Advantages Of Synthetic Oil based Mud over Water based Mud System

28th & 29th Dec, 2016
Institute of Drilling Technology
1 Introduction: Why the Need?
2 What are LTMOs and SOBMs?
3 Constituents For OBM Package
5 Advantages Of Oil Base Muds
6 Toxicity of LTMO and SOBM
7 Disadvantages of SOBM
8 History of SOBM in ONGC
Why Not Water Based Mud (WBM)?

- Hydration of Shale formations
- Not efficient at high temperatures
- Interference with the flow of oil & gas through porous rocks
- Promotes disintegration and dispersion of clays
- Dissolve salts
- Not as efficient lubricant as OBM
- Can promote corrosion
- High angle and extended reach wells
● Forces holding plates together: Overburden & Cementation
● Forces pushing plates apart: Pore Pressure & Hydration Stress (can be up to 80,000 psi = 5700 atm.)
● Clay types: smectite (worst), illite, kaolinite, chlorite, & mixed layers.
Drilling Challenges in Shale Formations

- Shale
- Swelling
- Stuck up
- NPT
- High Torque & Drag
- Hole Pack off
- Change in Stress
OBM have been developed to overcome certain undesirable characteristics of WBM.

OBM with High Speed Diesel (HSD) as base oil became ideal alternative to combat the disadvantages of WBM in late seventies.
OBM having HSD as base fluid is hazardous in nature and dumping of cuttings in environment with adhered oil was prohibited.

**Two alternatives were worked upon:**

(i) Low Toxic mineral oil with aromatic content less than 1% (LTMO)

(ii) Synthetic Oil
These oils are derived from the same type of crude oil streams from which Diesel oil, Kerosene, Gasoline and lubricating oils are derived.

A significant difference in the chemical make up for low toxicity oils is the fact that aromatics are completely removed.

These oils are composed of Paraffinic / Naphthenic components.
LTMOs Characteristics

- Low Sp. Gravity and High Initial Boiling Point
- High Flash Point
- Low Viscosity
- High Aniline point
- Low Pour Point
- Low Aromatic Content
Synthetic Oil Base Muds

- Linear Alpha Olefins (LAO)
- Internal Olefins (IO)
- Poly Alpha Olefins (PAO)
- Esters
- Ethers
Constituents For OBM Package

- Base oil
- Primary Emulsifier
- Secondary Emulsifier
- Lime
- Brine
- Organophilic Clay
- HTHP Fluid Loss agent
- Weighting material
Advantages of Oil Base Muds

(1) Shale Stability:
   - OBM is non reactive towards shale formations.
   - Higher penetration rate.

(2) High Temperature tolerance:
   - Suitable for HTHP wells.

(3) Drilling salts:
   - Do not interfere with salt formations.

(4) Lubricity:
   - Minimize the friction between drill pipe and the wall of wellbore.
   - Reduces chances of Stuck-pipe.
Advantages of Oil Base Muds

(5) Low pore formation pressure:
- Mud weight as low as 7.5 ppg can be maintained.

(6) Corrosion control:
- Corrosion of pipe is controlled since oil is the external phase and coats the pipe.

(7) Reuse:
- They can be stored for long periods of time since bacterial growth is suppressed.

(8) Packer fluids:
- Oil muds may be used as long term stable packer-fluids, since the additives are extremely temp. stable.
SOBM has additional benefits compared to OBM:

- Low toxicity and reduce irritant property.
- Elimination of Diesel reduces pollution hazards.
<table>
<thead>
<tr>
<th>S.No</th>
<th>Category</th>
<th>Median Lethal Concentration (LC$_{50}$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Non Toxic</td>
<td>&gt; 100,000 mg/L</td>
</tr>
<tr>
<td>2</td>
<td>Practically Non Toxic</td>
<td>10,000–100,000 mg/L</td>
</tr>
<tr>
<td>3</td>
<td>Slightly Toxic</td>
<td>1000 – 10,000 mg/L</td>
</tr>
<tr>
<td>4</td>
<td>Moderately Toxic</td>
<td>100 – 1000 mg/L</td>
</tr>
<tr>
<td>5</td>
<td>Toxic</td>
<td>1-100 mg/L</td>
</tr>
<tr>
<td>6</td>
<td>Very Toxic</td>
<td>&lt; 1 mg/L</td>
</tr>
</tbody>
</table>
For Onshore Drilling Operations

- OBM having aromatic content less than 1% could be used under intimation to MoEF/SPCB.

- Chemical additives used for the preparation of DF should have low toxicity i.e. 96 hrs LC$_{50}$ should be $> 30,000$ mg/l as per toxicity tests.

- Drilled Cuttings separated from OBM after washing should have oil content less than 1%.
For Offshore Drilling Operations

Additional requirements are:

- Bulk discharge of Drilling Fluid is prohibited.
- Drill cuttings of any composition should not be discharged in sensitive areas notified by MoEF.
- The Drilled Cuttings wash water should be treated to confirm to the limits given by EPA.
- Discharge of Drilled Cuttings from the installation located within 05 Km away from the shore should ensure that there is no adverse impact on the marine eco-system.
Biodegradability of OBMbs

- Highly Biodegradable
- Slow and incomplete biodegradation
- Decreasing Toxicity

SOBM

LTMO

Diesel
Disadvantages Of SOBM

- Cost
- Kick Detection
- Not to use in Exploratory Wells
- Not against Pay zone
- Rubber parts are easily deteriorated by oil base.
(1) **Must be a synthetically produced base fluid**
- “oil” has poor environmental image.
- lower toxicity usually associated with synthetics.

(2) **Optimize environmental factors**
- high aerobic biodegradability
- low toxicity
- chlorides free

(3) **Low health & safety risk**
- avoid low flash points base fluids as they are classified as flammables.
Two wells SC-7 & SC-8 were drilled in 12 ¼” with LTSOBM by MI – SWACO on nomination basis in 2004. Prior to this a lone well up to 800 mts was drilled with OBM.

The success prompted ONGC to sign a contract for 100 wells with KMC Oiltools through Limited tender, of which 98 wells were completed.
This was followed by another contract for 175 wells with MI SWACO and ONGC completed 242 phases with LTSOBM.

A fresh contract has been signed by ONGC with MI-SWACO in 2012 effective from November 2012 for 200 wells for using OBM Package.

With the commencement of Kakinada OBM Plant, ONGC is also using the services of MI for LTSOBM Package in the Eastern Coast.
Thank you