

Identifying Artifacts in SEM-EDS of Fouled RO Membranes Used for the Treatment of Brackish Groundwater Through Raman and ICP-MS Analysis

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Abstract : Fouled reverse osmosis membranes are primarily characterized by Scanning Electron Microscopy (SEM) and Energy Dispersive X-ray Spectrometer (EDS) for a detailed investigation of foulants; however, this has severe limitations on several accounts. Apart from inaccuracy in spectral properties and inevitable interferences and interactions between sample and instrument, misidentification of elements due to overlapping peaks is a significant drawback of EDS. This paper discusses this limitation by analyzing fouled polyamide RO membranes derived from community RO plants of Rajasthan treating brackish water via a combination of results obtained from EDS and Raman spectroscopy and cross corroborating with ICP-MS analysis of water samples prepared by dissolving the deposited salts. The anomalous behavior of different morphic forms of CaCO_3 in aqueous suspensions tends to introduce false reporting of the presence of certain heavy metals and rare earth metals in the scales of the fouled RO membranes used for treating brackish groundwater when analyzed using the commonly adopted techniques like SEM-EDS or Raman spectrometry. Peaks of CaCO_3 reflected in EDS spectra of the membrane were found to be misinterpreted as Scandium due to the automatic assignment of elements by the software. Similarly, the morphic forms merged with the dominant peak of CaCO_3 might be reflected as a single peak of Molybdenum in the Raman spectrum. A subsequent ICP-MS analysis of the deposited salts showed that both Sc and Mo were below detectable levels. It is always essential to cross-confirm the results through a destructive analysis method to avoid such interferences. It is further recommended to study different morphic forms of CaCO_3 scales, as they exhibit anomalous properties like reverse solubility with temperature and hence altered precipitation tendencies, for an accurate description of the composition of scales, which is vital for the smooth functioning of RO systems.

Keywords : reverse osmosis, foulant analysis, groundwater, EDS, artifacts

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