“BAIS” and “Continuous Injection” Advanced production optimization methods using wellhead compression
Principles of Wellhead Compression

• Increase the flow of oil and gas from the reservoir into the well-bore by decreasing the flowing wellhead (and bottom-hole) pressure. The gas is then compressed to reach gathering system pressure.

• Reduce liquid loading by assisting wells to achieve critical flow rates through reduced pressure and increased rate.

• Unlike other forms of artificial lift, wellhead compression keeps the well unloaded and reduces the wellhead back pressure to keep the well flowing at new higher rates.
Typical Well With Liquid Loading Issues

Well Decline Curve

Volume

781 mcfd

625 mcfd

500 mcfd

Well loaded with fluid

Year One

Year Two

Year Three

2-3/8 Tubing

Average 20% decline per year

Time
Compression Solution

Well Decline Curve

Volume

781 mcfd
625 mcfd
500 mcfd

Install GasJack (Avg. 126 mcfd benchmark uplift on 2 3/8" tubing)

Well loaded with fluid

Year One
Year Two
Year Three

2-3/8 Tubing
Average 20% decline per year

Time

COMPRESSCO PARTNERS™ L.P.
Sample Gas Well with Liquid Loading Issues Before and After GasJack Installation

IND 1-96-IND-7674 - RIVERTON DOME

IND 1-96-IND-7674 -- Riverton Dome, Wyoming
Frontier Reservoir

GasJack Installed on 10-2003

5 Year GasJack Life/ 17.7% decline
336 MMcf incremental Gp
Total NPV10 = $1,547,932

Projected w/o GJ
When the straight forward application of installing a compressor at the wellhead isn’t enough:

Backside Auto Injection System (BAIS)

and

Continuous Injection
Backside Auto Injection System (BAIS)

1. Falling tubing pressure indicates that the well has fallen below critical flow and liquids are starting to accumulate in the tubing.

2. Discharge gas normally compressed into the sales line is injected down the casing-tubing annulus when sensors detect a falling tubing pressure.

3. This injected gas combines with produced gas to generate the higher rate needed to naturally lift liquids to the surface.

4. The detection of rising tubing pressure indicates the well is unloaded and compression resumes to the sales line.
We achieve this with 2 pilot-operated valves sensing the tubing pressure – one valve normally opened on the discharge – and the other normally closed going to the casing. We are still able to sell liquid down the discharge to sales or to a tank.

When the tubing pressure falls below the required set point – to provide maximum MCFD flow up the tubing, the normally closed valve running to the casing starts to open while the normally opened valve to the sales, simultaneously closes. This will remain in this position until the tubing pressure rises above our required set point.

This procedure allow us to be as far above the critical flow rate as possible, while selling and inverting flow. At the same time preventing the well from liquid loading.
BAIS Success Stories
BAIS Success Story

06-28-34-27W4

DAYS #1-7, GAS JACK WITHOUT BACKSIDE INJECTION

DAYS #8-30, GAS JACK WITH BACKSIDE INJECTION

DAYS

GAS FLOW (MCFD)

0 50 100 150 200 250 300

2 3/8 TUBING CRITICAL FLOW RATE @ 10 PSI
BAIS Success Story

CANADA #137 UPDATE

- DAILY GAS PRODUCTION INCREASED FROM 140 MCFGPD TO 440 MCFGPD
- AND THE GASJACK HAS HELPED SUSTAIN PRODUCTION OF 300 MCFGPD
- WITH CALCULATED INCREMENTAL RESERVES OF 123 MMCF OF GAS
- PRODUCED OVER A 1.6 YEAR PERIOD
BAIS Success Story

After installing GasJack 9/28/2005, the rate of decline went from 48% to 13% and incremental reserves of 175 MMCF of gas were produced over 3-1/2 years at an average daily prod rate of 180 MCFGPD.

Projected Decline Rate of 48%
Casing Pressure
400 to 800 pounds
Well would unload but
production up and down.
Line pressure 30 pounds.
Gas Jack before and
after injection

With Injection System

Gas Jack Pulling on
well
130 MCFD and 5 Barrels of Oil
Casing pressure is now 130 pounds
Customer set three more compressors the next week.

Well was on plunger
70 mcfd
1 barrel of fluid.
Casing pressure 330 pounds.
BAIS Success Story

Rate/Time Graph

Lease Name: ALBERTA (WELL B)
County, ST.: 
Location: 0-0-0

WELL B

AFTER BAIS, DAILY PRODUCTION INCREASED FROM 30 MCFGPD TO 170 MCFGPD MAINTAINING AVG. DAILY RATE OF 188 MCFGPD OVER 22 MO. PERIOD. CALCULATED INCREMENTAL RESERVES OF 98 MMCF OF GAS WERE PRODUCED OVER THIS SAME TIME PERIOD.

DAILY OIL PRODUCTION WENT FROM A LOW OF 2 BOPD TO AN AVG. OF 4 BOPD OVER THE NEXT 22 MONTH PERIOD.

---

GAS

OIL

WATER
Continuous Injection

- Similar to the BAIS, the “continuous injection” process directs a portion of the compressed gas into the casing-tubing annulus, however, this system does so on a continuous basis.
- The combined rate from injection and the reservoir keep the well above critical flow and therefore lifting fluids to surface.
- Only the required minimum amount of gas is injected down the annulus to maximize the volume of gas produced to the sales line.
AFTER INSTALLING THE GASJACK, THE DAILY GAS RATE WENT FROM 66 MCFGPD TO 157 MCFGPD AND THE GASJACK HAS HELPED MAINTAIN AN AVERAGE DAILY GAS RATE OF 95 MCFGPD VS A FORECASTED DAILY RATE OF ONLY 35 MCFGPD WITHOUT THE GASJACK.
Increasing Production from Oil and Gas Wells for over 10 years

- Improved Cash Flow from existing wells
- Easy to operate, easy to maintain
- Outstanding Safety Record
- Nearly 4000 installations worldwide
Company Highlights

Compressco Inc. created in 1999 has an installed base of ~4000 GasJacks operating world wide. World Leader in the niche product range for Wellhead Gas Compression technology.

Compressco (GSJK on the NASDAQ) is a majority interest owned subsidiary of Houston based TETRA Technologies (TTI on NYSE).

Compressco is headquartered in Oklahoma City with divisional offices in Calgary, Canada (established 2001), Mexico (established 2005), Indonesia (established 2007), Ukraine (2008), Argentina (2008), Brazil (2008), Romania (2009)
High Quality Customer Base

Compressco has +/-400 current customers.
Diversified cross-section of Major and Independent Producers
Compressco Value Proposition

- **Broad Application Range – Sweet Gas**
  - Suction Pressure from 16” Hg vacuum to 60 PSIG (4bar)
  - Discharge Pressure from 50 to 450 PSIG (30 bar)
  - Up to 20 Compression Ratios

- **Natural Gas throughput up to 750 mcf/Day (20,000 m3/day)**
  - Dependant on suction and discharge pressure. See curves.

- **Standard 36 Bbl/Day (6 m3/day) capacity blow case separator – 1.5 Bbl/Hr slugging up to 1 Bbl**
  - Can double capacity with slight modifications to liquid-dump line

- **Optional Gravity Feed Vessel (GFE) increases liquid handling to +/- 6 BPH.**

- **Over 156MM hours of field proven up-time experience since 1999**
GasJack - Specifications

- Capacity: Maximum of 750 mcf (20,000 m3/day)
- Pressure Range: Discharge:  
  - min 50 psig (3.4 bar)
  - max 450 psig (31 bar)
  
  Suction:  
  - min 0
  - max 60 psig

- Compression Ratio: Maximum of 20 ratio with single stage!
  
  • High compression ratio allows for very flexible compressor with wide application range.
  
  • Compared to a screw compressor, the GasJack is much more adaptable to changing operating conditions often seen on liquid loaded marginal wells.

Integral V8 Engine/Compressor

- 170 CID compressor
- 230 CID, 46 HP engine
- Highly efficient cooling
- US Patents: 4,961,691 & 5,203,680 & 5,189,905 & 5,267,843
GasJack – Specifications Continued

- CE certified GasJack compressor (ATEX and PED certified)
- Emissions control equipment available to meet EU specifications.
- Noise suppression solutions available to meet EU specifications.
- Fuel Gas: natural gas from well head. No external power required.
- Minimal site preparation (no concrete pad)
Additional Applications for GasJack Compressor

Pumping Oil Wells – Annular Gas
- Compress annular gas to reduce flowing down hole pressure to increase oil and gas production from the well.

Flare Recovery / VRU
- Eliminate flaring and/or venting by collecting low pressure gas sources and compressing them to nearest pipeline.

Flare & Smoke at Semberah S-14
→ Before VRU GasJack Compressor online

NO MORE flare at Semberah S-14
→ GasJack recovers 0.25 MMcfd ; Ps=0.5 psi ; Pd=59 psi
Kevin Book, P.Eng,
Vice President – International Operations
Office: (405) 677-0221
Cellular: (405) 397-6551
Email: kbook@compressco.com

Web Page
www.compressco.com