Application Data Sheet
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DESALINATION OF SEA WATER

BACKGROUND

Desalination is the name given to processes that remove salt from water. Although 70% of the world's surface is covered with water, almost all of this water cannot be used without some removal of salt. Areas with large, growing populations and little fresh water resources are increasingly turning to desalination for their water needs. Many industrial plants and electrical utilities are located by the ocean so that they can be assured of a large, dependable, fixed-cost water supply. Sea water, however, is so corrosive that it is generally more cost effective to remove the salt than to replace piping or install pipe of more resistant materials.

In a typical desalination process, raw seawater is filtered to remove solids and then combined with acid in a treatment tank. The treated seawater is heated in an evaporator, with its resulting vapor collected and recondensed in the condenser (see Figure 1). The condenser product is fresh water, and the salt from the seawater is removed as brine. One of the problems in this process is scale formation on the hot surfaces of the evaporation equipment. Careful pH control can minimize some of the scaling problems.

SCALING AND pH CONTROL

There are two separate scaling problems that must be dealt with in a sea water evaporator. The first includes both calcium carbonate (limestone) and magnesium hydroxide scale. These are formed under higher pH conditions when bicarbonate ions can form carbonate ions and when more hydroxyl (OH^-) ions are present. Carbonate and hydroxyl ions react with the calcium and magnesium normally present in seawater (Figure 1).

$CaCO_3$ and $Mg(OH)_2$ scaling can be minimized by lowering the pH of the feedwater under 5.7, thus preventing the formation of appreciable amounts of scale. This is commonly achieved by adding citric acid, ferric chloride, or sulfuric acid. However, too much acid will result in corrosion. A proper pH balance can be maintained using the Rosemount Analytical Model 1055 dual input analyzer and the Model 399 pH/ORP Disposable sensor.

The second scale problem appears when the feed solution becomes saturated with calcium sulfate.

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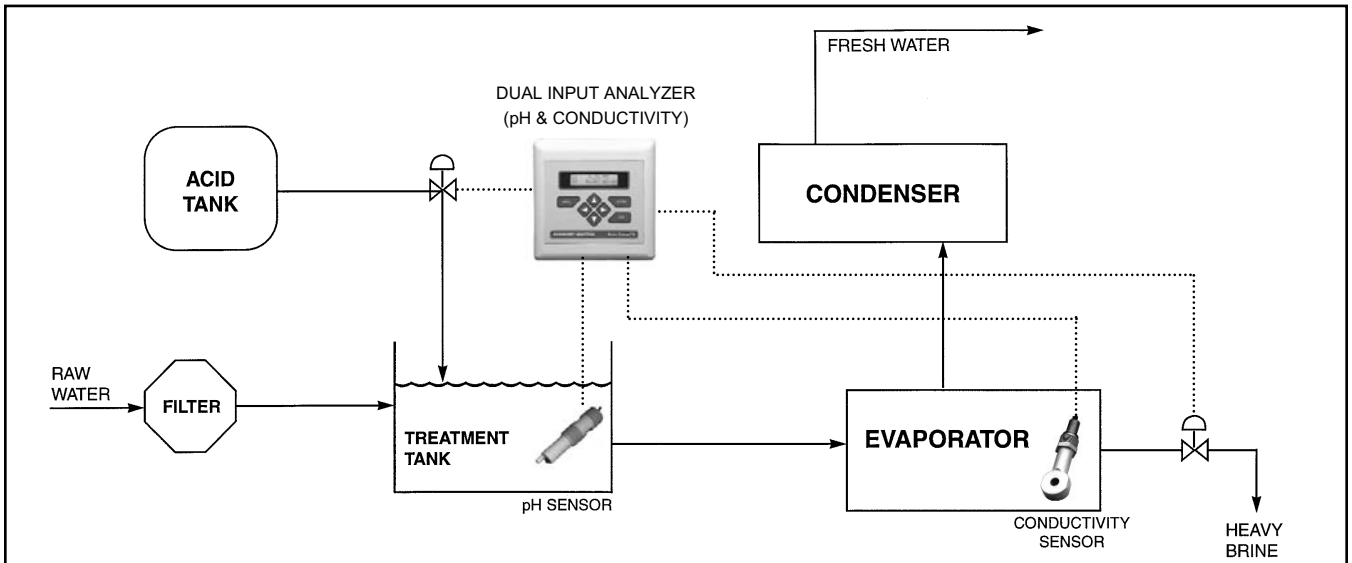

FIGURE 1. Seawater Desalination

$CaSO_4$ cannot be controlled by pH adjustment. It is necessary to maintain the $CaSO_4$ concentration below the saturation point (roughly 2 gpl) by removing a portion of the heavy brine in the evaporator. Although measuring conductivity does not provide a specific indication of the concentration of calcium sulfate, it does correlate to the level of all dissolved solids.The Rosemount Analytical Model 1055 dual input analyzer and the Model 228 toroidal conductivity sensor can be used to prevent the excessive buildup of the dissolved solids that would lead to fouling in the evaporator. The Model 1055 is a dual input analyzer, and can accept both the pH and toroidal sensor. If advanced features and controls are required, the Rosemount Model 54e series analyzers can be utilized. For two-wire applications and advanced communication, the Model Xmt offers a choice of HART or FOUNDATION fieldbus communication.

INSTRUMENTATION

Model 1055 Dual Input Analyzer

- Multi-parameter input instrument for pH and conductivity.
- Two 4-20 mA outputs, plus three fully-programmable alarms.
- Multi-language (English, French, German, Italian, Spanish, or Portuguese).
- Choice of enclosures for pipe, surface, and panel mounting.
- NEMA 4X (IP65) enclosure.

Model 228 Toroidal Conductivity Sensor

- Toroidal measurement principle greatly reduces sensor fouling problems.
- High temperature PEEK sensor operates at temperatures up to 200°C (392°F).
- Installation options include insertion in a tee, submersion on a standpipe, and a high pressure mechanical retraction assembly.

Model 399 pH/ORP Disposable Sensor

- Convenient and economical disposable design.
- Chemically rugged Tefzel[1] body completely sealed to eliminate sensor leakage.
- Double or triple junction reference cell to protect reference from poisoning ions.

[1] Tefzel is a trademark of E.I. du Pont de Nemours and Co.

Model 54e Analyzer/Controller (pH and Conductivity)

- Three alarms with programmable logic, plus one dedicated fault alarm.
- NEMA 4X (IP65) weatherproof, corrosion resistant enclosure.
- Optional PID and TPC control capability.
- HART and AMS aware.

Model Xmt Transmitter

- Two-wire transmitter.
- Choice of enclosures for panel or pipe/surface mounting.
- NEMA 4X (IP65) enclosure.
- Choice of HART or Foundation Fieldbus communication.

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