Compartmentalizing Tanker Truck Safety Design: Minimizing the Potential for Fires from Collisions

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For this research, we collected data on Alabama accident rates and experimentation on different types of dry foams and heavy inert gases being exposed to fire. We sought to determine what type of techniques should be used to puncture the truck-similar materials to simulate collisions and to construct a prototype (mock tanker truck).

According to Alabama accident data, a total of 2258 accidents involving heavy transport trucks carrying hazardous cargo have occurred in the state during the past five years. Of these accidents, 202 involved overturning of the vehicle with 33 resulting in fires or explosions, five resulting in spills of hazardous materials, and 91 cases of hazardous cargo becoming separated from the truck. It can be noted that this five-year period encompasses 1825 days, thus leading to the conclusion that an accident involving hazardous materials occurs on the Alabama highways at the rate of more than one per day. Approximately once every two months a tanker accident occurs that results in a fire or explosion. One notable tanker truck accident (January 5, 2002) on I-65 near the I-20/59 interchange resulted in the collapse of the bridge. Removal of the bridge cost more that $1 million and replacement of the bridge ~$3 million. Prevention of such fires to tankers as a result of a collision may result in considerable cost savings.

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Specific Aims

The objective of this research was to investigate various approaches to minimize or prevent fires as a result of accidents involving tanker trucks and railcar tankers carrying flammable materials such as kerosene, gasoline, petroleum, etc. Methods studied included: 1) compartmentalizing the tanker truck/railcar tanker to segregate the cargo involved; and 2) use of a pressurized foam spray system that is triggered as a result of an accident. The goal of the foam spray system is to minimize or prevent contact with the air (oxygen), thereby reducing the likelihood of a fire occurring.

In our investigation of the option to use compartmentalized subsections in a tanker truck in order to prevent the entire contents contained within the tanker truck from being exposed to potential ignition sources, we found little, if any, evidence that such an approach is being pursued. In researching the second option, using foam to prevent the spread of fire, we found that some tanker trucks are already equipped with secondary containment systems, with a hardened foam placed between the inner and outer tanks, providing both secondary containment and thermal resistance. Our proposed foam spray is envisioned to act like a water sprinkler system in a building in response to heat or flame.

Methods

To conduct this experiment, we first drew a scale (1/24) of the prototype; drew the dimensions on the plywood; prepared the wood for sawing; used carpenter's glue for the plywood model where our dry foam was contained (where the long circus balloons were held); and used L-joints and screws/

Table 1. Results of collision for wood panels without a scratch

Angle (°)	Observations
10	Not enough force; no effect.
30–50	Got small dents. (10 times)
70	Noticed a dent and a small crack at the right side. (10 times)
90	Got very good impressions. (10 times)
100	Larger holes were observed. Splitting of the surface on the 9th or 10th hit. On the 20th hit, you can see straight through on the other side. (25 times)

Table 2. Results of collision for wood panels with a scratch

Angle (°)	Observations
10	No effect.
30–50	Made some impressions. (10 times)
70–90	Surface layers started to split and holes are getting larger. (25 times)
100–110	From 10–20 times, wood started to split in the back. Portion of the wood under the right clamp split. (25 times)
120–140	Wood is so weak; it can be broken by hand. (50 times)

bolts to make sure the body of the model was secured tightly. We took two 3″ metal clamps that held both sides of the wood panels together on our A-frame.

Data was collected throughout this project. Before testing began, we hypothesized that the wood panels with a scratch down the center of the wood would break more quickly than the panels without a scratch. To test the wood panels, we measured different angles with a protractor and used a plum bob to simulate impact as a result of a collision. Tables 1 and 2 illustrate results for the panels with and without scratches.

CONCLUSION

In conclusion, we found out that using the screw driver helped weaken the wood and it split much faster in a shorter amount of time. My hypothesis was that the screw driver would break the wood more quickly and our data supported this claim.