Use of Calcium Carbonate as a Drilling Fluid Additive

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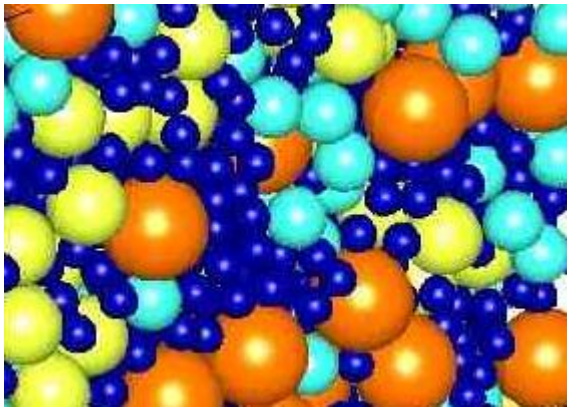
Who is Carmeuse?

- 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?

	Drilling Fluids			Oilfield Cementing	
	Weighting Agent	Drill-in Fluid	Lost Circulation Material	Loss Circulation Material	Acid Soluble Cements
Calcium Carbonate	X	X	X	X	X

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

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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

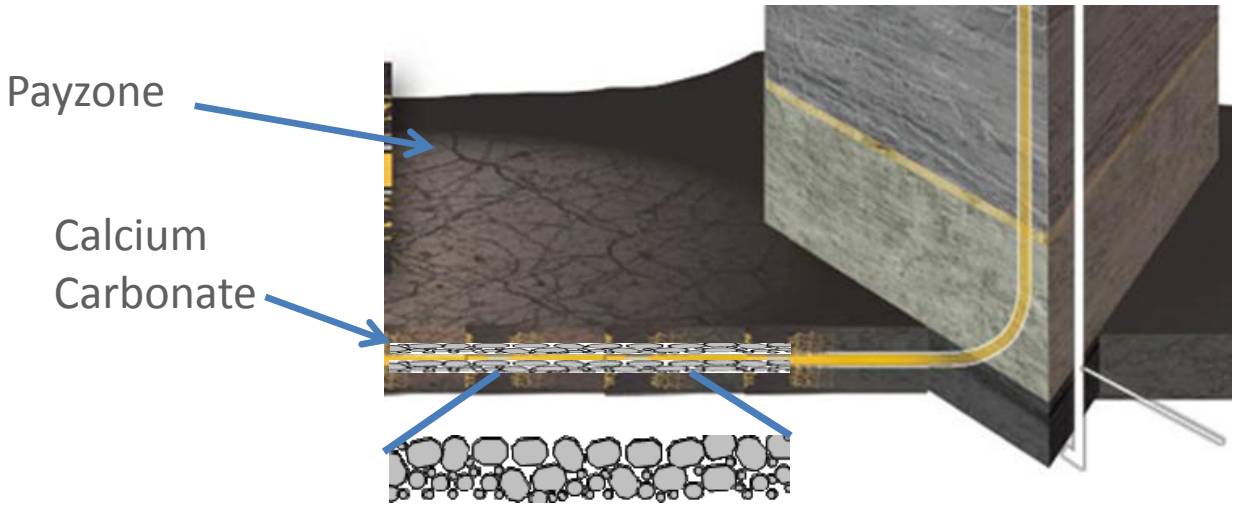
Weighting Agent

Mineral	Sp Gr	Mud Density	
CaCO3	2.7	Low	12 lb/gal
Barite	4.1	High	> 12 lb/gal

Shale Play	Average Depth, ft
Devonian	5,000
Marcellus	6,300
Barnett	8,000
Bakken	10,000
Woodford	11,500
Utica	13,000

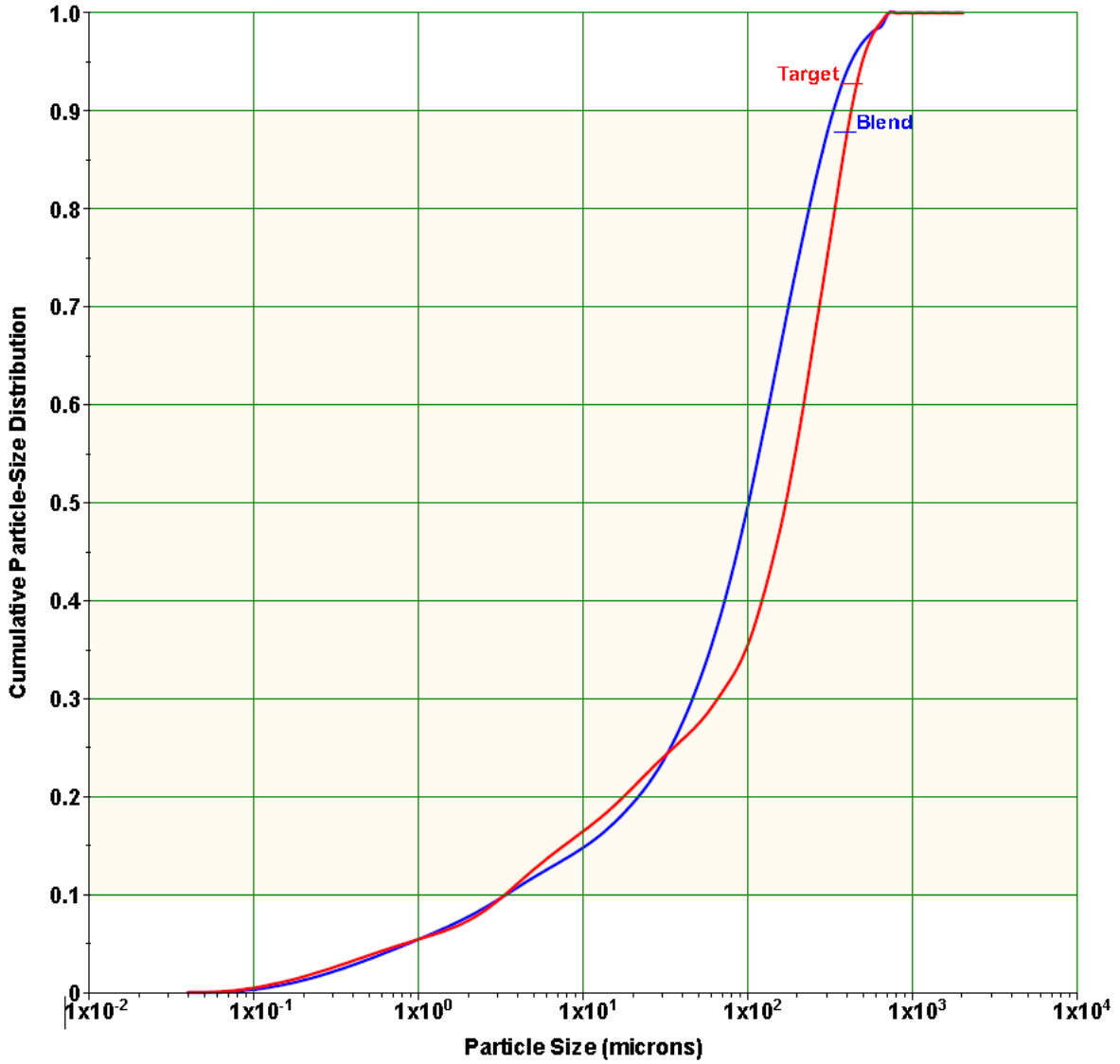
Drill-in Fluids

- Reservoir drilling fluid aka ***"drill-in fluid"…***
  - Minimize formation damage when drilling into the "payzone"
  - **Calcium Carbonate** added to:
    - Form a "bridge" or "filter cake" over formation pores
    - Prevent migration of particles into the reservoir
  - Then remove with acid or chelant at a later stage



Source: M.I. Swaco

Optimum Bridging Agent Blend

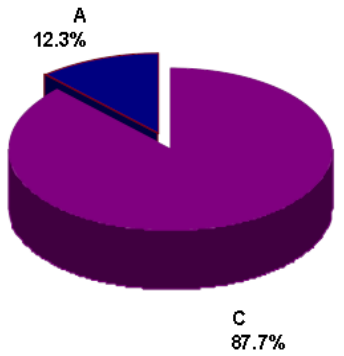


D10 - D50 - D90

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

Brand Name	Bridging Agent(kg/m³)	Vol %
A=MICARB 07-96	11.6	12.26
B=MICARB 160	0.0	0.00
C=MICARB 400	83.4	87.74

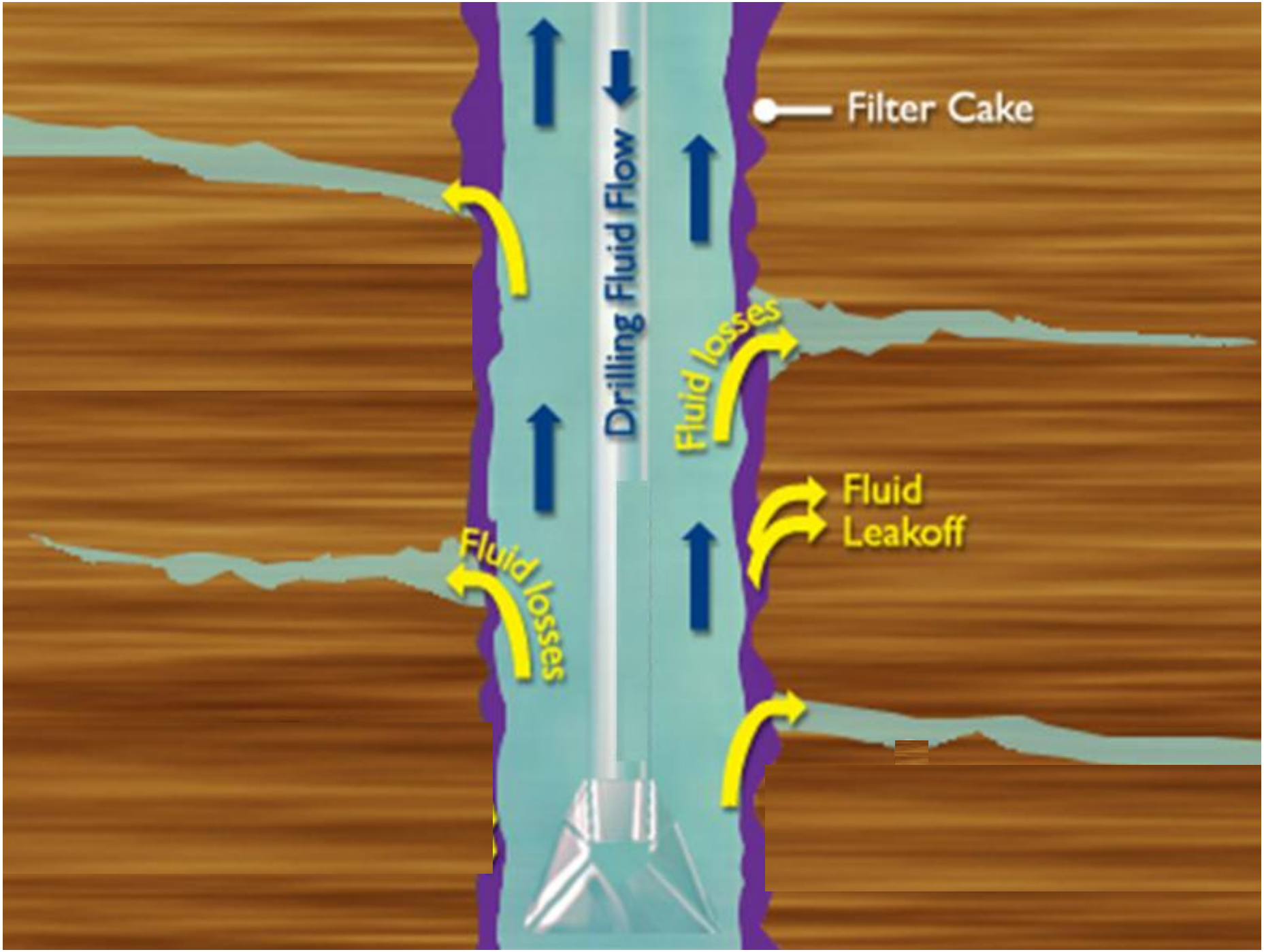


Simulation Accuracy

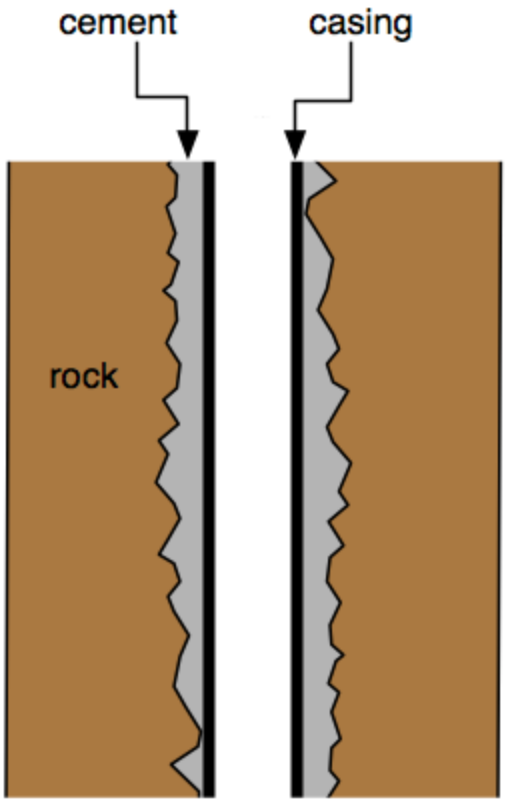
Calcium Carbonate added :	95	kg/m³
Avg Error 0 - 100 % CPS Range :	3.04	%
Max Error 0 - 100 % CPS Range :	18.70	%

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


Filter Cake
Drilling Fluid Flow
Fluid losses
Fluid Leakoff
Fluid losses

Oil Well Cement



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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 (**$CaCO_3$**) pieces

Thank you!

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