World Oil ShaleTech™ Hydraulic Fracturing Forum: Fall 2018

FAQ: "The Value Proposition of Regional Sand vs. Northern White Sand"

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Q: Did you ramp straight to 6000-psi or did you start at 1000-psi?

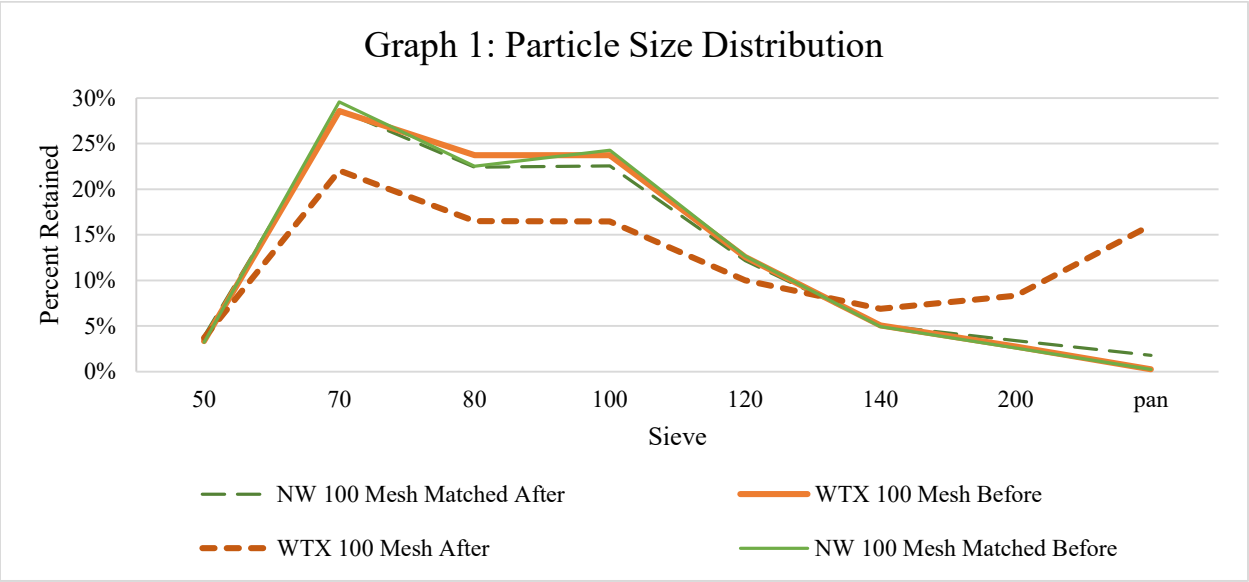
A: Samples are ramped to 1000-psi at a rate of 500-psi/min. Samples are then degassed for a period of approximately two days (depends on grade because fine samples retain more air bubbles). Once degassing is complete, samples are then ramped to 6000-psi at a rate of 100-psi/min.

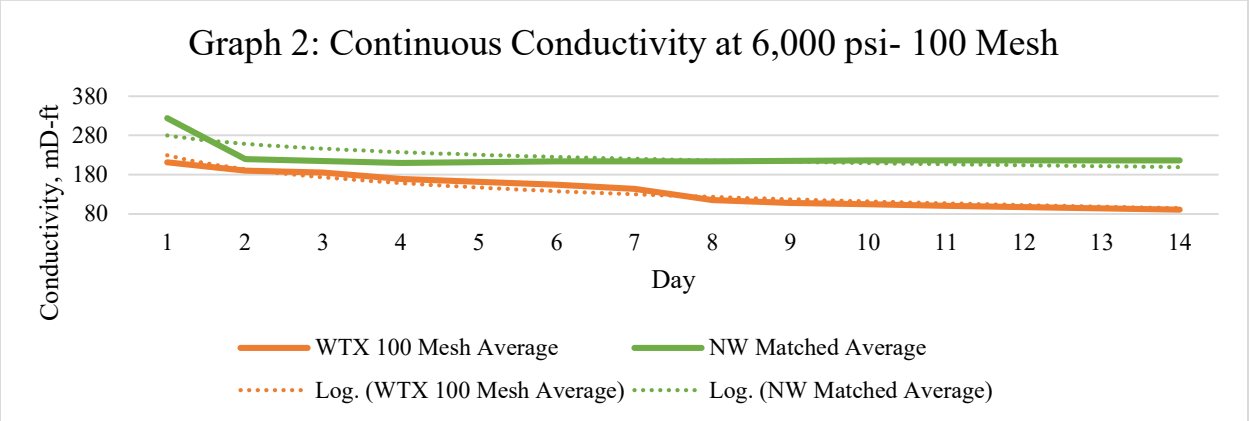
Q: How is the conductivity of your proppants tested?

A: Standard API 19D procedure is used to build cells, load proppant and load cells onto the press. The press closure pressure is then ramped to 1000-psi at 500-psi/min where it is held for the duration of the degassing process (this ensures all pore space is filled with water and no air bubbles are present, as air will alter readings). Once degassing is complete, the press is ramped to 6000-psi at 100-psi/min where it will remain for the duration of the 14-day test. Readings are taken every 50-hours and proppant conductivity is calculated using proppant pack permeability times proppant pack height. Conductivity is reported in units of mD-ft.

Q: Do you attribute the conductivity difference to the proppant size variability of the West Texas sand?

A: Size range certainly plays a role in conductivity, however, even when we matched a WTX particle size to a NW particle size, the absolute conductivity of the NW proppant was still higher. The first graph (Graph 1), is the Particle Size Distribution graph of a NW 100 Mesh matched to a WTX 100 Mesh. Graph 1 also highlights the fines generation of the two sands before and after the conductivity tests. Graph 2 shows that NW 100 Mesh displays far more endurance than WTX.





Q: Did the reduction of conductivity and increased fines during the aging tests occur with-in the stated crush strength envelopes?

A: Not always. Most of the NW proppants we tested did not generate more fines than their advertised K-value and overall outperformed, although some of the WTX sands we tested generated far more fines than the standard API 19C crush test originally represented.

Q: Was there any liquid present in the sand pack or was the testing conducted on dry sand?

A: All sands are tested dry.

Q: Do you account for rock surface texture change throughout the length of the fracture when doing crush and conductivity tests? Any future efforts on this?

A: We have not run any tests incorporating a lab simulation for rock surface texture yet. So far, we have tried to minimize variables as much as possible by using standard Ohio sandstone cores for conductivity and steel cells for crush.

Q: Attributing higher IP to quality of proppant is a risky comparison if you consider different job designs. What is the sample size of tests done? Is it in the same formation? Same designs?

A: Parent samples come from plants in 2.5 to 5-gallon buckets. Samples are collected from a "flowing stream" and in accordance with API 19C Standard Proppant Sampling Procedure section 4.1-4.5. Parents samples are then split in the lab also according to API 19C Sample Handling and Storage section 5.1-5.3. One parent sample bucket is used for ALL tests within a project.

Q: Could it be possible to know if the Northern White sand is composed only of silica?

A: Yes, X-ray fluorescence determines bulk chemistry and X-ray diffraction allows the analyst to determine how those elements are arranged into various mineral species. For example, by XRF analysis, a sand sample may yield 98% SiO_2 (elemental weight %), whereas XRD would express that as 98% quartz (mineralogy).

Q: I understand the production results came from the same operator. Were the wells in questioned using similar stimulation design, same region of the basin, same overall approach of completion, fit same type curve?

A: Yes, they were all in the oil window in the Eagle Ford, in the same formation. We normalized lateral length and proppant quantities.

Q: What were the assumptions in the cost model you did?

A: We assumed $60 WTI and with normalized production from a 7,500 ft well. We also assumed that the price differential between Norther White and Regional sand is $50. The model was undiscounted.

Q: At what proppant concentration was your conductivity testing performed and does that reflect reality?

A: Cells are loaded at 2lb/ft^2, so it depends on the bulk density of the sand. Bulk density is measured in our API 19C lab prior to conductivity testing. In reality, it would be optimal to perform the test with a lesser concentration, but for now, we are lab constrained and must follow the 19D standard loading procedure to ensure consistent data comparisons are being made.

Q: When you say mixed sand, do you mean regional sand as lead slug, and tail off with Northern white sand?

A: Unfortunately, we don't know how it was mixed, we don't have that level of detail, as it was not given to us by the E&P Company.

Q: What is the main reason cheaper sands lose conductivity?

A: West Texas sands contain less Silicon Dioxide (SiO_2) and therefore, aren't as strong. Clay and carbonate material found in regional sands does not exhibit strength or resistance to acidic conditions. Weaker regional sands cannot endure laboratory simulation pressures thus generating more fines. These fines inhibit permeability and decrease overall conductivity.

Q: Was the Eagle Ford proppant study performed in the oil window, volatile oil window or gas condensate window?

A: Oil window.

Q: Given that the conductivity differential between even crushed sand and any nano-Darcy rock is so huge, does proppant quality really matter in an unconventional frac (as opposed to a higher permeable rock in conventional fracturing)

A: Yes, the crushing of the proppant creates fines migration, degradation of fracture width, proppant pack rearrangement which all contribute to decreases in conductivity. Regional sand does not have the strength to withstand the constant abuse that opening and closing the well creates.

Q: Do all local sands behave this way or is this particular to the sample?

A: The regional sands in the Permian behave this way. Not all sand deposits are created equal, so testing is suggested when considering a different type of sand.