

Abstract

The current study focused on two aspects: first, assessing the concentrations of naturally occurring radioactive materials NORM, and second, evaluating the concentrations of micro, essential trace elements, and toxic heavy metals in crude oil samples collected from the oil fields of Thi Qar Province. This research was conducted as part of the University of Thi Qar's strategy to assess the impact of pollutants on the environment and living organisms in the region, as well as to investigate the potential causes of the noticeable increase in cancer rates in the province.

Thirty crude oil samples were collected from three major crude oil fields in Thi Qar Province: Al-Nasiriyah, Gharraf, and Saba field. The samples were carefully prepared in the laboratory for measurement and analysis. Three spectrometric techniques were employed to analyze the samples: gamma-ray spectrometry using a NaI (Tl) scintillation detector “3×3” to measure the concentrations of the targeted natural radioactive materials (NORM), namely ^{238}U , ^{232}Th , ^{226}Ra , ^{228}Ra , and ^{40}K . Additionally, X-ray fluorescence XRF and atomic absorption spectrometry AAS were utilized to analyze the micro, essential trace elements, and toxic heavy metals. These advanced techniques provided reliable measurements of the targeted elements. Elevated levels of the targeted materials in this study could pose significant risks to workers involved in crude oil extraction and to the ecosystems near the oil fields.

The obtained results in the current study of naturally occurring radioactive materials showed variations in concentrations among the crude oil fields. Saba field indicated the highest levels of natural radioactivity compared to the other fields. The average concentrations of radioactive activity in Saba field were 4.96, 4.86, 4.85, 4.67, and 142.69 Bq/L for ^{238}U , ^{232}Th , ^{226}Ra , ^{228}Ra , and ^{40}K respectively. All other

parameters associated with concentrations, such as the equivalent activity of nuclides, absorbed doses, lifetime cancer risk, external and internal hazard indices, and annual effective dose, were also measured. In addition to measuring naturally occurring radioactive materials, the concentrations of essential trace elements, and toxic heavy metals in crude oil samples were analyzed using X-ray fluorescence XRF. This technique detected many important elements in crude oil, such as vanadium, lead, nickel, copper, chromium, and others. To increase reliability and accuracy in measurements, another technique, atomic absorption spectrometry (AAS), was used to measure the same elements. The results indicated that all measured values were within safe limits according to the recommendations of reputable international organizations and agencies, such as UNSCEAR, WHO, IAEA, ICRP, and EPA. This suggests that there is no significant radiological threat to workers or the surrounding environment. However, continuous exposure could lead to future health effects, particularly in Saba oil field. On the other hand, the results regarding contamination with toxic heavy metals and trace elements found in the same oil fields indicated that the crude oil does not pose a significant environmental or health risk. This also reflects the high quality of crude oil extracted from the fields in the province.