Who is Carmeuse?

- Largest lime (CaO) producer in North America
- Top 10 largest limestone (CaCO$_3$) producer in U.S.
- Eight pulverized/screen-grade limestone production sites in N.A.
- Oilfield Products Laboratory in Pittsburgh PA
Calcium Carbonate  FAB Statement

• **Features**
  - Limestone, marble
  - Milled or screened
  - Specific gravity (Rel. Density)
  - Particle size distribution...particle packing
  - Acid soluble
  - Readily available

• **Advantages**
  - Densifies drilling fluid
  - Controls circulation loss
  - Prevents formation damage

• **Benefits**
  - Safe
  - Cost effective
  - Versatile
CaCO₃...Where it’s Used?

<table>
<thead>
<tr>
<th>Calcium Carbonate</th>
<th>Drilling Fluids</th>
<th>Oilfield Cementing</th>
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<tbody>
<tr>
<td></td>
<td>Weighting Agent</td>
<td>Drill-in Fluid</td>
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<td>X</td>
</tr>
</tbody>
</table>

**Drilling Fluids**
- Weighting Agent
- Drill-in Fluid
- Lost Circulation Material

**Oilfield Cementing**
- Loss Circulation Material
- Acid Soluble Cements
CaCO₃...How it’s Used?

• Sold to service cos., then formulated (or blended on-site)
• Packaged (50 lb - 3000 lb)
• Purchased at corporate level
• Small portion of drilling fluid cost
Drilling Fluids
Drilling Fluids

• Drilling fluid, aka “mud,” is added to the wellbore to facilitate drilling:
  ▪ Suspend cuttings
  ▪ Control pressure
  ▪ Stabilize exposed rock
  ▪ Provide casing buoyancy
  ▪ Cool & lubricate

• Types:
  ▪ Water
  ▪ Oil
  ▪ Synthetic oil-based

• Cost:
  ▪ ~ 10% of the well drilling
Weighing Agent

• Used to increase density of drilling fluid:
  ▪ finely divided solid
  ▪ high specific gravity

• Fluid density required to:
  ▪ Maintain borehole stability
  ▪ Control formation pressures
  ▪ Prevent penetration of formation fluids
  ▪ Facilitate pulling dry pipe

• Calcium Carbonate:
  ▪ Can be removed during well completion, minimizing formation damage
## Weighting Agent

<table>
<thead>
<tr>
<th>Mineral</th>
<th>Sp Gr</th>
<th>Mud Density</th>
</tr>
</thead>
<tbody>
<tr>
<td>CaCO3</td>
<td>2.7</td>
<td>Low 12 lb/gal</td>
</tr>
<tr>
<td>Barite</td>
<td>4.1</td>
<td>High &gt; 12 lb/gal</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Shale Play</th>
<th>Average Depth, ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>Devonian</td>
<td>5,000</td>
</tr>
<tr>
<td>Marcellus</td>
<td>6,300</td>
</tr>
<tr>
<td>Barnett</td>
<td>8,000</td>
</tr>
<tr>
<td>Bakken</td>
<td>10,000</td>
</tr>
<tr>
<td>Woodford</td>
<td>11,500</td>
</tr>
<tr>
<td>Utica</td>
<td>13,000</td>
</tr>
</tbody>
</table>
Drill-in Fluids

• Reservoir drilling fluid aka “drill-in fluid”...
  ▪ Minimize formation damage when drilling into the “payzone”
  ▪ **Calcium Carbonate** added to:
    o Form a “bridge” or “filter cake” over formation pores
    o Prevent migration of particles into the reservoir

▪ Then remove with acid or chelant at a later stage
Optimum Bridging Agent Blend

D10 - D50 - D90
D10 Target / Blend: 3.4 / 3.4 microns
D50 Target / Blend: 169.9 / 100.8 microns
D90 Target / Blend: 424.5 / 330.7 microns

Optimum Blend for 0 to 100% CPS Range

<table>
<thead>
<tr>
<th>Brand Name</th>
<th>Bridging Agent (kg/m³)</th>
<th>Vol %</th>
</tr>
</thead>
<tbody>
<tr>
<td>A = MICARB 07-96</td>
<td>11.5</td>
<td>12.26</td>
</tr>
<tr>
<td>B = MICARB 180</td>
<td>0.0</td>
<td>0.00</td>
</tr>
<tr>
<td>C = MICARB 400</td>
<td>83.4</td>
<td>87.74</td>
</tr>
</tbody>
</table>

Simulation Accuracy
Calcium Carbonate added: 95 kg/m³
Avg Error 0 - 100% CPS Range: 3.04 %
Max Error 0 - 100% CPS Range: 16.70 %
Lost Circulation Material (LCM)

• Added to drilling fluid to prevent loss of fluid due to fractures in the formation

• OR as a “pill” treatment to seal fractures where significant losses have already occurred

• Forms:
  - Flake (mica)
  - Granular (DE, Calcium Carbonate)
  - Other (Gilsonite®)
  - Chemical (polymer thickening agents)

• Calcium Carbonate builds a filter cake at the entrance of the fracture to seal it up
Oil Well Cement
Oil Well Cement

- Cementing a well- pumping cement into place in a wellbore
  - Used to prepare for further drilling, production or abandonment

- Lost circulation addressed via Calcium Carbonate
  - Placement of a “pill” to seal the loss zones before cementing OR
  - Bridging/plugging agent into the cement slurry itself
Oil Well Cement

• **Acid Soluble Cement (Shale Gas)**
  - **Calcium Carbonate** ...component of cement
  - After frac’ing, broken cement pieces plug casing holes
  - Pump acid into casing to dissolve the cement ($\text{CaCO}_3$) pieces
Thank you!

Photos courtesy of:
Imerys
Oilfieldair.com
Osha.gov
tungsten-spheres.com
Leancrew.com
Chesapeake Energy