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Morphology, Rheology and Thermal Stability of Drilling Fluid Formulated from Locally Beneficiated Clays of Pindiga Formation, Northeastern Nigeria

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Abstract: Locally beneficiated clays from Pindiga Formation in northeastern Nigeria have been found to attain standard rheological properties required for Oil and Gas Well drilling after addition of some percentages of poly anionic cellulose. But these properties were measured under ambient temperature (32°C). There is the need therefore to ascertain morphology, Rheology and the performance of these beneficiated clays at field/down-hole conditions (high temperature and pressure). In this study, three of these clays (GHZ, PNG and SGN) were chosen because of their high rheological performance among others as already reported in our earlier work, formulated and subjected to different temperature (ambient (32°C), 40°C, 50°C, 60°C, 70°C and 80°C) together with API grade bentonite and at each temperature, their rheological properties were computed to ascertain their performance improvement or deterioration under these conditions. Physical and other properties (Loss On Ignition, Specific Gravity, Particle Size Distribution, Textural Classification and Formulated CEC) of the sample were also determined and compared with API grade sample. The results obtained indicated that formulation using samples beneficiated with 12% $Na2CO_3$ had viscosity values (cP) range of 2.0 – 7.1, 2.2 – 7.3, 2.2 – 7.9, 2.4 – 7.7, 2.5 – 7.6 and 2.0 – 6.4 at ambient temperature (30°C), 40°C, 50°C, 60°C, 70°C and 80°C, respectively with sample PNG recording the highest values of 7.9cP at 50°C. For the API grade sample, these values ranges (cP) from 4.5 – 15, 4.5 – 15.6, 4.7 – 15.6, 4.8 – 15.9, 4.8 – 16 and 4.2 – 14 for ambient temperature (30°C), 40°C, 50°C, 60°C, 70°C and 80°C, respectively. Viscosity results for formulation using same beneficiated sample but with addition of 0.8 and 1.5g poly anionic cellulose indicated that formulation with 0.8g poly anionic cellulose had the most impressive improvement among other formulations. Other parameters (Loss On Ignition, Specific Gravity, Particle Size Distribution, Textural Classification and Formulated CEC) determined had values/behaviors comparable with standard specifications. Thermal stability results indicated that as it is with viscosities of the different formulations at ambient temperature, sample PNG could possibly give a better result (behavior at the measurement conditions) compared with the others even at down-hole conditions and can favorably compete with even the API grade. But at temperatures greater than seventy degrees (70°C), the performance of both the API grade and the locally beneficiated and formulated drilling fluids began to deteriorate (fail) sharply.

Keywords: Formulation; Down-hole; Condition; Nigeria; Viscosity; Behavior; Drilling