Riteks MS Spacer Technology

Membrane Sealing Spacer

MS Spacer Technology

- Creates a low permeability membrane across the formation.
- Develops surface tension as penetrates surfaces, micro-fractures & pores to aid in mitigating losses
- Reduces Damage From Filtrate Invasion From Hundreds of Feet to Only Inches
- Completely displaces drilling fluid to prepare hole for cementing
- Superior Hole Cleaning Performance
- Delivers effective zonal isolation
- Enhances cement bonding
- Achieves designed top of cement
- Prevents cement losses & mitigates formation damage
- Enables ECD to exceed the fracture gradient
- Optimizable rheology (YP hierarchy) with elevated temperature stability
- Prevents Gas Migration by reducing fluid loss of the cement slurry
- Excellent Compatibility with Drilling Fluids and Cement
- Prevents Fall Back & Settling

Recommended Loading Levels

- For low to no losses (for proper sealing)
  – 15ppb MS Spacer + 0.5ppb RadiLock 3mm Fiber
- For <10bbl/hr losses during drilling
  – 20ppb MS Spacer + 1.0ppb RadiLock 3mm
- For <100bbl/hr losses during drilling
  – 25ppb MS Spacer + 1.5-2ppb RadiLock 3mm

Benefits vs. Competitive Spacers

- Faster hydration time and not as clumpy when mixed to density.
- Hydration time of 2-5 minutes, while we've seen other polymers take upwards of 7-10 minutes for hydration.
- More consistent product throughout the blend, and lower viscosity but improved YP for suspension.
- Better suspension properties and holding of weighting agent.
- Less foam generated in mixing the product with water with the MS Spacer.
- Rheologies of the MS Spacer at 80F and 150F were very similar, showing consistency & stability.
- Product was designed to give good carrying/suspension, while at lower viscosities than typical spacers.
- Improved Costing to allow better profits and to utilize the products in more applications with the necessary weighting agents for density.
  - Addition of 0.5-2.0#/brl of fiber is much more cost effective and easier to handle/process than large quantities of LCM particulate.

MS Spacer Calculators & Decision Tree

- Available upon request @ service@riteks.com
- Membrane Sealing Calculator & Decision Tree is a combination of base spacer loadings and increased spacer loadings depending on the type of losses encountered as seen on drilling reports or discussed with drilling engineers.
- MS Spacer Flow Calculator was created based on hundreds of rheology testing with the product. This train of thought is more for "tunable" spacers, though you still will get the membrane sealing effect, it isn't geared towards severe or total losses.
  - This calculator will give you spacer loadings that will effectively remove the mud from the hole based on the mud rheologies. This calculator takes into consideration the wellbore geometry and displacement rate to determine a cost effective spacer loading.
  - The calculator considers a 20% increase and decrease in rate, as displacement rates may vary in the field, so you will still effectively remove the mud from the hole with rate changes.

Competitive Advantage

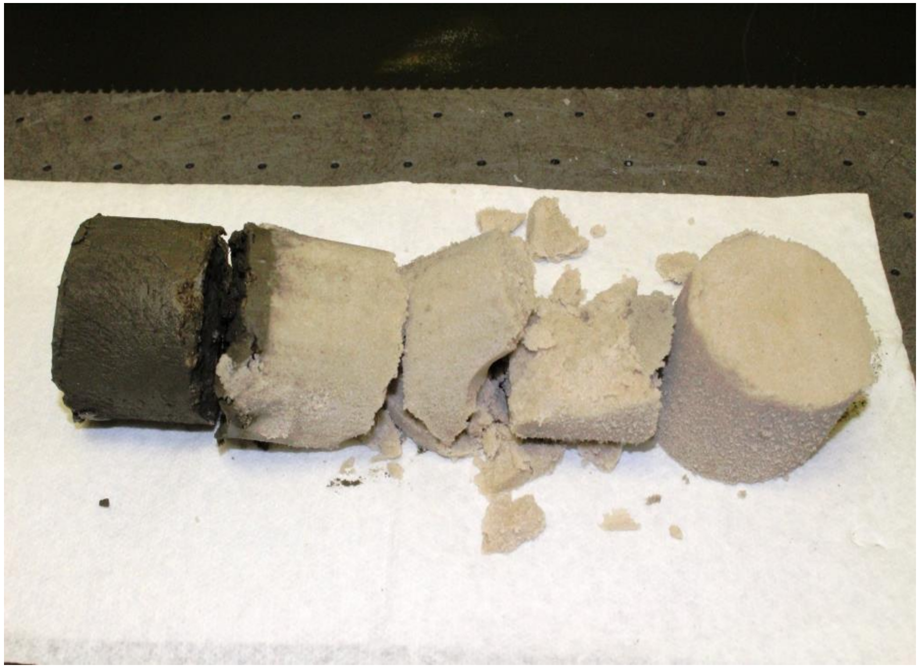
Operational benefits seen with MS Spacer vs. competitive spacers.

- Faster hydration time and mixability with density.
- Hydration time of 2-4 minutes vs. other polymers that need 7-10 minutes for hydration – effective to run ‘On the Fly’.
- Consistency throughout the blend, and lower viscosity but improved YP for suspension.
- Rheologies at 80F and 150F are very consistent & stable.
- Faster processing due to less foam generated in the blending & mixing process.
- Better suspension properties of weighting agents & cleaning of the hole.

Test Procedure – MS Spacer

- Test Procedure
- Fluid loss cell w/ 325 mesh screen at the bottom with 100 mesh sand inside the cell.
- Add 120mils of water to the sand bed, open the bottom valve, and allow the water to drain from the cell for 10 minutes.
- Once the water had drained, the bottom valve was closed.
- Add fluids to the sand bed (cement / spacer)
- Apply 1000psi pressure using nitrogen gas to the fluid loss cell for 30 minutes.
- Carefully remove the sand bed and record results.

Test 1: Neat Cement



- 16.4 ppg class H cement slurry was mixed and 113 mls were poured on the top of the sand in the fluid loss cell.
- All the fluid blew out in 3 seconds and over 100mls of filtrate was collected.
- Figure 1 shows that the cement penetrated deep into the sand layer and a portion of the cement left dehydrated on top of the sand bed.

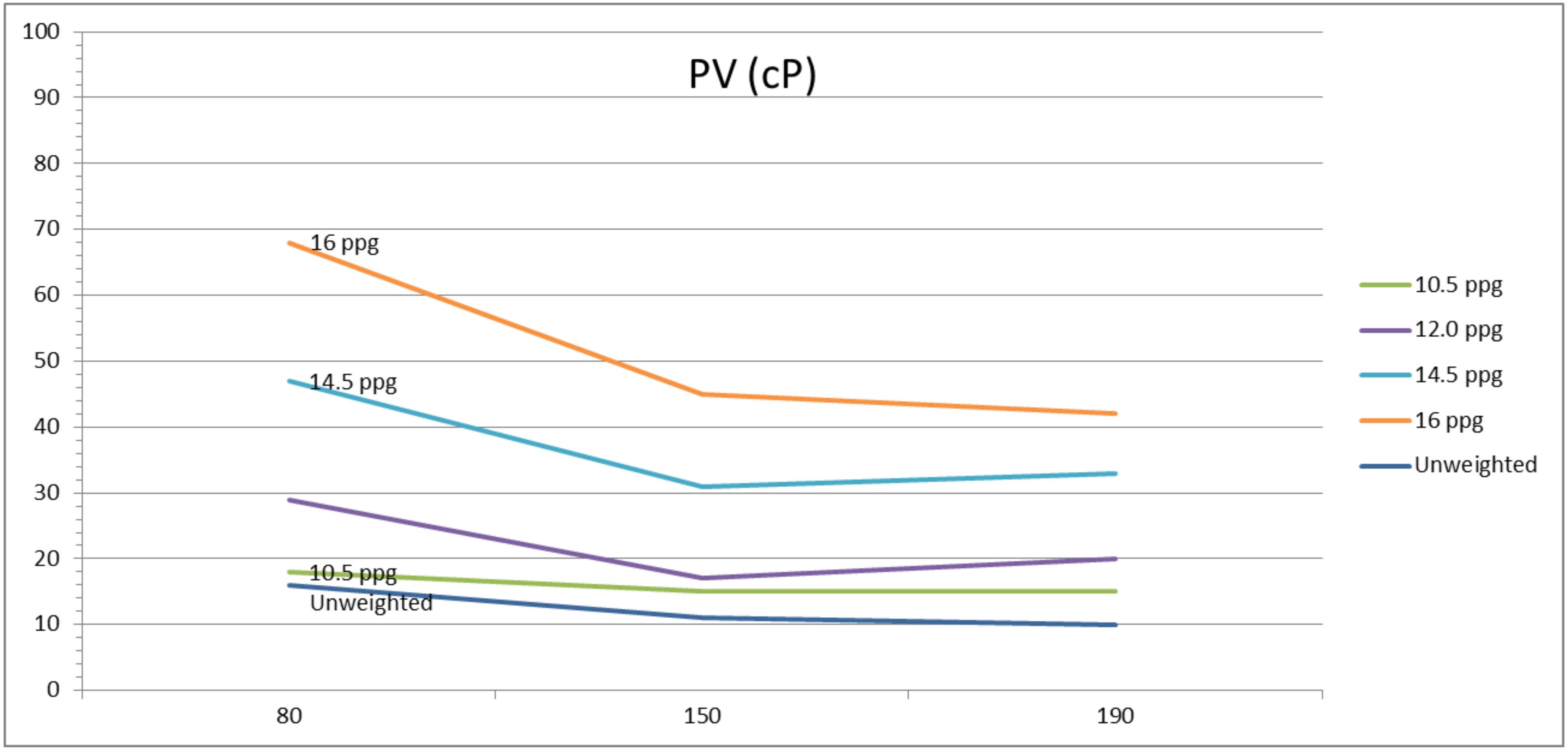
Test 2: MS Spacer

- Unweighted MS Spacer (8.5 ppg density) was then mixed and 113 mls were placed in the fluid loss cell.
- Pressure was maintained for 30 minutes and 63 mls of filtrate collected.
- Approximately 60 mls of spacer were collected.
- Figures 2 shows that the spacer formed a barrier across the top of the sand bed.

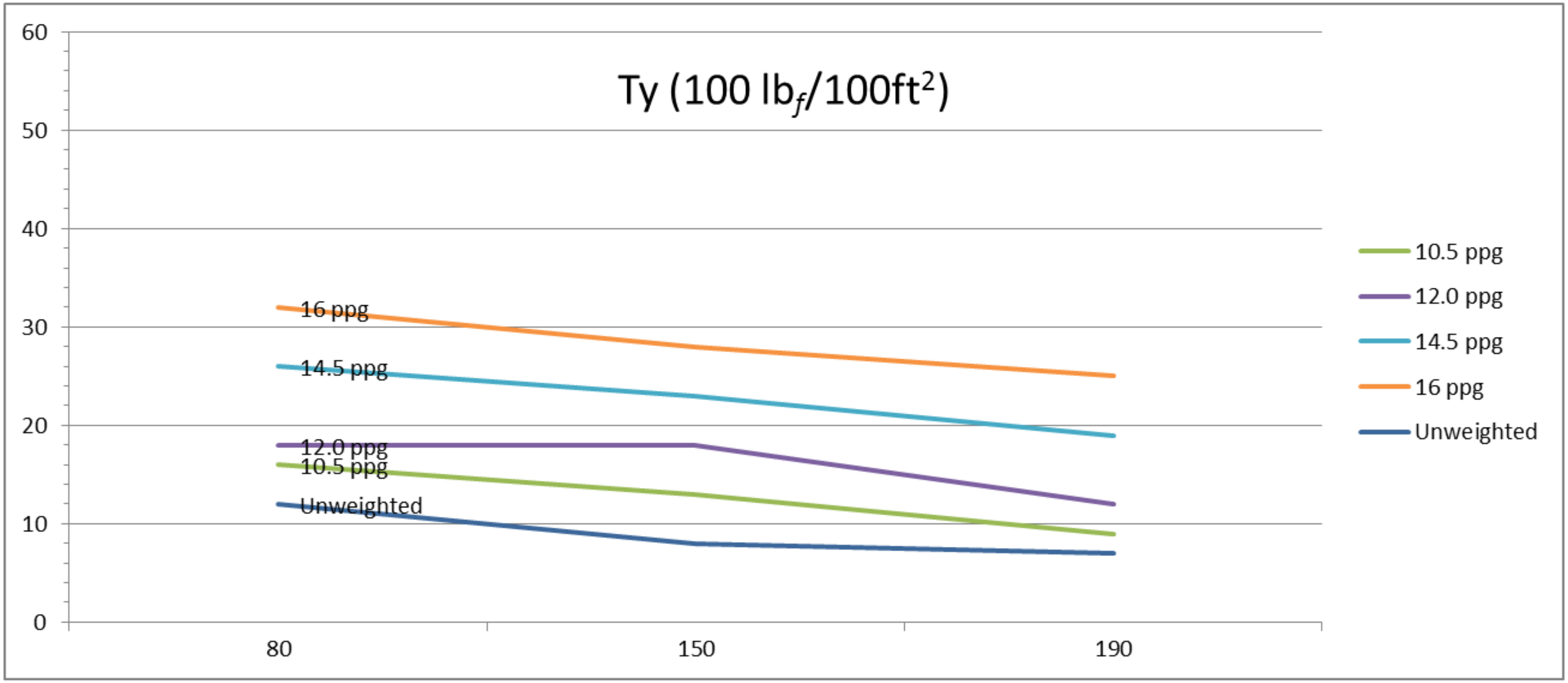
Test 3: MS Spacer & Neat Cement

- Test 2 was repeated with additional 113 mils of 16.4 ppg class H cement slurry added.
- Pressure was maintained for 30 minutes
- Approximately 100 mils of filtrate were collected.
- Figures 3 shows the membrane sealing effect of MS Spacer creating a barrier at the surface of the sand that prevented the cement becoming totally dehydrated.

Normal Spacer Concentration



Normal Spacer Concentration



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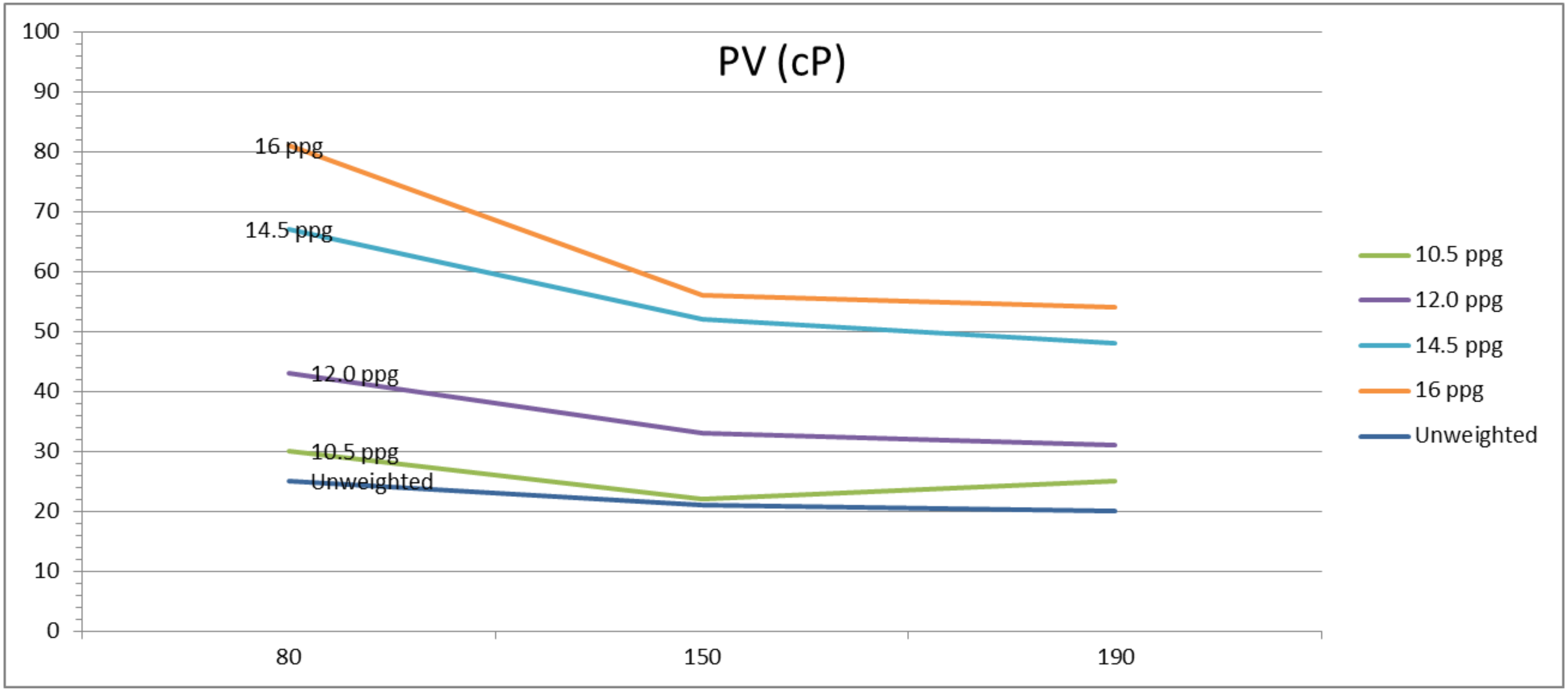
25% Extra Spacer Concentration



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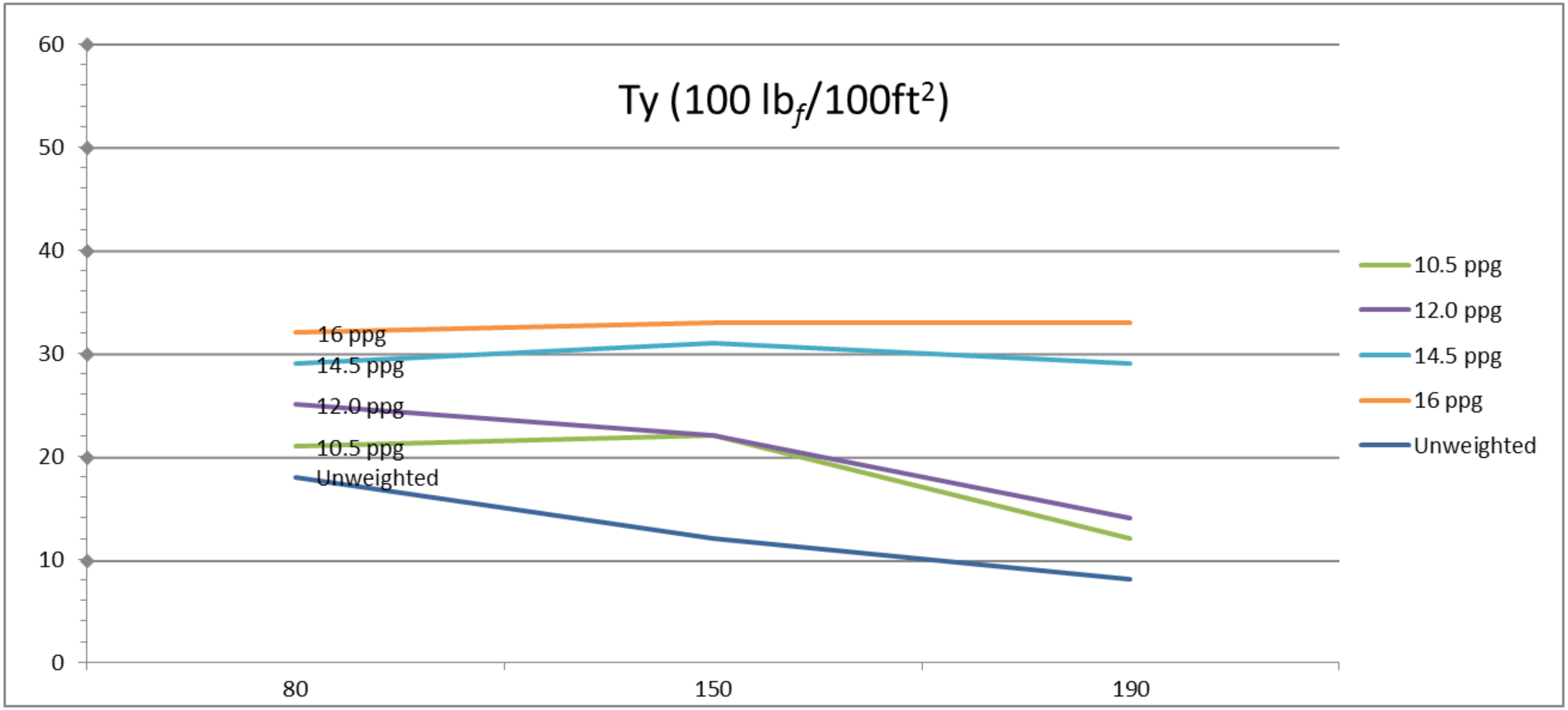
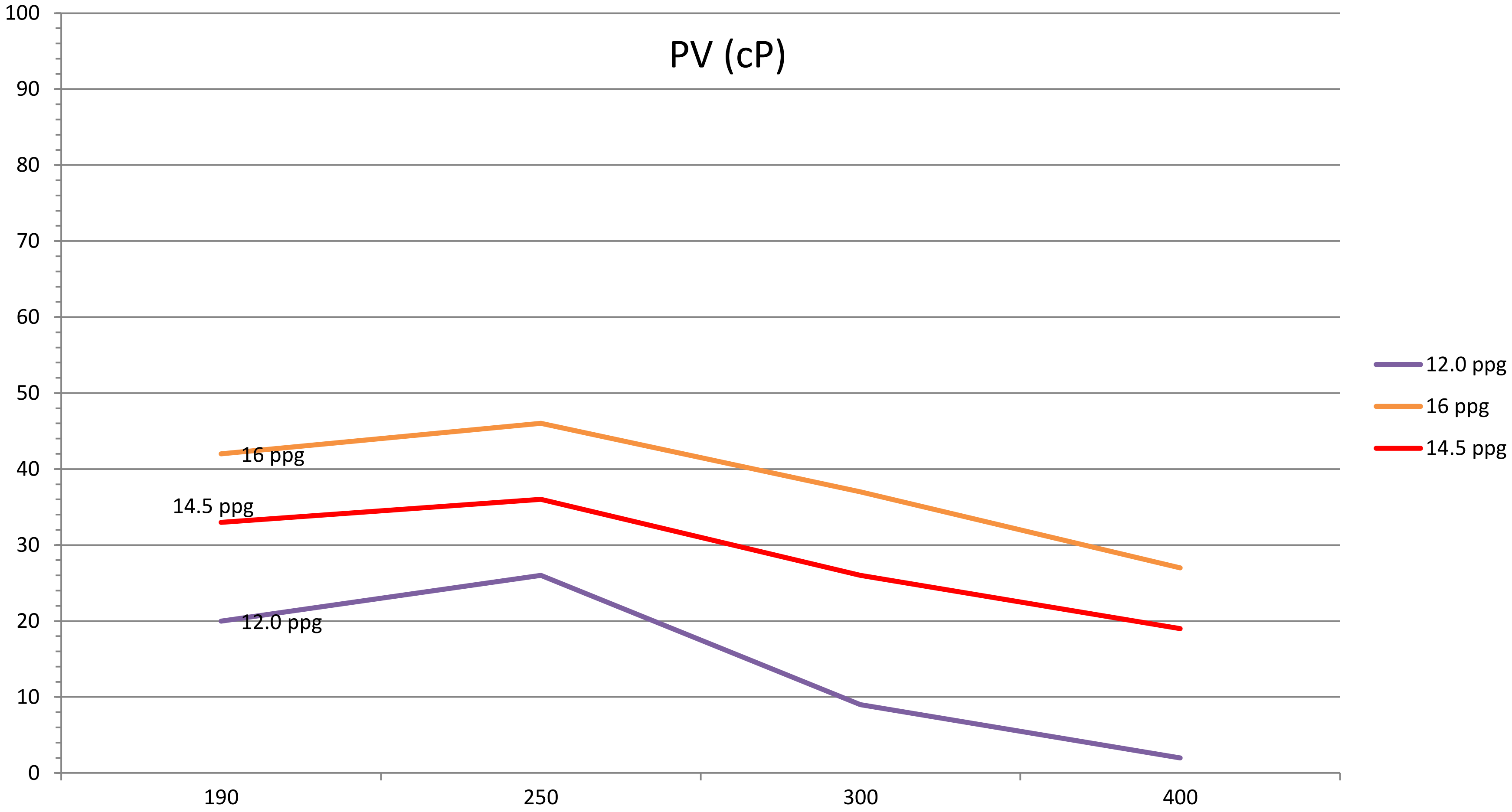


Spacer Rheology (HPHT Conditioning)

Density (ppg)	12.0 ppg				14.5 ppg				16 ppg			
Conditioning Temperature (°F)	190	250	300	400	190	250	300	400	190	250	300	400
300	30	34	12	4	50	50	40	32	64	60	50	40
200	26	29	4	2	41	43	35	29	52	49	41	32
100	18	23	6	2	31	33	29	25	39	39	31	28
60	16	19	5	2	25	29	26	22	32	32	26	22
30	11	15	4	2	19	23	23	20	25	25	20	20
6	6	9	2	2	11	15	15	13	17	15	14	13
3	5	7	2	2	9	12	11	11	14	11	11	10
PV	20	26	9	2	33	36	26	19	42	46	37	27
YP	12	12	3	2	19	18	18	16	25	19	16	16

*190°F readings taken after atmospheric consistometer conditioning

Spacer Rheology (HPHT Conditioning)



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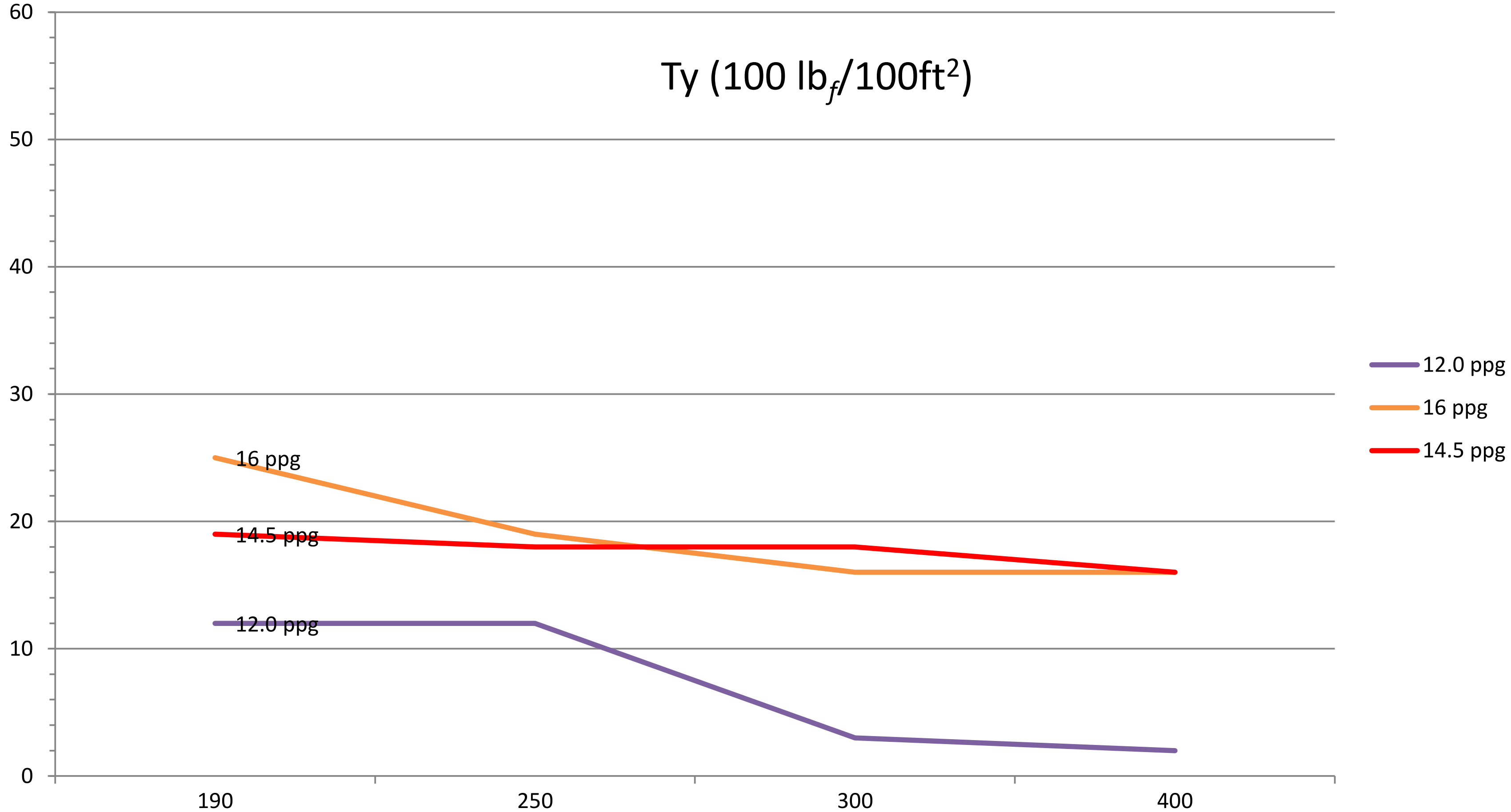

Contaminated Slurry Tests
90% Cement:10% Spacer

Slurry Density: 16.4 ppg

Spacer Density: 14.5 ppg

BHCT: 166 °F

BHST: 175 °F

Thickening Time

Slurry	Initial BC	40 Bc (hr:min)	70 Bc (hr:min)	100 Bc (hr:min)
100% Cement	19	3:31	3:37	3:41
90% Cement : 10% Spacer	22	4:19	4:25	4:30

UCA Compressive Strength

Slurry	500 psi (hr:min)	12 hrs (psi)	24hrs (psi)
100% Cement	5:30	1934	3145
90% Cement : 10% Spacer	6:28	1348	2189

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