of flammable products and confine them in a productive enclosure and provide retention facilities to prevent the spread of flammable products;
- installation of detection and autonomous extinguishing means near equipment at risk;
- sufficient water capacity for firefighter intervention.

Appendix:

1-Results of the air analysis