RDX EXPLOSIVE ACCIDENT INVESTIGATION REPORT

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DATE AND TIME OF INCIDENT

9:00Am, April 30, 2013

1.INCIDENT LOCATION

1.1.Name and facility

The explosion accident happened in an experimental facility of Nanjing University of Science and Technology. The experimental facility was built in about 1970. In 2013 school demolished the experimental facility.The school is located in Nanjing, Jiangsu province, China.

1.2.Equipment

The explosion accident happened in the 2nd room in Workshop 819 of the experimental facility.This room in Workshop 819 was a steel structure with three floors. On the Northeast side of the first floor there were two kilogram stage reactors positioned. At the South wall of the second floor there was a 300 liter reactor (also known as granulator). This was connected with two high level measuring tanks. Floor three contained a 300 liter reactor with one 20 liter reactor and one 100 liter reactor just above the 300 liter reactor. At the North side of the East wall of the second floor there were four shell and tube condensers, below the condensers two gas-liquid separators and a cyclone separator were positioned.

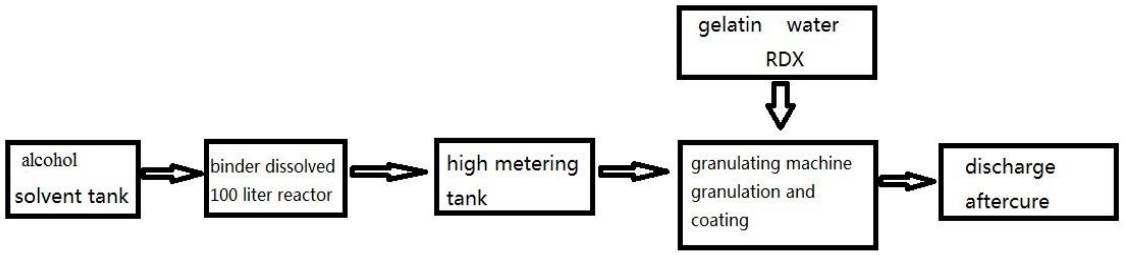
1.3.The experimental process

In this room historically shellac granulation of RDX for detonator charge experiments were conducted.

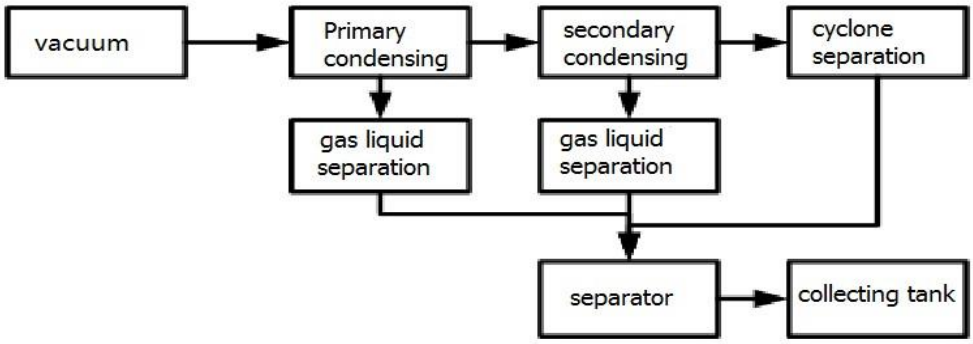
1.3.1 The detonator charge consists of RDX, gelatin, shellac and alcohol. Shellac as a binder and alcohol as a solvent for the binder.

1.3.2 Technological process.

1.3.2.1 Granulation process



1.3.2.2 The process of driving and recycling alcohol solvent



2.DESCRIPTION OF INCIDENT

The accident happened during the demolition of the 2nd room of Workshop 819. In this accident, the operator dismantled the condenser with a gas cutting, which resulted in burning of the residual RDX, and some seconds later, an explosion happened.

3.IMPACT OF INCIDENT

According to public security department's statistics, the accident caused one death , one seriously injured and two others mildly injured.

As a result of the blast wave, buildings one to three completely collapsed. All the walls were blasted to the outside. In the surrounding residential area a large number of windows were broken.

The two kilograms stage reactors were destroyed by a falling concrete slab. The 300 liters reactor on the second floor toppled over and was deflected clockwise. As an effect of the blast wave, the steel structure was displaced Southwest, and was broken. It should be noted that there has been intensive bottom-up perforation of the steel platform of the third floor by shrapnel .

3.LIKELY CAUSE OF INCIDENT

3.1.TNT equivalent

After the explosion, two damaged windows were selected(marker 1, marker 2)from the surrounding residential area.as well as a wooden door and window (marker 3) of the workshop 827 as the markers for estimating the TNT equivalent. The results are shown in Table 1.

Table 1 Parameters related to TNT equivalent

Marker	Overpressure $\triangle P$, 10^5Pa	TNT equivalent (kg)	Destruction Introduction
Marker 1	0.04	3.8	This marker was about 46.8 meters away from the explosion point; secondary damage,weak
Marker 2	0.03	6.4	This marker was about 71.3 meters away from the explosion point; secondary damage,weak
Marker 3	0.05	8.2	This marker was about 49.7 meters away from the explosion point; secondary damage,strong

According to Table 1, we can determine the TNT equivalency of the explosion at about 3.8kg ~ 8.2kg.

3.2.Explosion origin

According to the on-site investigation, based on the evidence, the origin of explosion accident is the shell and tube condensers and associated piping on north side of the East wall of the second floor,which is at the second room of the workshop 819.

Evidence 1: the flight direction of the steel platform of the third floor was Northwest, which proved the blast wave was from the Southeast side of the platform. There also has been intensive bottom-up shrapnel perforation on the steel platform of the third floor, which proved the fragments were from the lower part under the platform.

Evidence 2: The steel platform of the second floor sustained multiple penetrating fragments from top to bottom,which proved the fragments were from the above of the platform. The steel structure was displaced Southwest as a whole ,and was broken, which proved the blast wave was from the Northeast side of the whole steel frame.

Evidence 3: The shell and tube condenser's debris was found at the scene. This proved that the shell and tube condensers exploded.

3.3.Explosives analysis

After the site survey and analysis, this accident was from shellac, RDX and other flammable substances residual in tube condenser and related piping.

Evidence 1: In the process of shellac granulation RDX experiment, If process parameters was not properly controlled , some flammable and explosive substances may overflow to the tube condenser and related piping.

Evidence 2: We could see from the traces struck by fragments left behind on the piping, equipment, steel, container that explosion produced a large number of fragments, and they had a large kinetic energy, which proved that Fragments formed from explosion of condensed matter.

3.4.The cause of explosion

The cause of this explosion was clearly the gas cutting action which ignited the combustible and flammable residue in the pipe ,which then burned to detonation.

Evidence 1: Gas and oxygen cylinders used for gas cutting were found at the scene.

Evidence 2: From the device and pipes already demolished it was evident that flame cutting was used

4.ACTIONS TO PREVENT RECURRENCE

It consists of two parts: on the one hand, prevent the overflow of the explosive material in the experiment, on the other hand, do the engineering supervision seriously.

5.TAKE HOME MESSAGE

We should get some lessons from this incident. Firstly, for the laboratory personnel the residual dynamite and the waste material produced in the test must be disposed promptly and correctly. Whilst in the experiment, one should prevent the overflow/spillage of the sensitive material. Secondly, during normal experimentation it must be assumed that there will be residual explosives in equipment and any type of hot work should be forbidden. Thirdly, for business managers and safety professionals, ensure not to hire operators without qualification.