

# METTLER TOLEDO APPLICATION NOTE

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## Reverse Osmosis Measurements

### BACKGROUND

Reverse osmosis is a technique for removing dissolved solids from filtered raw water. It is used in a variety of industries to condition water for plant use, to desalinate brackish water to make drinking water, or as a first step in the demineralization process. Reverse osmosis works by pressurizing water and forcing it through a semi-permeable membrane, which is permeable to water but relatively impermeable to dissolved solids. The effectiveness of a reverse osmosis unit is based on its percent efficiency in removing dissolved solids from raw water, and generally, the better the quality of raw water, the better the quality of the processed water.

### THE PROCESS

#### *pH Control*

The key factor in reverse osmosis is the condition of the semipermeable membrane. The typical membrane material is cellulose acetate, which tends to be degraded by alkaline (high pH) water, resulting in a loss of efficiency. The reverse osmosis membrane can also represent a considerable capital investment. In raw water with calcium hardness, precipitation (scaling) can occur on the sample side of the membrane in alkaline pH ranges, due to the increase in concentration of dissolved solids.

To protect the membrane and avoid scaling, the pH of alkaline raw water can be adjusted to the acidic side; pH 5.5 is the usual target. The control action is not difficult since raw water does not typically tend to have major pH fluctuations or load changes (changes in the titration curve). To accommodate changes in flow rate, a flow measurement can be used to trim the pH control. The mode of control will be specific to the application.

#### *Conductivity Control*

Efficiency of the membrane decreases due to damage to the membrane caused by the material in the feed water. The efficiency of the membrane is calculated by dividing the amount of dissolved solids content of the product water by the volume of feed water. In a new system this will be between 2-5% passage or 98-95% rejection. In time the efficiency will decrease to the point that the membrane should be replaced.

One conductivity cell, referred to as the feed water cell, is on the input to the reverse osmosis system. A second cell, called the product cell, is placed on the outlet of the reverse osmosis system. The ratio instrument then measures the conductivity of each cell and calculates the percent passage or percent rejection. The instrument would have an alarm for monitoring the ratio, and a second alarm for monitoring the product water conductivity.

### INSTRUMENTATION

For the conductivity measurement, the Model 7050 analyzer and the InPro<sup>®</sup> 7000 Conductivity sensor is recommended.

For the pH measurement, the Model 2050 pH analyzer and the InPro<sup>®</sup> 4500VP pH sensor can accurately measure pH in a reverse osmosis system.

## PRODUCTS

### 7050 Conductivity Analyzer

- Economically priced, full featured transmitter
- Large, easy-to-read LCD allows quick view of information
- Two relays as limit contacts with delay timer to minimize false alarms and one relay as alarm or wash contact

### InPro<sup>®</sup> 7000 Conductivity Sensor

- Recommended for high accuracy measurement in low conductivity process media
- Variety of materials of construction and process fittings to meet most process requirements
- Stainless Steel sensors are steam sterilizable for hygienic applications
- NIST-calibrated to ensure maximum accuracy

### 2050 pH Analyzer

- Economically priced, full featured transmitter
- Large, easy-to-read LCD allows quick view of information
- Two relays as limit contacts with delay timer to minimize false alarms and one relay as alarm or wash contact

### InPro<sup>®</sup> 4500VP Solid Polymer pH Electrode

- Patented Xerolyt<sup>®</sup> solid polymer reference system maintains a stable potential for accurate and repeatable pH measurement and low maintenance
- Open junction eliminates reference clogging and extends sensor life
- High pressure resistance eliminates requirement for pressurizable housing
- Xerolyt solid polymer is particularly suitable for use in emulsions, suspensions, heavily contaminated or sulfide-containing media, and solutions with a high concentration of suspended solids