Maxam Brazil Accident

October / 2016

November 2022

Location after explosion

- Maxam Brazil, Cruzeiro Plant (Lead Azide production)
- Date / Hour: At 9:52 AM (local time) on October 13th, 2016
- Consequences
- 1 fatality (UAP coordinator) and 1 serious injury (maintenance manager).
- The plant was partially destroyed.

New engine

On October 12th, 2016, a new engine (pneumatically powered) was installed to rotate the granulator stirrer. Here it can be seen after the explosion.

Stirrer room

The tests performed had the purpose of finding the right working parameters for the engine. Speed of rotation.

Previous operations 1

First tests to set-up the right working conditions (rotating velocity) were done on October 12th from 15h to 17h **using water**. The tests were done with the presence of the two plant operators and the maintenance manager.

On October 13th another test is done from 8AM to 9:44AM also using water. The test takes place, again, with the presence of the two plant operators and the maintenance manager. In addition, also the plant supervisor is present. In the last phase of the test the UAP coordinator is also present.

After the tests with water were finished, the UAP coordinator and the maintenance manager, in the presence of one plant operator, **decided to perform tests with lead azide.**

Previous operations 2

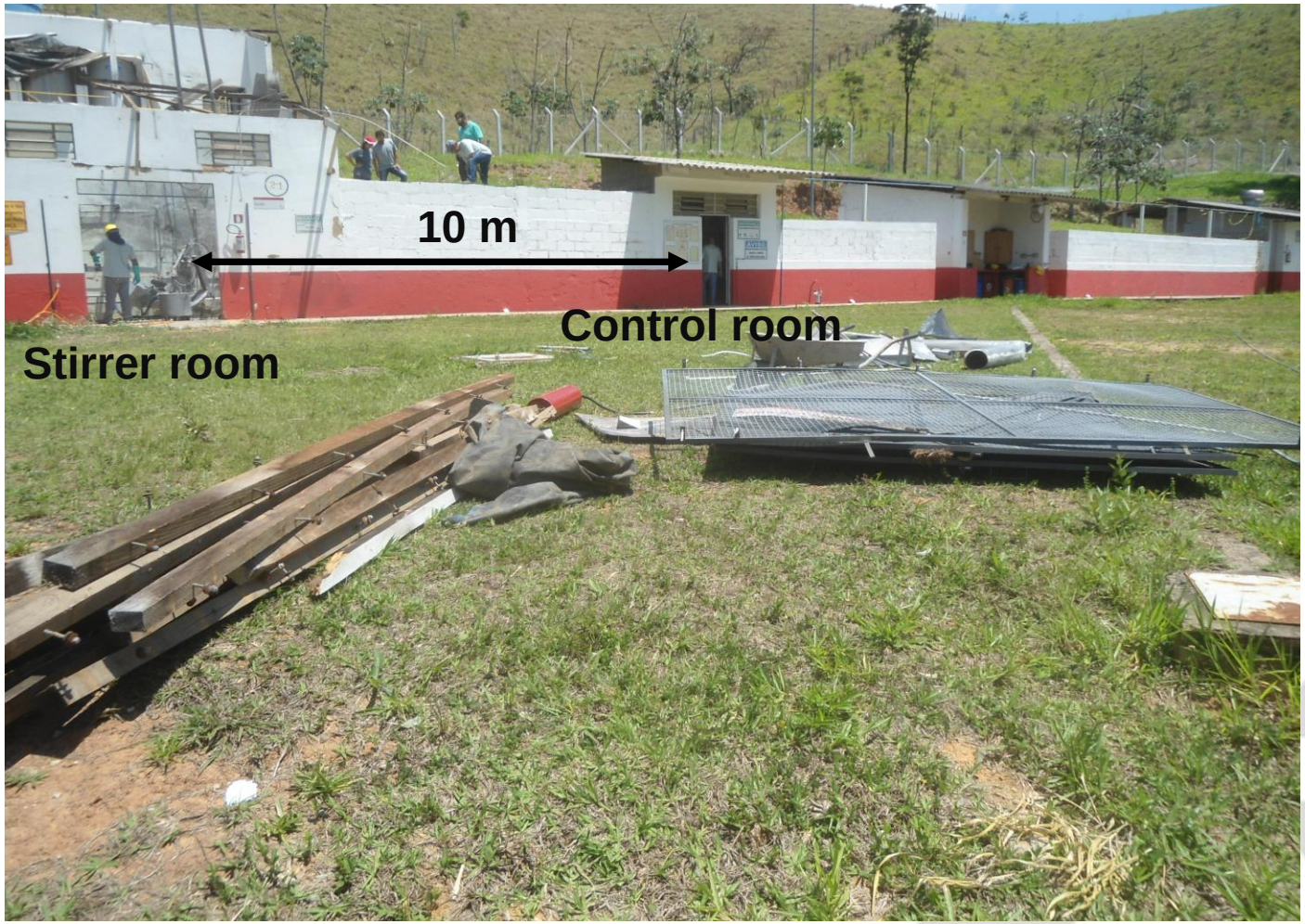
Following standard operating procedure, 6 small containers of lead azide were poured onto the feeder (around 4kg). At 9:44 the water from the previous test was dumped into the floor.

At 9:48 the two plant operators loaded the granulator with Alcohol and Acetone and set the azide feeder into position.

Previous operations 3

At 9:49:53 the lead azide feeder dumps the explosive into the granulator, while the stirrer was already rotating at first speed. These actions (switching on the first speed and activating the feeder) were remotely performed from the control room by plant operator 1 (according to his own testimony). In that moment, plant operator 2 and the plant supervisor were with him. Also, the maintenance manager and the UAP coordinator were present near the control room, **although they started moving towards the granulation room, which is some ten meters away.**

Relative position between stirrer and control rooms



Unsafe operations

These statements were in agreement with the video footage of the security cameras, where plant operator 2, the maintenance manager and the UAP coordinator could be seen **entering the granulation room <u>after ten</u> seconds**. The three persons were seen approaching the granulator and observing its inside while the stirrer was working. Plant operator 2, while being interviewed during the investigation, referred some unknown noise coming from the granulator. This noise had not been heard during the previous tests performed with water.

At 9:51:18 an increase in speed could be seen. Plant operator 1 stated that the command to increase velocity was given verbally by the persons inside the granulator room. In the video, the UAP coordinator could be seen approaching the granulator shortly after the increase had taken place, as it to inspect the result of the increase.

Operator leaving stirrer room

At 9:51:49 (1 minute and 50 seconds after starting the process) plant operator 2 was seen leaving the granulation room.

Moment of explosion

Ten seconds after leaving the room an explosion took place. In the moment of the explosion, only the UAP coordinator could be seen in the room. He was approaching the granulator for visual inspection, exactly in the same manner as he had done after the second speed had been engaged.

Immediate cause

Some mechanical effect due to the stirrer. During the investigation it was concluded that the assembly had been correctly done. If this cause was to be ruled out, the remaining possibility pointed to the design of the process. It was proved that the engine of the original design had 0,5 CV of power, while the new one had 3 CV.

Also, it was known that the rotating speeds of the first design were:

- Speed 1: 200 rpm. Speed 2: 400 rpm. Speed 3: 600 rpm

A hand-written document, apparently belonging to the maintenance manager, was found in the area, showing **new calculations** for every one of the three speeds:

- Speed 1: 606 rpm. Speed 2: 760 rpm. Speed 3: 846 rpm

Immediate cause

Apparently, these calculations showed the expected range of velocities when using the stirrer with lead azide.

In this new situation, the initiation of the lead azide could well be due to the possibility that the impact or friction of the blades of stirrer, against the grains of lead azide, were higher than the sensitivity threshold of the explosive for that mechanical stimulus.

The standard procedure allowed a maximum speed of 600 rpm, while the new attempt of design could have amounted to nearly 850 when engaging the last speed.

This significant increase in the amount of energy transferred to the explosive in the last stage of the test was believed to be the immediate cause of the initiation.

Root cause

The root cause of the accident is a lack of knowledge about the required properties of the process. This cause could have been avoided if the Management of Change procedures had been followed.

The OHS team had no notice of the tests that had been taking place for days.

The five people performing these tasks were the only ones aware of the tests going on. Following the procedure would have involved a larger number of people from different areas (multidisciplinary team) which would have probably reached a better technical solution.

And, if the knowledge of the team had not been enough to avoid an explosion during the tests, at least, issuing proper “Special Works” documents would have, for sure, avoided the presence of people in the granulation room during the movement of the stirrer.

Basic cause: a clear **lack of safety culture and awareness** of the hazards involved in the activity that was being developed.