

Explosion of a wood chip refiner and fire

20 and 25 January, 2005

Corbenay – [Haute-Saône]

France

Explosion / Fire
Chipboard
Silos
Dust
Risk analysis
Organisation
Uncoupling
Thermal imaging camera
Vents

THE INSTALLATIONS IN QUESTION

The site:

The chipboard manufacturing plant, located in Corbenay, in the region of Haute-Saône, was set up in 1969 to produce chipboards for the furniture industry. The company then diversified to manufacture specific products for hardware stores. The main activities include :

- ✓ Furniture manufacturing,
- ✓ Specific products intended for the general public via hardware stores.

Since 1981, the company has been a 99.9%-owned subsidiary of a group, which is the leading furniture manufacturer in France and its primary customer.

In 2006, the plant manufactured 430,000 m³ of chipboard produced from 542,000 tons of wood.

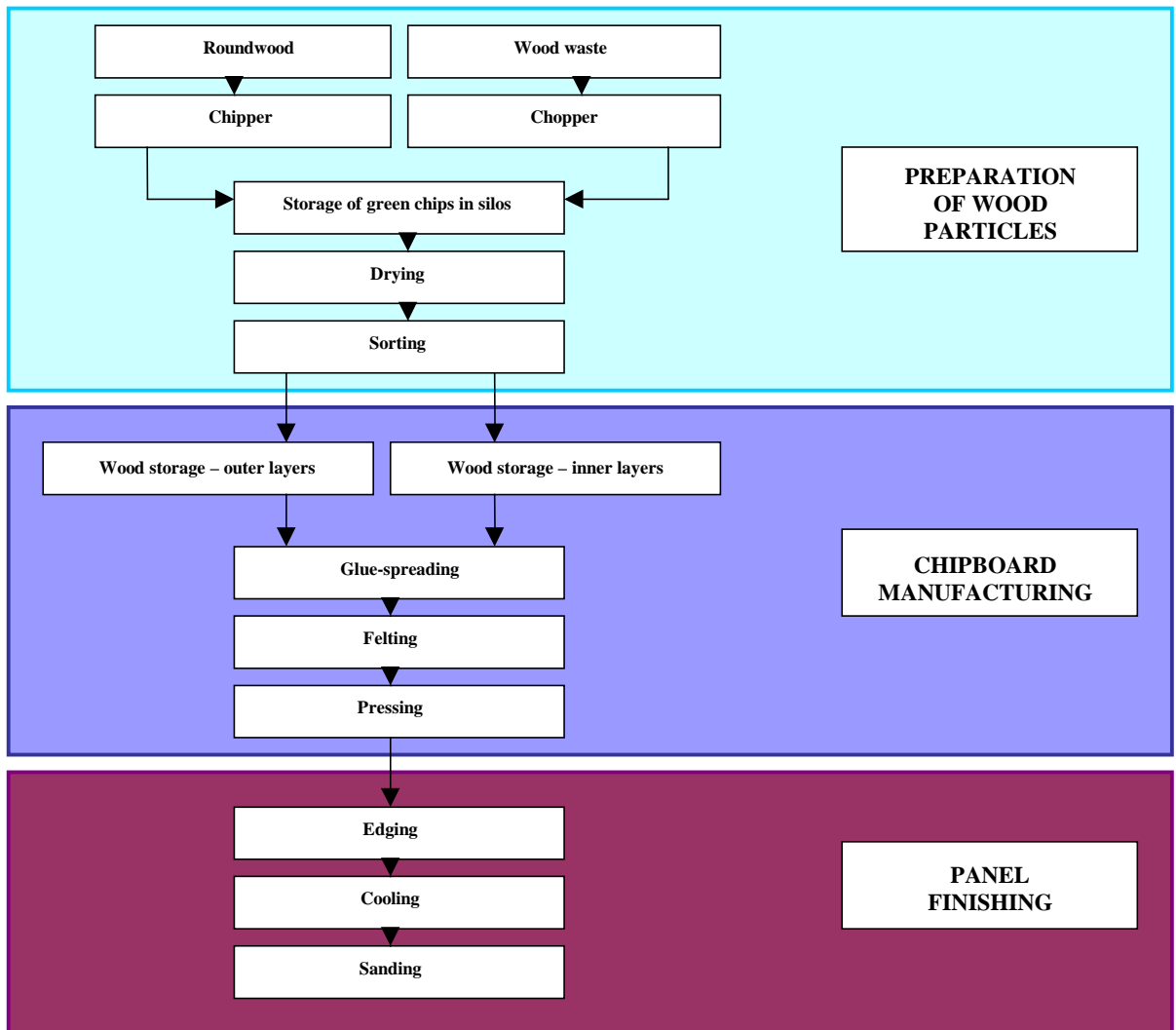
The plant employs 200 persons and posts sales of 75M euros.

This plant is a "classified" installation whose operation is subject to authorisation governed by the Prefectoral order of March 8, 2005.

The sector involved:

Chipboard is produced by hot-pressing a mixture of wood chips and glue. The wood chips are obtained by chipping up green wood, which is then dried and sorted. The chipboards are then produced through a series of glue-spreading and pressing operations.

The manufacturing process can be illustrated as follows:



The accident occurred in the wood chip preparation sector, after the chips had been dried.



Photo Drire France-Comté

THE ACCIDENT, THEIR BEHAVIOUR, EFFECTS AND CONSEQUENCES

The accident of January 20, 2005:

January 20, 2005 at 2.58 am, at part of the refiner breaks (the mill grinder that transforms large dry chips into small dry chips). The resulting spray of sparks is carried along by the suction and ventilation equipment.

At 2.58'02", the refiner's cyclone explodes. The force of the explosion causes it to rupture, despite the presence and operation of the vents. The fire spreads to all the adjoining installations: redler conveyors, suction equipment, air graders, sorters, dry silos, etc.

At 2.58'07", an explosion occurs in the suction equipment causing the vents to open.

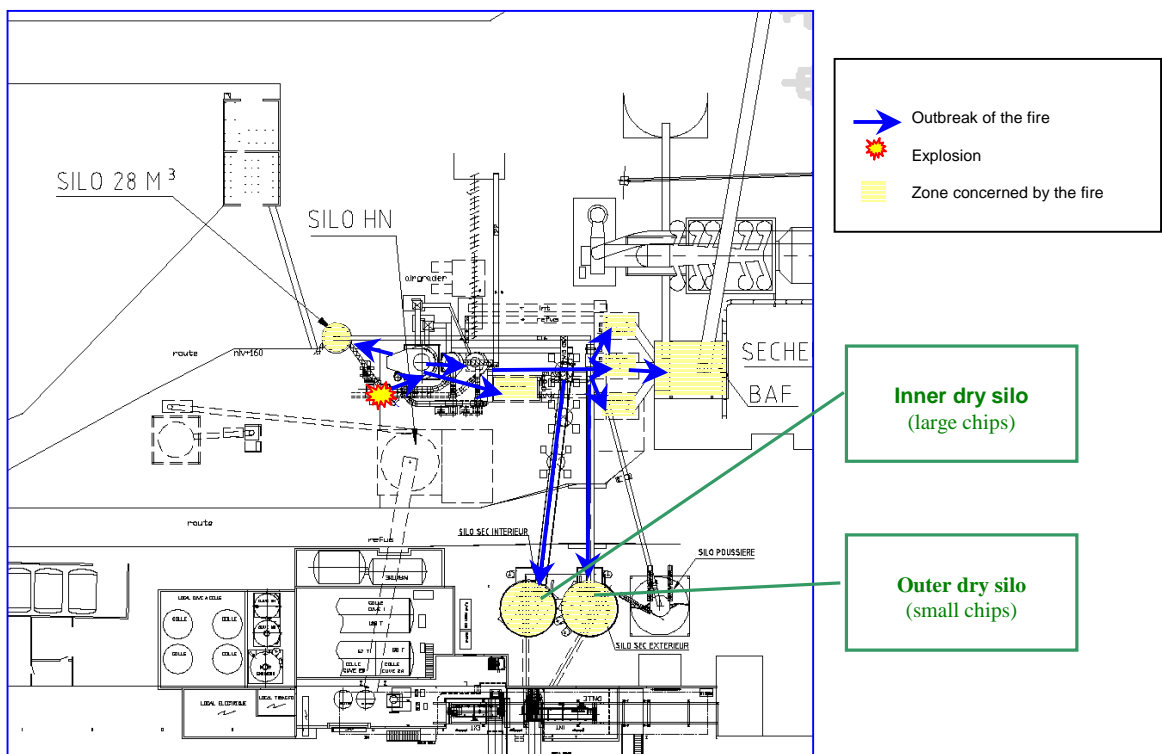
At 2.58'10", the "inner" and "outer" dry silos explode. The fire reaches the refiner silo, cyclones, cyclofilters and suction equipment, sorters, fire boxes and the "inner" and "outer" dry silos.

At 5.00 am, the fire was brought under control by the plant's firemen, and the public fire protection departments.

The following day at 8.30 am, the silos containing the dry chips were emptied to ensure that no embers remained.

Production operations resumed at 10.30 pm.

Schematic diagram of the chronology of explosions on January 20, 2005



The consequences:

The accident had no human casualties.

Material losses were evaluated at 250,000 euros, attributed to the replacement of the refiner (at the origin of the accident), and the damage caused to the sorter and cyclofilter. The silo and cyclofilter vents also have to be replaced. The plant also reported 750,000 euros in production losses due to the production line being shut down for two days.

The wood chips in the damaged silos were used in one of the plant's boilers. The fire fighting water was collected in a retaining pond and analysed before being released into the natural environment.



Photo Drire Franche-Comté

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 which oversees the application of the 'SEVESO' directive, this first accident can be characterised by the following 4 indices, based on the information available.

Dangerous materials released			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Human and social consequences		<input type="checkbox"/>	<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"/>	<input type="checkbox"/>
Economic consequences				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

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

The level 1 rating of the "Dangerous materials released" index characterises the explosion that occurred (parameter Q2 : the quantity of explosive substances was estimated to be < 100 kg of TNT).

The index relative to the economic consequences is rated level 2 due to the production losses that were evaluated at 750,000 € (parameter €16).

The accident of January 25, 2005:

On January 25, 2005 at 6.10 am, an explosion followed by fire occurred inside the "inner" dry chip silo. The silo's vents opened, thus limiting the effects of the shock wave.

The production crew and the plant's firemen triggered the manual water injection system inside and outside the dry silos as well as inside the redler conveyors supplying the "inner" silo.

The firemen set up a water nozzle upon their arrival to cool down the silo. A second explosion occurred during the cooling operations.

This explosion caused the fire to spread to the building behind the silos.

The fire was quickly brought under control. Production operations resumed in the evening after the two "inner" and "outer" dry chip silos had been emptied.

The consequences:

The consequences were minimal in comparison to the first accident. The production shut-down was limited to 14 hours; the storage silo's explosion vents and electrical cable that melted during the fire must be replaced.

Operating losses were evaluated at approximately 45,000 euros.



Photo DIRE Franche-Comté

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 which oversees the application of the 'SEVESO' directive, the second accident can be characterised by the following 4 indices, based on the information available.

Dangerous materials released		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Human and social 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 type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

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

The level 1 rating of the "dangerous materials released" index characterises the explosion that occurred (parameter Q2 : the quantity of explosive substances was estimated to be < 100 kg of TNT).

ORIGIN, CAUSES AND CIRCUMSTANCES OF THE ACCIDENTS

The cause of the first accident was easily determined during the examination of the refiner. The breakage of the metal part created sparks that caused three explosions and the subsequent fire. The various safety devices installed by the operator were triggered :

- ✓ The vents on the silos and the cyclofilter opened, thus limiting the consequences of the explosions. The cyclofilter, however, had been torn open.
- ✓ The spark detection system coupled to the water injection points had reached alert level number 2, injecting water on a permanent basis.
- ✓ The sounding of the alarm in the control room enabled the company's firemen to intervene in less than 10 minutes. The internal response teams are organised in synergy with the firemen of the neighbouring company, a subsidiary of the same group. Furthermore, the operator had developed an emergency response manual outlining the emergency procedures to be followed in the event of an accident.
- ✓ The silos' sprinkler system was put into operation by a manual valve.

Immediately following the explosion, the burners were shut down thus securing the chip zone, the driers were reversed to stop the flow of dry chips and thus stop the supply of fuel.

The cause of the second accident was attributed to embers that had remained in the bottom of the "inner" dry chip silo, following the fire of January 20, 2005. Smouldering embers had been trapped under a very heavy bell-shaped piece of equipment, the silo's extraction unit. The fire had been smouldering for 4 days. In the morning of January 25, 2005, the silo's level had dropped until it was empty and the embers ignited the cell's dusty atmosphere, resulting in an explosion. The cause of the second explosion, which occurred while the installations were being cooled down (accident of January 25), was not determined. Several hypotheses were submitted : BLEVE, water gases, dust particles in suspension, etc.?

ACTIONS TAKEN

The operator implemented several protective measures following the first accident :

- ✓ the refining installation was uncoupled from the rest of the installations. As a result, a cyclofilter dedicated to the refiner was installed and a fire box was added.
- ✓ the emergency response procedure, comparable to an internal contingency plan, was submitted to evaluation by a third party.
- ✓ the rupture of the cyclofilter, even though vents had been installed, led the operator to check their dimensions.
- ✓ as for the second accident, failing to check for embers under the dry chip silo's extraction unit is the reason behind the accident. The following improvements were recommended :
- ✓ modification of procedures dealing with accident intervention and post-accident silo restart operations, with the addition of the verification of the extraction unit.
- ✓ the purchase of a thermal-imaging camera to check installations after a fire.
- ✓ call upon a third-party expert to inspect the installations, the safety systems and the intervention procedures. The main conclusions of the third-party inspection are presented below.

LESSONS LEARNT

The chipboard industry is subject to fire and explosion hazards, considering the manufacturing processes used, the presence of large quantities of combustible materials and the production of dust.

The safety measures implemented at the site, including spark detection equipment coupled with water injection systems, proved their efficiency. Feedback from the detections recorded by these systems will certainly reduce the frequency of fires and explosion.

The installation of uncoupling systems, separating the installations in to distinct units, prevents an explosion or fire from spreading to other equipment. The most recent one implemented corresponds to the installations downstream from the refiner vis à vis other cyclofilters and dry chip silos (following the accident of January 20, 2005).

The third-party inspection opened up avenues of improvement in terms of site safety, with namely:

- ✓ creation of an Internal Contingency Plan,
- ✓ the installation of vents on the buffer storage systems,
- ✓ the modification of safety instructions,
- ✓ the installation of a new flooding device in sorter T4,
- ✓ protection of the manual valves enabling the sorters to be sprayed down.