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AMMONIA

Transportation & Delivery of Anhydrous Ammonia

By

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Chemical Marketing Services, Inc.

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Characteristics Of Anhydrous Ammonia

- Appearance: Colorless liquid or gas
- Odor: Strong, penetrating & pungent
- Physical State: Gas at ambient conditions (65º F and 14.7 psi)
- Ph: 10.6 – 11.6, Strongly alkaline when dissolved in water
- Explosive Limits: 16% to 25%
- Inhalation Hazard: OSHA PEL 60 ppm
- Dense Gas

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Safety Classifications

- DOT – Hazardous Material
- OSHA – Hazardous Material
- EPA – Extremely Hazardous Substance

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Transportation Information

Regulated by Department Of Transportation (D.O.T.)

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D.O.T. Shipping Name	Ammonia, Anhydrous
D.O.T. Hazard Class	Poisonous, non-flammable compressed gas
D.O.T. Placard	Poison gas, non-flammable ga
D.O.T. Label Code	Inhalation hazard
D.O.T. Reportable Quantity	100 lbs or 20 gallons

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U.S. Anhydrous Ammonia Capacity

(The Fertilizer Institute & U.S. Department of Commerce)

Capacity	Number	Capacity (MM tons)
U.S. Operating Plants (2006)	23	13.2

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U.S. Anhydrous Ammonia Supply

(The Fertilizer Institute & U.S. Department of Commerce)

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Supply	MM tons
U.S. Plant Production (est. 2005)	12.0
U.S. Imports (2005)	8.5
U.S. Exports	0.3
Total U.S. Supply	20.2

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U.S. Anhydrous Ammonia Consumption

(The Fertilizer Institute & U.S. Department of Commerce)

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U.S. Consumption (2005)	MM tons
Fertilizer	
Anhydrous & Aqua Ammonia	3.94
Feedstock (for other fertilizers)	10.35
Industrial (Feedstock for chemicals)	5.85
Total Consumption	20.14

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Anhydrous Ammonia Modes of Transportation

- Pipeline
- Pressure Tank Car
- Pressure Tank Truck
- Pressure Nurse Tank
- Refrigerated Barge

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Anhydrous Ammonia Transportation Container Regulations

Type	Regulation & Capacity	Min Design Pressure
Tank Truck	MC 331 – 11,500 gal	300 psi
Rail Car	D.O.T. 112J340 – 33,500 gal	340 psi*
Stationary Tank	2000 – 120,000 gal – ASME Code Sec VIII, Div 1	250 psi
Barge	US Coast Guard & American Bureau of Ships	> 20 psi

*Current proposal under study by AAR Tank Car Committee to change design standard to 500 psi. If adopted, current ammonia cars would have to be phased out of service over a 10 years period.

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Anhydrous Ammonia Pipeline Infrastructure

Pipelines	Regional Coverage & Storage Terminals
▪ Magellan Ammonia Pipeline	▪ 1,100 miles 20 Terminals 528,000 tons Storage Texas to Minnesota Delivery Capacity: 900,000 tons/yr
▪ Kaneb Pipeline	▪ 2,000 miles 24 Terminals 1 million tons Storage Louisiana to Nebraska & Indiana Delivery Capacity: 2 million tons/yr

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Existing Ammonia Rail Car Fleet

- Type: D.O.T. 112J340
- Number of Cars in Service: ~ 6000
- Average Age of Fleet (est): 25 years
- Maximum Allowable Service Life: 40 years

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Existing Ammonia Barge Fleet

Type: 2,500 ton Capacity – Refrigerated

Typical Years of Service: 40 years (~ age of current fleet)

Barges in Service:

Mississippi River System	24
Inter-Coastal Waterway	4
Pacific Northwest	2
Total U.S. Barge Fleet	31

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Types Of Anhydrous Ammonia Storage

Location	Type Of Storage & Regulation
▪ Locations with > 10,000 lbs	▪ Risk Management Program (RMP) Rule 40 CFR 68 Process Safety Management (PSM) Rule 29 CFR 1910.119
▪ Producing Plant & Large Distribution Terminals	▪ Refrigerated Storage ~ 30,000 tons @ < -28 ºF, 15 psi
▪ Local Distribution, “Dealers”	▪ Pressure Tank ~ 30,000 gal 265 psi minimum design & Local Municipal codes
▪ Farm	▪ Nurse Tank ~ 1,000 gal 265 psi minimum design

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Anhydrous Ammonia Production & Distribution Infrastructure

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Pipelines	Coverage & Storage Terminals
Pipeline Terminals	44 Terminals - 2.9 million tons
River Storage Terminals	30 Terminals - 780,000 tons Mississippi, Illinois & Ohio Rivers
U.S. Production Points	23 Plants 767,000 tons Storage
Storage Terminals (>1,000 tons)	~ 1,500,000 tons
Total Storage	~ 4,575,000 tons

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U.S. Ammonia Infrastructure

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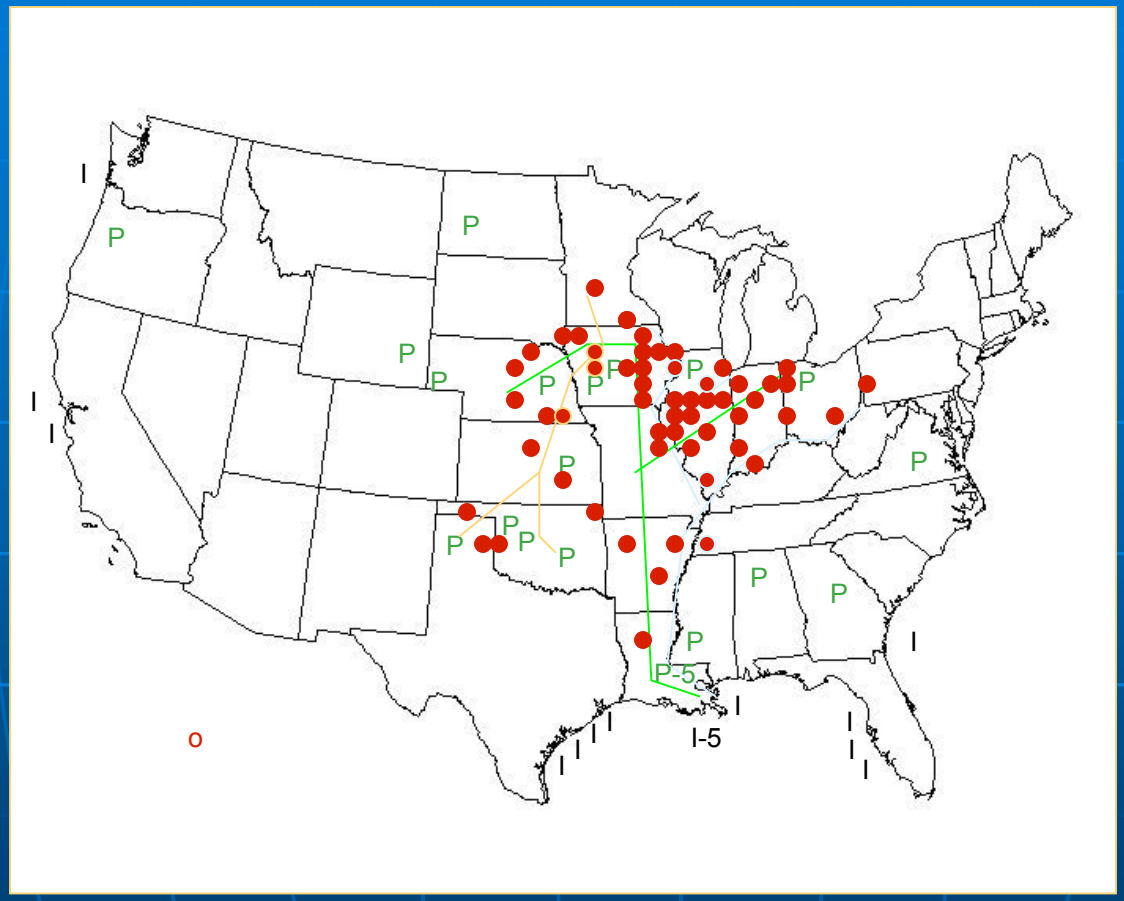

P Ammonia Plants – 23

● Storage Tanks (Pipeline & River) – 70

I Import Tanks – 17

Kaneb Pipeline

Magellan Pipeline

Mississippi - Ohio River System

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Fueling Station Stationary Tank Requirements

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Tank Design	ASME Boiler & Pressure Vessel Code Sec VII, Div 1, 250 psi minimum
Tank Sizes	2,000 – 120,000 gallons
Location, Design, Construction & Operation	Depart of Labor Requirement: Conform to 29 CF1910.111 American National Safety Institute ANSI K61.1
Location	Local Code: Most municipalities now prevent the placement of ammonia storage tanks within city limits.

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Ammonia Infrastructure Capital Costs

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Capital Item	Cost $
Conventional Grass Roots Plant 1,500 tons/day with storage	~$330 MM
Pipeline 12” Diameter – 1,000 miles	~$240 MM
Large Refrigerated Storage Terminal 30,000 ton capacity	$20 MM
Pressure Storage Tanks – 30,000 gallons (~ $5/gallon installed)	$150,000
Ammonia Rail Tank Car	
Current design: 340 psi	$118,000
Proposed design: 500 psi	~$135,000 - $150,000

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U.S. Motor Transportation Fuels Supply 2005

Refinery Production Capacity

Operating Refineries	147
Gasoline Production (1,000 Bbls)	3,013,930
Distillate Fuels (1,000 Bbls)	1,441,365
Imports of Motor Fuels (1000 Bbls)	1,141,065

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U.S. Motor Transportation Fuels Consumption 2005

	1,000 Bbls	MM tons
Gasoline Sales	3,330,805	419.68
Diesel Sales	1,500,252	220.54

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Energy Content Comparison

	Density Lbs/gal	Heat of Combustion Btu/lb
Motor Gasoline	6.10	20,504
Diesel	7.10	19,534
Ammonia	5.15	8,001

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Anhydrous Ammonia
New Production Capacity for Fuel Use

Assumption:

Anhydrous Ammonia Replaces 20% of Motor Gasoline and Diesel Demand (on a Ton for Ton basis)

Requirement:

U.S. Total Motor Fuel Consumption (2005):	640.22 MM tons
Anhydrous Ammonia to Replace 20%:	128.04 MM tons
U.S. Anhydrous Ammonia Production (2005):	12.00 MM tons

U.S. Anhydrous Ammonia Production would have to increase by a factor of 10.67

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Anhydrous Ammonia
New Production Capacity for Fuel Use

Assumption:

Anhydrous Ammonia Replaces 20% of 2005 Motor Fuel Demand (on a BTU for BTU basis)

Requirement:	MM Tons	Trillion BTU
U.S. Motor Fuel Consumption (2005):	640.22	25,825
Anhydrous Ammonia to Replace 20%:	322.75	5,165
U.S. Anhydrous Ammonia Production:	12.00	192

U.S. Anhydrous Ammonia Production would have to increase by a factor of 26.9

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Petroleum Administration for Defense Districts

- The East Coast (PADD 1)
  - Has no crude oil production
  - Limited Refining
  - Highest regional demand for refined products
  - Refineries process foreign oil
  - Receives 60% of refined products shipped from other PADDs
  - Receives almost all of the refined products imported into the U.S.

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Petroleum Administration for Defense Districts

- The Midwest (PADD 2)
  - Significant crude oil production
  - Receives Canadian & other foreign crude by pipeline
  - 88% of crude refined comes from outside the region
  - Regional refined products supplemented by Texas Gulf Coast

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Petroleum Administration for Defense Districts

- The Gulf Coast (PADD 3)
  - Largest producer of U.S. crude (55%)
  - Refineries account for 47% of U.S. of refined products
  - Refineries account for 80% of product shipments among PADDs
  - Most refined product shipments go to PADD 1 and to PADD 2

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Petroleum Administration for Defense Districts

- The Rocky Mountain Region (PADD 4)
  - Lowest refined product consumption
  - Imports crude from Canada to supplement regions production
  - Inter-regional trade of finished products keeps supply in balance

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Petroleum Administration for Defense Districts

- The West Coast (PADD 5)
  - Logistically is separate from the rest of the U.S.
  - Crude supply dominated by Alaskan crude (55%)
  - Remainder of crude (45%) comes from California fields
  - Unique product requirements (CARB)
  - All of California's product requirements are met by the state's refineries

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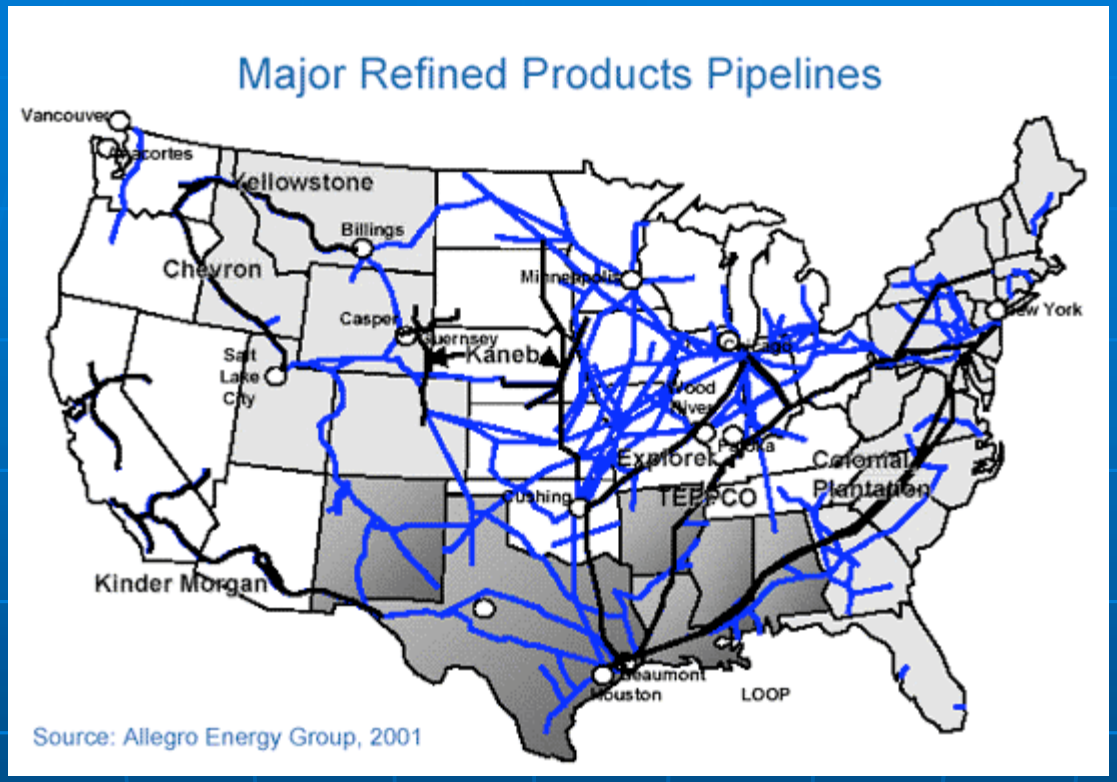

95,000 miles of refined products pipelines
5.3 billion barrels per year of refined products
845 Distribution Terminals
167,350 Service Stations

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Capital Investment Required for AA to Replace 20% of Motor Fuels

Item	Capital Required Billions $
Plants – 615 (1500 tons/day)	$202.95
Pipeline System (19,000 miles)	$4.56
Storage Terminals – 169	$3.38
Service Stations – 33,470 (Storage & pumps added to existing stations)	$6.69
Rail Car Fleet – 161,400	$21.79
Tank Truck Fleet – 47,340	$8.28
Total Investment	$247.65

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Infrastructure Hurdles to Overcome for AA to Replace 20% of Motor Fuels

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- Public & Regulatory Acceptance of the Hazardous Nature of AA
- Permitting of Retail Sites
- Capital Required for Plants and Logistics Infrastructure
- Feedstock – Natural Gas or Coal Gasification?