

## Self-ignition of animal meal

20 July, 1999

Plouisy (Côtes d'Armor)

France

Self-ignition  
Bulk storage  
Animal meal  
Controls -  
Temperature

### THE INSTALLATIONS IN QUESTION

The ministerial order of June 28, 1996 made mandatory the destruction of meat-and-bone-meal produced prior to this date. Upon application of the order, only animal meal at risk was destroyed. The French government was in charge of finding suitable storage locations pending its destruction. The meal stored at Plouisy (Côtes d'Armor), considered to be of 'high risk', were earmarked for incineration.



Photo DR

Between November 1996 and February 1998, 47,000 tons of animal meal were stored in Plouisy in two covered hangars at a cattle feed manufacturing plant (a Trieux cooperative). Hangar No. 1 contained 34,000 tons of meal reaching heights of 16 to 18 meters, and hangar No. 2 contained 13,000 tons measuring 6 to 7 meters.

### THE ACCIDENT, ITS BEHAVIOUR AND CONSEQUENCES

During the night of July 19 to 20, a motorist noticed abnormal luminosity through the transparent sheet roofing of hangar No. 1. The guard was alerted. A dry chemical fire extinguisher sprayed over a few square meters was enough to stop the phenomenon. The firemen were summoned to stop the warming phenomenon.

The characteristics of the storage facility complicated the operation: the recommended height of 8 meters was significantly exceeded, solidification of the lower layers complicating temperature mapping efforts, dust explosion risk ...

An expert was called in. Continuous measurements revealed hot spots (up to 150 °C). An attempt to cool down the meal with dry ice was made but rapidly abandoned due to its inefficiency and the release of CO<sub>2</sub>. The decision was made to spread out the meal into thin layers of approximately 50 cm thick. The piles were covered in tarps to prevent the exothermal reaction (while limiting the influx of air) and overall lowering of the temperature. The left part of hangar No. 2 was emptied, and part of the stock from hangar No. 1 was transferred, after being cooled below 35 °C, to hangar No. 2 to a height below 8 meters. The cooling and transfer operations between the two hangars (No. 1 and No. 2) took place from July 1999 to December 1999. Air samples taken in a radius of 500 meters showed that no notable pollution was generated. In June 2000, meal destocking operations were still in progress as the process was reliant on the incineration capacities of a cement factories or specialised centres. As of March 23, 2000, 23,000 tons of meal remained to be eliminated. In late 2001, the stock was eventually completely evacuated to foreign cement factories for use as a substitute fuel.

## European scale of industrial accidents

The Plouisy accident did not result in the release of dangerous materials governed by the SEVESO 2 directive and resulted in no known human, social or environmental consequences. On the other hand, as an estimate of the damage and measures implemented was not made, the financial impact could not be characterised by the scale officialised in February 1994 by the Committee of Competent Authorities of the member States which oversees the application of the 'SEVESO' directive.

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"/>
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>.

## **ORIGIN, CAUSES AND CIRCUMSTANCES OF THE ACCIDENT**

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Since 1996, the French government has been in charge of finding storage locations for stocks of animal meal pending their incineration. In 1998, 85,000 tons of animal meal were incinerated in cement plants, thereby regularly eliminating the flow of meal and begin cutting back the stocks. As of December 31, 1998, 100,000 tons of animal meal remained that was essentially accumulated in 1997. These often over-filled bulk storage facilities are progressively destroyed. These facilities must thus be monitored owing to the potential danger of self-ignition risk of the piles. Furthermore, certain confined storage facilities represent a dust explosion danger.

Storage heights reached 18 meters in locations within hangar No. 1. Calculations show that the flammability of animal meal is directly linked to the volume, and thus the height of the pile. An expert evaluation concluded that the critical self-ignition temperature for a cubical storage mass of 4 cm per side is 160 °C. For 2 m per side, this temperature is only 75 °C. This perfectly explains why self-ignition took place in hangar No. 1 and not hangar No. 2 where the more reasonable storage height did not exceed 6 to 7 meters. It should be noted that the incident occurred during the summer, with high outdoor temperatures.

The combustion and the handling operations generated odours, gases and dust which worried the local residents. Two series of analyses to detect the levels of CO, H<sub>2</sub>S, methane and dust inside the storage facilities and in the environment, revealed concentrations significantly below the recommended limit values.

## **ACTIONS TAKEN**

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Various emergency measures were undertaken on July 22 and 23, 1999:

- ✓ Precise temperature mapping was carried out in the storage facility in order to carefully determine the location of the heart of the fire;
- ✓ The hottest zone in hangar No. 1 was spread out and sprayed down;
- ✓ Shovel loaders were used to create an access ramp onto the hot area of hangar No. 1 in order to remove the meal, which involved considerable "earthmoving" operations.

Other measures were taken later on:

- ✓ Continued temperature mapping;
- ✓ Continuation of the removal of meal from hangar No. 2 in order to spread out the hot meal from hangar No. 1;
- ✓ Opening of hangar No. 1's roof to create natural ventilation;

- ✓ The installation of tarps on the edges of the left and right piles in hangar No. 1 to limit the influx of air;
- ✓ Creation of a water retaining catchpit should spraying operations become necessary.

This incident contributed to enhanced monitoring of this type of storage facility and, particularly, constant follow-up of the temperatures even after the meal has been cooled.

## LESSONS LEARNT

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Incidents of this type confirm that bulk animal meal storage facilities can promote self-ignition phenomena and thus need to be monitored on a permanent basis. Several measures must be taken to limit this risk:

- ✓ The meal should preferably be stored in bales;
- ✓ Meal should be stored on a flat floor;
- ✓ The warehouse must be hermetic (air and humidity);
- ✓ The ends of the storage facility should be closed off with tarps;
- ✓ The storage of humid meal on dry meal and conical storage configurations should be avoided;
- ✓ Storage heights must not exceed 7 to 8 meters;
- ✓ Temperature readings should be taken and must not exceed 30 °C; hot meal should be spread out;
- ✓ Combustible substances or fuel must not be stored in the same facility;
- ✓ Handling equipment must be protected from fire.

In addition, preventive measures against the risk of explosion may be necessary for certain types of meal that may create dust when handled.

It should be noted that this type of storage facility no longer exists as the production and "transit" storage of animal meal is currently prohibited.

The accident at the Cléguer animal meal storage facility (ARIA document No. 16174) presents a similar problem.