

A Novel Ex-situ Scale Observation Detector (exsod) for Mineral Scale Characterization and Online RO Process Monitoring

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SUMMARY

UCLA researchers at the Water Technology Research Center have developed a method and a device for real time monitoring of reverse osmosis membrane scaling for large scale water purification applications.

BACKGROUND

The major fraction of large scale water desalination processes use Reverse Osmosis (RO) membranes. RO membranes clog with mineral salts and other foulants which shorten membrane life and decrease process efficiency. RO desalting occurs when the feed solution flows over the membrane surface, water permeates through the membrane and rejected ions accumulate next to membrane surface. For example, three of the most problematic mineral salts are calcium carbonate, calcium sulfate dihydrate, also known as gypsum and barium sulfate (barite). Calcium carbonate can be controlled by operating at pH lower than about 7 while gypsum but barite solubilities are pH insensitive. Scale mitigation can also be accomplished, in part, by antiscalant addition to the RO feed. Early detection of scale formation is essential in order to avoid irreversible scaling and membrane loss. Flux decline, membrane cleanup and replacement of membranes increase process cost and also represent operational problems that this invention seeks to mitigate.

INNOVATION

The innovation is a detector that monitors membrane scaling in real time, thereby enabling timely anti-scaling measures to be used before irreversible membrane damage. The innovation consists of a specially designed plate-and-frame high pressure RO membrane cell with optical windows. The feed solution can be fed to the cell from any side-stream in the RO plant. Pressure, feed and permeate flow rates, conductivity and pH are continuously monitored. A unique optical imaging system provides real-time imaging of the membrane surface capable of detecting and characterizing the onset of surface mineral salt crystal formation. The data are collected by computerized data acquisition system and displayed in real-time as well as stored for off-line analysis. The innovation consists in optical surface imaging tools and interface for collection of process variables with optical image analysis. There is also innovation in the use of the detector without impeding flow through the system. The system can also be used as a stand-alone system for rapid diagnostic evaluating the performance of scale mitigation strategies.

STATE OF DEVELOPMENT

A detector has been constructed tested using commercial membranes and various feedstocks, such as agricultural drainage water in continuous experiments lasting greater than a week.. The onset of surface crystallization of various mineral salts were observed, including gypsum. Video shows mineral buildup in real time on computer monitors. This leads to an understanding of crystal morphology, nucleation and membrane scale buildup. ABOUT THE PRINCIPAL INVESTIGATOR Professor Yoram Cohen, Department of Chemical and Biomolecular Engineering, <http://www.chemeng.ucla.edu/YCohen/index.html> Prof. Cohen is the Director of the Center for Environmental Risk Reduction (<http://www.watercenter.ucla.edu/>). See the Center website for further research information.

PATENT STATUS

| Country | Type | Number | Dated | Case |
|--------------------------|---------------|-----------|------------|----------|
| United States Of America | Issued Patent | 7,910,004 | 03/22/2011 | 2006-408 |

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OTHER INFORMATION

KEYWORDS

materials, cleantech

CATEGORIZED AS

- ▶ **Environment**
 - ▶ Sensing
- ▶ **Engineering**
 - ▶ Engineering
- ▶ **Sensors & Instrumentation**
 - ▶ Environmental Sensors
 - ▶ Physical Measurement
 - ▶ Process Control
 - ▶ Scientific/Research

RELATED CASES

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