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Experimental and numerical approaches for application of density and thermal neutron tools in slim borehole

Seho Hwang (1), Jehyun Shin (1), Byeongho Won (2), and Jongman Kim (1)

(1) Korea Institute of Geoscience and Mineral Resources, Geologic Environment Division, Daejeon, Korea, Republic Of (hwangse@kigam.re.kr), (2) Heesong Geotek Co., Ltd

To perform the groundwater investigation, geological surveys, geotechnical investigation, generally 3 inches diameter borehole is drilled, and PVC or steel casing having a 50 mm inner diameter is installed to prevent for collapse borehole in the case of shallow unconsolidated formation or fractured zone. In this case, well loggings for formation evaluation have many limitations, and especially radioactive tools having large diameter are basically difficult to apply. Available radioactive logs can be applied within the casing are natural gamma ray log, density log and neutron logs. Natural gamma ray log is used for estimation of shale volume, stratigraphic and facies classification such as shale and sandstone, and almost borehole environment can be corrected using manufactured charts. In the case of the small diameter borehole such as 50 mm diameter cased borehole, we should apply the small diameter radioactive logging tools. However the measured data is generally count per second. So we should convert the measured count per second to meaningful physical properties such as density or neutron porosity according to the strength of radioactive source, the distance between the source and the detector, the mud and casing type, and so on. In this study, the experimental and numerical methods are used to convert the measured count per second to density and neutron porosity for density and neutron logs logging tools having one detector. 1Ci Am-Be single neutron logs were compared using 3Ci Am-Be dual neutron logs in the same boreholes, and empirical relationship between the single and dual neutron log is derived. The diameter and lithology of target boreholes are 3 inches and granite, sandstone, mud, etc. The response characteristics for a very small diameter and no orientation of the radioactive source density logging (4 pi omni-directional source) were analyzed using the MCNP. Numerical modeling was performed while varying the distance of the radioactive source – detector, and source intensity. This result is expected to increase the reliability and applicability of density and neutron logs having single detector in the small diameter borehole.