Challenging Concrete Applications

Oil and Gas

Vinod Veedu, PhD
Director of Strategic Initiatives
Email: Vinod@Oceanit.com

ABOUT OCEANIT

Founded 1985 in Hawai'i

160+ Employees

Multi-Disciplinary Staff (25% PhDs)

Recent Awards

- *2018 Wins AI Ag-Tech hackathon, will deploy at largest Coffee Farm in US*
- *2016* ***CEO of the Year****, Hawaii Business Magazine, Patrick K. Sullivan*
- *2015* ***30 Years of Innovation*** *State (Gov/Mayor) Event*
- *2014* ***Oceanit Spin-Out IBIS Networks wins East meets West***
- *2013* ***Commitment to Green Employer of the Year,*** *Pacific Edge*
- *2012* ***Outstanding Civil Engineering Achievement Award*** *– Best Study & Research Project, ASCE*

Cementing in Oil & Gas

- Portland Cement used in oil fields since 1903
- *Readily available, economical, controllable density, strong and impermeable*
- Currently American Petroleum Institute (API) Class cements are used
  - Class G & H

Cementing in Early 1900's

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Need for Cementing

- Casing Anchor (Axial Support)
- Protect Casing from Corrosion
- Support wellbore walls
- Protect Aquifer
- Restrict fluid movement between formations
- Prevent blowouts, shock during drilling
- Isolate Casing Seat for Subsequent Drilling
- Zonal Isolation – Critical for Safe Well Operation

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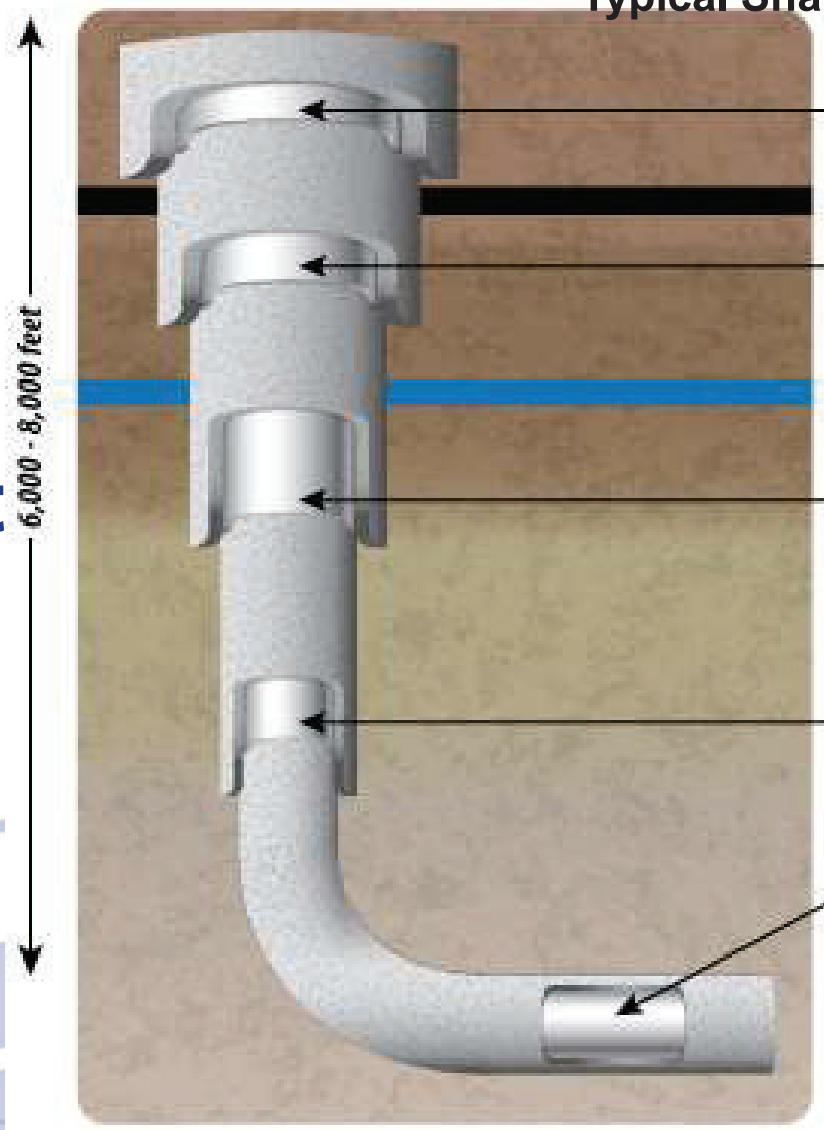
State of the Art Cementing

Typical Shale Well Design



30-60 feet
20" Conductor Casing
Cemented to Surface

100-500 feet
16" Casing
Cemented to Surface
Only used if coal seam is present

600-1,000 feet
13-3/8" Casing
Cemented to Surface

2,000 feet
9-5/8" Casing
Cemented to inside 13-3/8"

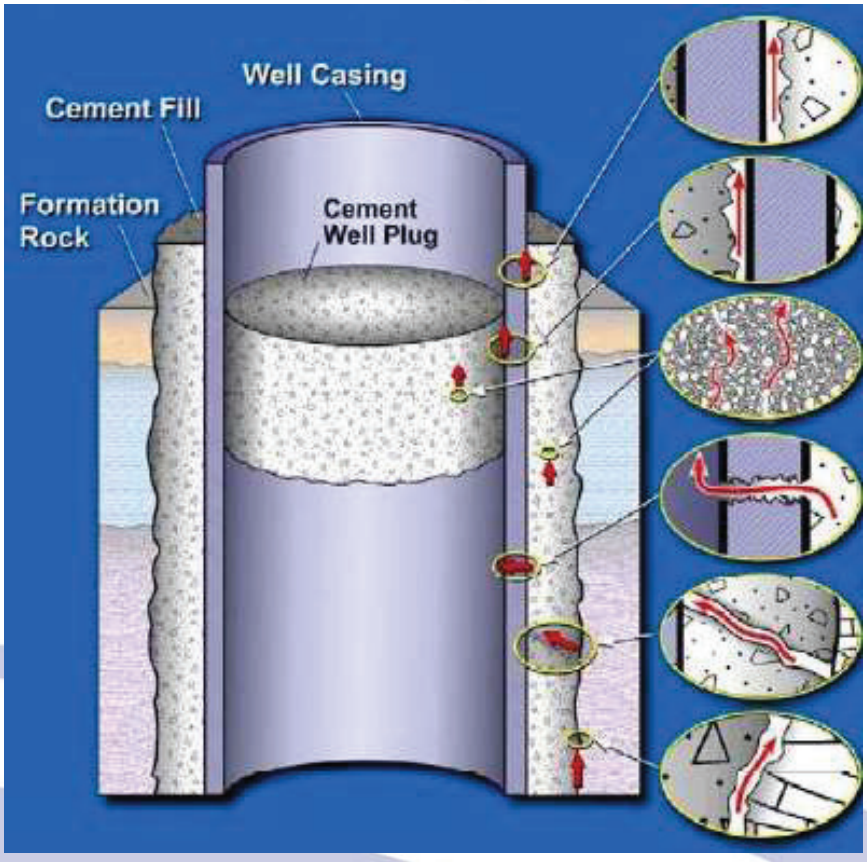
10,000-14,000 feet*
5-1/2" Casing
Cemented to inside 9-5/8"

*Represents total measured depth

= Cement
= Pipe / Casing
= Coal Seam
average depth 50 - 500 feet
= Water Table
average depth 100 - 600 feet

Good Cementing in Oil and Gas?

- Good Cementing Practices
  - Uniform cement fill between casing & formation rock
  - Tight seal between interfaces
  - Prevents *micro annulus, leaks,gas migration sustained casing pressure* and vent flow
  - Maintains strength through lifetime of well, minimum intervention



Potential Leaks & Gas Migration Through Cement Sheath

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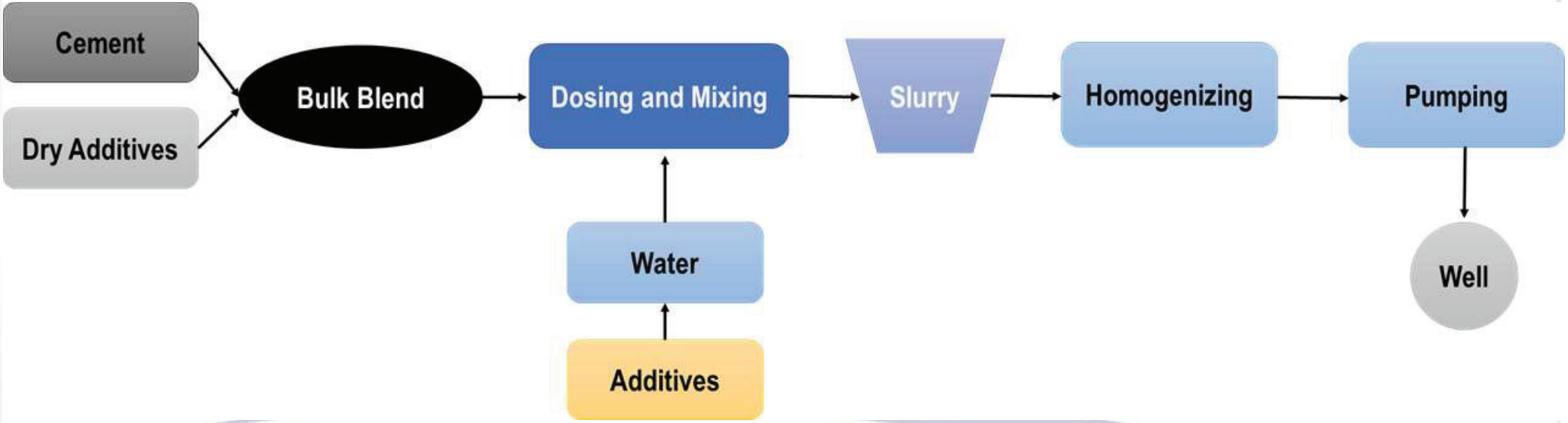
Cement Mixing Process



Cement strength, pumping, spreadability, density, curing and sensing can be modulated with proper additives

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Additives in Current Cementing Technology

Types of Additives	Chemicals
• Accelerators • Light weight • Retarders • Defoamers • Heavy weight • Dispersants • Loss circulation • Fluid Loss	• Lignosulfonates and cellulosics • Super and super plasticizing agents • Polyamine/imine • SB Latex, Copolymers • AMPS • Hematite, Hausmanite, Ilmenite • Barite

Next Generation Cementing

Stimuli Responsive Cement

- Healable Cement, Intrinsic, extrinsic and self-healing

Sensing Cement

- Nanomaterials incorporated

Shape/Volume Changing

- Water swellable

Controlled Release of cement admixture

- Release of double layer hydroxides, encapsulation

Nanocarbon reinforced

- CNT, graphene,fullerene

High Density,High Performance Slurries (HDHPS)

- Particle loaded, litecrete ™

Cement Properties Modification Using Innovative Materials Technologies

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New Challenges and Requirements

- Less energy intensive cement production
- Low temperature cementing in deepsea and arctic exploration
- Zonal isolation under high pressure and temperature
- Smart cement for sensing and stimuli responsive behavior
- Plugging and abandonment
- Increasing durability in cement

Durable Cementing in Oil & Gas?

- Strength alone not sufficient
- Additives are only a partial solution
- ***Cement Durability = Tight seal across all interfaces (rock-cement-casing)***
- Long term solutions require
  - Enabling technologies to achieve good cementing & zonal isolation
  - Smart cementing solutions for non-invasive long term monitoring of health

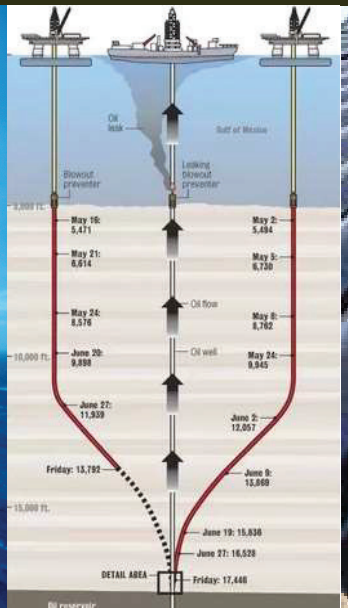
SCIN
NANO BOND TECHNOLOGY

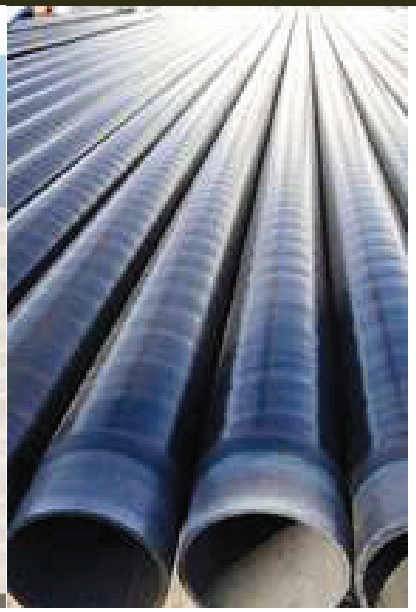
USE CASES TECHNOLOGY TESTIMONIALS COMPANY RESOURCES

THE FUTURE OF OIL & GAS DOWNHOLE CEMENT TECHNOLOGY

SCIN's patented treatment offers a superior interface between steel and cement that significantly improves the steel cement bond strength and corrosion resistance of casing pipe used in oil & gas wells.

LEARN MORE





PARTNERS

Shell

U.S. DEPARTMENT OF ENERGY