



INVESTIGATION REPORT

(For e-mail as soon as possible to secretariat@safex-international.org)

**INCIDENT
NOTICE NO.**
IN15-09

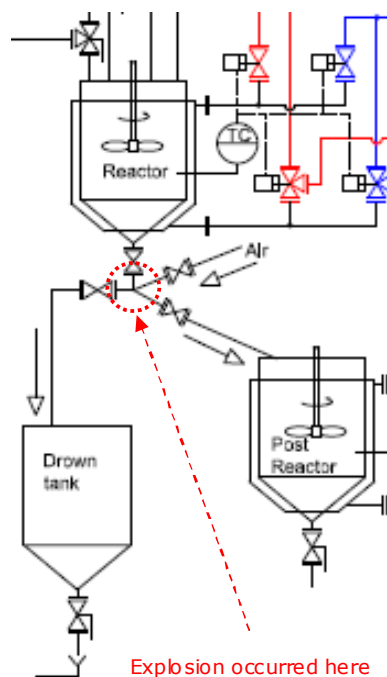
**INVESTIGATION
REPORT NO.**
IR846

1. **DATE AND TIME OF INCIDENT (When?):** 01 June 2009 at 7:00 am.

2. **INCIDENT LOCATION (Where?):**

- a. **Company name:** Austin Powder Argentina
- b. **Company facility:** HMX Plant, Rafaela, Santa Fe, Argentina
- c. **Process outline:**

The process used for the manufacture of HMX is a modified Bachmann process (see diagram alongside) which has been operated for almost 20 years without incident. It is a batch process involving the reaction of hexamine and nitric acid/ammonium nitrate in the presence of acetic acid and acetic anhydride. The process consists of several stages to produce the final recrystallized product. The incident occurred in the nitration/reaction vessel. The vessel is a simple, water-jacketed, vertically mounted reactor with a vertical stirrer. Once all the ingredients have been added to the nitrator, the reaction continues for some time with the temperature controlled to approximately 44°C by means of the water jacket. Once the reaction is complete the vessel is discharged by gravity through a series of hand operated valves to another vessel. The lines are purged using compressed air after each discharge operation. The chemistry of the process is complex and several by-products, which are not well characterized, are also produced in very small quantities.



This stage of the process results in the preparation of the crude HMX as a suspension. There are a few other operations in different parts of the world following the same or a similar reaction principle and incidents have been very rare. HMX in suspension is considered to have a low sensitivity to friction and impact.

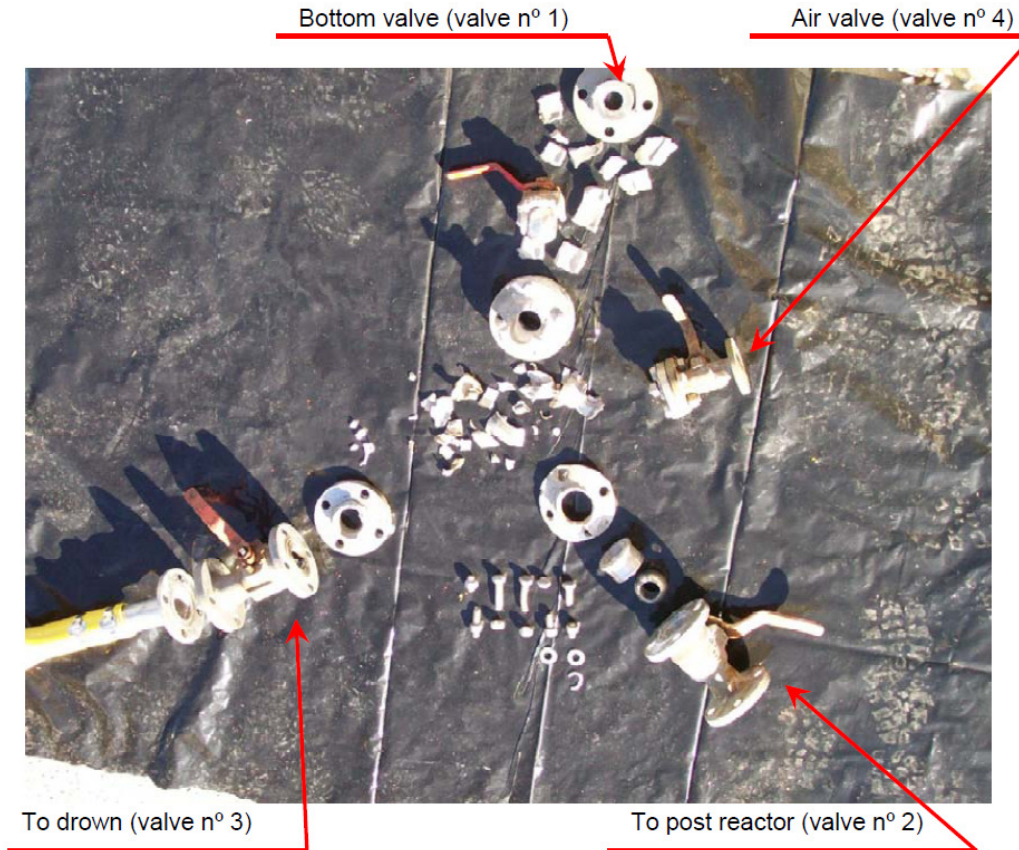
3. **DESCRIPTION OF INCIDENT (What happened?):**

On the day of the incident 8 batches of HMX had already been processed. There was nothing unusual reported by the plant personnel. The operator had just finished discharging batch 9 to the next vessel and was in the process of clearing the lines and valves when the explosion occurred in the discharge

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lines/valves. The precise actions that took place when the explosion occurred are not clear. From the official statements and the positions of valves, it is thought that the explosion coincided with or immediately after the opening of the valve on the compressed air line.

The damage to the valves is shown below.



The explosion did not propagate beyond the valves and is thought to have involved a very small quantity of material.

After attending to the injured operator and inspecting the plant, the remaining crude HMX was processed in the normal fashion.

4. IMPACT OF INCIDENT (What effect?):

One operator was injured and sent to hospital and another only slightly injured.

The discharge pipe and 3 valves were damaged. The entire material damage was small. There was no damage to buildings or structures. There were no other health or environmental effects.

5. LIKELY CAUSE OF INCIDENT (Why did it happen?):

The investigation revealed that operating procedures were followed at all times. The most likely causes were either impact or friction on the by-products that form during the process.

Impact may have been caused by small metal particles from inside the piping that were accelerated by the air used to clear blockages in the pipe as the suspension was transferred for separation/filtering

When the operator turned a ball valve, an ignition by friction of accumulated by-product in the inside surfaces of the valves/connecting pipes is also possible.

6. ACTIONS TO PREVENT RECURRENCE (How to prevent it?):

As the chemistry in this complicated process is not fully understood, the process flow was studied in detail and the following modifications proposed.

- a. The reactor outlet was enlarged and metal piping was replaced with a reinforced plastic hose (less confinement and to mitigate the consequences in the event of reaction/explosion).
- b. The compressed air line has been removed completely.
- c. The total number of valves has been reduced and all ball valves were replaced with diaphragm valves which will involve less potential for friction on any deposited product.
- d. Routine maintenance procedures have been improved to reduce the potential for deposition of product in lines and valves.

Other actions taken include:

- a. The whole process was reviewed applying a HAZOP study. This led to the implementation of further safety devices to deal with other hazards that did not contribute to this incident.
- b. The inventory of samples was reduced. These are now kept in a separate location that cannot be hit by shrapnel. (While it was not the case in this instance, it could have happened).

7. LEARNING POINTS (What can we learn from this incident?):

- a. Wet materials (HMX and by-products) may not be as insensitive as assumed.
- b. Processes that have been operated for a longer period of time should be reviewed regularly using Hazard Studies (and HAZOP where applicable).
- c. Basis of Safety documentation should be reviewed regularly as new knowledge becomes available from literature or other resources.

8. OFFICIAL REPORT (Will there be an Official Report to follow?): No

9. ORIGINATOR (Who submitted this report?):

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