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Elemental composition of membrane foulant layers using EDS, XPS, and RBS

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Abstract: Existing studies investigating the elemental composition of membrane foulant layers typically use one of the following analytical techniques: energy-dispersive X-ray spectroscopy (EDS), X-ray photoelectron spectroscopy (XPS), or Rutherford backscattering spectrometry (RBS). However, given that EDS, XPS, and RBS have different capabilities, limitations, and depths of analysis, these techniques may provide differing results from each other. Thus, to understand the suitability of each technique for the analysis of membrane foulant layers, a thorough study is needed that compares EDS, XPS, and RBS results for a diverse set of fouled membranes. As such, the objectives of this study were to identify the strengths, weaknesses, and limitations of EDS, XPS and RBS in the characterization of the elemental composition of foulant layers, and evaluate whether the three techniques yield consistent and/or complementary results for sample composition and structure. We studied four diverse fouled membranes, each before and after cleaning, as well as the original unfouled membranes, and assessed the suitability of each technique for various applications, such as the detection of major elements in thick and thin layers, characterization of sample depth heterogeneity, evaluation of overall membrane cleaning efficacy, among others. Results show that in the analysis of membranes and foulant layers: (i) applying a single technique may lead to incomplete or incorrect conclusions about composition or structure; (ii) RBS is the most advantageous technique for elemental analysis; (iii) EDS has important limitations, but is appropriate for evaluating overall elemental composition of foulant