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Effect of non-acid-soluble minerals on acid-etched hydraulic fracture morphology and conductivity for acid-fracturing in carbonate rock

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Acid fracturing is a primary stimulation technique for carbonate reservoirs. Acid selectively etches hydraulic fractures, forming high-conductivity channels capable of transporting oil and gas under the influence of normal closure pressures. Numerous fracture acidization models have focused on factors such as reservoir temperature, acid fluid type, and distribution of carbonate minerals, but few have explored the impact of non-acid-soluble minerals, such as talc and quartz, on the fluid-flow and reaction mass-transfer mechanisms within hydraulic fractures in carbonate reservoirs.
This study developed a hydraulic fracture acidization model that considers the influence of non-acid-soluble minerals, and the model was validated through laboratory-scale API rock plate acidization experiments. Furthermore, the study extensively discussed and analyzed the effects of non-acid-soluble minerals on acid etching of fractures.
The results demonstrate that the model effectively captures the acid etching characteristics of hydraulic fracture walls containing non-acid-soluble minerals. Non-reactive minerals on the hydraulic fracture walls influence the flow paths of the acid and the diffusion rate of hydrogen ion, leading to non-uniform dissolution on the fracture surfaces and the formation of rough fracture faces. Non-acid-soluble minerals retards the rate of acid-rock reaction, and as their content increases, the extent of surface dissolution on the fractures gradually diminishes, resulting in a reduction in non-uniform etching. However, non-acid-soluble minerals can act as a support for the fractures after closure, to some extent enhancing both fracture conductivity and its sustaining capacity.
This study reveals the impact of non-acid-soluble minerals on the acid etching morphology and conductivity of hydraulic fracture, providing valuable insights for the design of acidizing process design in carbonate reservoir.

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