Government of **Western Australia**
Department of **Mines, Industry Regulation and Safety**
Dangerous Goods Safety

INFORMATION SHEET

Ammonium nitrate emulsion tanker trailer explosion – a brief summary for the transport industry

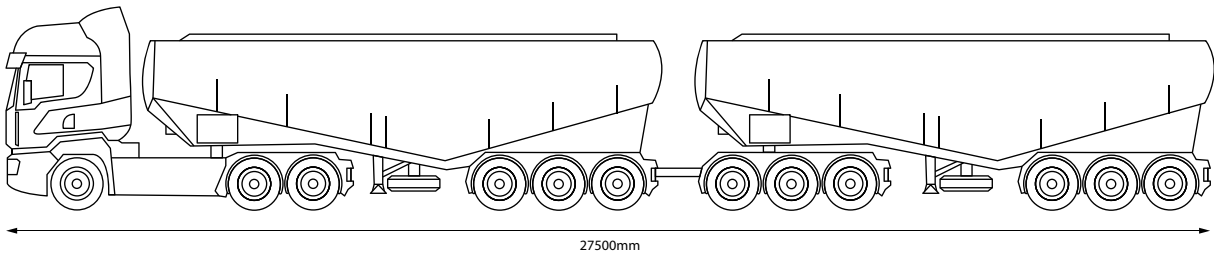
Background

A tanker trailer and dolly transporting ammonium nitrate emulsion were destroyed on the Great Central Road, Western Australia, on 24 October 2022. This was as a result of a tyre fire in the rear of two tanker trailers, which led to a destructive explosion approximately two hours later.

The Department of Mines, Industry Regulation and Safety (the Department) investigated the incident. This information sheet summarises the findings with a focus on key learnings for the transport industry. A complete copy of the incident investigation report, *Ammonium nitrate emulsion tanker trailer explosion* (ANE tanker explosion report) can be found on the Department's website.

Investigation summary

On 23 October 2022, a double road train, consisting of a prime mover carrying a tri-axle lead tanker, tri-axle dolly and a tri-axle rear tanker, was loaded with 61.61 tonnes of ammonium nitrate emulsion (ANE) [UN 3375] at Kwinana, Western Australia. The vehicle was bound for the Gruyere mine site, which is approximately 1,175 km north-east of Perth.



Schematic of road train with two tanker trailers and dolly

The driver travelled approximately 850 km before resting overnight at Leonora. The next morning he travelled 125 km to Laverton, then onwards to the mine site. The road is sealed bitumen for the first 50 km out of Laverton, with the remaining 150 km to the mine site composed of unsealed gravel.

After 96 km on the unsealed road, the driver saw black smoke among the dust behind the vehicle. At 9:31 am, the driver pulled over a little to the side of the road and found the two passenger-side (left-hand) rear tyres of the rear tri-axle on fire. Over a period of approximately 14 minutes he attempted to extinguish the fire, which was increasing in intensity. He used all three on-board fire extinguishers with little success.

The route of the vehicle and location of the incident near Gruyere mine site

The driver disconnected the rear tanker and dolly from the rest of the road train and drove 3 km further east to the turn-off to the mine. The driver used the vehicle to barricade the road, stopping other vehicles from entering the area from the east and waited for assistance.

The emergency response team from the mine arrived approximately an hour later. At around 11:15 am they entered the barricaded area to assist two other vehicles. While within the barricaded area they observed the tanker and dolly were alight, with the front of the dolly burning from the ground. They also observed white smoke, characteristic of decomposing ammonium nitrate (AN), as a result of a loss of containment from the tanker.

At 11:33 am on 24 October 2022, two hours and two minutes after the driver first noticed the fire, the tanker exploded. This is the world's first detonation involving ANE during transport since bulk transport was introduced in the 1980s.

The explosion completely destroyed the dolly and tanker trailer and formed a large, shallow crater in the road, with the deepest point being approximately 1.1 m deep. The crater was irregular in shape, roughly elliptical, 17 m long by 9 m wide, with a total area of approximately 120 m².

The likely cause of the tyre fire was a loss of pressure in the air supply line that operates the tanker trailer's braking system. This caused the brakes to be applied and overheat, leading to a fire.

In this instance, the fire was intense and prolonged by the 26 tyres on the tanker trailer and dolly. The aluminium tanker shell melted and the ANE flowed from the tanker. However, it became trapped in the gully of the road and continued to be exposed to flames from the fire.

The fire decomposed the trapped ANE, causing its structure to break down and the fuel component to burn off. The resulting product, molten sensitised AN, continued to be exposed to fire, which led to the explosion occurring.

If the driver had been able to extinguish the fire then it would not have progressed to an explosion. It was fortunate that the explosion occurred in a remote location and no one was injured.

Aerial drone image capturing the crater and the spray of rocks from the road, most pronounced, to the north of the crater (Credit: Gold Fields, Gruyere JV)

Emergency response to fires involving ammonium nitrate emulsion tankers

All reasonably practicable precautions need to be taken to prevent a fire, as all plausible pathways to an explosion from an ANE tanker start with a vehicle fire.

If fires are detected early and there is sufficient firefighting capability to extinguish the fire, then an explosion is unlikely. Fires start on the vehicle and not in the product being transported, so while it is a 'vehicle fire' and not a 'cargo fire' involving the tanker, drivers should attempt to extinguish the fire.

The potential outcome or consequences of an incident can be significantly different depending on the early actions taken by the driver, where safe to do so.

Information for drivers

Key considerations for drivers fighting ANE tanker fires.

- If a fire is detected, where possible, drivers should pull over to an area of road where the product will flow away from the vehicle should the tanker have a loss of containment. Undecomposed ANE in its original form poses no risk of an explosion once it is located away from the fire.
- Fighting a fire involving a road tanker carrying ANE should only be attempted while the fire is controllable and has not engulfed the tanker. The driver's safety comes first at all times.
- Drivers of aluminium tankers can have confidence that no explosion will occur when fighting fires in the early stage before a loss of containment. The level of decomposition of ANE is too small to pose a risk of explosion at this stage because of the protective physical properties of the emulsion structure.
- Pressurised foam or water-based firefighting systems provide the best firefighting capability for tyre fires. When fitted to a vehicle, these systems should be used for as long as it takes to extinguish the fire and sufficiently cool any tyres involved so as to prevent re-ignition unless the driver is endangered by the fire and/or the likelihood of success becomes low.
- Emergency services should be alerted as soon as is reasonably practical.
- If fire engulfs the tank, firefighting is unsuccessful or a loss of containment is either imminent or has occurred, the driver must immediately evacuate and consider disconnecting the prime mover and any intact tankers to a safe distance, where possible.
- The driver should establish an exclusion zone (greater than 1.6 km) to limit traffic access to the incident scene, with assistance of emergency services or others if available.
- If it is a fire involving a steel tanker or isotainer, drivers should stop fighting fires as soon as the flames begin to engulf the tanker/tank. Steel ANE tankers pose a risk of a pressure explosion when exposed to heat as well as the subsequent risk of a detonation from ground-based ANE decomposing close to a fire.

Information for transport companies

Key considerations for transport companies to minimise tyre/vehicle fires and improve firefighting.

- Vehicles should have sufficient and appropriate firefighting capabilities (extinguishers and firefighting systems). Foam or water based firefighting systems should be fitted to vehicles to better equip drivers to extinguish ANE tanker fires (Chapter 11 of the ANE tanker explosion report). Pressurised foam and water-based firefighting systems are superior for extinguishing tyre fires.
- Vehicles should have early warning temperature and pressure monitoring systems installed.
- Tanker design should be improved by including stainless steel mudguards, installation of fire screens and protective shields for critical components of the running gear of the vehicle.
- Vehicles and trailers require regular or increased levels of servicing, especially where they are driven on unsealed roads.
- Drivers should be provided with practical training on portable fire extinguishers, firefighting systems and the explosion risks of ANE and other AN explosion risk goods.
- An appropriate emergency response plan must be implemented when the fire becomes uncontrollable e.g. evacuating to a safe distance of 1.6 km from the incident scene.
- All drivers should have access to communication systems that enable them to contact others in the event of an emergency.
- Journey management plans should be regularly reviewed and updated to take into consideration road conditions and speed.

Given there is potential for an incident to occur within a built up area consideration should be given to increasing efforts to combat the fire in these locations (Chapter 7 of the ANE tanker explosion report). The risk of fire not being fought in a timely way in a densely populated area could be catastrophic. Companies should consider re-evaluating their emergency response policies if drivers are not currently trained to monitor and respond to tyre fires.

For further detail on emergency response to ANE tanker fires, including recovery of product, see Chapter 10 of the ANE tanker explosion report.

Recommendations for safer road transport of ammonium nitrate explosion risk goods

The recommendations made are to assist industry in reducing the fire risk to improve the safe and secure transport of AN explosion risk goods. For the purpose of this information sheet, reference to ‘AN explosion risk goods’ means the following products:

- AN suspensions or gels, grouped along with ANEs under UN 3375
- solid AN prill of UN 1942 and 2067
- hot, concentrated ammonium nitrate solutions (ANSOL), UN 2426.

This group of dangerous goods all contain AN, which in a fire scenario can decompose and potentially explode.

The cost-effectiveness, application and implementation of the recommendations is required to be investigated by industry and Australian regulators in a cooperative effort. It is intended that the recommendations will be formally communicated to relevant stakeholders including the national Competent Authorities Panel, Australian Standards, tanker manufacturers, industry safety groups and associations, and transporters. For more detail on the individual recommendations see Chapter 11 of the ANE tanker explosion report.

The Department has made 16 recommendations for industry to consider:

1. A national code of practice should be developed by industry to provide detailed guidance on the safe road transport of AN explosion risk goods.
2. Vehicles transporting AN explosion risk goods should be fitted with a hub and tyre temperature and pressure monitoring system.
3. Mudguards should be fitted with heat shielding properties (e.g. stainless steel) to protect the tank or cargo containing AN explosion risk goods from the heat radiation of a tyre fire.
4. Fire screens should be fitted beneath loads of AN explosion risk goods.
5. Critical components of the vehicle's running equipment should be protected from rocks and debris for the safe operation of the vehicle.
6. Vehicles should be fitted with a sufficiently large pressurised foam or water-based firefighting system that meets the requirements of Table 12.1 Note 4 of the Australian Code for the Transport of Dangerous Goods by Road & Rail Edition 7.8 (the ADG Code).
7. Automatic fire suppression systems should be considered for tyres of vehicles transporting AN explosion risk goods.
8. A review of Table 12.1 Note 4 of the ADG Code should be conducted by the National Transport Commission in order to support recommendation 6.
9. Drivers should be provided with a Journey Management Plan formulated after a risk assessment. Where possible, the transport of AN explosion risk goods should avoid the use of poorly maintained gravel roads.
10. Maintenance schedules of vehicles should be increased, especially when driven on poorly maintained gravel or dirt roads.
11. Vehicles should carry an appropriate means of communication capable of raising the alarm at any point in the journey and to provide essential information to emergency services.
12. Emergency evacuation distances should be increased in the *Australian & New Zealand Emergency Response Guide Book*, Guide No. 140 to 1.6 km for fires involving ANE and ANSOL.
13. Drivers should be provided with training to ensure they are competent in the safe and secure transport of AN explosion risk goods.
14. Any party involved in a firefighting capacity of AN explosion risk goods should be aware of when it is safe to fight a vehicle fire transporting these products and when evacuation processes should be undertaken.
15. Fire tests should be conducted to determine the rate of decomposition and explosive potential of ANE in open fires where the fuel and ANE entrapment are similar to the explosion incident.
16. Fire tests should be conducted on steel tankers to determine the effectiveness of the new emergency venting requirements of Australian Standard AS 2809 part 4 (2022).

Further information

The *Ammonium nitrate emulsion tanker trailer explosion: Incident investigation report* and animation is available on the Department's website or use the QR code.

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