Multilateral Stimulation Technology

Connect your reservoir with simplicity, accuracy and efficiency

Winner OTC 2015
Spotlight on New Technology
Winner ONS 2014
SME Innovation award
**Fishbones development timeline**

- **2009**
  - R&D contract
  - Fishbones for Carbonates

- **2012**
  - Fishbones full scale tests
  - JIP - Fishbones for Hard rock, 5.5” Dreamliner

- **2013**
  - First Fishbones installation (CBM)

- **2014**
  - 1st well JCR* Fishbones pilot well program (Carbonate)
  - First Middle East order

- **2015**
  - JIPs - 4.5” Dreamliner and Extreme hard rock
  - First Dreamliner installation (Sandstone)

- **Today**
  - Several installations being planned worldwide

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**JCR** (Joint Chalk Research group) – BP, ConocoPhillips, the Danish North Sea Fund, Dong, Hess, Maersk, Shell, Statoil and Total
Track record

- Number of MST subs run: 120
- Maximum number of MST subs in one run: 48
- Vertical wells: 1
- Horizontal wells: 4
- Longest horizontal section: 2012m / 6600ft
- Deepest installation, TVD: 3853m / 12641ft
- Fishbones MST installations: 4
- Dreamliner MST installations: 1
- Highest temperature application: 142°C / 288°F
Fishbones’ space

Daily production split by liquid source - kbbl/d
Product portfolio

Fishbones
- Carbonates
- Coal bed methane
- Oil sands

Dreamliner
- Sandstones

Other products:
Backbone anchor - Float shoes - Catcher screen - Fishbasket
Addressing challenges

- Low vertical permeability
- Heterogeneity
- Formation damage
- Depleted reservoirs
- Stimulation into unwanted zones
Case histories
First Fishbones MST installation

- Sumatra island, Indonesia, Nov 2013
- Coal Bed Methane application
  - Water jetting
- Vertical well
- 8.5in hole, 800m / 2620 ft deep
- Two Fishbones subs
- Successful installation
  - Needle extension confirmed
- Initial production rates ~4 times higher than offset well
Swellable packers

Plug for isolation during jetting

Slotted liner

8 ½" OH

9 5/8" csg
First carbonate installation – USA

- JCR installation #1, April 2014
- Tight limestone formation in the Austin Chalk, Texas
- Horizontal well, 6.5” open hole
- 15 ea. Fishbones subs and 3 ea. Backbone anchors
- Successful installation
  - Run to TD
  - Needle extension confirmed
- 60 laterals created, 5 hrs total pumping time
- SPE 171804
7 5/8"
29.7#

10,531' MD
10,250' TVD

6 ½"
OH

11,355' MD

+/-5% porosity, fractured, 250°F, Pres1500psi, unstable hole, multiple prior acid stimulations
Achievements

• Proved Fishbones can be safely and practically installed in a well, at an acceptable operational risk level. **No major issues.**

• Proved that the **liner may be rotated** while getting the completions to TD.

• **Full 40’ (12m) deployment** of the Fishbones needles was confirmed from pressure chart reading. Also confirmed positive identification method.

• **The Backbone anchor was set.**

• **The acid releasable shoe closed.**

• **Lab jetting testing results** predict penetration rate and required pumping volume.

• **30 X PI**
16 months’ production
Fishbones MST installation #2 in USA

- JCR installation #2, June 2015
- Buda formation, Texas
- Tight, fractured limestone
- Horizontal well, 6 1/8" open hole
- 15 ea. Fishbones subs, 3 ea. Backbones
- Successful installation
  - 60 laterals, 4 hrs total pumping time
    - Similar pump chart profile as first well
- Flow back results are encouraging
6 1/8" OH
7,400ft TVD
7,588ft MD
9,217ft MD

7" 26# @ 7,522ft

Eagle Ford formation
Buda formation

3-6% matrix porosity, naturally fractured, 0.01-0.4 mD permeability,
Tres 185°F, Pres 750psi, no previous stim, drilled in 2013
75 days’ production

75 day production after oil 644 bbls (avg= 8.6 bopd) and liquids 3479 bbls (avg 46 bpd)

30 day production before oil 192.6 bbls (avg= 6.4 bopd) and liquids 308.2 bbls (avg 9.9 bpd)
First Dreamliner MST installation

- Offshore Norway, July 2015
- New well in tight sandstone formation
- 2012m / 6600ft horizontal section
- 8.5” open hole with 5.5” liner
  - 48 ea. Dreamliner subs – 144 laterals
  - 7 ea. Backbone open hole anchors
- Successful installation
  - Liner run to TD without issues
  - 6 hours mud circulation time for laterals drilling
  - Pressure responses indicate extension of needles
Motivation for using Dreamliner MST

- Fracture length – Underlaying reservoir is gas filled. Risk of fracturing into with conventional fracturing
- Internal barriers – Internal barriers in reservoir that need to be penetrated for increased reservoir contact
- Sand strength – Competent and consolidated sandstone requiring no sand control
- The downside risk assessed to be limited
"This is an important step forward in testing and implementing a technology that enables increased oil recovery from reservoirs where the method of fracking is not feasible. The experience gained with long reservoir sections and «fishbones» opens up for several new projects both at the Åsgard field and elsewhere on the NCS," states Petech manager at Åsgard Mari Skaug.
Minister of Petroleum & Energy, Norway

Oslo 15. October 2015
Simfish

- SINTEF MRST - Fenix Consulting Delft
- Fishbones vs. Open hole
- Simplified grid
- Estimates oil rates, PI increase and incremental oil
- Producers and injectors
- 1-6 min execution
- Generates Eclipse compatible wellbore geometry
Simfish example – input deck

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Oil Model

Production Scenario

- Oil API Gravity: 41 [ppm]
- Bubble Point Pressure: 2515 [psi]
- Reservoir Temp: 250 [F]
- Gas Gravity: 0.6 [ppm]
Simfish example – results
Work process

Initial contact/meeting

- Client to fill in Well Information sheet
  - Fishbones evaluates information
    - Client to provide core samples for testing if deemed needed
      - Fishbones performs core sample testing and report
        - Fishbones develops technical solution if project is feasible
          - Fishbones technical/commercial proposal to client
            - Client Purchase Order
              - Well planning
                - Fishbones delivery, assembly and installation
Global footprint – Focus on NOCs & Majors

Joint Chalk Resource group (JCR)

- bp
- Eni
- Statoil
- Shell
- Total
- Hess
- ConocoPhillips
- DONG Energy
- MAERSK

Fishbones office
Agent / Alliance partner
Thank you

Connect your reservoir with simplicity, accuracy and efficiency