Ben's Design Tip Corner

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Membrane Technology Applications in Water Reuse

Water Reuse is receiving increased national and international attention as an approach to effectively address sustainable water management mandates and proactive water supply planning. Effective reuse allows the implementation of safe, fit for purpose, and cost-effective water solutions that reduce or eliminate the unnecessary waste of limited water supplies. To address water shortage and scarcity, Indirect Potable Reuse (IPR) or Direct Potable Reuse (DPR) are becoming an important component of the water balance in many regions around the world. Examples are: California, Texas, Singapore, Australia, UK, South Africa, Belgium and many others.

Membrane technologies, such as Reverse Osmosis (RO), Microfiltration (MF), Ultrafiltration (UF) (as RO pretreatment), and Membrane Bioreactors (MBR) will continue to play a key role in producing highly purified recycled /reused water.

RO typically provides safer product water, as compared to other non-membrane technologies, due to its ability to simultaneously remove a wide range of contaminants including dissolved solids, low molecular chemicals, emerging contaminants, as well as viruses, pathogens and bacteria.

However, due to the potential presence of micro-pollutants, dissolved organics, endocrine disruptors, and pharmaceutically active compounds in wastewater, the RO and membrane industry are facing a number of unique challenges and questions for water reuse applications. Examples are:

- How well do we know this "new" feed water?
- Pathogen removal credit and membrane integrity testing is more difficult than traditional surrogate parameters, such as conductivity. What sensors and real-time monitors to use to prove integrity?
- What new surrogates could be available, which are specific to potable water reuse? Are available online monitors such as: total organic carbon, sulfate, UV254 or fluorescence adequate?
- How to manufacture low fouling membranes, which are compatible to this new source?
- How to design membranes specifically for micro-pollutants removal?
- Although the RO membranes have a great rejection for viruses and pathogens, how to prevent RO systems reduced performance due to broken seals, damaged glue lines, oxidized membranes, and/or abrasion caused by particles in the feed?
- UV and GAC can be effectively coupled with membranes for various applications. What other technologies can be coupled with membranes to achieve greater removal credit?
- How do we get public trust and acceptability?
- How do we make regulatory agencies partners in this "unfamiliar" path?

Many membrane manufacturers, researchers, and application engineers globally are trying to answer the above questions.

There are many new combinations of technologies and approaches, such as:

- Combined MF-RO-UV/H2O2 treatment
- MBR-RO
- An Osmotic Membrane Bioreactor (OMBR)
- Hybridization of Forward Osmosis (FO) or Membrane Distillation (MD) with a crystallizer for concentrate disposal

There are also many new ideas on high performance membrane materials, such as:

- Nanocomposite Membranes
- Ceramic Membranes
- Nanostructured Polyamide Membranes
- Customized membranes specific to organic micro-pollutants removal
- Backwashable NF Membranes
- Chlorine and oxidant tolerant RO and NF Membranes

I have no doubt that with these creative innovations and further development of membranes and performance monitoring methods, the membrane industry will overcome these challenges and once again be in the forefront, just like the desalination market in the 1970's. ■