

‘Team tech talk, Globe 2006 ‘

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Speaker:

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Xebec Inc.

- Established 1967, owned by domnick hunter (UK) founded in 1967.
- Manufacture and supply of high added value filtration, separation and purification products.
- ISO 9001 (2000) certified
- ASME VIII Code
- China SQLO
- CSA Electrics and other electrical codes.

“World leader in Natural Gas dryer for NGV applications and present in the NGV market for over 20 years.”

Xebec Inc.



What is Xebec?

- The industry leader in the manufacturing of Compressed Air and Natural Gas purification and dehydration equipment for the World market.
- An industry employing more than 120 knowledgeable and experienced people sharing the same goal: meeting the market standards **to the extent** at the best possible competitive price.
- An industry cumulating more than 25 years in the manufacturing of Natural Gas drying equipment with a dedicated CNG team at every level of the process.

Science of drying Natural Gas

- Using the latest technology (**Low pressure suction side**), Natural Gas needs to be contaminant free when introduced into HP compressors used in NGV applications.
- Although improving compressors performances, the LP dryer system is acting as a Natural Gas **polisher** to meet both ISO standards and generally recognized standards for moisture content while protecting HP cylinders against corrosion.

Science of drying Natural Gas

- Using Molecular Sieve as a drying media, the ultimate goal is to dehydrate and eliminate **'right from the source'** any trace of unwanted contaminants to insure a safe and reliable operation.

And how does it affect our daily operations?



***The tip of the Iceberg,
the “Joule-Thomson” effect...***

- ∞ Freeze-ups at dispenser nozzles***
- ∞ Freeze-ups in the vehicles fuel injectors***

Drying Natural Gas

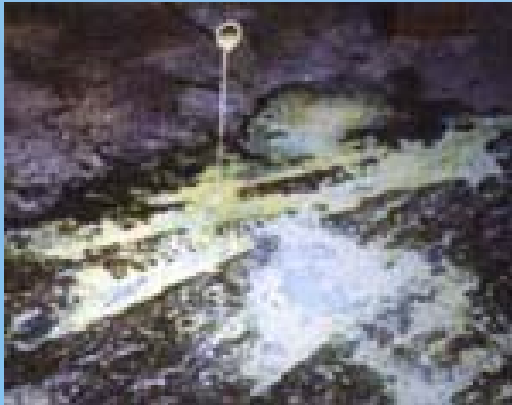
Operational issues!



- Actual waterload varies significantly from location to location
- Piping and distribution systems can contribute in increasing moisture in the gas
- In most cases, NG dryers are “polishers” in view of less than saturated inlet dewpoints.

Drying Natural Gas

Operational issues!



Formation of hydrates

- Hydrates are a solid phase complex of water and light hydrocarbons whose formation is dependent on gas composition, pressure and temperature.
- Hydrates form when enough water vapor is present in the gas



Drying Natural Gas - Safety issues!

International & Market Standards



- CNG Fuel Standards
 - ◆ ISO 15403 ←
 - ◆ SAE J1616

- CNG Fuel Standards
 - ◆ ISO 11439 ←
 - ◆ NGV2 Cylinders

Drying Natural Gas - Safety issues!

ISO 11439:2000(E), Paragraph 4.5-Gas Composition

4.5.3 Wet gas

This is gas that has a higher water content than that of dry gas.

Constituent maximum limits shall be:

- ◆ Hydrogen sulfide and other soluble sulfides: **23 mg/m³**
- ◆ Oxygen: **1 % (volume fraction)**
- ◆ Carbon dioxide: **4 % (volume fraction)**
- ◆ Hydrogen: **0,1% (volume fraction)**

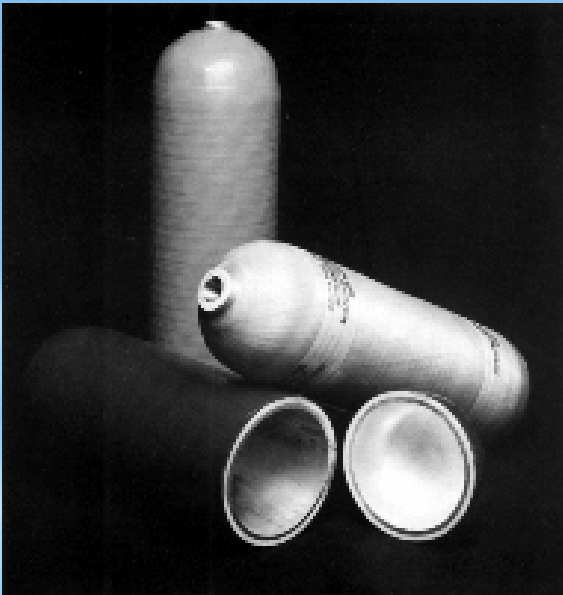
Since there is no economical means to detect and limit these H₂S and CO₂ constituents in the gas stream.

***“Conclusion reduce the moisture in the gas
with DESICCANT DRYERS.”***

Drying Natural Gas - Safety issues!

Long-term and serious problems:

- Natural Gas contains H_2S & CO_2
- Water + H_2S or CO_2 = Acids!!
- Internal corrosion of thin-walled high-pressure storage tank (spot corrosion)
- Combined with constant pressure cycling => corrosion fatigue



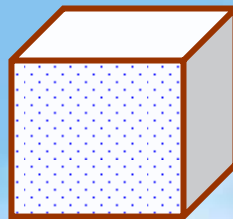
APPLICABLE EQUATION: ***CORROSION = EXPLOSION***

Pressure vs. volume...

Relation between pressure and volume

Boyle & Mariott Principle

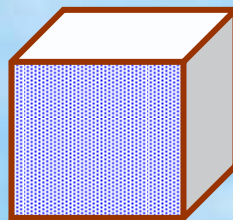
Compression = Concentration of molecules



1 F³ of gas

1 Atm. = 14.7 PSIA

7 Lbs. H₂O/MMSCF



1 F³ of gas

245 Atm. = 3600 PSIG

1715 Lbs. H₂O/MMSCF

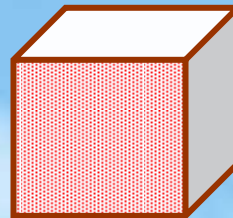
And what about gas temperature!

Pressure vs. temperature...

Relation between compression and gas Temperature - Joule-Thompson effect (aka Heat of compression/Expansion cooling)

Compressing gases:

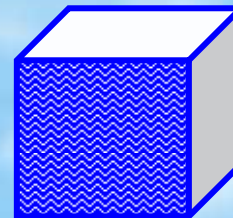
- Water per F³ increases
- Temperature increases



245 Atm. = 3600 PSIG
1715 Lbs. H₂O/MMSCF
100 deg. F

Expanding gases:

- Temperature decreases
- Moisture reaches dewpoint and turns into liquid!



Back to 1 Atm. = 14.7
Temp. ↓ 100 deg. F.
Dewpoint reached
FREE MOISTURE...

Natural Gas Composition

Water vapor!

Briefly...

Effect without dryer...

- Gas enters compressor, gets compressed (temperature and moisture concentration increases),
- Gas enters storages and expands (temperature decreases, moisture turns into liquid...too late)
- HP gas containing moisture is traveling to the dispenser, enters vehicle cylinder and expands once again...WATER!