The Texas City Disaster

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The Texas City Disaster

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Five hundred and Eighty-One persons are known to have lost their lives and over Three Thousand were severely injured because of fires and the ammonium nitrate explosions aboard two ships docked at Texas City, Texas on April 16-17, 1947. Property losses at the time were estimated at seventy million dollars, the equivalent of nearly one billion today. In terms of lives lost, this disaster remains the largest industrial disaster in United States history.

The tragedy was the result of explosive decomposition of ammonium nitrate fertilizer under fire conditions. The tremendous violence of the blasts resulted from the formation of large volumes of decomposition gases within the confined areas of the holds of the ships involved. Large loss of life occurred because of the immediate proximity of persons engaged in the industrial activity of the port and its exposed properties. This concentration of population was augmented by firemen and a considerable number of curious persons who had been attracted to the scene by the pre-explosion fire. The high level of property destruction was the result of the direct exposure to blast effects of high value industrial plants and facilities. Much of this property was particularly vulnerable to blast damage and self-propagated resultant fires due to the flammable nature of materials employed in the processing activities or stored in preparation of shipment or use.

Prior to 8:00 AM April 16th the 7,000 ton, converted WW2 liberty ship, S.S. Grand Camp had been loaded with approximately 2,300 tons of ammonium nitrate fertilizer. It was berthed in the north slip, adjacent to pier “O” of the Texas City Terminal Railroad company’s docking facilities. Only the prior day, had the vice president of the Texas City Terminal company. W.H. Swede Sandberg asked an Engineer from a local chemical company if there was any concern regarding ammonium nitrate and fire, the engineer told him that “he should not worry because ammonium nitrate cannot explode without a detonator”. The vessel was owned by the Republic of France and operated by what was commonly known as the French Line. It had arrived at Texas City on the morning of April 11th and loading operations had commenced that afternoon. The ammonium nitrate fertilizer had been shipped to Texas City via rail on government bills of lading from three Midwest ordnance plants since the material was produced by government war assets department munitions plants. It had been stored in warehouse O for three weeks before being loaded first on the High Flyer and then aboard the Grand Camp.

In 1942, the government initiated a program whereby 15 of its wartime ordnance plants would be required to supply 30,000 tons of “fertilizer grade ammonium nitrate” per month for

increasing domestic crop yields to support the war effort. Companies that had been consigned to the government due to the war such as Du Pont and Hercules Powder company were involved. At that time, the U.S. government had acquired the rights to manufacture ammonium nitrate explosives based on Cairns' Explosive Patent, No. 2,211,738 of Aug. 13, 1940. The Cairns' process contemplates a product substantially identical to the Texas City ammonium nitrate. The government produced ammonium nitrate at other federal plants and shipped it in solution to the reactivating graining centers for concentration. Thereafter, in addition to the traditional clay, a mixture of petrolatum, rosin and paraffin was added to ensure against caking through water absorption. The final step of graining to a number 200 screen grain size (like beach sand) was the only distinction making the material "fertilizer grade".

The ammonium nitrate cargos of both ships involved in the explosion came from the now surplus capacity of government controlled ordnance and munitions plants and it along with other needed supplies were headed for occupied countries. Following the world war II hostilities, the United States obligations as an occupying power, and the danger of internal unrest, forced this government to deal with the problem of feeding the populations of Germany, Japan and Korea. Direct shipment of foodstuffs was impractical and available fertilizer was in short supply. It was estimated that the United States would have to supply about 800,000 tons annually to these areas for at least two years. The decision to supply this large amount of this fertilizer to war torn regions as relief was made in Jan. 1946 after allied victory and shipments began soon afterward. The port of Texas City had handled approximately 150,000 tons of this material annually since that time without any incidents. It was this success that undoubtedly contributed to the lax enforcement of safety procedures and the general lack of knowledge of the materials' properties and hazards. Smoking was prohibited by dockworkers at any time and in any dock location while loading or unloading ships. This ban was entirely ignored and not enforced by any of the authorities involved at the Texas City facility according to witnesses. Only six days before the disaster, careless use of smoking materials had caused a fire at the dock that was extinguished without incident.

The carbonaceous materials added to the ammonium nitrate (petrolatum, rosin and paraffin) in the Cairns' production process were also included in this ammonium nitrate. These materials acted as a fuel source and greatly increased the detonation sensitivity of this fertilizer. This fact was one of several alleged errs that formed the basis of the large class action lawsuit brought against the United States government by about 8,500 claimants in Dalehite et al v.United States. Other subtle but significant changes made to the packaging and marking of this former "High Explosive" would become a part of the prosecutions arguments in this high-profile case.

When this material was supplied by the government as a military explosive during the war it would have been packed in 50 Lb. bags. A tight fighting, well-sealed, wooden case containing two of the bags would have been labeled according to figure 1,

Figure 1:

High Explosives

Secondary – Class 1

Ammonium Nitrate

32.5% Nitrogen

100 lbs. Net

(mfg. Name and Cage code)

Date of packaging

Handle with care

Had this material been marked in accordance with interstate commerce commission requirements in effect at the time of transport to Texas City, it would have been labeled according to figure 2,

Figure 2:

Hazardous Chemicals

Ammonium Nitrate

Fertilizer

32.5% Nitrogen

100 lbs. Net

OXIDIZER

Keep away from ignition sources and open flame

Note: Modern symbolism for oxidizing agents had not been adopted at the time, however the term: “OXIDIZER” and “Keep away from ignition sources and open flame” were required to be in yellow print as shown.

In sum, petitioners charged that the federal government had brought liability on itself for the catastrophe by (1) Using ingredients in the fertilizer that had been used as an ingredient of explosives. (2) By shipping or permitting shipment of the material to a congested area without

warning of the possibility of explosion under certain conditions. (3) Providing inadequate warning markings on the packages. (4) Failing to police the shipboard loading of the substance. (5) Bagging the fertilizer at an elevated temperature of 200 degrees F for purpose of economy to eliminate a final cooling and drying operation. (6) Using an asphaltic coating on two of the inner layers of the packaging that would have provided additional fuel for the mixture.
This case was decided initially in favor of the petitioners in 1952 by a lower court but was over turned when appealed and brought before the U.S. Supreme Court and on June 8, 1953. The court ruled that "the government and its representatives are granted discretion in their decisions regarding matters such as these."

The fertilizer was shipped, handled, and was being stowed in the Grand Camp in 100 pound, 6 ply, moisture proof paper bags marked "Fertilizer, Ammonium nitrate, Nitrogen 32.5%. The material had been stored in the warehouse on the pier and from this warehouse longshoremen were loading the ship.
Shown below is a representation of the all black markings on the bags involved in their relative size. As Shown in figure 3,

Figure 3:

FERTILIZER
(Ammonium Nitrate)
32.5% Nitrogen
100 lbs. Net
101.5 lbs. Gross
1.6 cu. ft
Made in U. S. A.

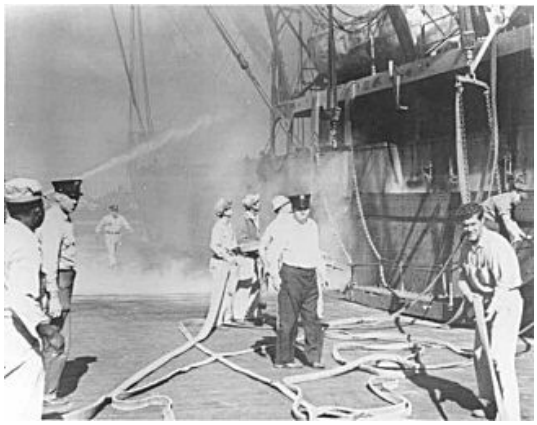
Approximately 1,400 tons had been stowed in No. 2 hold and 880 tons in lower No. 4 hold when loading operations ceased at 5:00 PM April 15th. Other cargo in separate holds included cotton, binder twine, peanuts, boxed machinery, oil well equipment (drill stems) and 16 boxes of small arms ammunition.

Loading operations were resumed at about 8:00 AM on the 16th in lower hold No. 4. No fire or smoke was visible at that time according to survivors. One crew of four workmen began to stow bags of the fertilizer already in the hold on the port side of the ship. A second crew of four sat down on the starboard side to await further supplies from topside. It is believed that one or more of this idle crew smoked a cigarette during this interval. There was known to be smoking on the main deck.

At about 8:15, smoke was observed in lower hold No. 4 on the starboard side coming from an open space about 8 inches wide between the hull and cargo battens. Attempts were made to extinguish the fire with drinking water and hand fire extinguishers but flames were observed to increase along the starboard side. The ship's whistle was sounded to give the alarm and all

persons were ordered out of the hold. A fire hose from the ship was lowered into the hatch, but the ship's 2nd Captain, Capt. Charles de Guillebon, ordered that no water be used as it would spoil the approximately $500 worth of cargo thus far involved (Water was available and the ship's fire pump was operating at full working pressure). Instead he ordered the hatches and vent cowls sealed and covered with wet tarpaulin and the hold to be steamed whereby steam is introduced into the hold through the installed steam smothering system to displace the oxygen and extinguish the fire. This was a common practice and successful with many cargo types however it was this decision, with this cargo, that made the impending disaster inevitable.
It was 8:30 by this time and the smoke continued to increase despite efforts to smother the fire. An alarm was received about 8:30 by the Texas City Fire Department and two fire trucks responded immediately followed by the two remaining pieces of equipment. A total of 27 volunteer firemen responded out of the total 50 members of the department. Crewmembers of the Grand Camp left their ship and assembled on the adjoining pier to assist firemen who had by then stretched hose lines from dock-side hydrants. Photographs taken between 8:30 and 8:50 clearly show one hose stream in use from the dock with another line being assembled (figure 5). It has not been possible to determine precisely what degree of firefighting was accomplished by these fire fighters before the explosion. Observers who survived noted that the ship's hull in the way of the fire was being heated sufficiently to boil the harbor water near the hull and to vaporize waves lapping up onto the hull. Pressures were being built up within the ship's hold as the hatch covers blew off and an orange-brown smoke, characteristic of oxides of nitrogen was observed.

Below: figure 4, The S.S. Grand Camp on fire moments before it exploded.



Above: figure 5, The Texas City Fire Department fighting the fire on the Grand Camp

At this point, a discussion of the properties of ammonium nitrate would be appropriate to help us understand the complexities of the reactions involved wh ubjected to a variety of conditions such as heat, pressure, shock, co humidity or any combination of these

Ammonium nitrate (N zing nitric acid (HNO3) with anhydrous amm es several steps, including solution forr ng, screening, coating and product bagging - forms depending on its use, but it is primarily r r in the manufacture of explosives. Liquid AN c form a dry solid product. This solid proc r may be incorporated as part of an explosive. hat is marketed in several different forms, lls are the most commonly produced for sity prills are used for fertilizer grade ammo e generally considered technical or e re used in the manufacturing of explosi ence is that small quantities of coatings and king and degradation.

Under normal conditions, pure solid AN is a stable material that usually is not sensitive to mild shock or other typical sources of detonation (such as sparks or friction) Ammonium nitrate does however exhibit three primary hazards in fire situations. These are (1) Uncontrollable fire (2) Decomposition with the formation of toxic gases and (3) Explosion. These hazards arise in part because AN is an oxidizer. This classification is demonstrated both by the U.S. Dept. of Transportation, which categorizes AN as a class 5.1 oxidizer and by OSHA, which describes it as an oxidizer in its explosives and blasting agents' standard, 29 CFR 1910.109. AN is classified as an explosive when the prills are produced with more than 0.2 percent carbonaceous material