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Nanometer and micrometer particle occurrence in the feed-concentrate channels of a nanofiltration membrane process

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ABSTRACT

The occurrence of submicron and micron-ranged particles in the feed-concentrate channels of an operating, production-capacity nanofiltration (NF) membrane process was investigated in this work. Nanoparticle tracking analysis and single-particle optical sensing technologies were utilized to evaluate the size (average diameter), distribution, and concentration of particles in the feed, interstage, and concentrate streams of a NF membrane process. Particles ranging between 50 nm and 70 μm were detected in the NF membrane feed-concentrate channel, and most of the particles identified had an average diameter of less than 1 μm. Submicron particle content averaged 64 million, 47 million, and 3.5 million particles/mL in the feed, interstage and concentrate streams, respectively. The concentration of particles less than 500 nm exceeded those greater than 500 nm by at least one order of magnitude. However, the less abundant microparticles occupied more of the volume within the feed-concentrate channel than the more concentrated submicron particles. The presence of particles larger than 5.0 microns, which is the nominal rating of the cartridge filters used in the plant's pretreatment process, were identified in each stream, some of which were on the order of 30–70 microns. Energy-dispersive X-ray spectroscopy was utilized to analyze the particles retained after filtering 20 L of the feed, interstage and concentrate streams through 0.2 microns rated 47 mm silver membranes. The results revealed deposits of calcium carbonate, elemental sulfur, and silts/clays in each stream; however, deposits of organic-based matter were mainly identified in the interstage and concentrate streams.

Keywords: Nanometer; Micrometer; Particles; Nanofiltration; Feed-concentrate channel; Single-particle optical sensing; Light obscuration; Nanoparticle tracking analysis

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