Vapor Recovery & The Capture of “Associated Gas”

Practical Applications & Case Studies

Rome 2008

Presented by:
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President & CEO
Hy-Bon Engineering Co.

“ASSOCIATED GAS”

Storage Tanks

Production Equipment

Casinghead Gas

OIL STORAGE TANKS

Vapor Recovery

Systems

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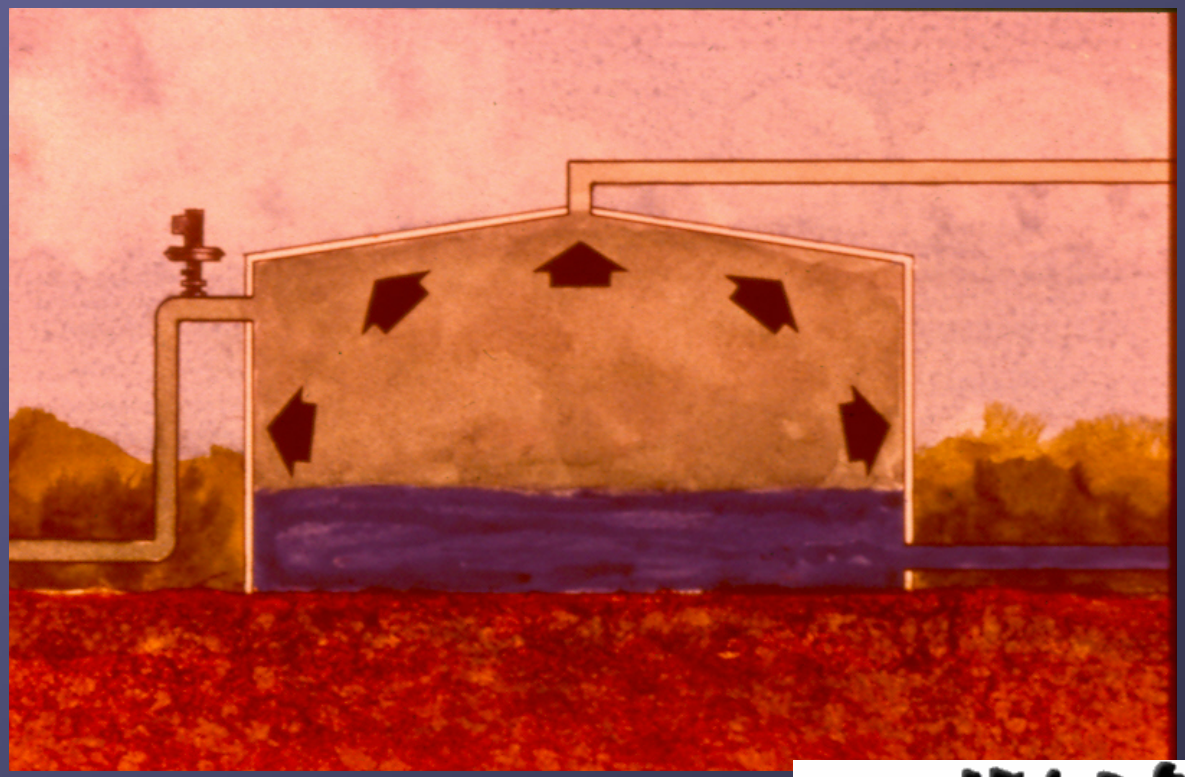
TANK OPERATIONS

As the oil resides in the tanks, it gives off vapors, thereby increasing the pressure inside the tank.

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Sources of Methane Losses

- Approximately 26.6 Bcf/yr of Methane are lost from storage tanks in the U.S. alone
  - Flash losses
    - occur when crude is transferred from containment at a high pressure to containment at a lower pressure
  - Working losses
    - occur when crude levels change and when crude in the tank is agitated
  - Standing losses
    - occur with daily and seasonal temperature and pressure changes

Source: Natural Gas STAR Partners

WHY LET $ ESCAPE INTO THE AIR?

Besides being an environmental hazard, escaping vapors result in the loss of a major revenue source for the oil company. Hundreds of oil companies have added significant money to their bottom line by capturing this valuable gas stream.

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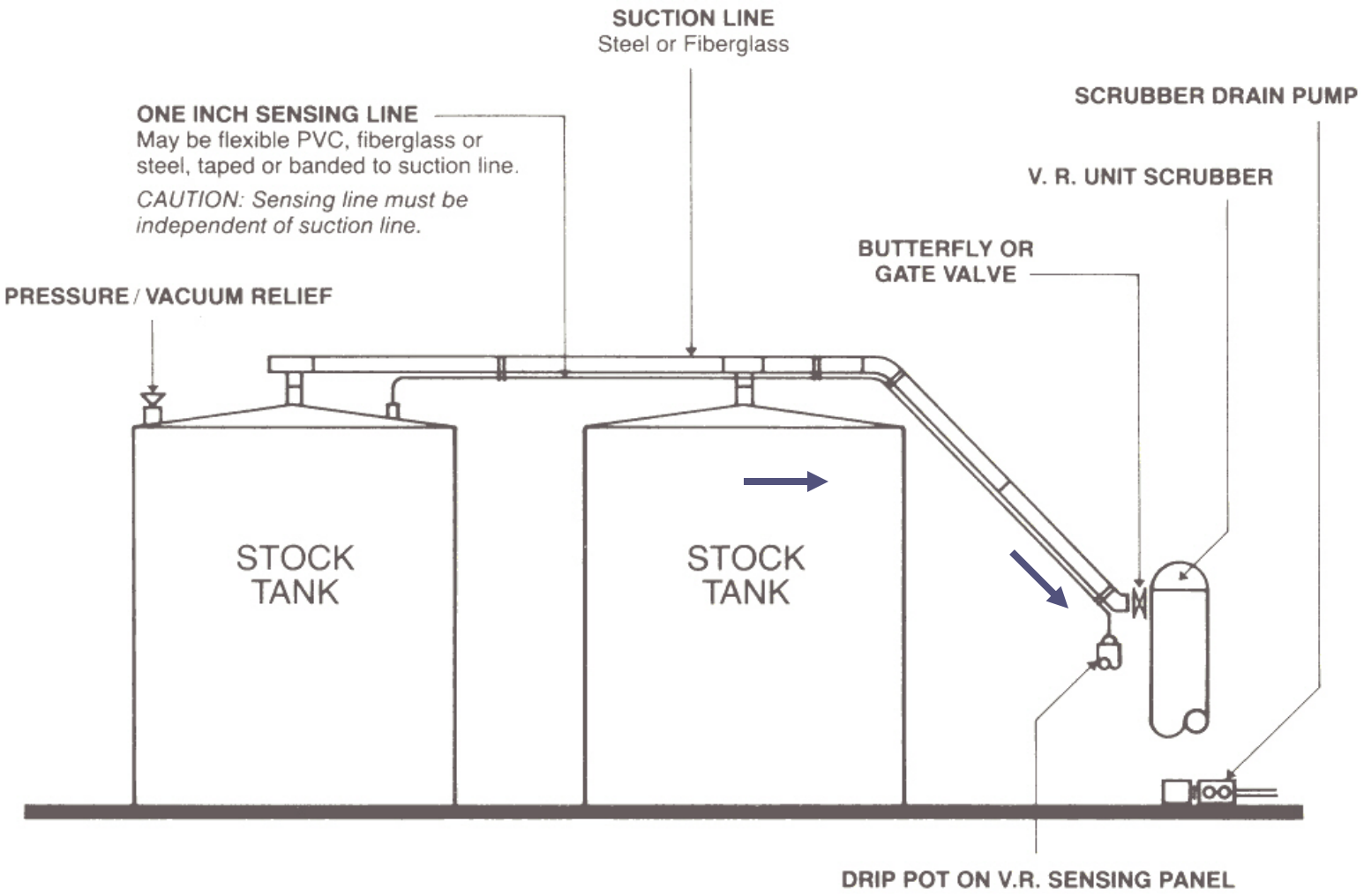

NOTES
All lines must be horizontal, or sloped down to V.R.U. suction as shown.
Scrubber fluid is piped back to tanks or to waste.
The system must be closed — no air entry.

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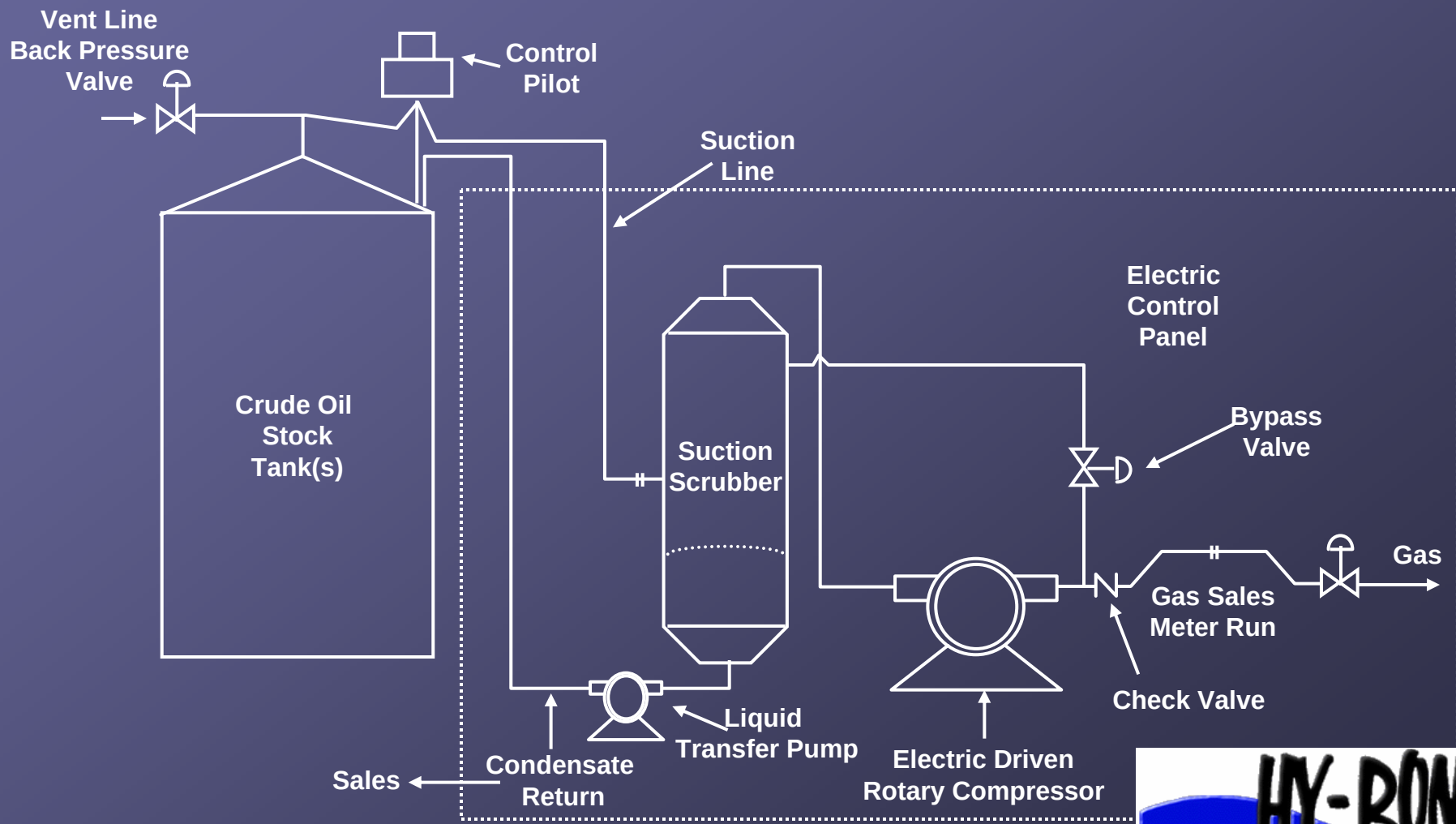
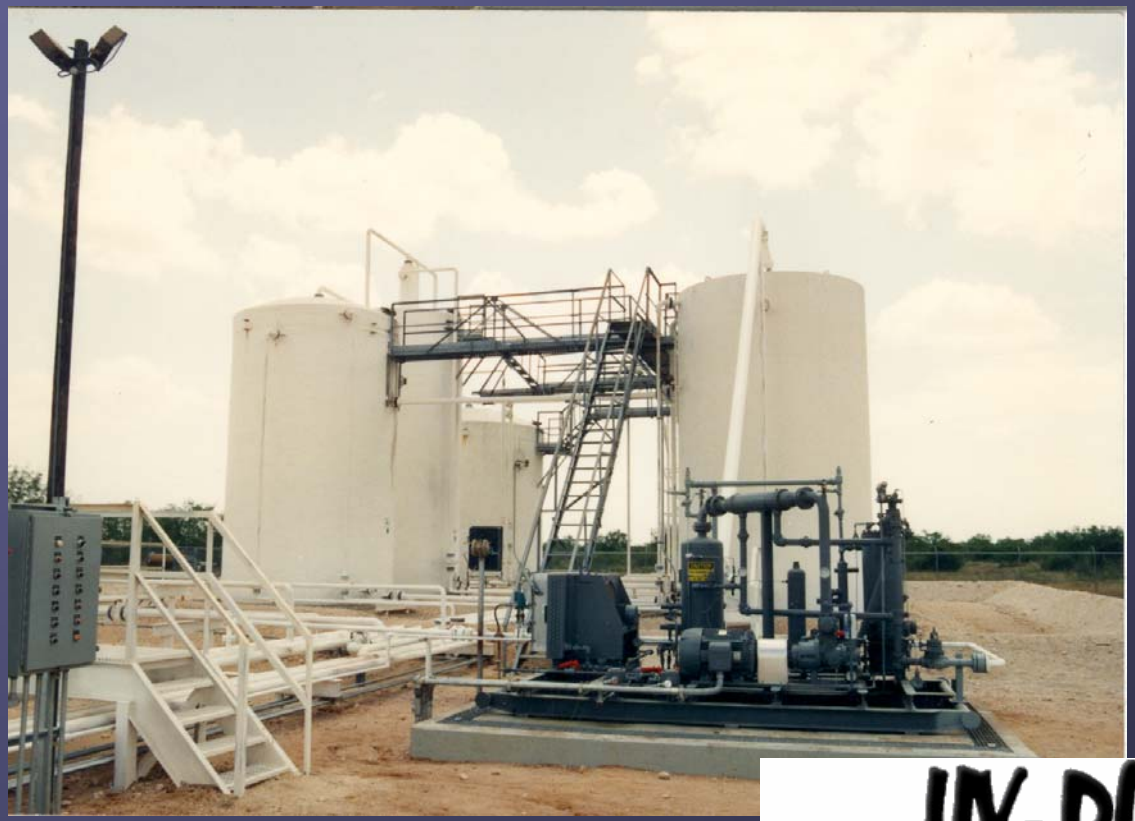
Standard Vapor Recovery Unit



VAPOR RECOVERY

Typical stock tank vapor recovery unit in operation. This unit is configured to capture 90 mcfd of gas and discharge into a 40 psig sales line.

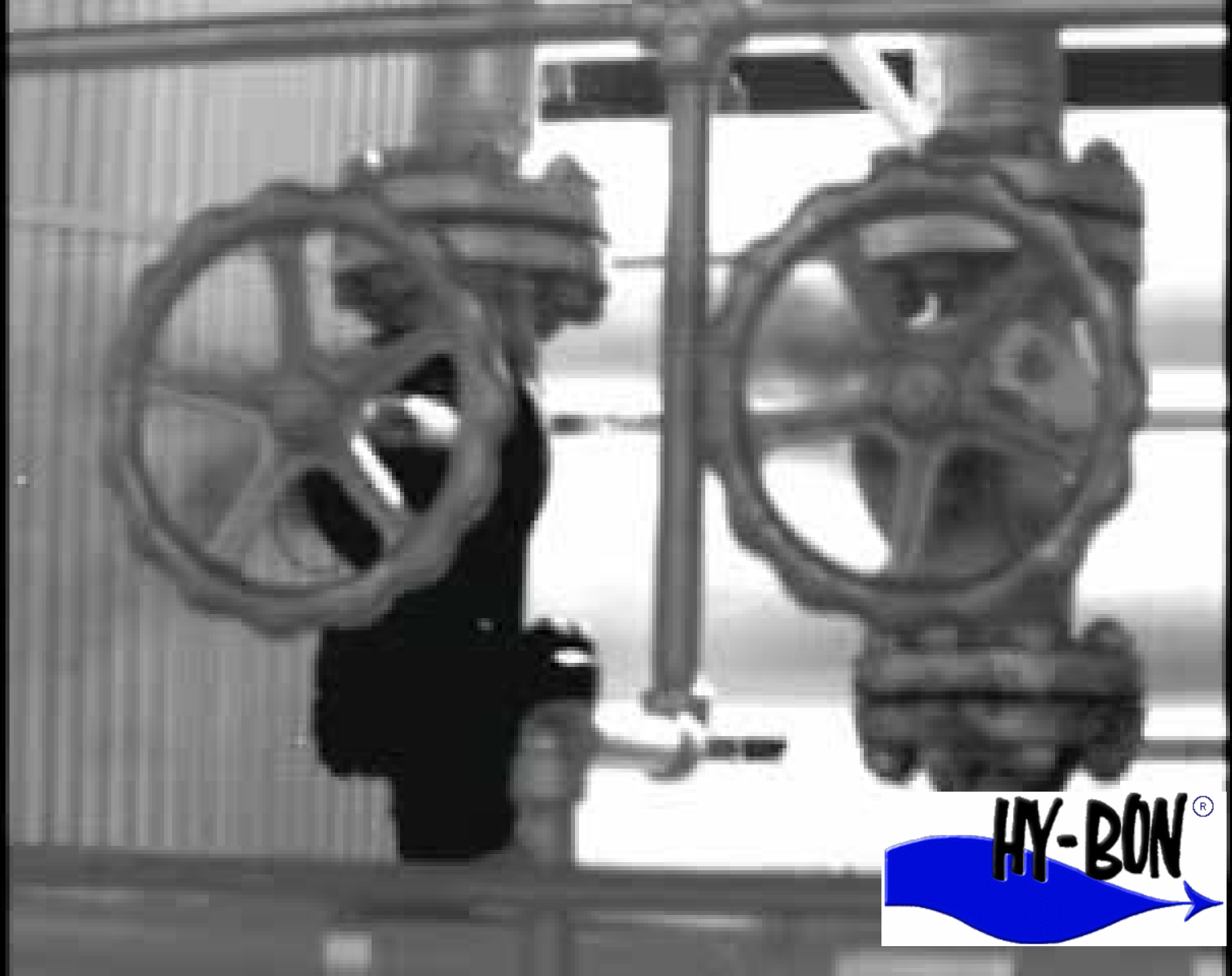


Benefits of Vapor Recovery Units

- Capture up to 95 percent of hydrocarbon vapors that accumulate in tanks
- Recovered vapors have much higher Btu content than pipeline quality natural gas
- Recovered vapors can be more valuable than methane alone
- Reduce regulatory & liability exposure

Quantifying the Gas Stream

- IDENTIFY emission sources using the FLIR GasFinder camera
- QUANTIFY emmissions using chart, E&P Tank, HiFlow Sampler, bagging techniques and actual tank tests per location with turbine meters, recording manometers and mass flow meters.
- RECTIFY emission by recommending best technical alternatives available in the industry for capturing each source and adding to the revenue stream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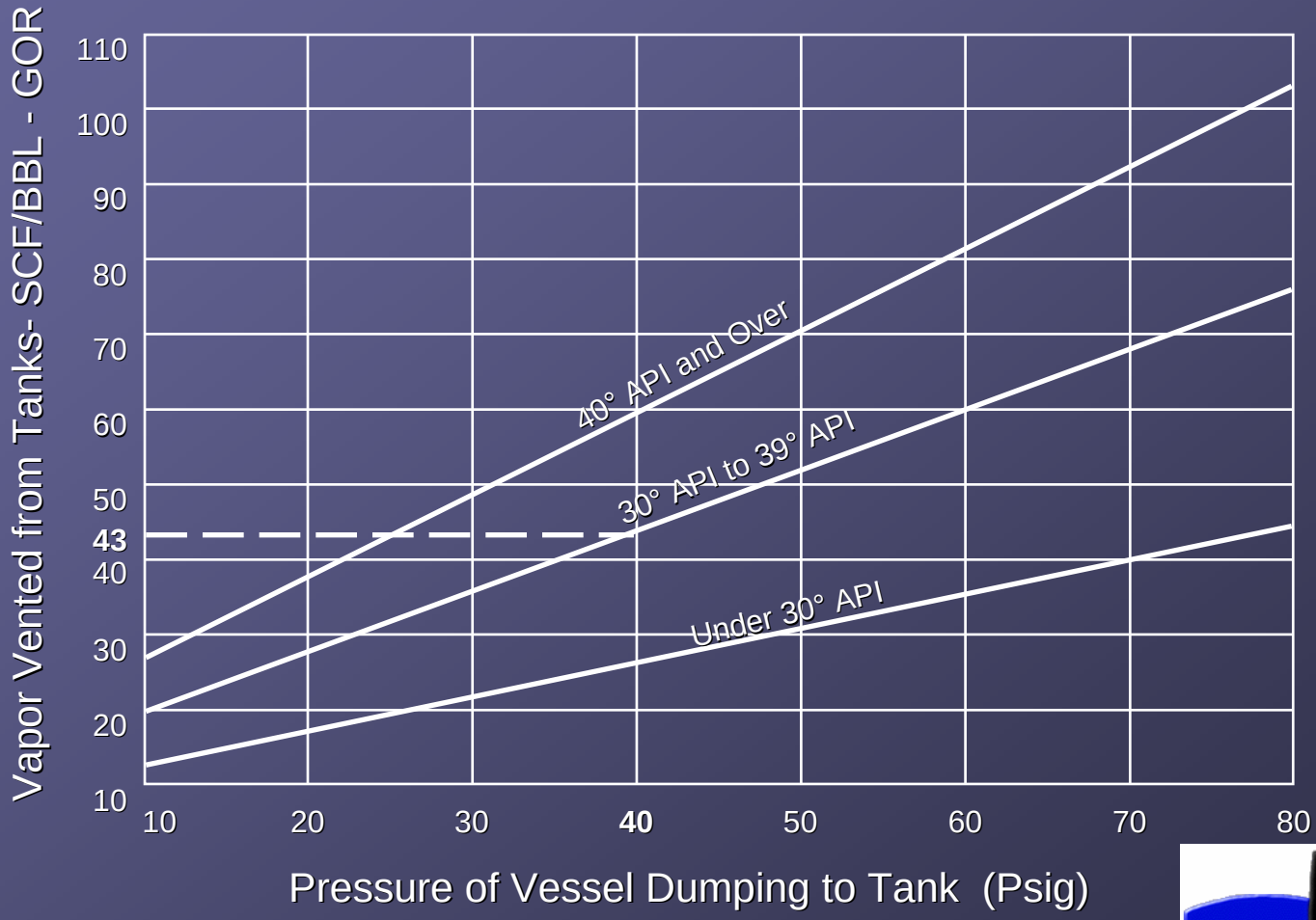
Estimated Volume of Tank Vapors



Estimating Tank Emissions

Chart method is a quick and easy way to get a fast ballpark estimate

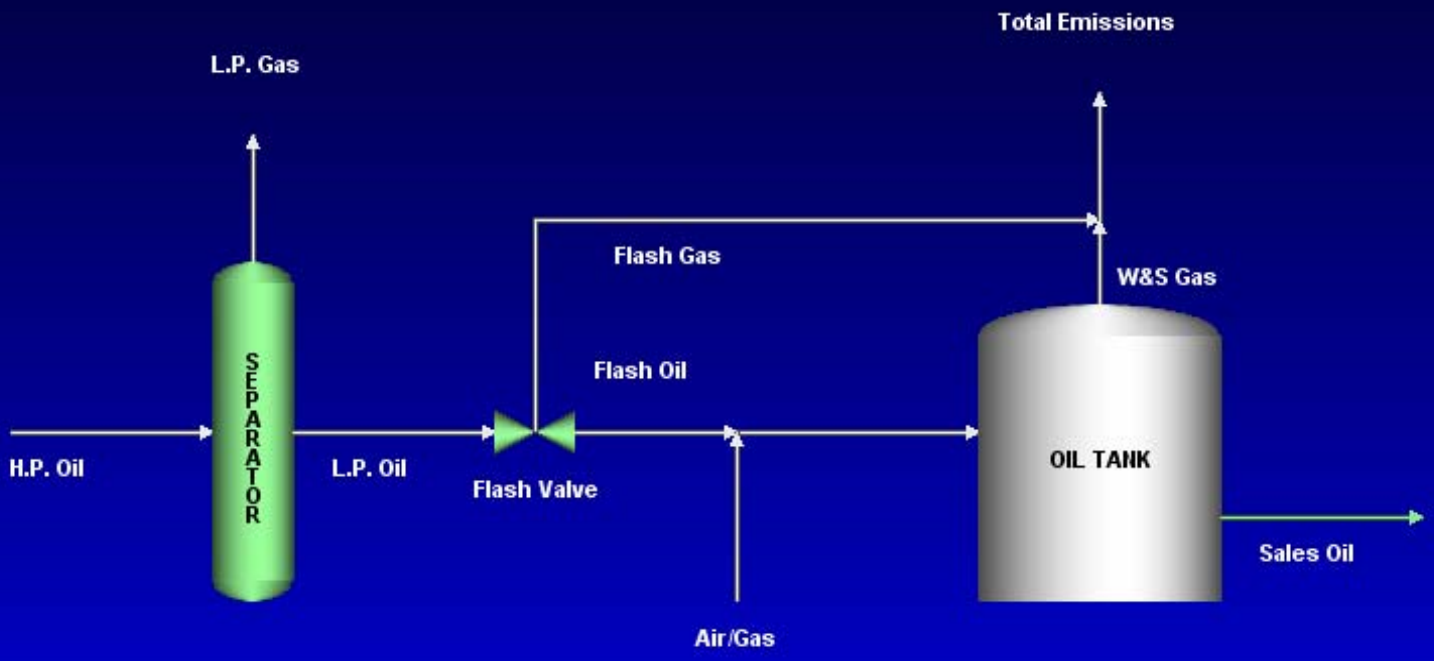
Notice the impact of higher gravity oil, as well as higher separator pressures

This method is VERY CONSERVATIVE and generally underestimates actual emission levels

Quantify Volume of Losses

- *E&P Tank* Model
  - Computer software developed by API and GRI
  - Estimates flash, working, and standing losses
  - Calculates losses using specific operating conditions for each tank
  - Provides composition of hydrocarbon losses

E&P TANK INPUT SCREEN


Total Emissions
L.P. Gas
Flash Gas
W&S Gas
Flash Oil
SEPARATOR
H.P. Oil
L.P. Oil
Flash Valve
OIL TANK
Sales Oil
Air/Gas

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E&P TANK EXAMPLE OUTPUT

-- Emission Composition ----------

Component	Uncontrolled [ton/yr]	Uncontrolled [lb/hr]	Controlled [ton/yr]	Controlled [lb/hr]
H2S	12.137	2.771	0.607	0.139
O2	0.000	0.000	0.000	0.000
CO2	85.667	19.559	85.667	19.559
N2	2.284	0.521	2.284	0.521
C1	122.391	27.943	6.120	1.397
C2	159.072	36.318	7.954	1.816
C3	415.158	94.785	20.758	4.739
i-C4	96.442	22.019	4.822	1.101
n-C4	261.360	59.671	13.068	2.984
i-C5	82.901	18.927	4.145	0.946
n-C5	97.357	22.228	4.868	1.111
C6	28.130	6.422	1.407	0.321
C7	26.984	6.161	1.349	0.308
C8	10.294	2.350	0.515	0.118
C9	2.081	0.475	0.104	0.024
C10+	0.544	0.124	0.027	0.006
Benzene	2.029	0.463	0.101	0.023
Toluene	0.250	0.057	0.013	0.003
E-Benzene	0.032	0.007	0.002	0.000
Xylenes	0.264	0.060	0.013	0.003
n-C6	19.202	4.384	0.960	0.219
224Trimethylp	0.000	0.000	0.000	0.000
Total	1424.579	325.246	71.229	16.262

-- Emission Summary ----------

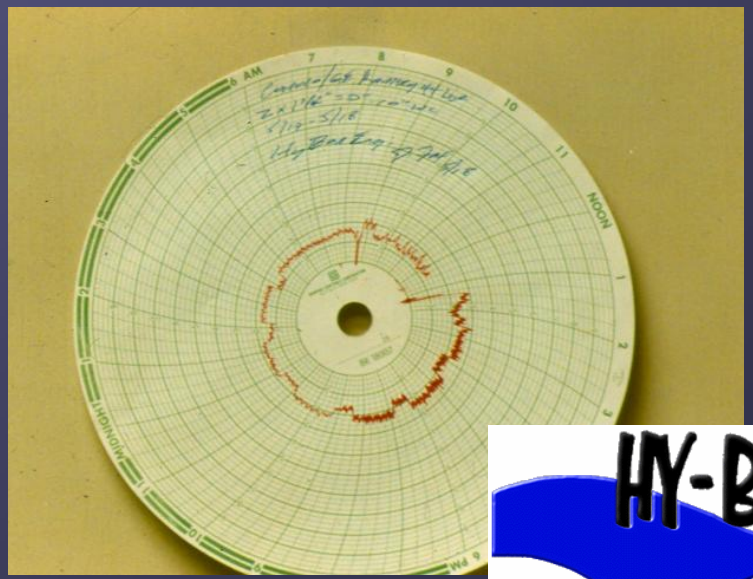
Item	Uncontrolled [ton/yr]	Uncontrolled [lb/hr]	Controlled [ton/yr]	Controlled [lb/hr]
Total HAPs	21.780	4.973	1.089	0.249
Total HC	1324.491	302.395	66.225	15.120
VOCs, C2+	1202.100	274.452	60.105	13.723
VOCs, C3+	1043.029	238.134	52.151	11.907

Uncontrolled Recovery Info.

Vapor	71.3400	[MSCFD]
HC Vapor	66.3900	[MSCFD]
GOR	35.67	[SCF/bbl]

TANK TEST

A chart recorder is set up on the tank battery for a 24-hour pressure test. The resultant chart is brought into the office for evaluation. Information such as ambient temperature, test apparatus size and orifice size is recorded and used in the calculation of volume of tank vapors.



TANK TEST

Ultrasonic meters, Turbine meters and Mass flow meters are also highly effective

The key is DURATION – a minimum of 24 hours of emissions must be charted for accurate results

CASE STUDIES
&
EXAMPLES

Industry Experience: Oxy

Oxy Case Study - Vapor Recovery

Wasson Tank Battery (CDU 1 & 2)

Denver City, Texas

Installed in 2004

Oxy purchased two vapor recovery units in August 2004 for capturing vapors from two separate tank batteries at their Wasson facility.

Each battery produces approximately 450 MCFD of tank vapors, which Oxy needed to gather and compress into a 45 psig sales line.

Due to the low discharge pressure, Oxy selected rotary vane compressor packages capable of moving 500 MCFD.

In order to minimize maintenance, Oxy selected electric drive units

(75 horsepower electric motors on each unit).

Oxy Wasson Tank Battery 1 (CDU 1)

Oxy Wasson Tank Battery 2 – CDU2

Industry Experience: Oxy

Purchase Cost	$92,500	$185,000
Installation Cost	$9,500	$19,000
Installed Cost	$102,000	$204,000
Gas Volume (mcfd)	450	900
Value @ $6 / mcf	$2,700	$5,400
Annual Revenue (with NO btu adjustment and no liquid sales)	$985,500	$1,971,000
Monthly Incr. Revenue	$82,125	$164,250
Payout (in Months)	1.24	1.24

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This is one of 3 Vapor Recovery Units that will be used to capture 25 Million cubic feet of gas in Angola for the Chevron Cabinda project – commissions in 2008.

Installed November 2007

Angola

Chevron Cabinda Flare Reduction Project - 25 MMCFD


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Project Overview – Chevron Cabinda Project (Angola)

- This project was the Chevron's largest flare reduction project in 2007 – Angola Cabinda
- Hy-Bon Vapor Recovery Units are scheduled to be commissioned in Fall 2008.
- The 25 MMCFD of flare and vent gas recovered has the same greenhouse gas effect of removing 812,000 cars from the road or planting 1.1 million acre of trees

Project Overview - PDVSa

This flare in Venezuela was causing a variety of health and environmental concerns. Billions of cubic feet of methane are vented and flared from oilfield separators and storage tanks in almost every producing country.

Project Overview - PDVSa

This dual flooded screw package for PDVSA is designed for volumes to 5.0 MMSCFD; moving tank vapors from 0 to 200 psig in Eastern Venezuela.

Project Overview - PDVSa

At this location, three of our compressor packages were set in tandem to move 15 MMSCFD of 2500-2600 BTU tank vapors.

Project Overview – PDVSa Gas Anaco (Venezuela)

- Vapor recovery units currently capture over 75 million cubic feet of previously vented and flared gas across 7 facilities
- Gas Anaco project, begun in 2006, targets over one billion cubic feet of gas across eastern Venezuela
- Conversion of much of the power and transportation infrastructure to natural gas is underway

Eni Dacion

Eni installed vapor recovery systems in their Dacion East and West facilities in Venezuela, each designed to move 1.4 MMSCFD of gas at pressures to 230 psig.

Eni Oil & Gas

Dacion Field, Venezuela

2004

Project Overview – Eni Dacion (Venezuela)

- Vapor recovery units were installed to capture up to 1.4 MMCFD per site
- White paper was written shortly after installation on the economic success of the project
- A highly valuable 70 API gravity condensate was recovered from the gas stream and used to blend with the primary low API gravity oil production – at an approximate daily rate of 100 to 150 barrels of condensate per unit.

M2M Project Update

Oxy Colombia

Initial project will be capturing approximately 350 mcfd of vent gas from the Caricare oil storage and production facility.

Purpose of the project will be incremental capture of natural gas liquids from this gas stream.

Two additional sites are planned following successful installation of the first project.

Subsequent project to utilize flare gas is also being evaluated by Oxy Colombia.


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Oxy Colombia April
2008

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2008

Other Emission Sources

Gas can also be captured from separators and other field equipment. This unit is capturing natural gas off several separators for sale down a high pressure line.

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Other Emission Sources

This unit captures a 98% CO2 gas stream in a field outside Snyder, Texas. Flooded screw compressor for volumes to 1.5 MMSCFD. The CO2 is captured and re-injected into the formation, dramatically reducing operating costs.

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CASINGHEAD PRESSURE REDUCTION

In the effort to wrench additional dollars from existing production, more and more producers are turning to the use of low horsepower compression to enhance production from mature wells.

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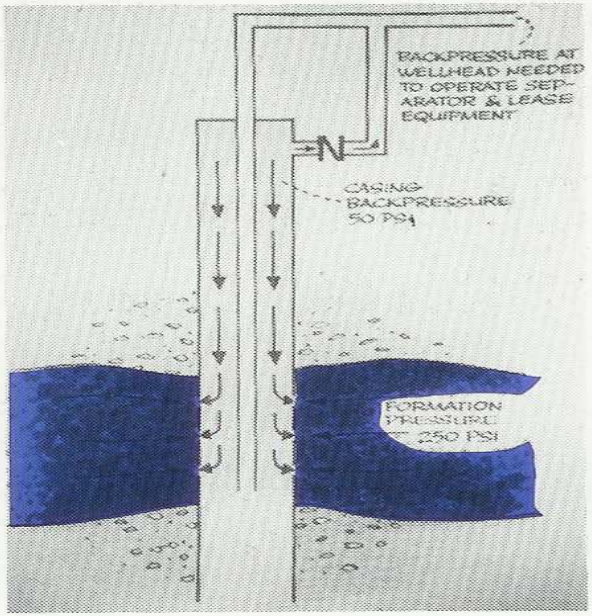
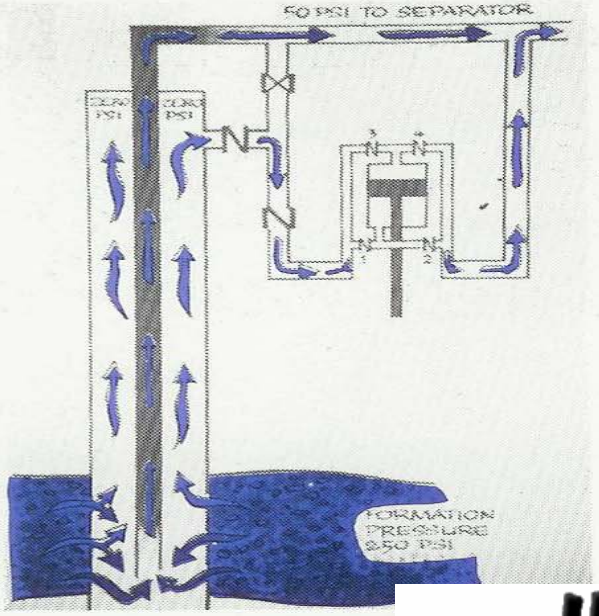
Relieving Back Pressure

BEFORE COMPRESSION

Restricting Back pressure holds back the flow of Hydrocarbons into the well bore.



AFTER COMPRESSION



Back pressure is relieved from the face of the formation allowing more hydrocarbons to flow into the well bore.

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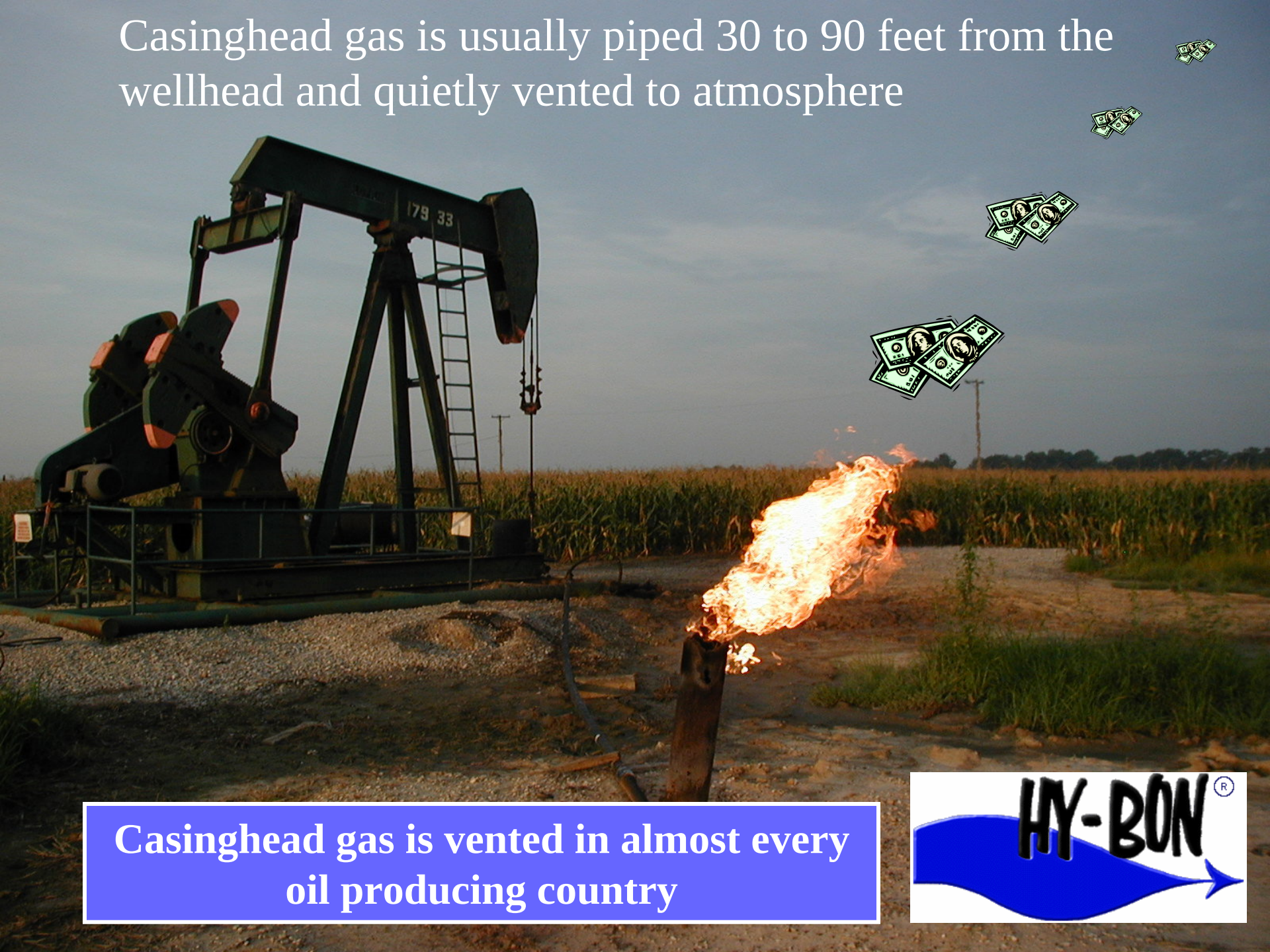
Casinghead gas is usually piped 30 to 90 feet from the wellhead and quietly vented to atmosphere



Casinghead gas is vented in almost every oil producing country

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Multiple Casinghead Pressure Reduction Case Studies and 2 published articles available at

www.hy-bon.com

In Conclusion …

- Hydrocarbon “Spills in the Air”
- Shareholder “Lost Product”
- Truly Unique Opportunity

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Setting a New Standard!!

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