A Review of Recent Accidents Involving Explosives Transport

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Abstract

When most people think of explosives transport they think of a hazardous operation. We all know that we aren't allowed to transport explosives through tunnels and are discouraged from traveling through heavily populated areas. Popular opinion suggests that explosives transport is a very risky operation. The authors decided to look into this a little more thoroughly and found just the opposite to be true.

While there have been some disastrous world-wide accidents involving the transport of industrial explosives, this is not the case in the U.S. Over the past 10 years, accidents related to the transport of explosives used in mining and construction have resulted in 5 major injuries, 11 minor injuries, and no fatalities. Explosives and ammonium nitrate (AN) transport outside the U.S. has not had such a good record; there have been 4 major explosives or AN transport accidents resulting in a total of more than 300 deaths. Most of these fatalities could have been prevented if the accident site had been evacuated once the explosive or AN cargo began burning.

The safe history of explosives and AN transport in the U.S. is due to diligent efforts by government, labor, and industry. However, accidents will become more common and disastrous if we become complacent.

Introduction

When most people think of explosives transport they think of a hazardous operation. We all know that we aren't allowed to transport explosives through tunnels and are discouraged from traveling through heavily populated areas. Popular opinion holds that explosives transport is a very risky operation. The authors decided to determine whether the hazards are as great as people believe.

A search of the internet identified a number of explosives and AN transport accidents, as shown in Table 1. The more serious explosives transport accidents all occurred outside the U.S. The most serious were the transportation accidents in Walden, Ontario, Canada (1998), Neyshabur, Iran (2004), Ryongchun, North Korea (2004), Mihailesti, Romania (2004), and Shengangzhai, China (2005). These will be discussed below.

On August 5, 1998 an explosives truck consisting of a tractor and trailer carrying 18,000 kg (40,000 lb) of blasting explosives went off the road near Walden, Ontario, Canada[5,6,7]. A fire started immediately. Drivers passing by stopped and helped the driver exit the truck and took him to safety. Explosive placards and the driver's warning alerted people to the hazard and they evacuated the site. The truck exploded about 35 minutes after the accident. The explosion caused two minor injuries, threw fragments of the truck up to 2,740 m (5,800 ft), and damaged several houses. At the time the truck exploded firefighters were in contact with the Canadian Transport Emergency Centre (CANUTEC) and were advised against approaching the scene. Evacuation of the accident site prevented any fatalities or serious injuries. The accident scene is shown in Figure 1.

Figure 1. Site of explosives truck accident in Walden, Ontario.

Table 1. Notable explosive transport accidents over the past decade.

Location	Date	Product	Outcome	Comments
Walden, Ontario[1,2,3]	8/5/1998	18,000 kg (40,000 lb) blasting explosives	Fire followed by explosion about 32 to 37 minutes later.	Two minor injuries, debris thrown 2,470 meters (5,800 ft)
Neyshabur, Iran[1]	2/18/200[illegible]	Cargo included fur, petrol, tilizers, cotton wool,	Explosion	More than 300 killed. 182 of those killed were emergency workers who apparently tried to fight the fire. 450 injured.
ongchon, North rea[3,4]	4/22/2004	80 MT (88 t) AN, tank car of fuel oil	Explosion	154 killed, 1,300 injured. Town severely damaged.
Mihailesti, Romania[6]	5/24/2004	20 Mt (22 t) of "nitrous fertilizer"	Fire, explosion	Killed: 7 firemen, 2 TV journalists, and 8 people who got out of their cars to watch fire. Police chief of Nechita injured. 5 firemen severely burned. Crater 10 meters deep. Damaged 20 houses.
Gwinnett County, Georgia[4]	9/2004	AN, detonators, and blasting boosters.	No fire, no explosion.	I-85 interstate closed. Cleared 150-m (500-ft) radius around accident scene.
Wells, Maine[5]	5/13/2005	1,360 kg (3,000) lb of an AN-based liquid and detonation devices	No fire, no explosion	Nearby homes and businesses evacuated. 30 km (18 miles) of Maine Turnpike closed.
Salt Lake City, Utah[9]	8/2005	16,102 kg (35,500 lb) of boosters	Explosion.	Crater 9 m (30 ft) deep and 21 m (70 ft) wide. 11 injured, 4 hospitalized.
Shengangzhai, China[8]	9/12/2005	18-MT (19.5t) truckload of AN	Explosion	Crater 5.6 m (18 ft) deep, 18.5 meters (60 ft) in diameter, 12 villagers killed, 43 injured.
Ouray, Utah[6]	5/31/2006	18.200 kg (40,000 lb) AN, 10,000 blasting caps, several hundred pounds of dynamite	No fire, no explosion.	Sparsely populated area. Authorities evacuated homes within 3.3-km (2-mile) radius.
Mesa, Arizona[7]	6/16/2006	10,000 kg (22,050 lb) AN, 8 cases dynamite, and 1,466 blasting caps.	Fire, no explosion	Newspaper clipping suggests that emergency responder did not handle this correctly.
Tumbarumba, New South	2/1/2007	AN	No fire, no explosion.	Truck rolled over into creek.

On February 18, 2004[9] a runaway train consisting of 17 cars of sulfur, 6 cars of petrol, seven cars of fertilizer, and 10 cars of cotton wool derailed, burned, and exploded in northeastern Iran, killing more than 300 people and injuring 450. ChinaDAILY[10] reported that 182 of the dead were emergency workers. Among the dead were the local governor, mayor, and fire chief. The large number of injuries and fatalities could have been prevented. The loss of so many firefighters and rescuers suggests that they were trying to fight the fire. The section of the U.S. Department of Transportation Emergency Response Guide (2004) (USDOT ERG) on AN states, "For massive fire use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn." The firefighters and rescue workers shoul evacuated the area and let the fire burn.

On April 22, 2004 a train disaster oc··rred in the town of Ryongchon, North Korea. It is unclear what was on the train but one explanation provided by the UN Office for the Coordination of Humanitarian Affairs.[11, 12]

> "The Government has now confirmed that there was a large explosion at Ryongchon Station, Ryongchon County, North Phyongan Province, and that it occurred during shunting operations at the city railway station. Two train wagons carrying AN came into contact with a wagon containing fuel oil. Each wagon contained 40 MT (44 t) of AN. This resulted in a massive explosion creating a large crater and leveling everything in a 500-m (1,640-ft) radius.
> ...the explosives were enroute to a construction site for the Pakma-cheol san irrigation project.
> ...the explosion injured approximately 1,300 people, 370 of which were hospitalized. So far, 154 bodies have been recovered, including 76 children."

The explosion produced a 15 m (49 ft) deep crater. The cause of the accident is also unclear but one report indicates that the accident may have occurred when the rail cars being shunted came into contact with a live electrical wire. Figure 2 shows the crater produced by the explosion. Damage to the Ryongchon Primary School is shown in Figure 3.

Figure 2. Crater produced by train explosion in Ryongchon, North Korea. Accident may have been the result of cars of AN coming into contact with electrical wires."

On May 24, 2004 a truck carrying more than 20 MT (22 t) of "nitrous fertilizers" overturned 50 km (31 mi) northeast of Bucharest[13]. (see

Figure 3. Ryongchon Primary School was severely damaged by the train explosion.

Figure 4.) The driver tried to extinguish the fire but when he was unable to he asked for help at a nearby village. A few cars stopped and some curious people watched the fire. A television news crew filmed the fire. Firefighters arrived and were preparing to fight the fire. The truck exploded killing 20 people,

including 7 military firefighters, 2 journalists, 3 local people watching the fire, and 5 people who stopped their cars to watch the fire. Again the accident site should have been evacuated once the "nitrous fertilizers" started burning.

Figure 4. Accident in Romania in which 20 MT (22 t) of "nitrous fertilizer" caught fire and exploded, killing 17 people.

On September 12, 2005 a truck carrying 18 MT (19.5 t) of AN exploded in the village of Shengangzhai, China[14]. It is unclear what caused the truck to explode. 12 villagers were killed and 43 were injured. The explosion produced a crater 18.5 m (60 ft) in diameter and 5.6 m (18 ft) deep. Some of the damage caused by the accident is shown in Figure 5.

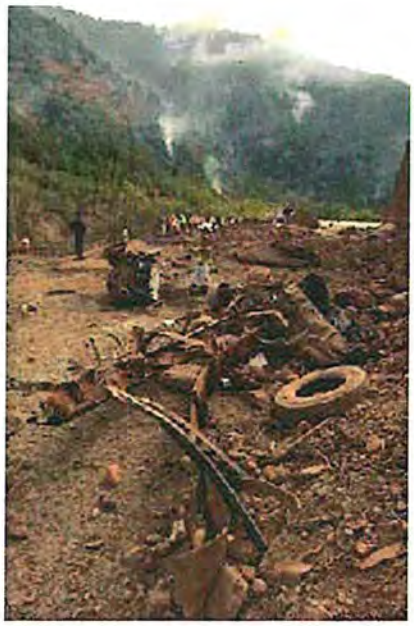
Figure 5. Damage caused by the 2005 explosion of an 18-MT (19.5-t) truckload of AN in Zhenganzhai, China.

The accidents above all occurred outside of the U. S. Table 1 lists five industrial explosives transport accidents in the U.S. None of the U.S. accidents resulted in fatalities. (There was a fatal accident involving Division 1.3 fireworks but the authors have limited this discussion to explosives used in industrial applications.) The worst accident was the explosion of 16,102 kg (35,500 lb) of explosives along Route 6 in Utah in August, 2005[15]. The truck driver apparently lost control of the truck on a curve and the truck tipped over and caught fire. Cars stopped and passengers rescued the driver and co-driver from the truck. The driver told his rescuers that the truck was carrying explosives. People were in the process of moving everyone away from the accident scene when the truck exploded. The produced a crater 9 m (30 ft) deep and 21 m (70 ft) wide. The driver and co-driver were hos Seventeen others were injured but most were not serious; two were hospitalized. The respon

accident was consistent with the guidelines in USDOT ERG; people were evacuating the accident site as quickly as possible.

Crater, 20-35 feet deep

Crater and damaged roadway



Remains of truck

Figure 6. Results of the explosion of 16,102 kg (35,500 lb) of explosives along Route 6, in Utah.

Discussion

The authors realized that a search of the internet would identify the more serious accidents but would not identify all of them. To get a more complete picture USDOT's Hazardous Material Incident Data (HMID) were reviewed. Information on explosives transport accidents from this source is shown Tables 2, 3, and 4. Review of the tables reveals many zeroes. There was only one accident that resulted in a fatality. This was a 2003 accident involving fireworks (see Table 3). The accident occurred while fireworks were being unloaded from a trailer. Apparently the trailer caught fire and exploded. Five workers were killed and one was injured.

Another serious incident is listed in Table 2. This is the previously reviewed accident in which a truckload of Class 1.1 explosives overturned, caught fire, and exploded on Route 6 in Utah.

In 1998 there were two Memphis, TN accidents involving Class 1.4 smoke-producing signaling units. In both cases a package of signaling units initiated while on a conveyor belt in a package sorting facility.

Another incident occurred in 2001 in Richmond, VA. In this case, some type of tear-gas ammunition initiated while at a trucking company, causing 3 minor injuries.

Table 2. U.S. explosives transport incidents involving Class 1.1 and 1.2 explosives.

Year	Incidents		Major Injuries		Incidents Involving Major Injuries		Minor Injuries		Incidents Involving Minor Injuries		Deaths		Incidents Involving Deaths	
	Division		Division		Division		Division		Division		Division		Division	
	1.1	1.2	1.1	1.2	1.1	1.2	1.1	1.2	1.1	1.2	1.1	1.2	1.1	1.2
1997	3	2	0	0	0	0	0	0	0	0	0	0	0	0
1998	2	1	0	0	0	0	0	0	0	0	0	0	0	0
1999	3	3	0	0	0	0	0	0	0	0	0	0	0	0
2000	3	2	0	0	0	0	0	0	0	0	0	0	0	0
2001	3	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	1	1	0	0	0	0	0	0	0	0	0	0	0	0
2003	3	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	4	2	4	0	1[#]	0	7	0	1[#]	0	0	0	0	0
2006	3	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	26	11	4	0	1	0	7	0	1	0	0	0	0	0

[#]These were the same incident.

Table 3. U.S. explosives transport incidents involving Class 1.3 and 1.4 explosives.

Year	Incidents		Major Injuries		Incidents Involving Major Injuries		Minor Injuries		Incidents Involving Minor Injuries		Deaths		Incidents Involving Deaths	
	Division		Division		Division		Division		Division		Division		Division	
	1.3	1.4	1.3	1.4	1.3	1.4	1.3	1.4	1.3	1.4	1.3	1.4	1.3	1.4
1997	1	4	0	0			0	0	0	0	0	0	0	0
1998	0	13	0	1					0	1*	0	0	0	0
1999	2	11	0	0	0				0	1	0	0	0	0
2000	1	10	0	0	0				0	0	0	0	0	0
2001	2	8	0	0	0	0	0	1	0	1	0	0	0	0
2002	1	9	0	0	0	0	0	0	0	0	0	0	0	0
2003	1	5	1	0	1	0	0	0	0	0	5	0	1	0
2004	0	3	0	0	0	0	0		0	0	0	0	0	0
2005	5	21	0	0	0	0	0	0	0	0	0	0	0	0
2006	0	19	0	0	0	0	0	0	0	0	0	0	0	0
Total	13	103	1	1	1	1	0	4	0	3	5	0	1	0

*These were two different incidents.

Table 4. U.S. explosives transport incidents involving Class 1.5 explosives.

Year	Incidents	Major Injuries	Incidents Involving Major Injuries	Minor Injuries	Incidents Involving Major Injuries	Deaths	Incidents Involving Deaths
	Division	Division	Division	Division	Division	Division	Division
	1.5	1.5	1.5	1.5	1.5	1.5	1.5
1997	4	0	0	0	0	0	0
1998	9	0	0	0	0	0	0
1999	9	0	0	0	0	0	0
2000	4	0	0	0	0	0	0
2001	1	0	0	0	0	0	0
2002	5	0	0	0	0	0	0
2003	4	0	0	0	0	0	0
2004	8	0	0	0	0	0	0
2005	2	0	0	0	0	0	0
2006	6	0	0	0	0	0	0
Total	52	0	0	0	0	0	0

During the ten year period from 1996 to 2006 there was only one serious transport incident involving construction, seismic, or mining explosives in the U.S. This is a good safety record. The review of explosives accidents outside the U.S. illustrate the potential for significant fatalities and injuries resulting from an explosives transport accident. As an example, consider the Utah accident in which the truckload of Class 1.1 explosives overturned, caught fire, and exploded. The results of the accident could have been much more serious if it hadn't occurred in a remote area and the area wasn't being evacuated when the explosion occurred. Everything worked right to prevent a disaster. Suppose the accident had occurred in a more heavily populated area? Would there have been time to evacuate people from nearby homes and businesses? W the driver had been unconscious and was unable to tell his rescuers that the truck was carrying explosives? Suppose the drivers and passengers in the nearby cars hadn't moved quickly to begin evacuating the area? A disaster can happen if everyone isn't diligent.

Conclusion

Explosives and AN transport in the U.S. is very safe. Unfortunately the same cannot be said of explosives and AN transport in all parts of the world. The safe history of explosives and AN transport in the U.S. is due to diligent efforts by government, labor, and industry. However, accidents will become more common and disastrous if we become complacent.

Most of the incidents described above involved AN and there was a delay between the time the accident occurred, the cargo caught fire, and the cargo exploded. There is a potential to significantly reduce injuries and fatalities if the time between the fire and explosion were used for evacuation rather than fighting the fire.

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