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Risk assessment of human exposure to radionuclides and heavy metals in oil-based mud samples used for drilling operation

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ABSTRACT

This study investigates heavy metals and naturally occurring radionuclide materials (NORM) possible presence and pollution rates in oil-based drilling fluids system used to drill an oil and gas well. It also estimates the health risks of the drilling crew due to their exposure to these substances. Measurements from Atomic Absorption Spectrometry (AAS) revealed that, the concentrations of the metals present in the drilling mud samples varied significantly and decreased in the order of Zn > Al > Ni > Pb > Cr > Cu > As > Hg > Cd. Generally, amongst all the heavy metals considered, mud sample C had the highest heavy metal concentration when compared to samples A and B, respectively. When compared with the recommended maximum allowable limits, Cd and Ni were found to be higher than the International Reference Standard by factors of Cd (3 mg/kg) and Ni (50 mg/kg). The cancer risk obtained from this present study are 1.1×10^{-3} and 7.7×10^{-3} for the drilling crew, which is slightly above the acceptable risk range considered by the environmental and regulatory agencies. The concentrations of radioactive substances as obtained from analysis, show that K-40 is the dominant radionuclide in the samples with the highest value slightly twice the standard reference value. The concentrations of Ra-226 and Th-232 activity in the mud samples were found to be lower when compared with the International Reference Level. Also, the X-ray diffraction analysis helped to identify 16 very important/useful minerals in the three mud samples under consideration. The higher elemental concentrations of potassium and aluminum silicate found in sample C can be credited to the elevated heavy metal-content found in the mud samples. Significantly, these exposure risks found in this

present study indicate that the potential health risks due to radiological activities may not pose short – but long-term risks to the drillers.

KEYWORDS:

- [Heavy metal](#)
- [norm activity](#)
- [mineral/compounds](#)
- [human health risk assessment](#)
- [drilling mud systems](#)

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Conflicts of interest

The authors declare no conflict of interest.

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