**Understanding Nanofiltration:** **A Molecular Separation with Nanometer Effects**

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**Abstract:** Nanofiltration (NF) membrane, firstly named as “loose” Reverse osmosis (RO) or “dense” Ultrafiltration (UF) membrane, has two remarkable features: one is the molecular weight cut-offs (MWCO) ranges from 200 to 2000Da, and the other is the salt rejection depends on the ion valence and concentration. Several models for NF processes have been proposed, such as the pore model based on the sieving effect, the charge model [1] based on the electrostatic effect, the electrostatic steric-hindrance (ES) model [2], and the Donnan steric pore model (DSPM) have been proposed, which play an important role in understanding the separation mechanism and promoting the application of NF [3, 4]. Afterward, almost all of the RO membrane manufacturers have produced a series of NF membranes for the purification and advanced treatment of water. However, the performances of these NF membranes with features of “loose” RO membranes cannot be predicted by commercial RO simulation software. It leads to a long period of previous experiments and scale-up process, which severely restricts the large scale standardization applications of NF. In regard to these problems, we proposed a simple simulation model for the separation performance of mixed salts solution across NF membranes to promote the application of NF during the water treatment in the light of the competitive effect among co-ions and regulation effect among counter-ions. Both two effects can be determined by some specific experiments [5, 6]. And then based on the in-depth experimental studies on rejection performance and the attendant electrokinetic properties, some researchers have found that the performance of NF membranes cannot be predicted completely by merely considering the sieving and electrostatic effect, but some drawbacks still exist in the analysis of electrokinetic properties. The further studies have contributed to a deeper understanding on the particular effect caused by the nano-scale pore size and charge features caused by the complicated interaction in solution [7, 8]. Moreover, the dielectric effect in the transport process of ions through NF membranes [9] has been addressed and quantitatively analyzed. Recent studies have been paid much attention on the new generation of NF membranes improved by various nanostructured materials [10, 12]. We also made some try to develop some novel thin-film nano-composite NF membranes derived from the dual layer (PES/PVDF) hollow fiber UF membranes [13-20].

Keywords: Nanofiltration; Separation mechanism; Separation performance; Nanostructured materials

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