



Port Tank Farm: Frequent Falling and Explosion of Petrol Tankers, and Citizens Safety. Lagos Case Study

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ABSTRACT

Petroleum tankers play a vital role in the transportation of the major part of the world's huge production of crude oil. The bulk carriage of crude oil presents special problems, such as the surging and explosion of the liquid tankers. In addition, the hazardous nature of crude oil has to be taken into account; flammable vapours have to be dispersed safely, especially during fast loading of fuel at the depot terminals. To meet some of these requirements, tankers are equipped with inert gas systems and vapour control systems to minimize fire, falling of tanks and explosion risks. Despite the advances that have been made in tanker design which include fire prevention systems and firefighting technology, frequent falling and explosion of petroleum tankers remain a real threat. The enormous amount of hazardous and flammable materials transported by road raises concerns not only for the safety of the vessel's crew but also for the protection of the surrounding environment against catastrophic spills, pollution and the safety of the citizens of Lagos State. From the cases of the number of fallen and the explosion of petrol tankers, it was discovered that human errors, bad road and break failures were the cause of the accidents during loading operations and movement of petrol tankers. Strategies were provided to mitigate the frequent falling and explosion of petrol tankers and it was recommended among others that government should create and implement global standards for improved highway safety and regulation of oil tanker trucks and drivers.

Keywords: Tanker accidents, Fuel transportation, Explosion of Petrol Tankers, Safety Management

INTRODUCTION

Annually, accident from petrol tanker explosion accounts for 1.3 million fatalities and about 50 million severe injuries, with a global cost implication of 518 billion dollars (WHO, 2009). The primary cause of these accidents are most times a function of many multifaceted, and related social, technical and environmental causal factors (Akanbi et al. 2009; Rasmussen and Suedung, 2000). These intricacies must be effectively handled during an incident investigation, to ensure that the underlying causal factors are accurately identified, and to maximize learning towards preventing a recurrence.

Petroleum tankers play a vital role in the transportation of the major part of the world's huge production of crude oil. Supertankers carrying 300,000 tons or more of crude are in service (International Labour Office Geneva, 1983).

In general, the bulk carriage of crude oil presents special problems, such as the surging and expansion of the liquid cargo. In addition, the hazardous nature of crude oil has to be taken into account; flammable vapours have to be dispersed safely, especially during fast loading fuel at the cargo terminals. To meet some of these requirements, tankers are equipped with inert gas systems and vapour control systems to minimize fire, falling of tanks and explosion risks (Carlebur, 2005).

Despite the advances that have been made in tanker design which include fire prevention systems and firefighting technology, frequent falling and explosion of petroleum tankers remain a real threat (Mediola&Achutegui, 2000). The enormous amount of hazardous and flammable materials transported by road raises concerns not only for the safety of the vessel's crew but also for the protection of the surrounding environment against catastrophic spills and pollution and the safety of the Lagos citizens. A study by (Carlebur, 2005) identified human error as one of the biggest causes of these accidental losses.

Accident data gathered worldwide has verified that human errors were the cause of 64% of the accidents during loading operations and movement of petrol tankers (Hart et al.2004). According to the International Tanker Owner Pollution Federation Ltd (2000), the highest likelihood of occurrence for fires/explosions happens during operational activities at the loading/unloading and transportation of the crude oil.

Therefore, this paper looks at the cases of the frequent falling and explosion of petrol tankers on Lagos road. Causes of container falling trucks and strategies

to be implemented to mitigate the incessant falling and explosion of petrol tankers in the city of Lagos.

CASES OF FALLING AND EXPLOSION OF PETROLEUM TANKERS IN LAGOS STATE

According to a report by **Guardian (2021)**, a tanker conveying 45,000 litres of premium motor spirit (PMS) fell and exploded at Banire bus stop, in the Egbeda area of Lagos State. It was revealed that the tank was loaded at Amuwo Odofin local government had a brake failure and subsequently lost control, falling off the road which caused an explosion and fire outbreak.

Another report from **Wikipedia (2018)**, stated how a tanker fully loaded with petroleum product fell, leaked and exploded on the Otedola bridge on the Lagos/Ibadan expressway. The massive fire at the Lagos-Ibadan Expressway broke out after the explosion of petroleum filled tanker lorry leading to the transfer of flames to other vehicles approaching the lorry on the busy road. A total of nine persons were confirmed dead as a result of the incident and about 54 vehicles were burnt with the tanker.

Another report by **Vanguardngr (2020)** explained a tanker laden with 33,000 litres petrol tanker overturned and fell on the road along Aso-Odo road, area of Badagry Lagos as some resident defied possible explosion to scoop petroleum product from the scene of a fallen tanker

Another report by **Garda (2021)** reported that clean-up operations were done after a fuel tank explosion in Ikeja, Lagos, during evening hours, June 17. At least three fatalities were reported damaged following the incident involving a liquefied petroleum gas tanker on Mobolaji Bank Anthony Way. Up to 13 people were wounded and dozens of vehicles were destroyed. The nearby Sheraton Hotel was evacuated during the incident. An increased security presence is also likely as emergency operations continue.

Similarly, **Lindaikjeji (2021)** shared a video of a petrol tanker that reportedly fell near Abule-Ado junction in Satellite Town, Lagos due to a bad road. It was reported that the petrol tank is filled with 33,000 litres of petrol.

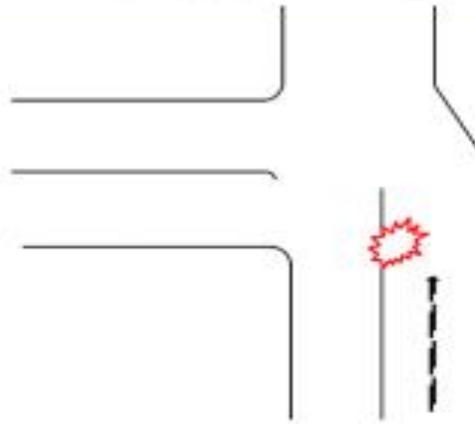


Figure 1: An area view of the incident zone of a fallen and explosion of a petrol tank.

Pulse (2021) also reported about a tanker that fell while trying to make a turn on a bridge at Iganmu. The tanker conveying 45,000 litres of PMS fell

sideways and spilt its content on the road, causing tension in the area.

Another report by **Sunnewsonline (2021)**, reported how a tanker carrying 33,000 litres of Diesel yesterday exploded along Oshodi-Apapa Expressway damaging the newly constructed Expressway by Dangote Company because of brake failure. The crash happened at Ladipo/Toyota Expressway. The accident resulted in heavy gridlock from Toyota Expressway to Cele busstop. While another gridlock from Oshodi and Airport Road to the scene of the mishap.

Also, **Ship_Port (2017)** reported that no fewer than 20 vehicles were burnt when a tanker laden with petrol fell and spilt its content on the Festac Link Bridge in AwuwoOdoFin area of Lagos State. It was reported that the tanker was coming from Apple Junction and going to FESTAC Town, was ascending the bridge but suddenly rolled back and fell. The impact of the fall separated the tank from the truck's body, resulting in an explosion.

Finally, **Pmnewsnigeria (2015)** reported how balls of fire enveloped the area as the tanker, with registration number Lagos KJA 238 XN conveying 33,000 litres of premium motor spirit, PMS, fell from a bridge at Iyanapaja and spilt its contents. Residents of the area ran for safety as fire engulfed houses and cars. No life was lost. Figure 1 below shows an area view of the incident zone of a fallen and explosion of a petrol tank.

The table below shows the cases of frequent falling and explosion of petrol tankers in Lagos State between 2015 to 2021.

S/N	Cases	Location	Year	How It Happened	Casualties
1	Petrol Tanker exploded in Lagos	Egbeda	2021	The tank driver was about to cross the highway before it fell.	No casualties
2	Petrol Tanker exploded on Otedola bridge along Lagos/Ibadan express-way.	Lagos/Ibadan Express Way	2018	Break Failure	54 Vehicles got burnt and 9 people lost their lives.
3.	Residents ignore the explosion threat, scoop fuel from a fallen petrol tanker in Lagos.	Badagry	2020	Break Failure	No casualties
4.	Fatalities reported following fuel tanker explosion in Ikeja, Lagos	Ikeja	2021	Human Error	Up to 13 people were wounded and dozens of vehicles were destroyed.
5.	Petrol tanker reportedly falls near Abule-Ado junction in Satellite Town, Lagos	Satellite Town	2021	Bad Road	No casualties
6.	No casualty as another fuel tanker falls in Lagos	Iganmu	2021	Trying to make a Turn	No casualties
7.	Gridlock in Lagos following oil tanker explosion.	Toyota Bustop, Apapa Oshodi Express Way	2021	Break Failure	No casualties
8.	Scores of vehicles burnt as tankers explode in Lagos, Abuja	Festac Town	2017	The Tanker was coming from Apple Junction and going to FESTAC Town, was ascending the bridge but suddenly rolled back and fell	20 vehicles were burnt
9	Petrol Tanker Fire Burns 44 Shops, 21 Cars in Lagos	Iyanapaja	2015	The Tanker fell off the bridge while taking a turn	21 Cars and 44 Shops got burnt

From the table above, it could be observed that there has been frequent falling of petrol tanks on Lagos road without any adequate measures to mitigate it. The Formal Lagos state governor Akinwunmi Ambode set up a committee and drafted out some rules for the tanker drivers but most of them refuse to abide by the rules and this has caused incessant falling and explosion of petrol tankers and has jeopardised the safety of Lagosian. Also, the Federal Government placed a ban on all petroleum tankers above 45,000 litres capacity from plying Nigerian roads. There have also been laws by state governments to restrict the movement of petrol tankers and trucks to prevent them from plying the same route as vehicles.

The Nigerian Senate at the national assembly directed its Committees on Petroleum Downstream to investigate the remote and immediate causes of petrol tanker explosions in parts of the country, with a view of preventing a reoccurrence.

Furthermore, the Senate also urged the regulatory and licensing authorities of the department of petroleum resources (DPR), state town planning authority, the fire service and the Federal road safety corps (FRSC) to review the modus operandi, safety procedures and licensing of petrol tankers and their mode of transportation in Nigeria. Department of petroleum resources (DPR) and Federal road safety corps (FRSC) also gave stringent guidelines/rules about the movement and operations of petroleum tankers in Nigeria. With all the aforementioned measures taken by the Government to reduce the menace of petrol tanker explosion, there is significantly no changes and reduction in the falling and explosion of petrol tankers on Lagos road.

CAUSES OF FREQUENT FALLING AND EXPLOSION OF PETROL TANKERS

There are several causes of frequent falling and explosion of a petrol tanker. They include Lightning, Operational error, Equipment failure, Crack and rupture, Leak and line rupture, Navigation, Bad road and Human error.

Lightning

There are two major causes of lightning-related fires. The first one is a direct strike and the second is the secondary effects such as the bound charge, electromagnetic pulse, electrostatic pulse and the earth currents (Carpenter, 1996). A direct lightning strike zone has a radius between 10 and 10 m. When a petrol tank is in the direct strike zone, flammable vapours exposed to the heating effect or the stroke channel may be ignited.

A storm cell induces a charge on the surface of the earth and structures projecting from the surface under the cell. The charged area varies in size from 15 to 150 sq km, which is much larger than a direct strike zone. The risk of secondary effects related to fire is far bigger than the risk of a direct strike. After the nearby strike, a well-grounded tank will still take on the storm cell-induced charge, but it releases the charge faster.

The rim seal of a floating roof tank is the most likely place to be ignited in a thunderstorm. Most rim seal fires were extinguished in a few hours, but a 1989 lightning strike in Dar Es Salaam, Tanzania led to a 3608 rim seal fire around an 80,000 barrels external floating roof petrol tanker containing crude oil that lasted for five days (Persson and Lonnermark, 2004). A rimfire on a Singapore storage tank in 1991 escalated to a full surface and bund fire. Tight sealing to prevent the escape of liquids or vapours is necessary for storage safety. The vent valve is also a likely place to be ignited. A flame arrestor should be installed.

The existing lightning protection standards for the petroleum industry provide little help. The conventional radioactive lightning protection installed on a Nigerian 670,000-barrel crude oil tank did not prevent the tank from lightning strikes in 1990 (Carpenter, 1996). The National Fire Protection Publication on lightning protection, NFPA78/780, describes the problem and industrial standard policies but provides no positive protection solutions.

Operational Error

Overfilling is the most frequent falling and an explosion of petrol tankers. When a tank containing flammable liquid overfills, fire or explosion is usually unavoidable. Any spark nearby may ignite flammable vapours released from the tank. 13 out of 15 overfilling cases led to fire and explosion. In a 1975 incident, vapours from an overfilled internal floating crude oil tank travelled to a boiler stack where they were ignited (Persson and Lonnermark, 2004). Most overfilling cases lead to fire and explosion.

Equipment Failure

There are always cases of equipment failure on the tankers carrying petrol without the drivers been aware. A typical external floating roof of a petrol tank consists of an open-topped cylindrical steel shell equipped with a roof that floats on the surface of the stored liquid. A seal system, which is attached to the roof perimeter and contacts the tank wall, reduces evaporative loss of the stored liquid. The seal system slides against the tank wall as the roof is raised and lowered with the liquid level in the tank. The floating roof may not function normally if the rooftop is out of balance or the tank body distorts. The roofs of several floating roof tanks sank after a heavy storm as a result of the low capacity of the roof drain. Flammable vapours were ignited by lightning or static charge. Another explosion that occurred as a result of petrol tanker equipment failure was reported by (Guardian (2021; Sunnewsonline, 2021)

Crack and Rupture

Most petrol tanker damages are attributable to age deterioration, corrosion and seismic motions. Cracks usually occur at the bottom of the welding edges.

Some of the unknown accidents of petrol tanks can be attributed to crack and rupture and this has caused so many explosions and destruction of properties in many countries of the world.

Leak and Line Rupture

Leaked for several hours from a petrol tanker without being detected can cause a serious explosion. In 2002, in the city Vishakhapatnam, a petrol tanker was leaking for several hours without been pinpointed which caused a lot of damages with a thick blanket of smoke engulfing the city which resulted in 37 deaths, 100 injuries, and property worth 64 million was lost (March and McLennan, 2002). Another explosion that occurred as a result of petrol leaking from a petrol tanker was reported by Wikipedia (2018) which killed 9 people and burnt 54 vehicles.

Navigation

Another cause of frequent falling and explosion of petrol tank is as a result of wrong taking navigation by the tanker driver. The explosion report by (Vanguardngr, 2020; Pulse, 2021) is a result of wrongful navigation. This could be a result of the inexperience of the tanker driver or the driver cares less about the safety of road users and citizens of Lagos State.

Bad Road

In many countries, mountainous terrain poses an additional challenge for professional drivers, particularly on the downhill when tanker drivers gain momentum and may be difficult to control. A major concern here is overheating the brakes through continual use. Preventing this situation requires drivers to plan routes wisely and drivers to use appropriate techniques (e.g. engine braking and low maximum speed) (Office of Transport Safety Investigations (OTSI), 2006). According to the study by IRU (2007), 5% of accidents are related to road conditions, but the road type has also an influence. Petrol tankers are more likely to be involved in accidents on highways than other drivers (bast, 2004). Accidents involving Petrol tankers due to congestion accounted for 20% of the total; rear-end collisions are predominant (bast, 2004). Some of the reported cases of petrol tankers were reported by (Lindaikeji, 2021; Ship_Port, 2017).

Human Error

Kirwan (1994) writes that "human errors are a natural by-product of human behaviour. Today, the most obvious impetus for this interest has been a growing public concern over the terrible cost of human errors. Events such as the fuel tank explosion in Ikeja, Lagos where 13 people were wounded and dozens of vehicles destroyed. Consequently, there are two basic types of human error as pinpointed by Reason (1990) which are:

- i. Slips and/or lapses, where the actions don't go according to the plan
- ii. Mistakes, where the plan itself is inadequate to achieve its objectives.

STRATEGIES TO MITIGATE FREQUENT FALLING AND EXPLOSION OF PETROL TANKERS

In order to ensure the safety of the citizens of Lagos State because of the frequent falling and explosion of petrol tankers, the following strategies are to be employed by the federal government of Nigeria.

1. Since the Federal government of Nigeria has been vested with the power to protect the lives and properties of the citizens of the country, the government should chasten the management of the Department of petroleum resources (DPR) and Federal road safety corps (FRSC) to undergo thorough scrutinization of every petrol tanker leaving the depot.
Some of this scrutinization includes:
 - Regular petrol tanker inspections for leaks
 - Regular petrol tanker inspections Crack and Rupture
 - Maintenance of Petrol tankers and checking of the tyres, brake pad before embarking on a journey
 - Confirmation of driver license by FRSC
2. Federal road safety corps (FRSC) should be present in petrol depot for tanker investigation
3. Special training and instruction should be given to petrol tanker drivers. This should be done by the Federal road safety corps (FRSC)
4. Visual activity tests should be done before obtaining a driver's license for petroleum tanker drivers.
5. The federal government of Nigeria should launch an agency to arrest and prosecute petrol tanker drivers.
6. With the implementation of all petroleum tanker drivers plying Lagos road at night been observed, any violator should be severely punished
7. Government should place restrictions on the age and health condition of tanker drivers.

CONCLUSION

Frequent falling and explosion of petroleum tankers are some of the many accidents in Lagos which result in many casualties including citizens losing their lives to it. The many casualties of fallen tankers and explosions were highlighted and the causes include Lightning, Operational error, Equipment failure, Crack and rupture, Leak and line rupture, Navigation, Bad road and Human error. Notwithstanding the extent to which the accident was appropriately managed, it still created traffic gridlock, negative publicity, loss of product, equipment damage, injury and the associated environmental impacts.

A repeat of such an undesirable event must be prevented at all means, particularly in the light of the information now available on the causal factors. The department of petroleum resources need to enforce the kick-off of a prevention program and device installation for petrol tanker drivers; although this does not guarantee that such a program would prevent all driver inherent errors, it can help in pinpointing ways to make the road safety for all Lagos citizens, even with the presence of fuel loaded tanker trucks.

This paper has revealed strategies to mitigate frequent falling and explosion of petrol tankers and preventing petrol tanker accidents requires a combination of goal-oriented strategies which incorporates managerial, technical, training, policy reviews, involvement of relevant agencies etc. as a holistic safety enriching approach.

RECOMMENDATION

Falling and explosion of petrol tankers disasters are a source of considerable morbidity and mortality, especially in Lagos State where instances of people scooping of petrol from a fallen tanker do not value their lives. Based on this research, we recommend the following:

1. Government should create and implement global standards for improved highway safety and regulation of oil tanker trucks and drivers.
2. Government should create and implement standardized emergency procedures for clearing the scene when an oil tanker truck is disabled or involved in a collision.
3. Government should expand emergency medical transport, including training civilians to assist in disasters.
4. Government should optimize hospital infrastructure to accommodate victims of disasters.
5. Government should provide community education about the dangers of scooping.
6. Government should engage petroleum companies in the communities where they procure and transport oil.
7. Petrol tankers should be discouraged from plying the roads during the day.
8. Government should encourage the use of the railway to transport petrol.
9. More fire service stations should be created and spread across Lagos State.

REFERENCES

- Akanbi, O. G, Charles-Owaba, O. E. and Oluleye, A. E. (2009). Human factors in traffic accidents in Lagos, Nigeria, *Disaster Prevention and Management: An International Journal*, 18, pp. 397-409.
- Bast (2004). Young workers died because of unsafe coupling practices. *Heft M* 156, 72 pp.
- Carlebur, A. (2005). Full-scale collision tests. *Safety Science*, 19, 171-178.
- Carpenter, R. B. (1996). *Lightning protection for flammable storage facilities*. Boulder, CO, USA: Lightning Eliminators, Consultants.
- Garda (2021). Fatalities were reported following the fuel tanker explosion in Ikeja, Lagos. <https://www.garda.com/crisis24/news-alerts/492141/nigeria-fatalities-reported-following-fuel-tanker-explosion-in-ikeja-lagos-june-17>
- Guardian (2021). Petrol Tanker exploded in Lagos. Available on: <https://guardian.ng/news/petrol-tanker-explodes-in-lagos/>
- Hart, T., Bea, R., & Roberts, K. (2004). Human and organizational errors in loading and discharge operations at marine terminals. Tech. Rep. Ser. California Sea Grant Coll. Program. University of California at Berkeley.
- IRU (International Road Transport Union). (2007). A scientific Study 'ETAC' European Truck Accident Causation, Executive Summary and Recommendations. http://www.iru.org/index/cmsfilesystem-action?file=mix-publications/2007_ETACstudy.pdf
- Kirwan, B. (1994). A Guide To Practical Human Reliability Assessment. Available on: https://books.google.com.ng/books/about/A_Guide_To_Practical_Human_Reliability_A.html?id=hrxB9VLPNrgC&redir_esc=y
- Lindaikiji (2021). Petrol tanker reportedly falls near Abule-Ado junction in Satellite Town, Lagos (video). Available on: <https://www.lindaikijisblog.com/2021/6/petrol-tanker-reportedly-falls-near-abule-ado-junction-in-satellite-town-lagos-video.html>
- March and McLennan (2002). *The 100 largest losses 1972-2001: large properties in the hydrocarbon-chemical industries*. New York, USA: M, M Protection Consultants.
- Persson, H., Lonnermark, A. (2004). Tank fires. SP Swedish National Testing and Research Institute, SP Report 2004:14, Boras, Sweden
- Pmnewsnigeria (2015). Petrol Tanker Fire Burns 44 Shops, 21 Cars In Lagos. Available on: <https://pmnewsnigeria.com/2015/06/02/petrol-tanker-fire-burns-44-shops-21-cars-in-lagos/>

- Pulse (2021). No casualty as another fuel tanker falls in Lagos. Available on: <https://www.pulse.ng/news/local/no-casualty-as-another-fuel-tanker-falls-in-lagos/0wdhv1x>
- Office of Transport Safety Investigations OTSI (2006). Bus Safety Investigation Report – Bus safety investigation – Jumbo travel – Jamberoo Mountain Road, Sidney.
- Rasmussen, J. and I. Suedung, I. (2000). Proactive risk management in a dynamic society: Swedish Rescue Services Agency.
- Reasons, J. (1990). Human error. New York: Cambridge University Press.
- Ship_Ports (2017). Scores of vehicles burnt as tankers explode in Lagos, Abuja. Available on: <https://shipsandports.com.ng/scores-vehicles-burnt-tankers-explode-lagos-abuja/>
- Sunnewsonline (2021). Gridlock in Lagos following oil tanker explosion. Available on: <https://www.sunnewsonline.com/gridlock-in-lagos-following-oil-tanker-explosion/>
- Vanguard (2021). Residents ignore the threat of explosions, scoop fuel from a fallen tanker in Lagos. Available on: <https://www.vanguardngr.com/2020/10/residents-ignore-explosion-threat-scoop-fuel-from-fallen-tanker-in-lagos/>
- Wikipedia (2018). Petrol Tanker exploded on Otedola bridge along Lagos/Ibadan expressway. Available on: wikipedia.org/wiki/Otedola_bridge_fire_accident/
- World Health Organization (WHO). (2009). Global Status Report on Road Safety: Time for Action," Geneva.