Porosity-Size Relationship of Drilling Mud Flocs: Fractal Structure

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Abstract: The porosities of flocs formed from a used drilling mud were determined by measuring sizes and settling speeds of individual flocs. These flocs were produced in a Couette-type flocculator under a variety of combinations of fluid shear and solid concentrations. In the calculation of floc porosities, a floc settling model was employed that can consider the effects of creeping flow through a floc on its settling speed. Results show that floc structure can be well described as a fractal with a fractal dimension of 1.53− 1.64 for the floc size range tested. The effects of flocculation conditions, such as fluid shear and solid concentration, on floc porosity and structure were examined. It was found that floc porosity and fractal dimension were not influenced by solid concentration, but they increased as fluid shear decreased. Empirical expressions for the porosity of drilling mud flocs are obtained from both the floc settling model and Stokes' law. For solid volume fraction in flocs, the relative difference between these two expressions could be as much as 38%. However, the fractal dimensions estimated based on the two settling models are nearly the same.

Key Words: Drilling mud • Flocs • Fractal • Porosity