Synthetic Natural Gas (SNG),
The LPG Opportunity
SNG Overview

• Introduction to fuel interchangeability
• Components required for an SNG system
• Applications for SNG
• General comments regarding SNG
Fuel Interchangeability

When LPG is mixed with air at the correct ratio, the resulting mixture will burn with the same characteristics as Natural Gas, making it an ideal fuel source to replace or supplement Natural Gas.

How does Interchangeability work? First, let’s look at the chemical make-up for each fuel:

[Diagram showing chemical structures of Methane (CH₄), Propane (C₃H₈), and Butane (C₄H₁₀) with dots representing Carbon (●) and circles representing Hydrogen (○).]
Wobbe Index

- W.I. = $\sqrt{\frac{1}{S.G.}} \cdot C.V.$
- S.G. = Specific Gravity of Gas
- C.V. = Calorific Value or Heating Value
Another Advantage - Lower Dewpoint
Components of SNG System
Liquid LPG Pumps

• Two main types of pumps
  – Positive displacement
  – Turbine
LPG Vaporizers

• Four main types of Vaporizers
  – Electric – Dry and waterbath
  – Steam – Bayonet and U tube
  – Hot Water – Bayonet and U tube
  – Gas Fired – Direct and Waterbath

• Classification
  – Explosion proof (Zone 1)
  – Nonincendive (Zone 2)
  – General Purpose
POWER®-Series
Dry Electric Vaporizer

[Image of a POWER®-Series Dry Electric Vaporizer]

[Image of a close-up of the vaporizer's vaporization head]

[Logo of Algas SDI]
Electric Waterbath Vaporizer
Dry vs. Waterbath

**Dry Electric**
- No possibility for corrosion
- Short heat up time
- No sediment to clog pump or prevent heat transfer
- No glycol expense
- Acquiring a permit and soil remediation are not a problem.
- Waterbaths require more maintenance;
  - Operator must take samples regularly
  - Operator must add make-up water.

**Waterbath Electric**
- Individual heater elements can be replaced.
- No direct contact between the heater and the LPG.
- Spill containment (dyke) may be required.
AZEOVAIRE® Steam/Hot water Vaporizer
AQUAVAIRE® Gas Fired Waterbath Vaporizers
VAPORAIRE® Venturi Operation
Air Regulator
Regulated air loads the gas pilot and diaphragm. Since the gas and air regulators are linked, the gas and air pressures are equal at the inlet to the piston.

Blender Valve
The Blendair™ valve accurately following the load provides a precision ratio of gas and air at all loads. Mixed gas leaves through an outlet (not in the plane of this cross-section) shown as a dotted circle.

Travel Indicator
The travel indicator shows the exact position of the piston at all times, making start-up easy.

Anodized Sleeve
The sleeve surrounding the piston is anodized, which prevents oily residue from causing malfunction.

Gas Regulator
Since air loads the gas pilot, the gas pressure at the outlet of the gas regulator is equal to the air pressure. Equal pressures mean a safe, accurate mix.

Air Regulator Pilot

Ratio Control
Turning the ratio control hand wheel rotates the piston, opening and closing the orifices for ratio control.

Ball Bearings
Promotes smooth piston function.

Diaphragm Operator
The diaphragm operator raises and lowers the piston, opening and closing the orifices for capacity.

Gas Governor Pilot

Gas
BLEENDAIRE® II Parallel Pipe Mixer
Parallel Pipe vs. Three Port Piston

**Parallel Pipe**
- Feed Forward Control
- Includes flow meters on air and LPG line.
- Easier to convert to peak shaving mixer.
- Not as susceptible to clogging.
- No added cost for ARA feature.
- Infinite turndown with line pack feature.

**Three Port Piston**
- Feed back control
- Must add flow control valve and flow meters to peak shave.
Venturi vs. High Pressure Mixer

**Venturi**
- No need for an air compressor
- No chance to create an unsafe mixture so control/operation is simpler; better reliability.
- Accuracy to +/-5%
- Pressure from 350 mBar to 1 Bar.
- Infinite turndown.
- More maintenance required for 24/7 operation.

**High Pressure Mixer**
- Air compressor required
- Controls are more sophisticated to ensure a safe mix.
- Accuracy to +/-1.5%
- More flexibility regarding ratio.
GA500 Calorimeter
DS Densitometer
Calorimeter vs. Densitometer

**Calorimeter**
- Direct measurement of wobbe index
- Provides a 4-20mA signal for control.
- Requires compressed air
- Classification: General purpose
- Must be installed inside a temperature controlled room.

**Densitometer**
- Indirect measurement
- Provides a 4-20mA signal for control.
- Does not require compressed air.
- Classification: Explosion proof
- Can be installed outdoors.
Filtaire Oil Demister

- Removes heavy LPG oils
- Knitted stainless steel wire mesh
FlareStack

- Purpose: To allow the operator to tune/calibrate the mixer after periods of inactivity.
Propane-Air (LPG-Air): A highly versatile and scalable tool used to supplement Natural Gas delivers. Systems can supplement 50 MMBtu/Day to 100,000 MMBtu/Day.

An extensive distribution network means propane is available wherever you need it.

Peak-shaving with propane-air offsets costly ongoing demand charges with a fixed asset,...
...and injection at select points can expand system capacity more economically than adding pipe.

Interruptible gas service rates encourage propane-air systems at end user sites. Customers see lower cost gas energy while suppliers gain a dedicated gas energy customer and a flexible swing load.

Propane-Air, providing supply security, flexibility and cost savings for gas energy utilities and consumers of every size.

Learn more about how propane-air can work for you.

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Liuzhou City-Base Load in China
Liuzhou City - Tanks
Liuzhou – Unloading compressor
Liuzhou-Pumps
Liuzhou City-Mixer and Vaporizer
Liuzhou Controls
Liuzhou City-Base load in China

- 3 Stations, 1100 MM BTU/Hr each
- Each station designed for 50,000 households
- 30 PSIG
- 2 x 1,000,000 gallon spherical tanks, rail unloading station, 3 x positive displacement pumps, 3 x hot water vaporizers, 3 x proportional LPG/air mixers, 3 x air compressors, 3 x dryers, 3 x air filters, 3 x LPG filters, calorimeter and flare stack.
- Purpose: Base load to feed city

- LPG Consumption: 6100 tons/month for each station
Dubai - Palm Jumeirah
Dubai-Palm Jumeirah Package
Dubai-Palm Jumeirah
Dubai Palm Jumeirah

- Base load system to supply SNG until NG arrives
- 250 MM BTU/Hr at 6 Bar
- STABILAIRE positive displacement pump, Packaged AQUAVAIRE vaporizer/BLENSITAIRE mixer/FILTAIRE in 40 foot ISO container, GA500 calorimeter, flare stack.
- Purpose: Base load to feed city

- LPG Consumption: 1400 tons/month
SNG General Comments

• Cost of a SNG system: 40-50% tanks, 25-35% equipment, 25-35% engineering/installation
• No technical limitation regarding the size of a LPG/air mixing station
• General rule: Higher pressure means higher cost
• Control can be completely automated
• Construction time for small system: 3 months
• Construction time for large system: 6 months
SNG General Comments

• SNG allows LPG companies to market directly to the biggest energy users-NG users.
• SNG mixing allows the customer to fuel switch and use the cheapest fuel available.
• Can be used in mobile applications.
• Can be used for power generation applications, but must be careful of the following:
  – Turbine applications require extremely high pressure; condensation is an issue.
  – Engine applications may require a special ratio
Questions?

Thank you for your time!!