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Particle size distribution match optimization by a superposition method for artificial core synthesis

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Enhanced oil recovery testing often relys on either a sand pack filled with sand or use Berea sandstone that doesn't take into account the full range of petrophysical properties of the actual reservoir. Among the most important reservoir petrophysical properties are the particle sizes and their distribution that serves as the key parameter that influences strongly other key petrophysical parameters such as permeability, porosity, pore throat distribution, capillary pressure, etc. In this work, the authors have devised a new method to synthesize an artificial core in which the porosity, permeability, and particle size distribution nearly match that of a target natural reservoir core: 1. The method entails having the thin section prepared on a sliced target natural reservoir core. 2. The particle size distribution analysis is done on the slice under a microscope. 3. Different sizes of sieved sands have particle size distribution analysis done by a laser particle size analyzer. 4. The particle size analysis of the sands and the target natural reservoir core is superimposed on the same plot and the best-fitting sand is visually picked out. 5. The best-fitting mesh size is either used directly or sieved to cut off a smaller or bigger fraction not found in the particle size distribution of the target natural reservoir core. 6. The sieved sands are compressed into an artificial core with addition of other micron sized sands served as fillers with a specialized adhesive at a set compression time and pressure. 7. The synthesized artificial core is sent for porosity and permeability analysis. 8. If porosity and permeability is not within 5% and 10% of the target respectively, then more fine sand fillers are used to dial down the porosity and permeability on another attempt to synthesizing another core. 9. If porosity and permeability are both matched within acceptable error, the artificial core is sent for thin section particle size distribution analysis. 10. If the medium size of the artificial core's particle size distribution and the shape of the distribution doesn't match the target, then another adjustment is made on the sand size and the process is repeated until it does. Through several trial and error attempts using this method, the particle size distribution, permeability, and porosity of the artificial core is closely matched to a set target natural reservoir core. Using this method, a more robust artificial core can be synthesized for use in enhance oil recovery testing.

References

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