Effects of Water Depth Workshop

BSEE
Bureau of Safety and Environmental Enforcement

Cement as a Barrier

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BSEE/ANL Effects of Water Depth Workshop
San Luis Hotel, Galveston, TX
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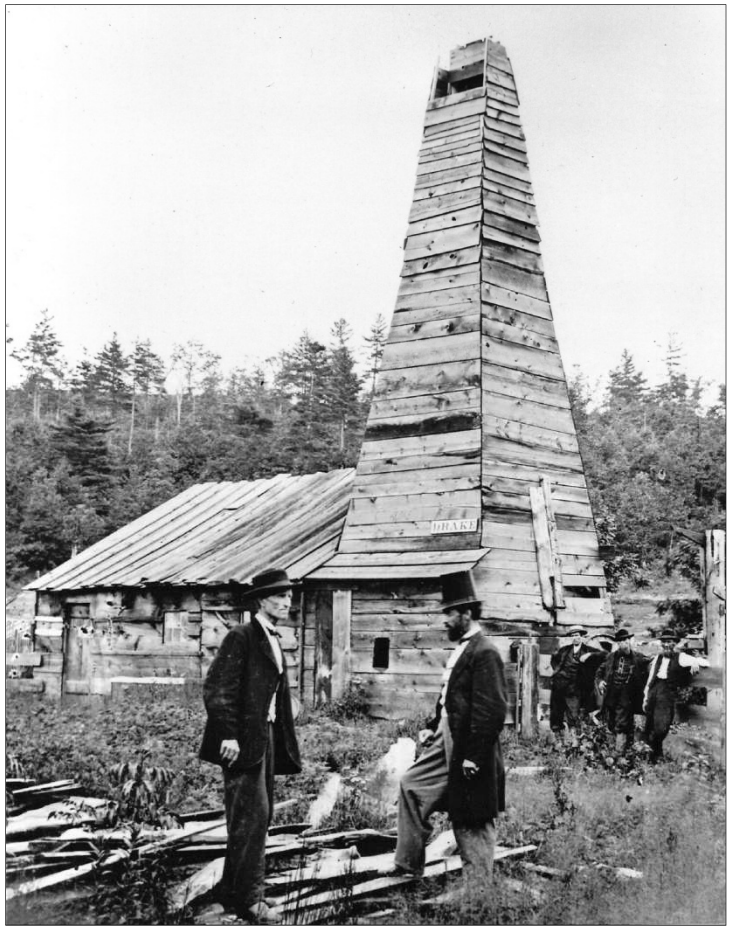
The Drake Well

First Commercial Oil Well in the United States

1859

"Colonel" Edwin L. Drake

Total Depth – 69-1/2 feet



The Drake Well Museum, Pennsylvania Historical and Museum Commission

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The First Cement Job

First Decade of the 20th Century

This marker credits a water shutoff treatment on Union Oil Company's Hill No. 4 in 1906 as the first cement job.

Industry Standardization

1937 – The American Petroleum Institute established the first committee to study well cement.

1940 – 1948 The Mid-Continent API Committee on Oil Well Cements proposed, developed and issued Code 32 – "API Code for Testing Cements Used in Wells.

1952 – 1956 – After changing Jurisdiction to the national API Committee on Standardization of Well Cements, Code 32 was advanced to API Recommended Practice 10B in 1956. The first edition of API Specification 10A was adopted in 1953.

Today – API and ISO subcommittees provide on-going support for 9 technically identical standards and 6 technical reports.

Regulations

- *CFR 250.198 Documents incorporated by reference.*
  - (h) (79) API RP 65–Part 2, Isolating Potential Flow Zones During Well Construction; First Edition, May 2010; Product No. G65201; incorporated by reference at §250.415(f).

- *CFR 250.415 What must my casing and cementing programs include?*
  - (f) A written description of how you evaluated the best practices included in API RP 65–Part 2, Isolating Potential Flow Zones During Well Construction (incorporated by reference as specified in §250.198). **Your written description must identify the mechanical barriers and cementing practices you will use for each casing string** (reference API RP 65–Part 2, Sections 3 and 4).

- *CFR 250.420 What well casing and cementing requirements must I meet?*
  - a)(6) Include certification signed by a Registered Professional Engineer that there will be **at least two independent tested barriers, including one mechanical barrier, across each flow path during well completion activities** and that the casing and cementing design is appropriate for the purpose for which it is intended under expected wellbore conditions. The Registered Professional Engineer must be registered in a State in the United States. Submit this certification with your APD (Form MMS–123).

- *CFR 250.420 What well casing and cementing requirements must I meet?*
  - (b)(3) **For the final casing string (or liner if it is your final string), you must install dual mechanical barriers in addition** to cement, to prevent flow in the event of a failure in the cement. These may include dual float valves, or one float valve and a mechanical barrier. You must submit documentation to BOEMRE 30 days after installation of the dual mechanical barriers.

Development of RP65-2 First Edition

- API Work Group charge was to document global industry "Best Practices" to:
  - Improve zonal isolation
  - Reduce occurrence of Sustained Casing Pressure (SCP)
  - Help prevent annular flow incidents before, during and after cementing operations
  - Applicable for land, shallow water and deepwater wells

Work commenced on API RP65-2 in early 2003

The first edition was published in May 2010 and incorporated into 30 CFR 250 on October 14, 2010

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Standard 65-2 Second Edition (expands discussion of barriers)

- Physical Barrier Elements
  - "hydrostatic, mechanical or solidified chemical materials (usually cement)
- Hydrostatic Barrier Elements
  - Hydrostatic pressure from well fluids (mud, cement etc)
- Annular Mechanical Barrier Elements
  - e.g. liner top packers, ECP, swellables
- Mechanical Wellbore Barrier Elements
  - e.g. Bridge plugs, retainers
- Set Cement as a Barrier Element

Set Cement as a Barrier

- WOC guidelines (first and second editions)
  - Set cement is considered a barrier when it has attained 50 psi compressive strength at temperature and pressure conditions at the top of the uppermost hydrocarbon bearing zone
  - Cementing events that could impact barrier removal (e.g. losses, deviation from design, premature returns, lift pressure indicating low TOC, influx prior to cementing, etc.)
- Shoe track as a barrier (second edition)
  - Two independent float valves
  - Set cement in the shoe track (50 psi)
- Cement plugs as a barrier (second edition)
  - Must meet regulatory requirements

Good Cementing Practices

- Good Slurry Design
- Stable Hole
- Minimize Rathole
- Computer Simulation
- Pipe Movement
- Centralization
- Scratchers/Wipers
- Two Plugs
- Adequate Shoe Joint
- Two Floats
- Avoid Casing Surge
- Condition Mud
- Spacers/Washes
- Good Density Control
- Displacement Technique
  - Rate
  - Density Hierarchy
  - Rheological Hierarchy
- Data Recording
- Post Job Analysis

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Data Recording and Post Job Analysis
Standard 65-2 Chapter 7

- Material Inventory
- Job Data
  - Volume
  - Density
  - Rate
  - Pressure
- Cement Evaluation
  - Objectives versus Results
  - FIT/LOT
  - Logs
    - Temperature Logs
    - Noise Logs
    - Acoustic and Ultrasonic Cement Evaluation Logs

Summary

- Portland cement has been used for zonal isolation in wells for a little more than 100 years.
- Industry standardization efforts began in 1937 and are very active today.
- API Standard 65-2 describes methods for isolating potential flow zones during well construction.
- There is a large body of knowledge concerning the successful design and placement of cement slurries for successful zonal isolation.

Questions or Comments?