Polysulfone Overview: Resin, Usage, Membrane, Migration, and Exposure

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1. Polysulfone resins are synthesized by condensation of the disodium salt of bisphenol A (BPA) with 4,4-dichlorodiphenyl sulfone (EC No 201-247-9, CAS No 80-07-9). (EFSA CEF Panel, 2015)

2. BPA consumption by polysulfone in the European Union in 2020 was 3,094 tonnes (ECHA, 2022), or 0.3% of the combined volumes of polycarbonate (955,000 tonnes) and epoxy resin (250,000 tonnes). Producers of polysulfone include Solvay, BASF, etc.

3. Due to their good thermal stability, toughness, transparency and resistance to degradation by moisture, polysulfone resins are used in electrical components, appliances, transport, medical equipment, pumps, valves and pipes, (EFSA CEF Panel, 2015). Membranes made with polysulfone are used in the applications of drinking and ultra-pure waters, food & beverage concentration, dairy processing, etc. (ECHA, 2022). Producers of membranes containing polysulfone include DuPont, Hydranautics, Koch, Lanxess, Toray, Veolia, etc.

4. Polysulfone plays an important role as either a separation membrane (as in micro-/ultra-filtration) or as a microporous support of a thin-film polyamide membrane (as in reverse osmosis/nano-filtration). (See Figure 1) No alternative has been found that can provide the necessary mechanical strength and chemical stability within the constraints of a commercially scalable phase separation process to make the microporous support structure suitable for high-performing reverse osmosis / nano-filtration membranes. (See Figure 2)

5. In addition to the purification of water, membranes containing polysulfone enables the critical preparation of safe food and safe food ingredients. Typical food applications include dairy processing, clarification and concentration of fruit juices, de-alcoholization of wine and beer, and purification of sugar. Dairy ingredients produced from milk and whey, offer essential nutrients such as amino acids and minerals that exist in forms easy to adsorb by the body and are used in infant formulas, clinical and sports nutrition products, and other food formulations.

6. Migration of BPA from polysulfone resin into food simulant is below the existing SML of 0.05 mg/kg.

7. Migration of BPA from membranes using polysulfone, as determined by French ACS in hot water for 22 migration periods (corresponding to 31 days of testing), was non-detect (LOD: 0.1 µg/L).

8. Migration of BPA from reverse osmosis / nanofiltration membranes is “non-detect” under NSF 61 Drinking water system components – Health Effects) test conditions (LOD: 20 µg/L).

9. Membranes using polysulfone are components of process media in service for more than one year and produce thousands of liters of fluids per day. If any BPA residuals remain in the membrane after the standard prestart up flush and cleaning practice, the concentration will be dilute by the volumes of fluid processes over the more than one year use of the product. Given the nature of membrane use in food processing, exposure to BPA concentration in the food is calculated to be negligible.

Figure 1: Use of polysulfone in different types of filtration techniques

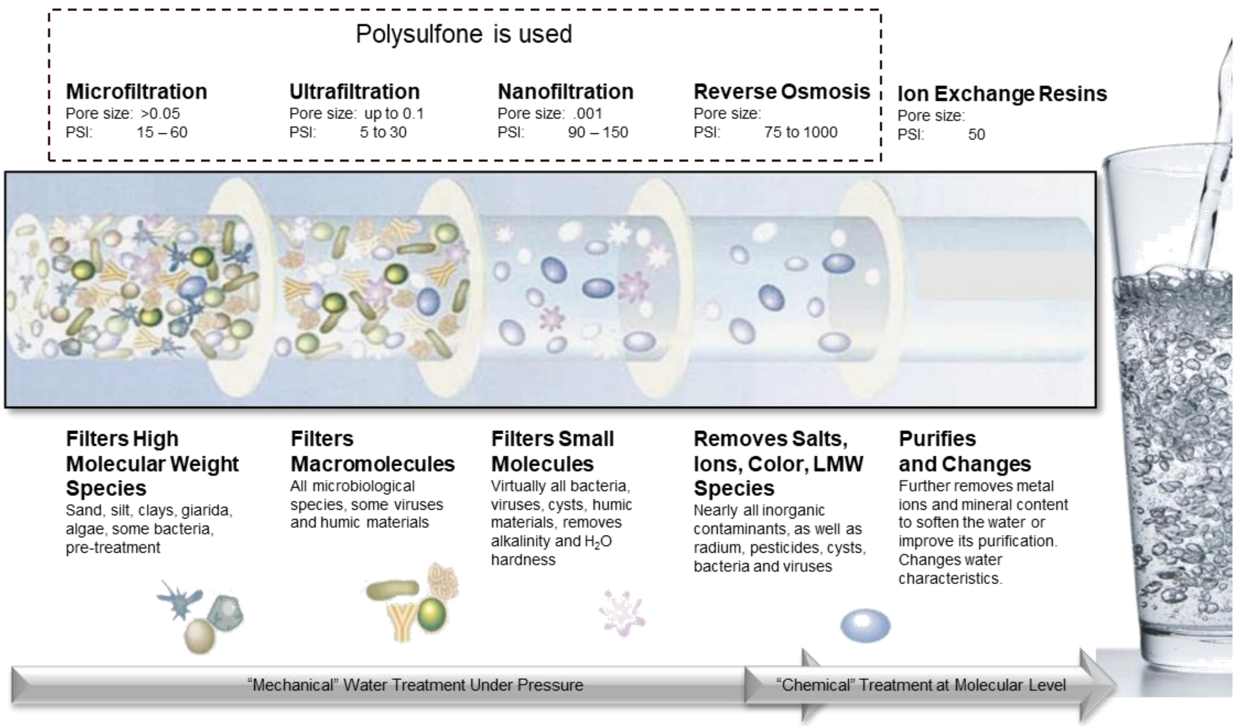

Figure 2: A cross-section of a Reverse-Osmosis Membrane

Polyamide (top, barrier), Polysulfone (middle, porous support), and PET (bottom, non-woven web)