Super-Safe Large Anhydrous Ammonia Tanks

Design Concepts for Ammonia Storage Safety – Prevention Design for Populated Environments

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Super Safe NH3 Storage Infrastructure
Introduction

- Quick review of how ammonia is stored, large and small
- New safer tank designs are needed to insure public safety where large stationary urban tank farms/tanks exist.
- Materials and Regulations – Other industry examples…
Anhydrous Ammonia Storage

- Producing Plant & Large Distribution Terminals
  - Refrigerated Storage ~ 30,000 tons @ < -28 °F, 15 psi

- Local Distribution and Storage
  - Pressure Tank ~ 30,000 gal 265 psi minimum design

- Agriculture/Farm
  - Nurse Tank ~ 1,000 gal 265 psi minimum design
Municipalities, counties, states, countries, and insurers - commonly referred to as the Authority Having Jurisdiction (AHJ), have adopted codes and standards to control hazardous materials and ensure public safety.
Stationary Tank Requirements

- Tank Design ASME Boiler & Pressure Vessel Code Sec VII, Div 1, 250 psi minimum
- Tank Sizes 2,000 – 120,000 gallons
- Location, Design, Depart of Labor Requirement: Construction & Operation Conform to 29 F1910.111, American National Safety Institute, ANSI K61.1
- Location Local Code: Many municipalities now prevent the placement of ammonia storage tanks within city limits
Anhydrous Ammonia Transportation Container Regulations

- Tank Truck: MC 331 – 11,500 gal 300 psi
- Rail Car: D.O.T. 112J340 – 33,500 gal 340 psi
- Most jurisdictions make it illegal to place or transport anhydrous ammonia in any container not designed, constructed, maintained or authorized for that purpose
TYPICAL HORIZONTAL ANHYDROUS AMMONIA STORAGE TANK
Super Safe Storage
Upright Tank Concepts
Super Safe Storage
Urban Location - Tank Farm

Tank Farm

NH3 Absorbent System

Perimeter Barrier

Seismic Loaded Foundation

NH3

NH3

NH3

NH3

NH3

NH3

NH3

NH3

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Horizontal Tank Concepts

Highest Risk Design

Outer Tank

NH₃
NH₃
NH₃
NH₃

NH₃ Absorbent System

High Risk Design

Outer Tank

Inner Tank

NH₃

NH₃ Absorbent System

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Multiple Tanks – Transport Application

Transport Design

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Minot, North Dakota
January 2002
Typical current design:
33,800 gallons
Union Tank Car Company

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NH3 Hot Rod Fuel Tank
What is involved with super-safe storage: tanks, fittings/valves, hoses, sensors, active neutralization

- Large and small super safe concept designs
  - Smaller tanks vs. huge tanks ... (limit capacities of tanks stationed near communities)
  - Double hulled (tanks-with-a-tank or tank within a tank)
  - Neutralization of vented ammonia - designs to capture vented NH3 and to neutralize same using automated method - sensors alert system)
Considerations

- Multiple Tanks vs. Monolithic Tank designs
- Double-Hull vs. Single-Tank
- Capture & Neutralization Systems
- Connection Systems Safety
- Seismic, Puncture, and Placement precautions
- Alerts & Monitoring - Training & Education
Issues

- Public acceptance of NH3 fuel could hinge on fail-safe storage and delivery. Perceptions vs. Realities.
- Authority Having Jurisdiction (AHJ)
- Difficulties in storage
  - Corrosion, Reactions
  - Pressure issues (ambient temperature factors, ammonia venting, ammonia transfer issues, breakaway valves)
Conclusion

Future

- Regulations
- Public relations and compliance
- Materials - aluminum, composite, fiberglass, metal foam etc.
Questions?
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