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SPE DISTINGUISHED LECTURER

Techniques to Reduce Operating Costs for Increased Reserves and Profitability

Philip E. Hart
Excalibur Ventures, Inc.

Society of Petroleum Engineers
Distinguished Lecturer Program
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Focus on Adding Value

➔ TOPIC 1: Improvements of an Accounting System

TOPIC 2: Benefits of Incremental Well Costs Analysis

TOPIC 3: Operational Techniques to Decrease Expenses

GOAL:

Accurate Incremental Analysis **+** Cost Reductions **=** Increased Reserves & Profits

Accounting System Improvements

1. Field: Easy input improves accuracy
   - One-page chart of accounts for expenses
   - Each equipment assigned ID to input
2. Accounting: Use allocations based on actuals
   - Electricity $ by KW-HR estimate vs nameplate

   - Chemical $ by well (Variable) vs lease/field (Fixed)

Well ID	Chem 1 Vol	Chem 1 $		Chem 2 Vol	Chem 2 $	Total $
Well 1	3	50		2	100	150
Well 2	2	35		4	200	235

3. Office: “True” incremental individual well costs

Case Study #1: Detailing Accounting Data

Total Pump Repair = $400,000 / Year

10 Pumps = $40,000 / Year Average

Detail → Pump P01 = $20,000 / Year

Detail → Pump P10 = $80,000 / Year

Field → Cleaned out discharge scale & slower speeds

Result → Saved $255,000 / year in repairs(↓64%)

Takeaway:

Individual equipment cost locates problems

Focus on Adding Value

TOPIC 1: Improvements of an Accounting System

➔ TOPIC 2: Benefits of Incremental Well Costs Analysis

TOPIC 3: Operational Techniques to Decrease Expenses

Develop Incremental & Individual Costs

Total Cost ($/Well/Month)

Fixed 25%

Incremental 75%

Lease Average $/Well/Month

OR

Individual Well $/Well/Month

Fluid Injection → $/bw

Artificial Lift → $/bf

--- **Better Allocations** ---

Fuel, Chemicals & Labor

Case Study #2: 1150 Wells@ 2300 bopd, 150,000 bwpd

Profitability at Various Well Conditions

Major Category	Avg. Incremental $/Well/Month	Well 1 @ 2 bopd 300 bwpd	Well 2 @ 2 bopd 10 bwpd
Labor	109	85	75
Fuel	248	563	22
Chemical	78	176	7
Wells	83	140	40
Other	4	5	3
Total Cost	522	842	153
*Profit	253	-67	622

Result → Shut-in 100 uneconomic wells with side benefits

Case Study #3:

Reactivated 50 Shut-In Wells for $2.5 Million

	Average Cost	Incremental = 80% of Average	25% Cost Reduction
Rate of Return (ROR)	Loss	18%	93%
Return on Investment (ROI)	0.14	1.13	2.75
Reserves (BOE)	(Zero)	1,814,000	3,236,000

Incremental Analysis & Cost Reductions Add Reserves

Acquisition Summary 1:

- Purchased $24MM with $1 MM/year cashflow
- Lowered Costs 25%
- Reactivated Wells
- Drilled Wells (15% ROR → 35% ROR → 80% ROR)
- Increased & Realigned Waterflood Injection
- Production Increased from 6,700 to 11,100 bopd (⬆67%)
- Valuation >>$300MM (⬆12X)

Focus on Adding Value

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Three New Improved Ideas

Searching for Expense Reductions (Part 1)

A. Utilize All Personnel - "Two Heads Are Better Than One"

- Encourage Ideas for Improvements

  ➔ ➔ Remove Fear of Failure for Personnel

"I have not failed. I've just found 10,000 ways that won't work." Thomas Edison

- Failures can save money

  - 72 well cleanout of $BaSO_4$ scale saves $306,000

  ➔ Old Way = $11,000/rig job with 100% Success

  ➔ New Way = $4,000/coiled tubing job w/ 25% failures + $11,000/extra rig job (⬇39%)

Searching for Expense Reductions (Part 2)

B. Vendor list of supplies or type of chemicals

- $200,000/year for 900 ball valves for 700 injectors

➔ Changed type & double valved = $180,000/yr saved

On/Off

Choke

(⬇90%)

- $ 180,000/year for demulsifier in pipeline (⬇100%)

➔ Cut off chemical for friction loss = $180,000/yr saved

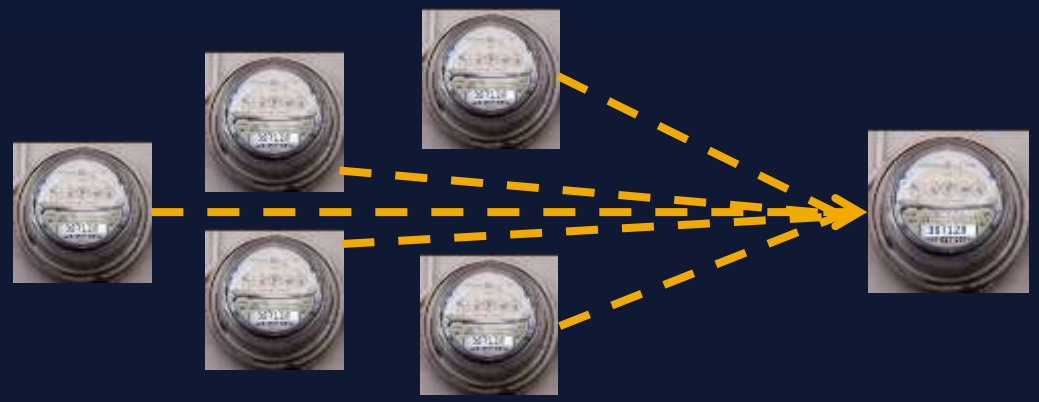
Searching for Expense Reductions (Part 3)

C. Contracts

- Electrical

➔ Rate negotiation saved $300,000/yr (⬇14%)

➔ Consolidate 5 meters to 1 meter = $100,000/yr saved



(Payout 9 months)

- Condensate ➔ Location sold 20% more BBLs

Searching for Expense Reductions (Part 4)

D. Major lease operating expenses (LOE)

- Labor – 25% to 40% savings
  - ➔ Developed "repair truck"
  - ➔ Changed pulling rig type – $160,000/yr saved(⬇25%)
- Water injection filter design (Rope to stainless screen)

Saved $400,000 / year in Well Cleanouts

- Artificial lift, electricity, chemicals (details to follow)

Focus on Rod Pumps

Case Study #4: Rod Pump Repairs

1. Set up database – track failures and future causes

2. Failures
   - Tubing holes
     - Rod wear
     - Corrosion due to rod wear
   - Corrosion from improper chemical application
   - Rod failures from stress

➔ 61% failure reduction = $1.7 MM/year savings

Pumping Failure Database Sheet

WELL NAME:	WELL ID:	FIEL
Tubing Rotation Reduces Failures	JOB # 1	JOB
Failure Date (Month/Day/Year) ===>		
Date Pulled (Month/Day/Year) ===>		
Pulling Unit #:		
DAYS OFF PRODUCTION:		
FAILURE TYPE		
Tubing Split		
Tbg Corrosion Hole	1	
Polish rod break/Scoured		
Sucker rod body break		
...		
FAILURE CAUSE (A = primary, B = Future)		
Wear	A	
C02 Corrosion (jagged,interconnected)		
O2 Corrosion(smooth large broad pits)		
H2S Corrosion(smooth, isolated pits)		
CaCO4 Scale		
Compression(cracks on 1 side of rod)	B	

Primary

Future

Well Solutions:

A. Corrosion hole from wear

➔ Manual tubing rotator


Compliments of Omega Technologies Inc.

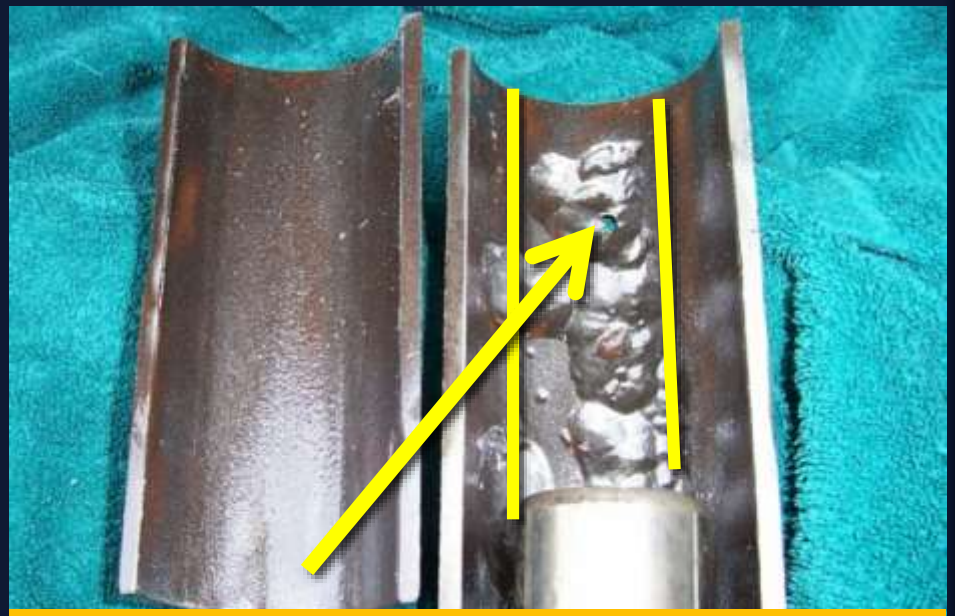
B. Rod compression

➔ Add sinker bars

➔ Change design

Manual Tubing Rotators Reduced Tubing Leaks by 83%

Typical Rod Wear on 20% of Tubing



Corrosion Hole: Wear Wiped Off Inhibitor

Takeaway: Manual rotation **5x** tubing Life

Artificial Lift Focus on Gas Lift Gas Systems

Gas Lift Gas (GLG) Operational Investigation

1. Low compressor suction pressure increases brake HP

2. Action ➔ Record rates & pressures (use same gauge)

3. Bottlenecks wasting energy:
   - Separators with high PSI to transfer water & oil
   - Line restrictions (Gathering, GLG, Transfer)
   - Gas lift valve designs

Case Study #5: Gas Lift Gas (GLG) Compressor Savings

GOAL ➔ Increase GLG from 18 MMCFD to 20 MMCFD

Optimization: Saved $276,000/year over prior fuel & rentals

1. Reduced anticipated HP by 17% ⬇
2. Raised suction pressure ⬆
3. Lowered separator pressures ⬇
4. Extra facility modifications = $50,000
5. Old wells increased > 100 bopd (⬆10%)

Takeaway:

Reduce Bottlenecks & Optimize Designs

Focus on Electricity

Centrifugal Vs Positive Displacement (PD) Pumps

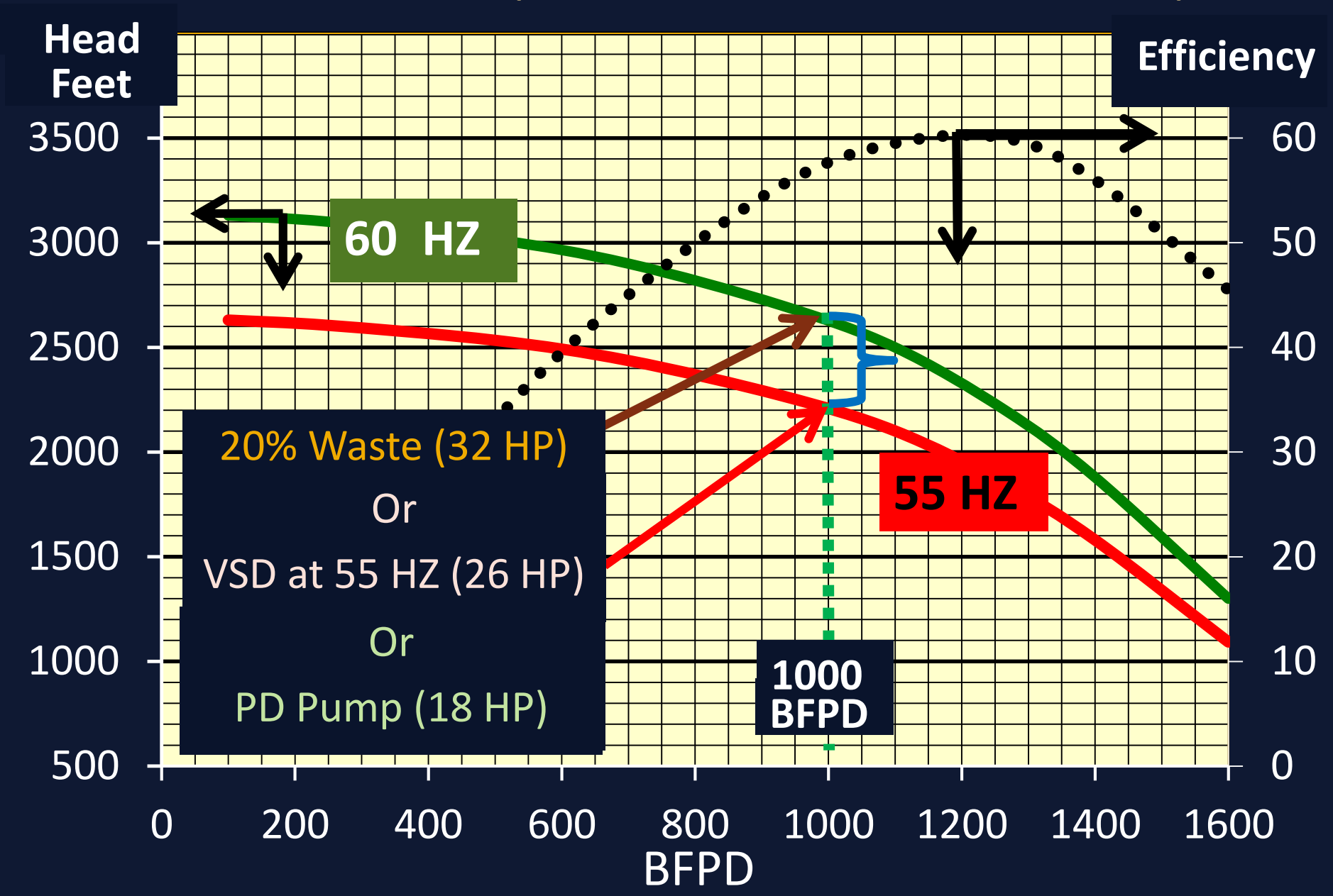
1. Centrifugal pumps are less energy efficient than PD pumps
   - "Ideal operating" centrifugals 20 to 45% less efficient
   - Choked centrifugals waste even more energy

2. Centrifugals have lower initial installation costs

Takeaway:

Balance Installation Vs Operating Costs

Chokes, Variable Speed Drives (VSD) and PD Pumps



Pump Operations (Saved $500,000/year)

Centrifugal Pumps

ON

OFF

Positive Displacement

Case Study #6: Turned off 2 of 3 centrifugal feed pumps

Savings = $100,000 per year by less choking (⬇66%)

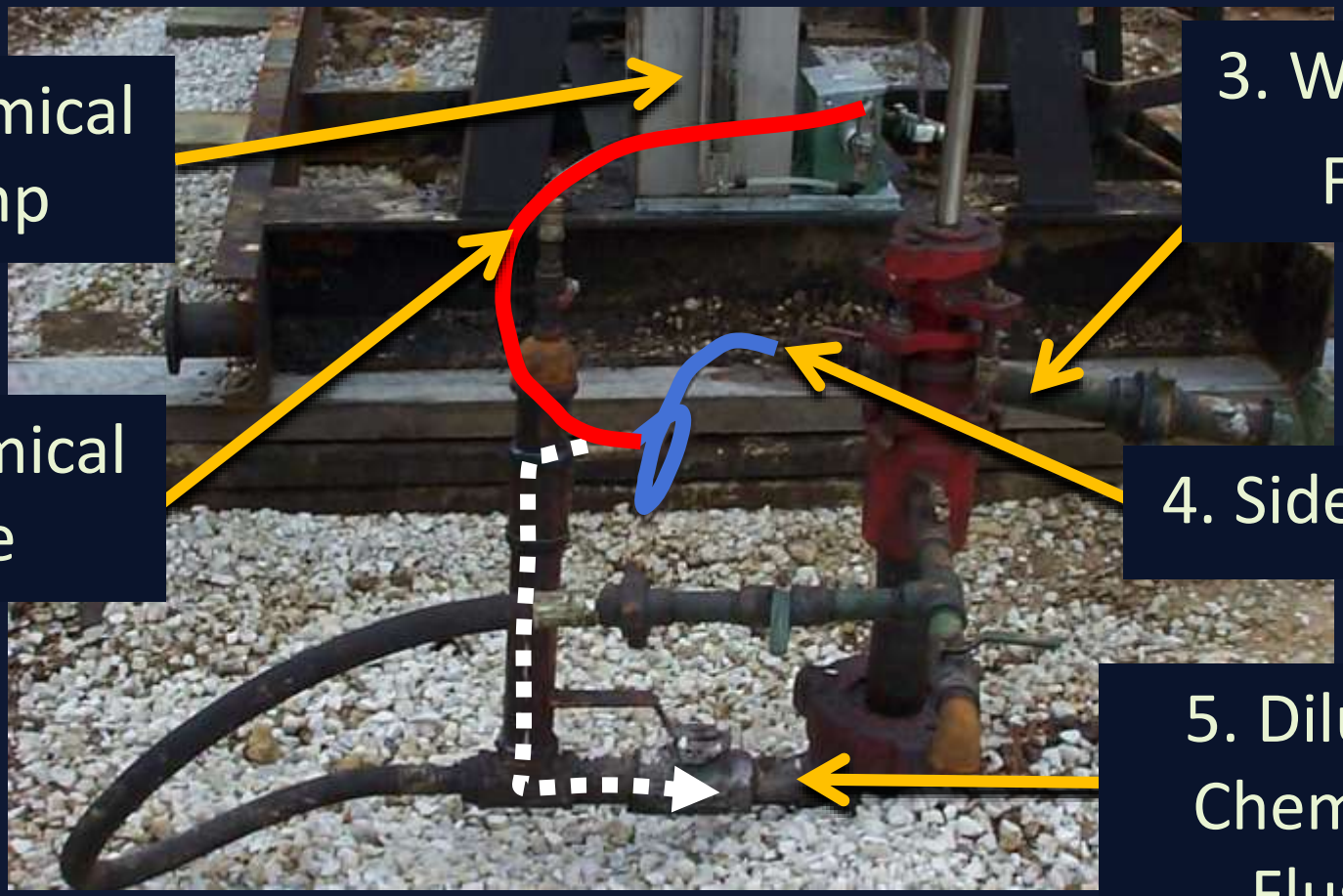
Case Study #7: Turned off centrifugal & start triplex pumps

Savings = $400,000 per year (⬇30%)

Takeaway: Less Choking or Utilize PD Pumps

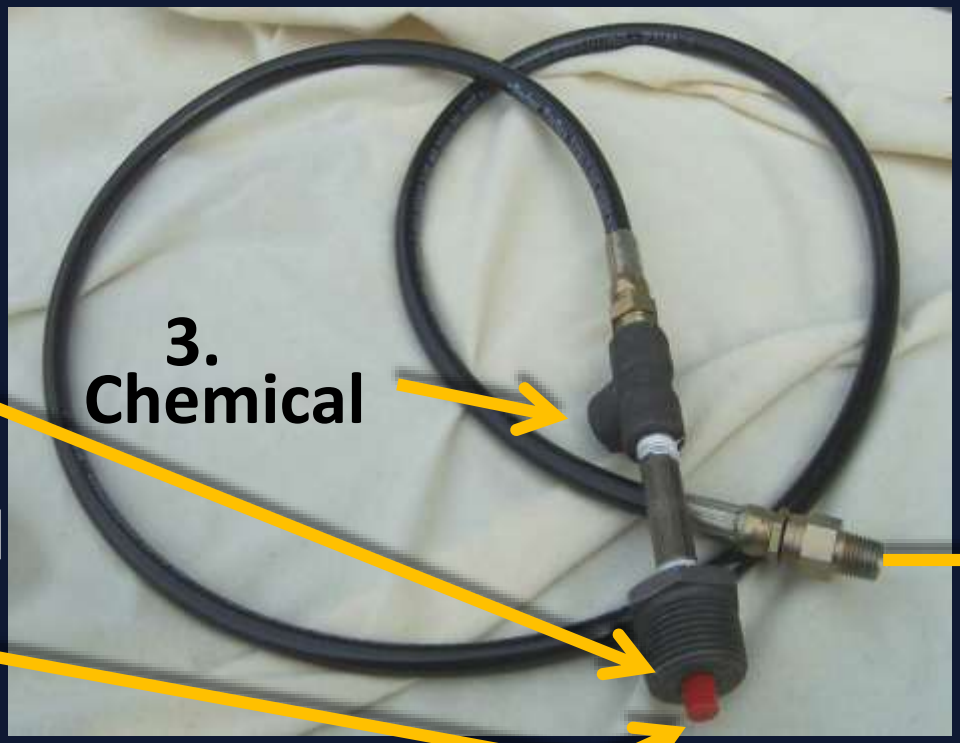
Focus on Wellhead Chemicals

Continuous Wellhead Chemical Injection



Sidestream Flush Restrictor (SFR) Improvements

1. Old sidestream in 300 wells = 75 bfpd/well (not metered)
2. Installed sidestream flush restrictors for 7 bfpd/well (⬇90%)
   - High friction hose replaces needle valve
   - Self-cleaning filter to prevent plugging



2. Filter

1. Wellhead Fluid

4. Annulus Sidestream

Compliments of Omega Technologies Inc.

Case Study #8: Installed 700 Sidestream Flush Restrictors

1. Reduced sidestream from 75 to 7 BFPD per well
2. Savings = $400,000 per year in electricity
3. Slowed down wells 30% ➔ ≅ $600,000 per year savings
4. Less plugging of line = Better chemical use
5. Three (3) month payout with over $1MM per year savings

Takeaway:

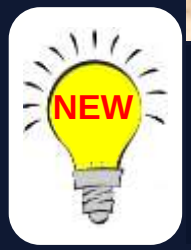
Less Sidestream Flush = Less Cost or More Oil

Focus on Positive Displacement Pumps

Reducing Vibrations in Triplex / Quintaplex Pumps

Typical Pulsation Dampener

Versus

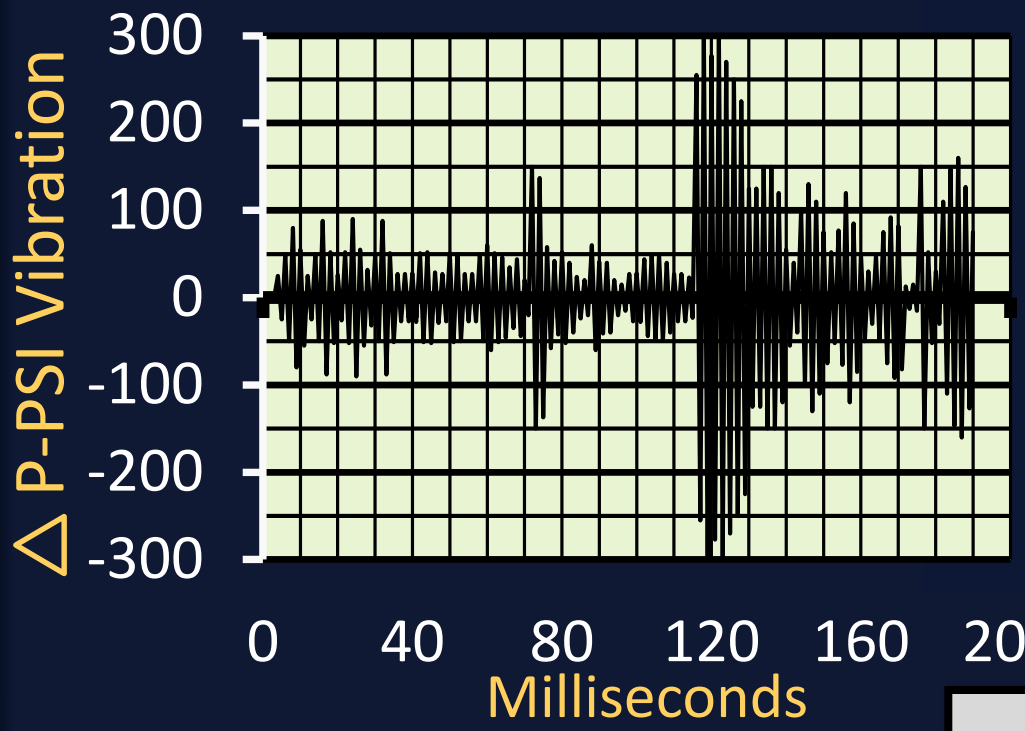


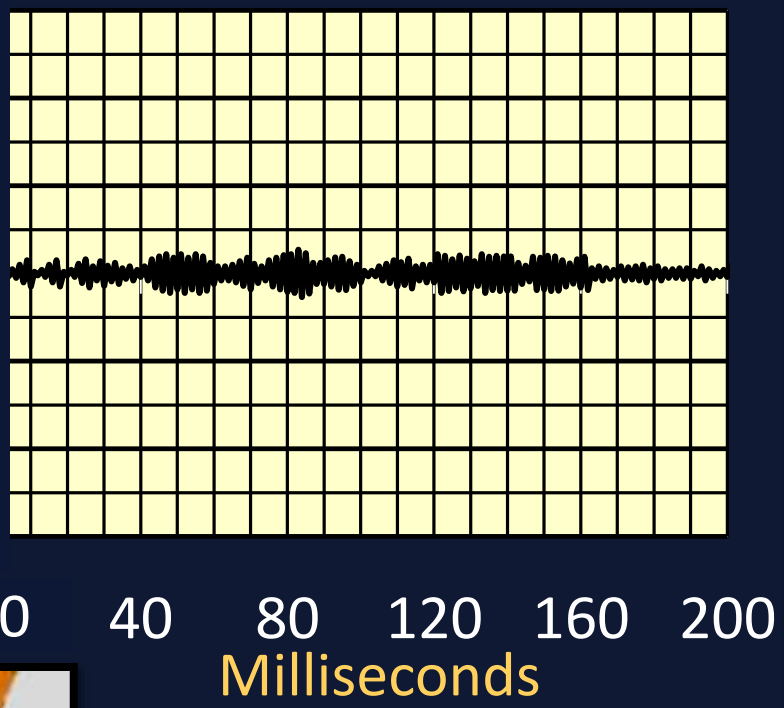
Large Header Design No Bottle

- Bladders, Gas Charges
- More Vibrations
- Higher Investment

- No Moving Parts
- Special Header Design
- Less Vibrations

Case Study #9: Acoustic Header Reduces Pump Vibrations





No Dampener
Peak 310 PSI

Acoustic Header
Peak 22 PSI

Takeaway:

Reduce Vibrations with Acoustically Designed Headers

Acquisition Summary 2:

- Purchased $22MM with $2.5 MM/year cashflow
- Lowered Costs (Gas Lift, Pump Dampeners, etc)
- Low Resistivity Pay downdip of 100% SW added 1.8 mmbo
- Reactivated / Recompleted / Drilled Wells
- Increased Water Flood Injection
- Production Increased from 270 to 1,500 bopd (⬆ 450%)
- Valuation >>$90MM (⬆ 4X)

Summary

TOPIC 1: Improvements of an Accounting System

➔ Develop more accurate accounting values

TOPIC 2: Benefits of Incremental Well Costs Analysis

➔ Utilize individual well costs for decision making

Added 3.2 MMBO with 50 Reactivations

TOPIC 3: Operational Techniques to Decrease Expenses

➔ 19 operational improvements saved $4.4 MM/year

10 year savings PW@10% = $28MM

The "Goal" ➔ Accurate Incremental Economics + Cost Reductions = Additional Reserves & Value

Thank You!

Any Questions or Ideas to Share?

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