Who is Air Products?

- Global atmospheric, process and specialty gases, performance materials, equipment and services provider
- Serving industrial, energy, technology and healthcare markets worldwide
- Operations in over 40 countries
- ~19,000 employees worldwide
- World HQ in Allentown, PA, USA.
  - European HQ in Hersham, Surrey
  - Asia HQ in Shanghai
- $9 billion company in FY10
  - Diverse markets and geographies
Modes of Supply

- Gases can be supplied in three main ways
  - Cylinders
  - Bulk gases (transported as Cryogenic Liquid)
  - On Site generation
    - Membranes
    - Air Separation Units (ASU)
Cryogenics at Air Products

Household Refrigeration > -12°C

Low Temperature Refrigeration < -40°C

Cryogenics < -100°C

-0°C Water Freezes
-18°C (0°F)

-42°C Liquid propane

-78°C CO₂ Sublimation (Dry Ice)

-183°C O₂ Boils

-196°C N₂ Boils

-269°C He Boils
-273°C Absolute Zero

Air Products Public Information
Air Separation – How is it done?

1 Air Feed  
2 Cleaning  
3 Compressing  
4 Cooling  
5 Separation  
6 Crude argon  
7 Vaporizer  
8 Gas Filling  
9 Liquid Filling  
10 Pipeline Supply
Air Separation – How is it done?

**Air**
- **LP (c. 1 bara)**
  - **78% N₂**
  - **21% O₂**
  - **1 % Ar**
  - Plus H₂O, CO₂ etc

**LOX (−183°C)**
- **21% O₂**
- **1 % Ar**
- **Plus H₂O, CO₂ etc**

**Ar**

**LN₂**

**Crude LOX (c. 40%)**

**HP (5 -7 bara)**

**Air (c. -175°C)**

**Air Products Public Information**
Cryogenic Applications – Liquid Nitrogen
Cryogenic Applications

- Cryogenic Applications R&D Facilities:
  - Laboratories in Basingstoke (UK), Allentown (USA) and Bangkok (Thailand)
  - Analytical capabilities
  - Customer demonstrations
  - Development of processes and equipment
  - Ideal for testing new products, processes and technologies

- Experienced R&D team:
  - App. 140 years of combined R&D experience
  - Frequent experience exchange and training

... from research to product development and implementation in the market place
Food Processing – Cryogenic Advantages

- Size of ice crystal
  - Freezing speed
  - Instantaneously (1min)
  - Quickly (5min)
  - Slowly (20min)

Freezing vs. thawing:
- Small ice crystals, cell wall intact
- Large ice crystals, damage to cell wall

Air Products Public Information
Other Cryogenic Advantages

- Cryogenic rapid freezing helps to produce
  - Individually Quick Frozen (IQF) products
  - Pellets
  - Coated or enrobed products
  - Formed products (e.g. patties)
Industrial Cryogenics

- Ultra-fine Grinding
  - Rubber and plastics
  - Particle sizes from 50 to 300 μm
  - Cryogenic temperatures to cause embrittlement
Industrial Cryogenics

- Solvent Recovery
- Cryogenic Condensation of Volatile Organic Compounds (VOCs) to meet stringent emission standards
Other Applications

- Process Cooling
- De-flashing
- Fridge recycling
- Reaction Cooling
- High Temperature Superconductivity (67 to 90K)
Thank you

tell me more

www.airproducts.com