

Deflagration to detonation transition of explosives without the effects of shock waves

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Abstract. In this paper, the deflagration to detonation transition in explosives without the effects of detonators was studied by the analyzing the accident in the production and storage process of explosives. Combining the decomposition mechanism of ammonium nitrate in the emulsion explosives and the lessons from the production of emulsion explosives explosion, the conditions of the emulsion explosives (matrix) thermal decomposition in the emulsifier are given that are the formation of hot spot and the accumulation of heat. Then the factors of hot spots generated in the production of emulsion explosives and the occurred conditions of the heat accumulation are analyzed and summarized.

Introduction

Explosives production, transportation and storage process, the security, the main thermal explosion hazards exist. From explosives production process, the high temperature environment is difficult to avoid. Explosive under conditions of heat accumulation reaches its ignition temperature of the combustion will occur. In the production, transportation and storage process, if transformed into detonation of explosives by burning, harmful consequences would be disastrous. So for non-explosive detonator role under the burning to detonation transition study is important not only for its safety in production, but also for the development of industrial explosives detonation theory also has far-reaching significance.

Accident

1997-05-26(Monday), Hebei Bureau of Mines Explosive Factory certain improvements in emulsion explosives technology and equipment, quality testing, colloid material when stopped running, abnormal (shrill voice), then exploded. Accident has killed two people were killed and two seriously injured, some of the equipment was destroyed. Note that the explosion occurred in the emulsion explosive test (pre-production) when the.

2002 -06-24 (Monday) morning, Zhejiang Yongjin China Chemical Co. emulsion explosive burst explosion.

2013 03 - 11 (Monday) Plant four plants in Yunnan packaging plant 18,000 tons / year of emulsion explosive production line will be held before the class after 6:01:12 power production, 6:20:52 Pharmaceuticals processes explosion. The presence of three workers died.

3.11 accidents latex matrix of transparent - red - breaking - take tobacco - an explosion, we study that: emulsifiers explosion exist three elements: 1) an explosion conductor, 2) strong stirring, 3) a confined space.

2013-05-20 (Monday) Paul Limin Zhangqiu Jinan Technology Co. emulsion explosive seismic charge workshop 502 Kobo early morning (6:00-15:30) normal start. 5:30, ingredients workers began ingredients; 6:10, classes before and after the related equipment is ready to normal, open 1,2 Charge Machine, began production of diameter 60 mm without detonating pieces seismic charge; 8:00, open the 4th Charge Machine, while the production of the 2nd diameter 70 mm rock emulsion explosive. 9:43-9:46, together with a team leader and charging member has lifted three bags of waste drugs (after investigation and verification for the remaining classes of waste drugs May 18 in) from a storage room on the west side of the sensitized machine; 9:52-10:47, feeding points and seven members of the mixer sensitization process to join the 36 shovel waste drugs; 10:51, the studio suddenly exploded.

Accident caused 33 deaths, of which: 30 plant workers, construction workers outside the shop three people; 19 people were injured, including: shop workers four people, construction workers outside the workshop 9 people, injured six people in other regions (including plant control room duty members of a person, other neighboring regions 5 people).

May 20, 2013 9:43-9:46, together with a team leader and charging member has lifted three bags of waste drugs (after investigation and verification for the remaining classes of waste drugs May 18 in) from a storage room on the west of sensitization machine; 9:52-10:47, feeding points and seven members of the mixer sensitization process to join the 36 shovel waste drugs; 10:51, the studio suddenly exploded. Can speculate: Waste medicine is breaking due to iron ions, the role of mechanical agitation and sensitization temperature, prompting the iron ion-induced sensitization of emulsion explosives inside the machine catalytic decomposition reaction, eventually leading to the explosion.

Black Monday: Weekend emulsifier accumulation emulsified paste, corrosion produce metallic iron ions.

Although emulsion explosive production process of continuous improvement, but can not do without water, heating oil phase of melting, emulsifying, sensitization, charging packaging, warehousing, storage and so the process. In actual production, these processes are likely to cause a risk of heat accumulation explosives. Ammonium nitrate as the main ingredient of explosives, the thermal decomposition of acceleration is explosive burning to detonation transition, causing a fire, the root cause of the explosion. According Huijun Ming Xie Lifeng findings:

1) of pure, dry ammonium nitrate has good thermal stability, the following occurs in 150 ~ 160 °C themselves because thermal decomposition are not pure, containing ammonium nitrate to reduce the thermal stability of some of the impurities. Where there is moisture on the catalytic decomposition of ammonium nitrate. Acid ammonium nitrate decomposition rate increases sharply, the thermal stability decreases. Chloride, chromium salts, cobalt nitrate decomposition thereof is very high activity catalyst, an organic hydrocarbon from the catalytic decomposition of ammonium nitrate acceleration.

2) ammonium nitrate below 200 °C autocatalytic thermal decomposition process, the catalyst is automatically nitrogen oxide decomposition products of ammonium nitrate and water.

Physical properties of explosives and chemical composition of the underlying causes detonation turn affect the combustion process, such as the gas product hematocrit, burning heat and mass burn rate, and the quality of the fuel consumption rate is the decisive factor, it depends on the oxygen balance of explosives, permeability and the shape and size of the particles. Those who can improve the quality of the fuel consumption rate factors can speed up the burning to detonation transition process. The smaller the particle charge, the mass burn rate is, the more easily achieved detonation combustor transition to.

Condensed turn explosive detonation in the combustion, the chemical reaction starts from the surface of the particle, the smaller the particle size, the more uniform mixing, the greater the surface area, the chemical reaction within the reaction zone, the greater the rate, the narrower the reaction zone, by the side of the Regional expansion wave impacts to the smaller effective energy support detonation propagation increases, the more stable detonation.

Emulsion explosives before the explosion occurred mostly caused by equipment problems, there have been problems in the equipment screw, reactor, colloid mill and continuous emulsifier. The test results by hot iron law MT66-1995 provisions [7], emulsion explosives at 245-255 °C (such as in confined conditions the temperature will be lower) can occur burn fiercely. If the combustion takes place in a sealed container, with the rapid rise in pressure inside the container can explode in a few seconds.

Screw is to rely on volume changes intermeshing screw and nut space to transport materials. Pumping cavitations phenomenon will result in severe drying emulsion explosive matrix in a single screw. Results drying are in direct contact with the local deputy stator and rotor, friction and heat. Once the drying time is longer, stator and rotor deputy will be in dry running condition. A high coefficient of friction of dry rubber and minimal thermal conductivity, dry friction is bound to make the pump residual emulsion explosive matrix rapid temperature rise. Under the drying conditions, the exothermic heat faster than the speed, the energy accumulation and temperature rise. When the temperature reaches 200 °C, the oxidizing agent in the matrix of emulsion explosives to accelerate the catalytic reaction may occur since, with temperature, pressure continues to rise, and the reaction process is strengthened. At this point, single screw stator and rotor stator pits Vice sealed internal cavity pumping air to produce a certain amount of memory and some Emulsion Matrix reach thermal decomposition state, a series of complex physical and chemical processes begin to burn, by burning to detonation. Another front screw plug, screw pump high pressure within the matrix can make the temperature rise caused by combustion or explosion.

Reactor, colloid mill and continuous emulsifier three categories emulsification equipment, especially before class two accidents majority. From the accident, we can find a commonality that they are either high-speed rotating parts of the machine due to equipment failure caused by high temperatures generated by the friction of metal parts, mechanical seals or inadequate measures to cool the high temperature; short are due to mechanical friction caused by the accumulation of heat cause local temperature, thereby detonating the emulsion matrix.

Summary

Iron ion catalyzed emulsion matrix non-impact detonation occurs. Iron ions cause the emulsion matrix changes as follows:

- 1) Breaking the emulsion matrix, color red;
- 2) Catalytic decomposition reaction to produce tobacco;
- 3) The formation of explosive conductor, non-shock initiation.

At the same time, the following factors need further study:

(A) the main component of explosives as well as the presence of ammonium nitrate product containing impurities, greatly accelerated the thermal decomposition is explosive burning to detonation transition root causes. Explosives under the physical and chemical properties of the role of

non-gaseous products hematocrit detonator explosives, burning heat and mass burn rate of internal combustion to detonation transition.

(2) Of explosives outside the production process links provided by the heat of combustion to detonation transition to create the conditions.

(3) The production of explosives and other production equipment of heat generated in the screw may cause heat accumulation leads to burning to detonation transition.

(4) Of explosives in the production, transportation and storage process potentially unsafe is an objective reality. How to improve the nature of the security of explosives also needs further study.

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