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Occurrence and Distribution of Per- and Polyfluoroalkyl Substances (PFAS) in the Coastal Groundwater of Eastern Saudi Arabia

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PFAS (per- and polyfluoroalkyl compounds) have emerged as prevalent pollutants in groundwater due to their vast past utilization in consumer products and industrial applications, coupled with their remarkable persistence. The current research investigated 17 PFAS chemicals in 10 groundwater samples from coastal multi-layered aquifer systems in Eastern Saudi Arabia, with seven samples from shallow aquifers (2-30 m) and three samples from deep aquifers (>70 m). The analysis utilized solid phase extraction and liquid chromatography-tandem mass spectrometry (LC-MS/MS) in accordance with EPA Method 537 and ISO 25101, with a detection limit of 10 ng/L. The results show that four PFAS substances were detected with values above the detection limits in shallow groundwater samples: perfluorobutane sulfonic acid (PFOS), perfluorooctanoic acid (PFOA), perfluorooctanoic acid (PFBA), and perfluorobutane sulfonic acid (PFBS). In contrast, no PFAS compound was found in the deep wells. PFOS was found in 29% of the samples (2 out of 7) with a maximum value of 23.6 ng/L. PFBA and PFBS were found in 14% of samples at 11 and 53 ng/L, respectively. PFOA was found to have a concentration of 10.9 ng/L and a detection frequency of 14%. The occurrence of PFAS, although currently at minimal levels, suggests potential pollution of the coastal aquifer that requires continuous monitoring and assessment to determine the source, the extent of the contamination, and its potential impact on human health and the environment. Additionally, while the highest PFOS concentration remained below the EPA's lifetime health advisory of 70 ng/L, it exceeded Vermont's PFOS drinking water standard of 20 ng/L. Recent research has linked PFOS exposure through drinking water to immune effects in infants at levels as low as ten ng/L. Further research is needed to investigate the potential spreading of PFAS plumes, identify potential sources of contamination, assess the extent of environmental and human health impacts, and develop effective remediation strategies. The findings add to the global contribution of PFAS contamination, underscoring the importance of having a proactive approach to monitoring and managing these persistent environmental pollutants.