Enhanced Recovery in a Mature Field Utilizing MazeFlo™, an Innovative Sand Control Technology

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Presentation Outline

• Introduction
• Geology background
• The Challenge: Increased Sand Production
• What is MazeFlo™?
• MazeFlo™ Candidate Selection
• Workover Candidate Well
• Post Workover Result
• Conclusion
Ubit Field is located in OML 67 part of NNPC and Mobil Producing Nigeria (MPN) Joint-Venture (JV) acreage
100-ft water depth; 36km from the Qua Iboe Terminal (QIT)
Largest producing asset in MPN with over 46 years of production (original oil in place ~2GBO)
Technical challenge: Optimizing recovery of remaining oil in a mature asset
Geology Background

Field Overview:
- Discovered in 1968
- First oil in 1970
- Matured field with 46 years of production
- Over 200 wells drilled till date

Reservoir Description/Structure:
- Faulted 4-way dip closure, 15k acres
- Major reservoir is Agate (97% of 2P EUR)
- Agate consists of Bedded Biafra and Disturbed Biafra
- Bedded - shallow-marine interbedded sand and shale
- Disturbed - slumped or churned shallow marine sand and shale
- Disturbed Biafra consists 70% of the Agate reserve
The Challenge: Increased Sand Production

- Agate reservoir consists of unconsolidated sands with potential for sand production
- In recent times, increased sand production in a number of Ubit field wells has become a key challenge
- Sand production is a key challenge in the oil and gas industry
- Sand control technologies developed to address this challenge in cased and open hole completions
- MPN’s open hole completion technique has evolved in the last two decades
  - ✓ Slotted liner >> Excluder screen >> Standalone Screen (SAS)
- Standalone screens despite its improved design are still prone to sand failure due to
  - ✓ Mechanical damage during installation and production
- Limited intervention options available for sand producers
- Self-mitigating screen required to ensure sand-free production throughout well life
  - ✓ MazeFlo™ designed to meet this challenge

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Challenge: Mitigate sand control screen mechanical damage during installation and production

- Uncertainty in how, when, and where a “hot spot” will occur over the well lifetime

Solution: MazeFlo™ self-mitigating sand control screens use *redundant sand screens* and *compartment baffles* to improve reliability and longevity in sand prone well production

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**What is MazeFlo?**

**Challenge:** Mitigate sand control screen mechanical damage during installation and production

- Uncertainty in how, when, and where a “hot spot” will occur over the well lifetime

**Solution:** MazeFlo™ self-mitigating sand control screens use **redundant sand screens** and **compartment baffles** to improve reliability and longevity in sand prone well production

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How Does it Work?

MazeFlo™ Screen

Maze Compartment

Standard Wire-Wrapped Screen
How Does it Work?

Self-Mitigating Sand Control Screen

- Sand Control Maintained
- No Workover

Standard Wire-Wrapped Screen

- Sand Production
- Lost HC Production
- Major Workover

continued HC Production from Other Compartments

Mechanical Damage
- Erosion
- Installation
- Compaction

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First Commercial MazeFlo™ Application - Candidate Selection

- Initial implementation targeted workover for remedial sand control
- MazeFlo™ Workover Selection criteria
  - Known / potential sand producer
  - Well completed without or failed sand control
  - Existing lower completion ID large enough for 2-3/8” MazeFlo installation
  - Ability to clean out existing completion of any sand fill
  - Good investment economics
- Evaluated 25 wells for MazeFlo™ remedial sand control application
- Well ‘X’ had the highest chance of success and meets the selection criteria
Workover Candidate Well – Ubit ‘X’ Well

• Horizontal oil producer with 1500 ft lateral section

• Unconsolidated sand along production section

• Completed with 4-1/2” pre-perforated liner

• Sand production started two years post initial completion

• Reduced rate to manage sand production

• Well eventually shut in on increased sand production

• Ideal candidate for MazeFlo™ intervention / workover
Workover Planning & Execution

• Workover objective
  • Install 1500 ft 2-3/8” MazeFlo screens in 4-1/2” pre-perforated liner

• Key front-end engineering performed
  • Well performance analysis
  • Sand transport hydraulic modeling
  • Torque and Drag analysis

• Conducted Workover On Paper (WOP) prior to workover execution

• Conducted Just In Time Training (JITT) prior to execution of each phase

• Executed successfully without LTI and 7.2% NPT

• Successfully installed 1500 ft of MazeFlo screens in liner
Post Workover Results

- Four years post MazeFlo™ installation repeated sand monitoring confirmed sand free production
- Drawdown of 60 psi comparable to conventional standalone screen completion
- Streamed at over twice the pre-workover rate
  - Sand free rates significantly improved from 1.7kbd to 3.5kbd (avg) plateau rate.

Sand Check Results at an Average of 3 Months Frequency

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Conclusion

- First global commercial application of MazeFlo™ technology successfully applied in Ubit field.

- Post MazeFlo™ Installation, the well has been producing at unconstrained sand-free rate for four years with increased EUR.

- Self-mitigating design makes MazeFlo™ more reliable for new installation and remedial sand control applications.

- This multidisciplinary collaboration has provided workover opportunity to fully deplete a mature field by tackling increased sand production.

- MazeFlo™ screen application is cost-effective and minimizes production downtime.
Acknowledgement

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