Improving Safety of Ammonium Nitrate and Products Containing Ammonium Nitrate During Road Transport by Reducing the Risk of Prolonged Fire-Induced Explosions

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Mission-To protect people and the environment from the risks inherent in the transportation of hazardous materials.

Scope: Bulk transportation

Goals: -Understand current level of risk

-Explore strategies that significantly reduce that level of risk

-Understand the economic impact of those strategies

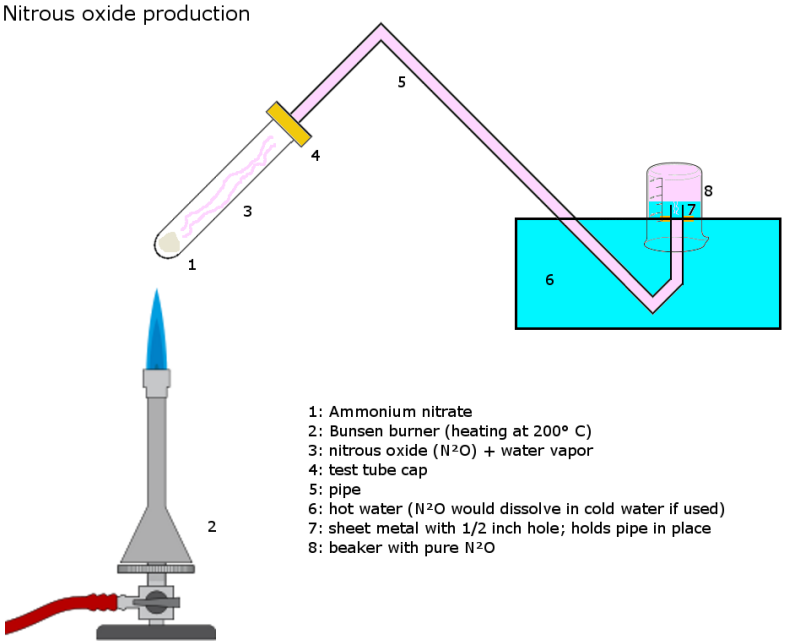
-Seek input from the stakeholders

U.S. Department of Transportation
Pipeline and Hazardous Materials Safety Administration

Ammonium Nitrate, NH_4NO_3

NH_4NO_3 (s) → 2 H_2O (g) + N_2O (g) + energy

This reaction occurs between 170 and 240 °C (338 and 464 °F), temperatures where ammonium nitrate is a moderately sensitive explosive and a very powerful oxidizer. Above 240 °C (464 °F) the exothermic reaction may accelerate to the point of detonation, so the mixture must be cooled to avoid such a disaster.



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Facts

- A truck fire occurs roughly once in every 53 million truck-miles in the US.
- When a truck fire occurs it is usually prolonged by the large amount of diesel fuel carried and the large multiple sets of tires.
- A typical truck tire contains about 117 pounds of hydrocarbon rubber which is roughly equal to 17 gallons of diesel fuel, but they burn “in-place” rather than “pooling”.
- A truck fire fed by 8 -16 truck tires and roughly 200 gallons of diesel fuel typically lasts 0.75-1.25 hours.
- Emergency responders typically arrive at a truck fire and begin to extinguish it after its already been burning 15-25 minutes.

Incidents

Worldwide, there have been four major hazmat truck explosions/detonations preceded by prolonged tire/fuel fires lasting 30-60 minutes with ammonium nitrate and/or ammonium nitrate products in the past 42 years:

1. 1972 – Taroom-Bauhinia road, 100km N-N-W of Taroom, Australia – 3 fatalities, burn time ~ 60 mins.

2. 1998- Walden, Ontario Canada- 0 fatalities, burn time ~ 35 mins.

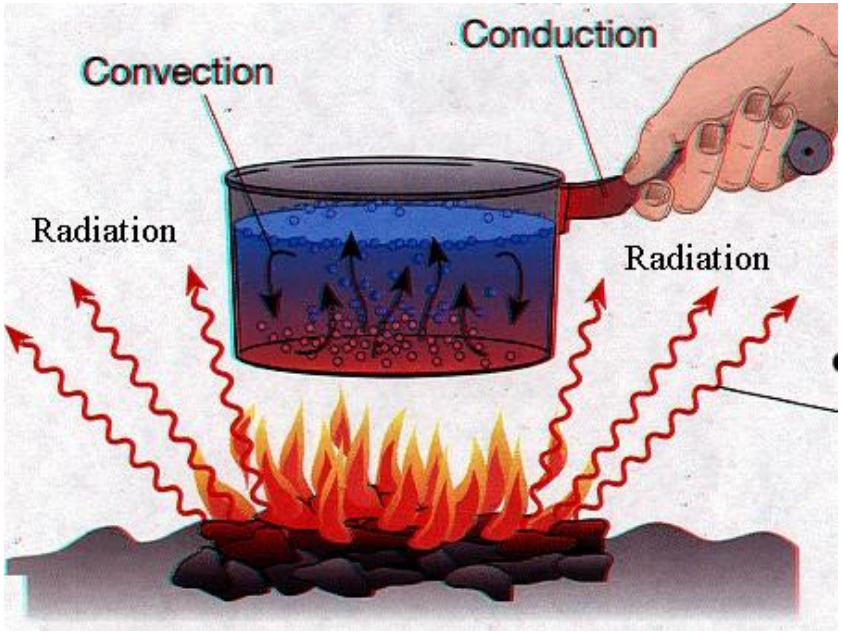
3. 2004 - Mihailesti, Romania – 18 fatalities (including 7 firefighters and 2 news crew), burn time ~40 mins.

4. 2009 Celemania, Mexico- +25 fatalities many more injured from watching the fire after getting out of a soccer game across the road, burn time ~60 mins.

In a FIRE-Heat Transfer is the **Enemy**

Stop or slow the heat transfer

- Fire Prevention
- Insulation
- Shielding
- Other Methods



What a tire fire looks like? – here's a potential disaster involving an eight tire fire underneath liquefied hydrogen gas that DID NOT HAPPEN!– Superb Insulation!

Shielding

Must be sufficient to protect the vehicle's cargo for the duration of the fire event

The heat flux is cut by the rate of *n+1* where *n* is the number of shields

- 1 shield ½ the rate
- 2 shields 1/3 the rate

Other Passive Methods

- Reduce the tire mass
  - Super single tires

- Distance the tires, fuel and combustibles from the cargo

Deliverables

- Strategies for consideration
- Energy calculations/strategy- goal T<200F starting ambient 32F and 85F
- Additional costs to currently offered design/strategy
- Risk- frequency calculations current design vs. strategy as individual and stacked strategies
- Proof of concept via experimental data
- Stakeholder inputs per strategy

Thank you

Questions ?