



**How is the next generation motivated by oil
industry of 2015 in CEE region**

Conference

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Specific nature of well stimulation in North Adriatic Offshore Experience overview

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Content

1

- **Why do we need acid stimulation in NA offshore wells?**

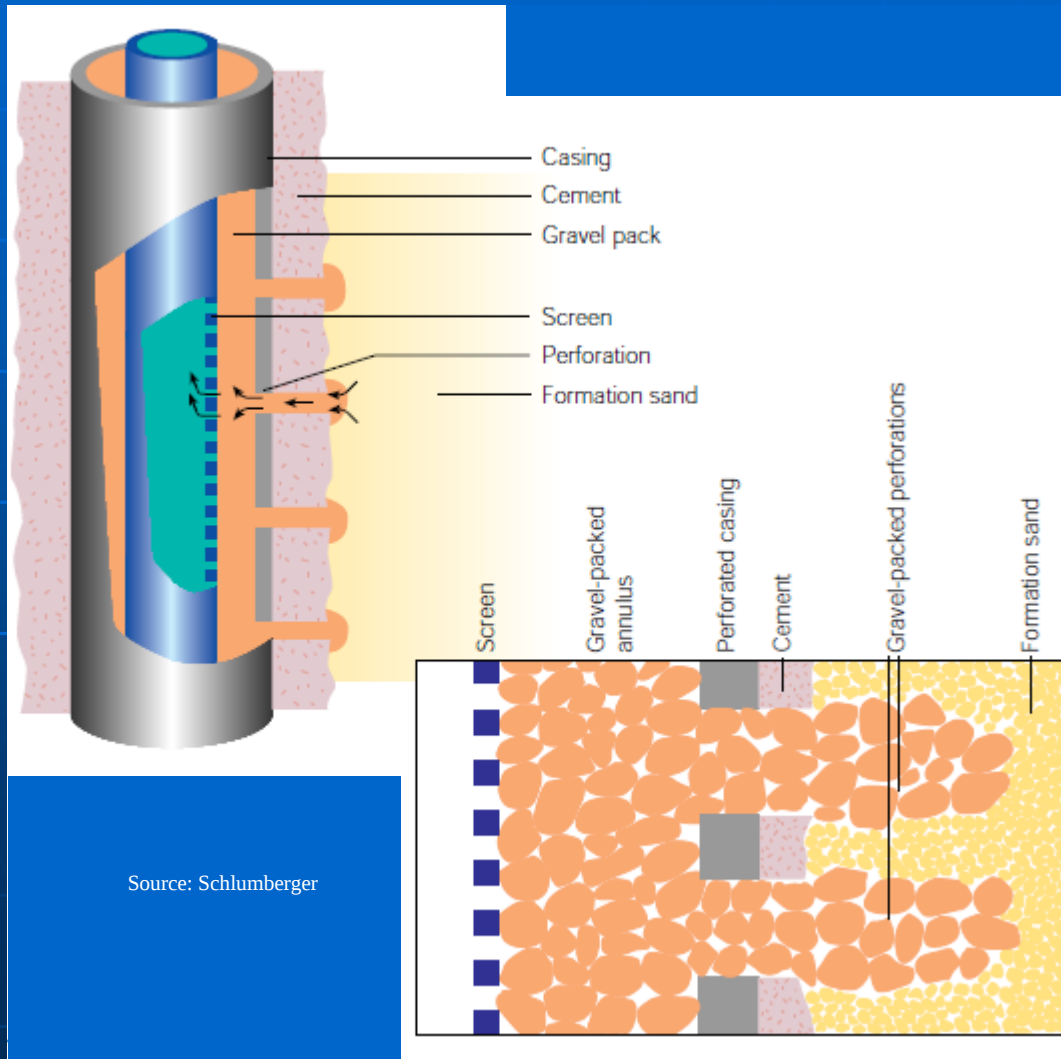
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- **When is the right moment to do it? (lesson learned)**

3

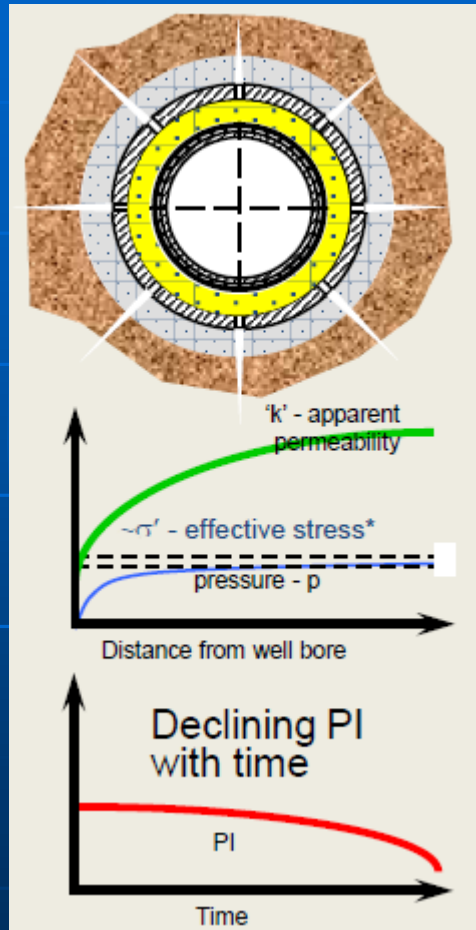
- **How to do acid stimulation? (case studies)**

Why do we need acid stimulation? (part 1)



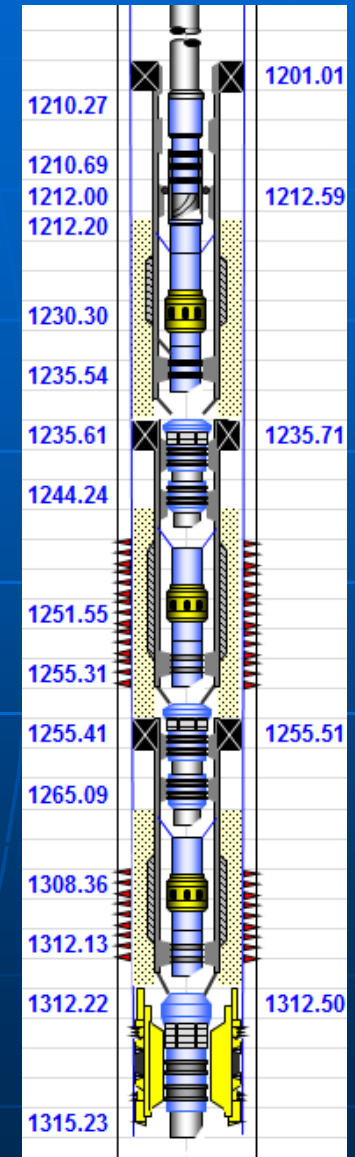
- ❖ All sand reservoirs in Northern Adriatic are non-consolidated
- ❖ Production is impossible without gravel packs
- ❖ Gravel pack is impediment to production because of additional damage caused by lost of fluid during installation and additional pressure drop in the gravel pack itself
- ❖ During production gravel pack could be plugged by scale deposition or fines (silt/clay) movement with significant productivity reduction

Why do we need acid stimulation? (part 2)

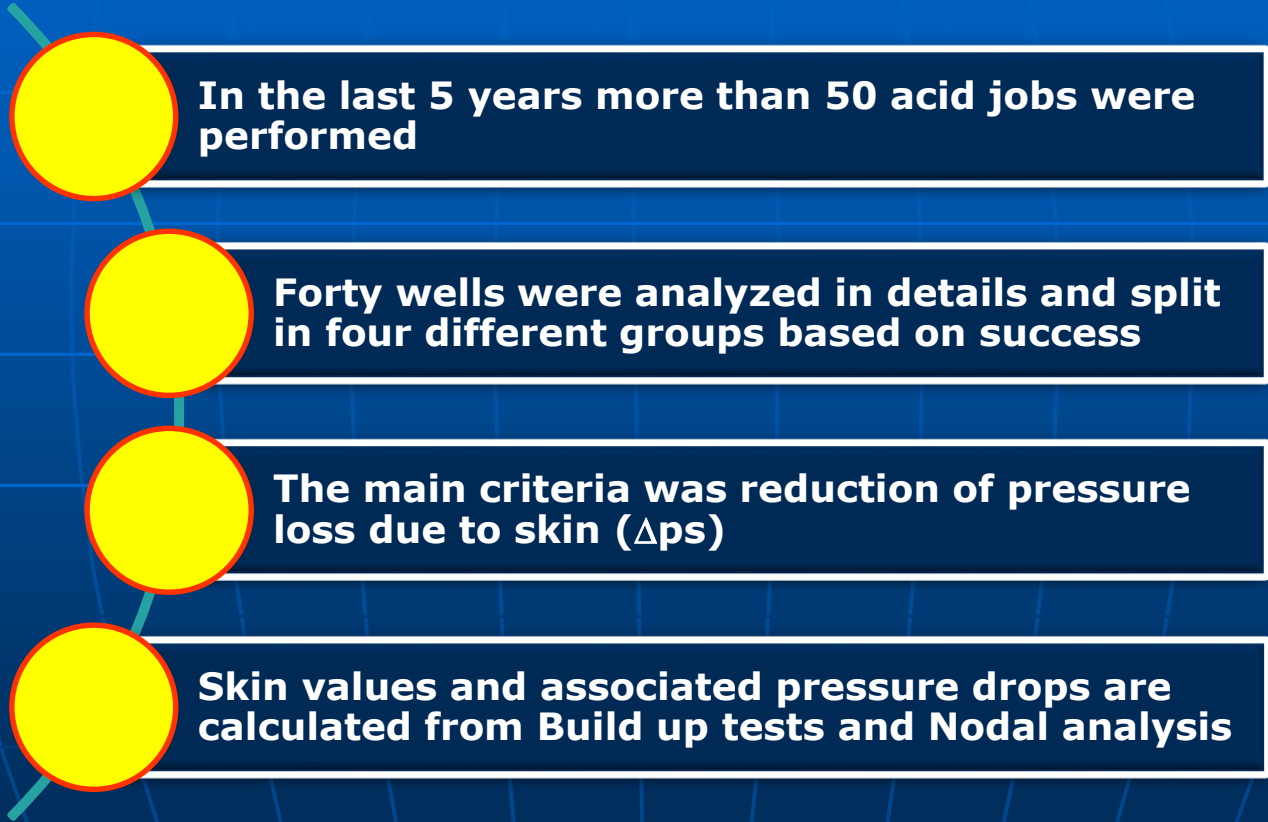


Source: SPE

- ❖ Productivity of the well with cased hole gravel pack is usually reduced by 50% or more because of skin presence
- ❖ To improve it/reduce skin acid stimulation has to be performed
- ❖ Acid stimulation in the early production phase clean near wellbore area of damage imposed by D/C
- ❖ Acid stimulation in later production phase remove scale/unplugg the gravel



When is the right moment to do it? (lessons learned part 1)



In the last 5 years more than 50 acid jobs were performed

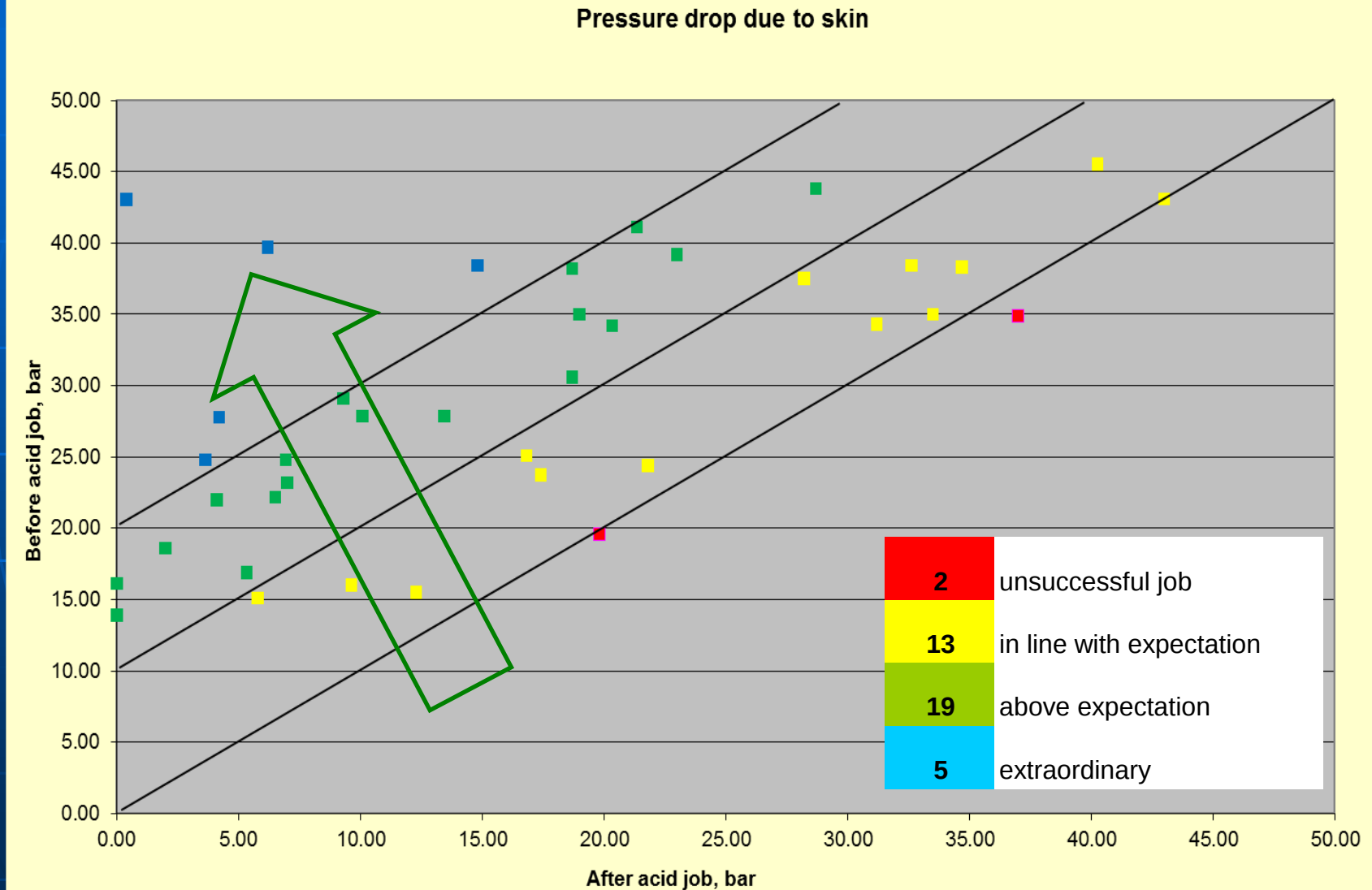
Forty wells were analyzed in details and split in four different groups based on success

The main criteria was reduction of pressure loss due to skin (Δp_s)

Skin values and associated pressure drops are calculated from Build up tests and Nodal analysis

When is the right moment to do it?

(lessons learned part 2)



When is the right moment to do it? (lessons learned part 3)

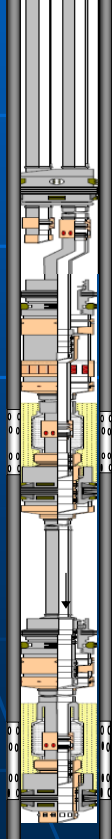
MAIN RESULTS

- ☐ **No well without losses during D/C**
- ☐ **Increase of gas rate up to 165 %**
- ☐ **Increase of THP up to 130 %**
- ☐ **Better results in wells with less water**
- ☐ **Only AM wells were treated in the early production phase**
- ☐ **Repetition of the job in AM wells showed significant improvement (better results than first time)**

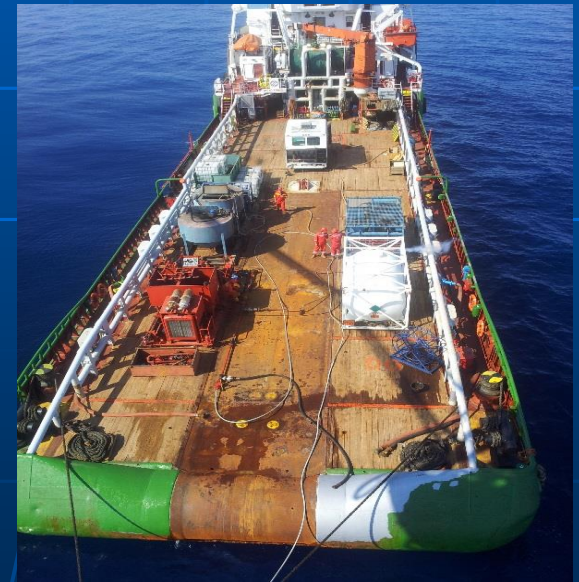
Acid stimulation – general review (part 1)



Supply vessel connection with gas production platform for execution Acid stimulation job (bull heading).



Equipment for acid stimulation set up on supply vessel: Pump unit, N2 unit with Liquid Nitrogen Tank, 2" line + 1" copflex line, Double mixing tank, Communication set, Formic acid and rest of chemical.



Acid stimulation – general review (part 2)

Piping connection from wellhead to supply vessel for acid stimulation job



Piping connection from supply vessel
to casing – fill up (water) if it is
necessary and pressurize 5 bar



Case study (part 1)

Casing 7"
OD=177.7 mm
34.22 kg/m
ID=161.7 mm

Tubing 2 3/8"
OD=60.3 mm
6.84 kg/m
ID=50.06 mm
1055.5 m

Packer "GT 47 C2
MD 904.27 m

Packer SC -1R
MD 928.44 m

Packer SC -1R
MD 961.69 m

LAYER X
MD 1039.0 -1046.5
TVD 892.0 -898.0
LAYER Y
MD 1047.0 -1054.0
TVD 898.4 -904.0

PRODUCTION BEFORE ACID JOB:

Production data (22.01.2015):

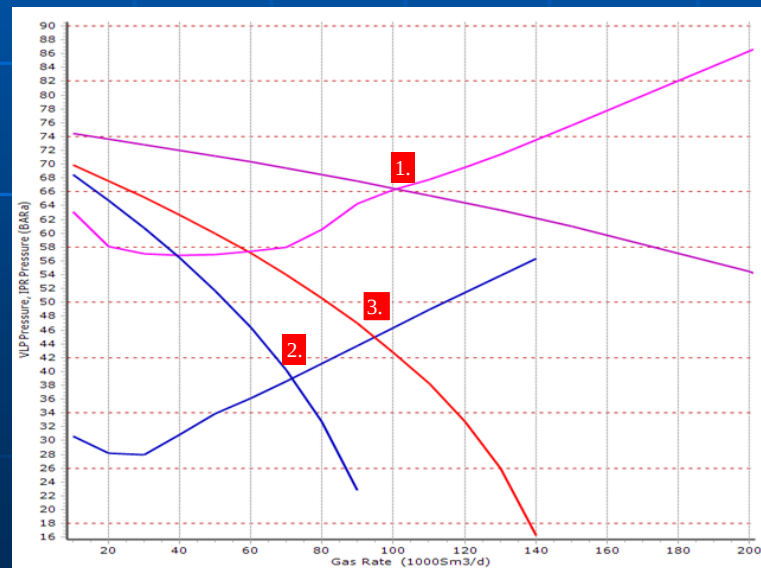
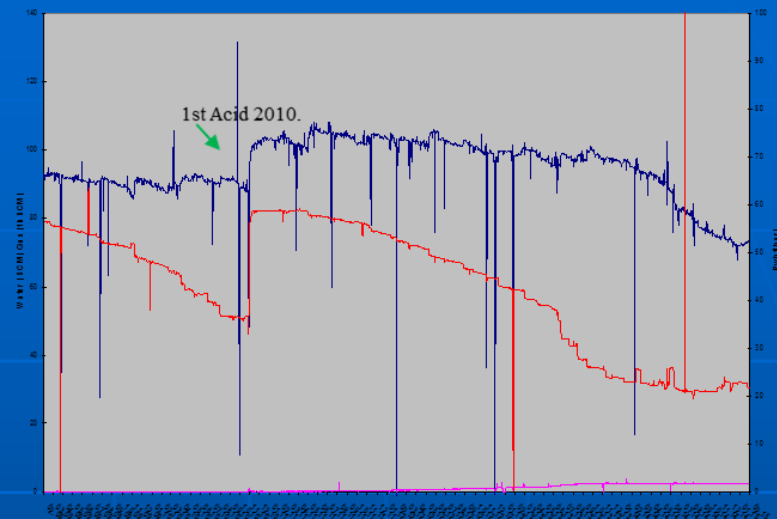
- $Q_g = 72600$ SCM/day;
- $Q_w = 2.31$ CM/day;
- $P_{whf} = 22.7$ bar.

PROPOSED ACTION PLAN :

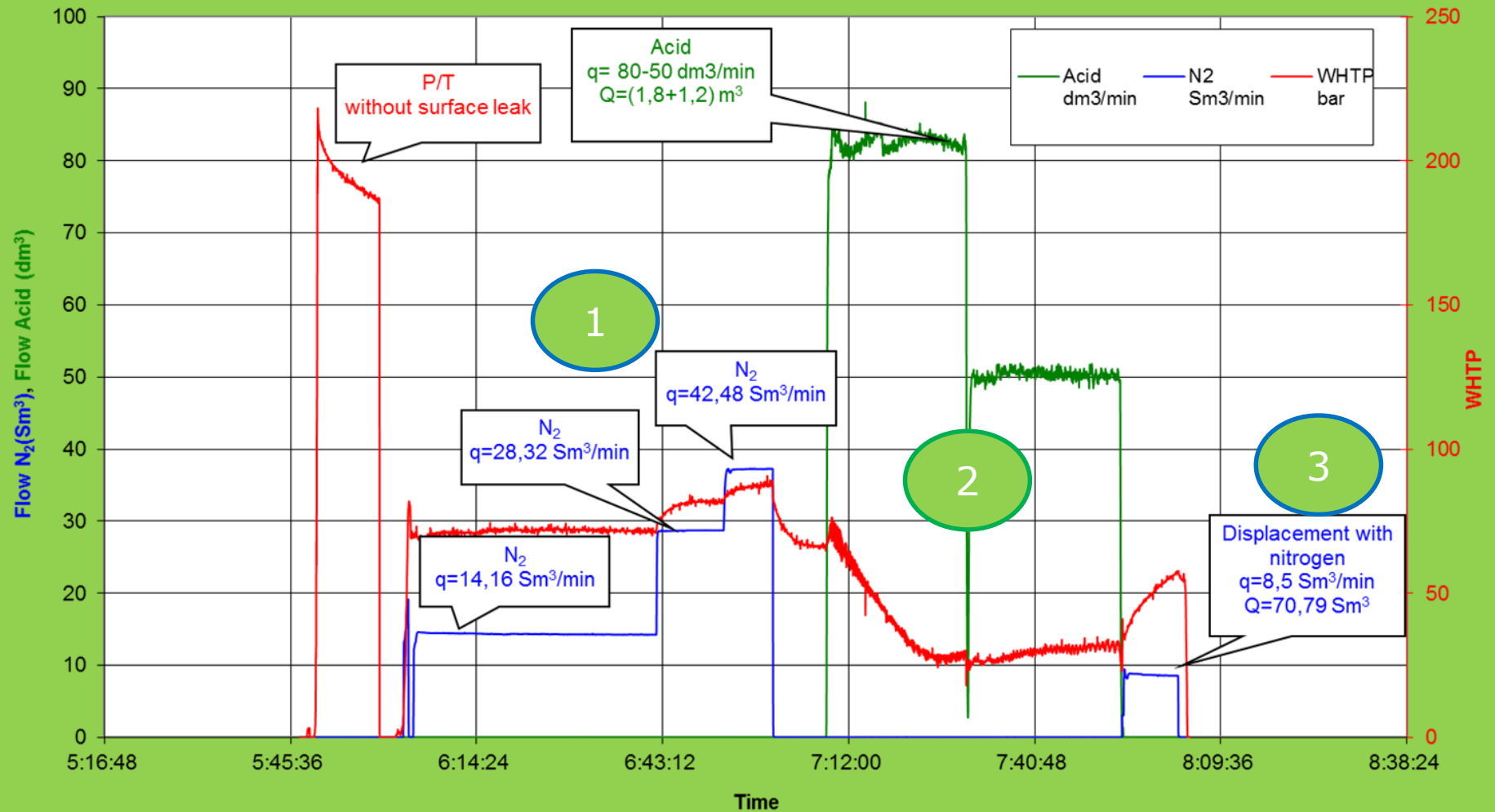
- Acid stimulation of reservoirs X and Y

EXPECTED RESULTS:

	P_R	Q_g	P_{whf}	P_{wf}	s	Δp_s
	bar	Sm ³ /d	bar	bar	dimensi- onless	bar
1. WT 2012	75.18	101000	49.6	66	160	7.5
2. Before acid job	72	72600	22.7	39	190	38.54
3. S-40%	72	90000	22.7	40	114	25

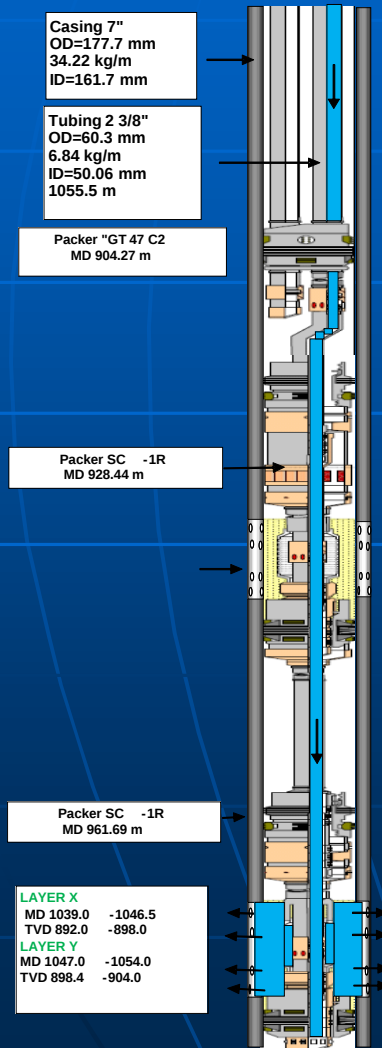


Case study (part 2)



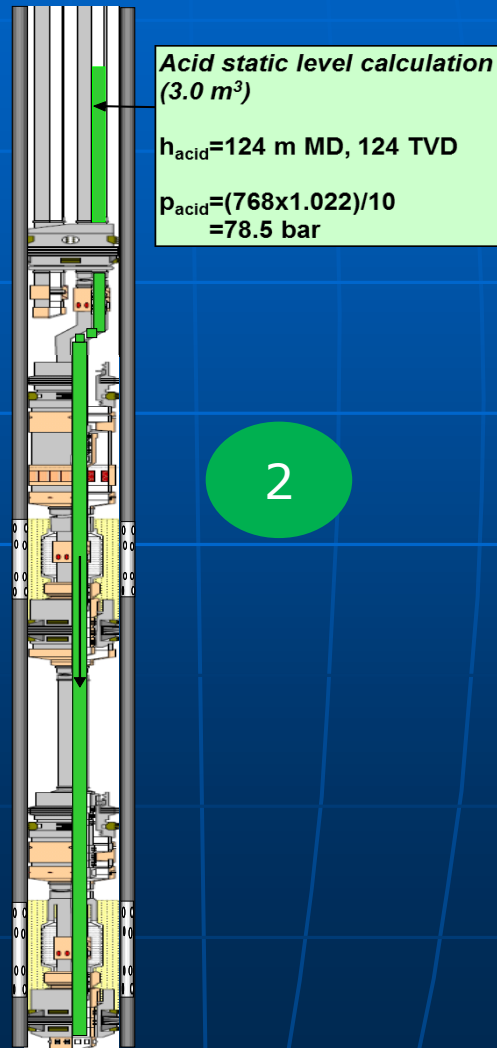
Case study (part 3)

Injecting nitrogen at tree different stabilized rate to remove liquid from gravel pack



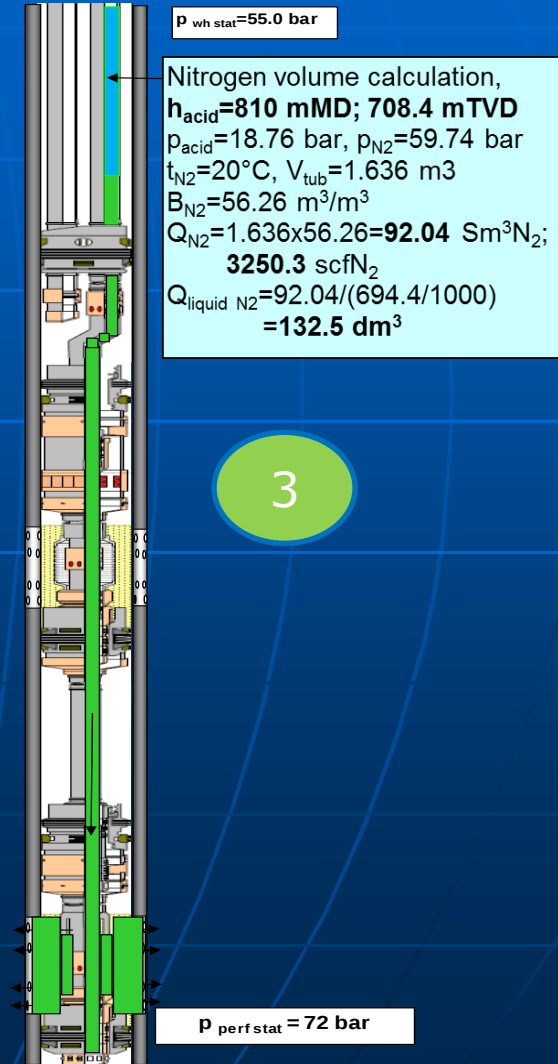
1

Pump the HCOOH 10% (bull heading) with rate of 80 – 50 dm³/min



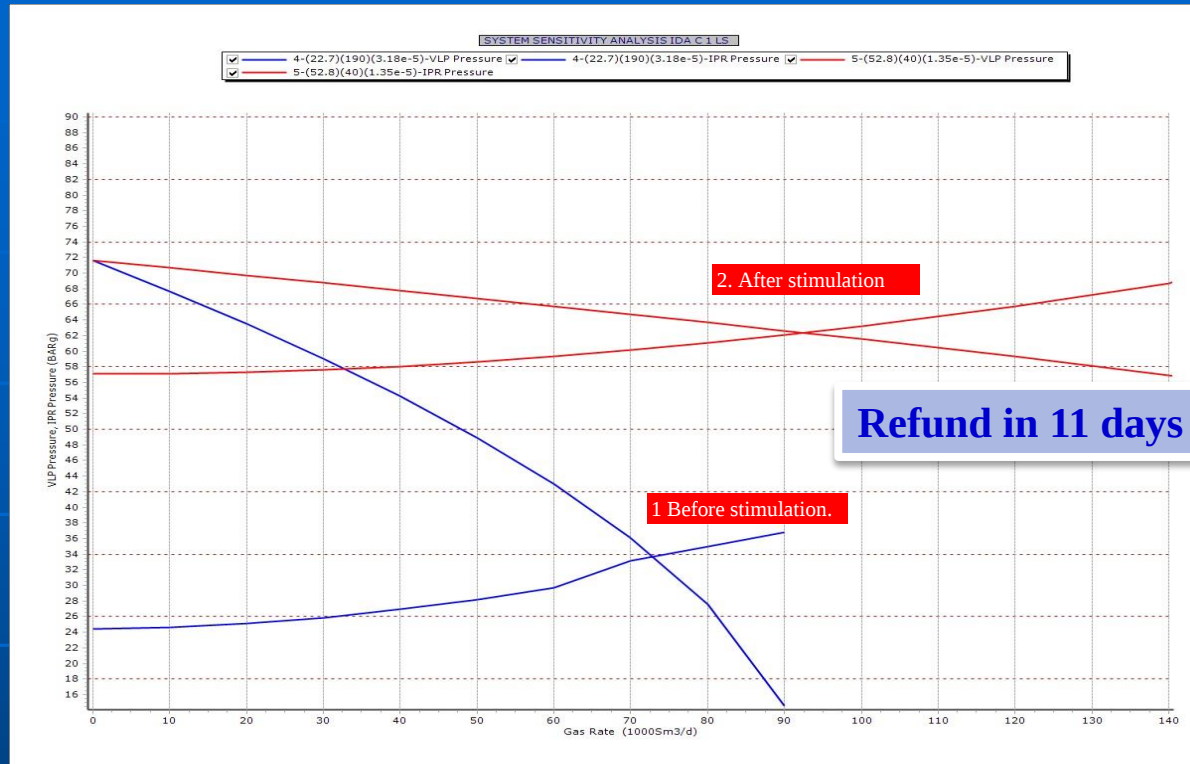
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Displace acid pumping nitrogen

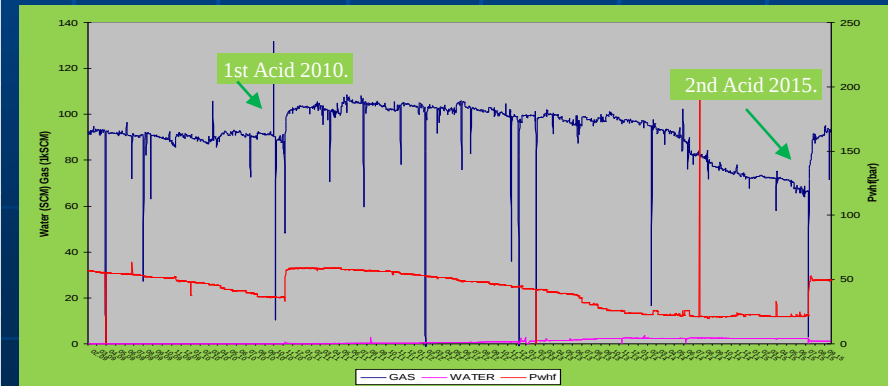


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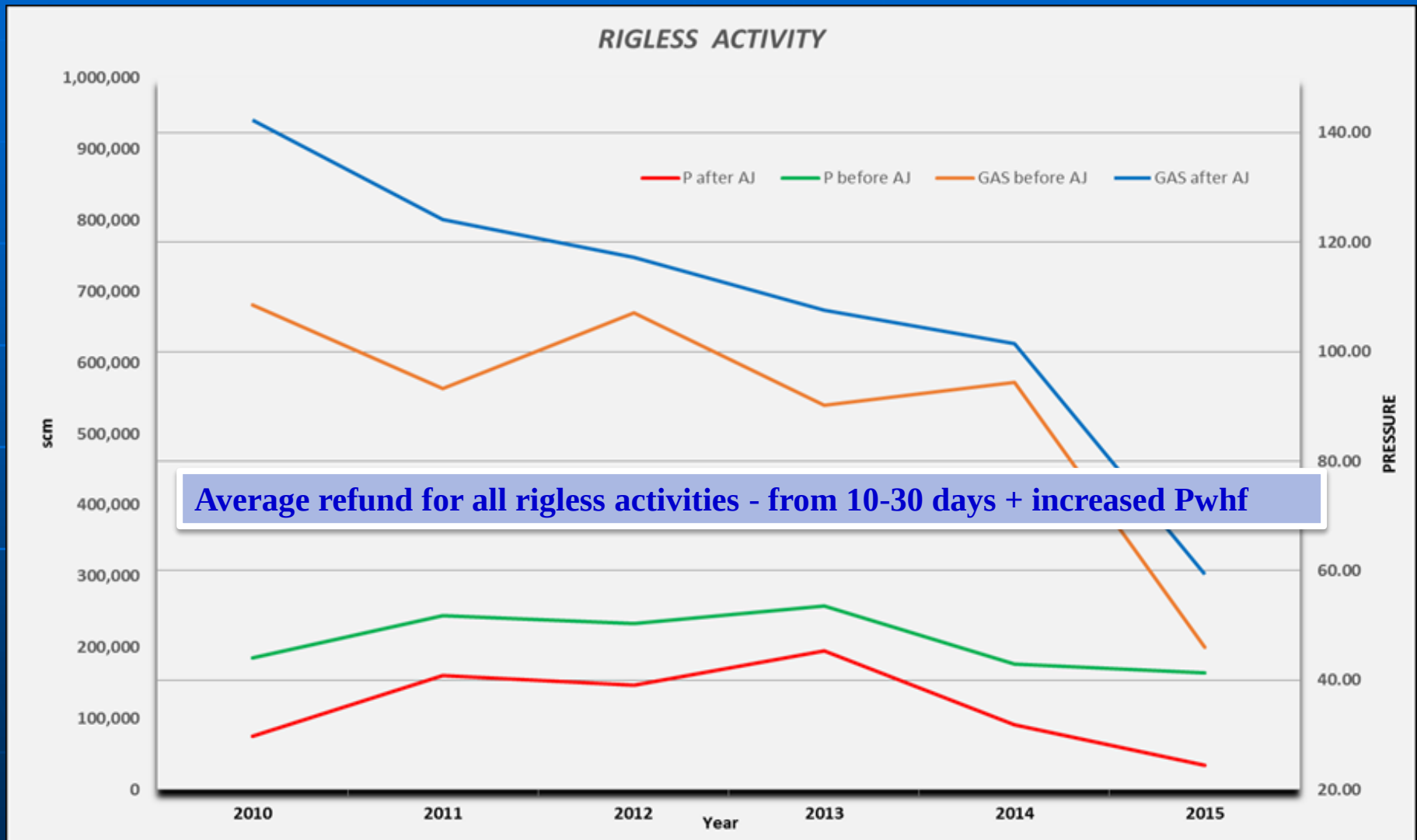
Case study (part 4)



	P_R	Q_g	Q_w	P_{wf}	s	Δp_s
	bar	Sm ³ /d	m ³ /d	bar	Dimension-less	bar
1. Before Acid Stimulation	72	72600	2.31	22.7	190	36.54
2. After Acid Stimulation S-80%	72	92700	1.2	52.5	40	7.8



Benefit of all acid stimulations from inception



Conclusion

1

- Acid stimulation in gravel packed gas well is mandatory in order to enhance productivity

2

- The first acid stimulation should be in the early production phase (if skin is calculated from PTA) to remove any remedial obstacles from D/C

3

- Acid job should be periodically repeated to clean the gravel from plugging of scale or fines

4

- Big constraint to successful acid job is water content