Lead Azide Explosion - Brazil

Where and When

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.

What happened (from testimonies and video recordings)

On October 12th, 2016, a new engine (pneumatically powered) was installed to rotate the granulator stirrer. First tests to set-up the right working conditions (rotating velocity) were done 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.

According to testimonies collected from interviewed personnel, the tests performed had the purpose of finding the right working parameters for the engine.

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.

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.

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.

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 after ten seconds. The three persons can be seen approaching the granulator and observing its inside while the stirrer is 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.

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

Facts

The video footage showed a total elapsed time of 2 minutes from dumping of the explosive to the granulator to the explosion.

If the persons that performed the test had been following the standard procedure in terms of granulation, they were supposed to have maintained every one of the three speeds for an elapsed time of two minutes each. I doesn´t make any sense that in only two minutes they switched on every one of them, one after another. Hence, if the three valves had been turned on in such a short time, it means that they were not following standard procedure. This turned out to be the most likely explanation.

Plant operator 2 could be seen leaving the granulation room (apparently in a hurry) just 10 seconds before the two first minutes are elapsed. And there was testimony from the other plant operator that he was heading for the control room where he arrived just as the explosion occurred.

Hypothesis

The process started with the engagement of the first speed from the control room. The stirrer started moving inside a previously dosed volume of alcohol and acetone. Subsequently, also from the control room, the remote dumping of the explosive into the granulator was performed. From this moment, following standard procedure, two minutes at speed 1 must have passed before engaging the next speed.

This time was shortened as the second speed was engaged shortly after the first minute.

The three persons present in the granulation room could be seen by the camera for 1 minute and 50 seconds. In that moment, plant operator 2 leaves the area and proceeds hurriedly to the control room. It takes approximately ten seconds to walk that distance and, exactly ten seconds later, the explosion takes place.

It seems likely that the operator received the command to go to the control room and shift to speed 3. The fact that the explosion occurred just when the operator arrived at the control room suggested that the engagement of the third speed was what triggered the explosion.

If this hypothesis was correct, the immediate cause of the explosion was related to 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

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 stirrer itself, 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 explosion 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.

The basic cause of the accident is a clear lack of safety culture and a lack of awareness of the hazards involved in the activity that was been developed.