

ZI-CHEM 4150

Seawater Evaporators Scale Control

INTRODUCTION

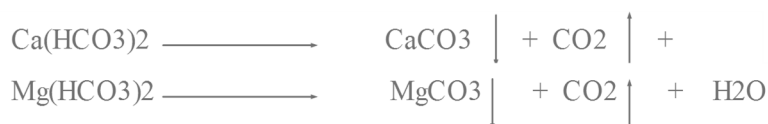
Seawater evaporators are designed to produce distilled water from sea water for use as boiler feed water, engine cooling water and domestic purposes. The two basic types of evaporator, namely the flash and submerged element or coil type, both suffer from the problem of scale formation on their heat exchange surfaces.

This scale impairs heat transfer, thereby reducing the efficiency of the evaporator and eventually necessitating evaporator shut-down for either chemical or mechanical cleaning. Therefore there is a requirement for an effective method of controlling or preventing scale formation.

BACKGROUND TO SCALE DEPOSITION

The two types of scale that occur in sea water evaporators are the alkaline hardness scales, and calcium sulphate scales. The former is composed of calcium carbonate, magnesium hydroxide and occasionally magnesium carbonate. Other compounds are found in scales however, resulting from absorption or co-precipitation. The nature and composition of the scale formed is dependent on the operating temperature of the evaporator and to a lesser extent on the brine concentration in the evaporator.

To understand the effect of temperature on the composition of scales, it is necessary to consider the principles of scale formation. Scales result by a process of crystallisation from supersaturated solution. The alkaline hardness scales arise by a series of reactions. Firstly calcium and magnesium bicarbonates are decomposed to their carbonates according to these equations:



These reactions both commence at a solution temperature of 55 °C. Calcium carbonate is relatively insoluble and is precipitated but magnesium carbonate is relatively soluble and remains in solution. As the temperature of the solution rises hydrolysis of magnesium carbonate results in precipitation of magnesium hydroxide:



The reaction starts at a solution temperature of 80°C. Therefore scales formed in evaporators operating at temperatures below 80°C will consist essentially of calcium carbonate. As the temperature of operation is increased from 80°C to 100°C then the scale will consist increasingly of larger amounts of magnesium hydroxide together with calcium carbonate.

Calcium sulphate will be found in small amounts in these scales because of co-precipitation.

Calcium sulphate is moderately soluble in sea water at ambient temperature. However, it has a negative solubility index. This means that as the temperature rises, the solubility of calcium sulphate decreases. At temperatures of operation above 100°C calcium sulphate can become the predominant scale forming compound. Scales rich in calcium sulphate can be found in the high heat transfer zones or hot spots in an evaporator.

THE BENEFITS

- Increase distillate production
- Higher Flux rates across membranes
- Eliminate downtime for cleaning
- High quality distillate

COMMON APPLICATIONS

- Power generating facility
- Oil Refinery
- Petrochemicals

TYPICAL PROPERTIES

- Appearance: Clear straw to amber color liquid
- Specific gravity: 1.1 – 1.2
- pH (neat) 1.0 – 3.0
- Freeze point: -50C
- Flash point: Not flammable

PACKAGING

- 25kg pails
- 200kg drums
- 1,000kg IBC's or in bulk

HANDLING & SAFETY

ZI-TECHASIA maintains a database of material safety data sheets (MSDS) on all our products. These contain health & safety information to assist in the safe and appropriate chemical handling, ensuring the protection of personnel.



PRIMARY APPLICATIONS

ZI-CHEM 4150 is normally dosed at a rate of 8 mg/L of distillate produced. The correct treatment level depends on the type of evaporator and its operating conditions along with the maximum brine concentration to be maintained.

Your ZI-TECH representative will establish the correct operating level.

FEEDING & CONTROL

ZI-CHEM 4150 should be diluted at least 20 times, preferably using fresh water injected continuously to the feed line. Overdosing is not detrimental.

ZI-CHEM 4150 is not corrosive to steel mixing tanks or dosing pumps.

SCALE DEPOSITION PREVENTION OPTIONS

1- Acid Dosing

There are two main chemical methods available for scale control in evaporating plant, namely acid dosing, and the use of additives. Acid dosing is normally used on land-based plant and prevents the formation of alkaline hardness scales by converting the calcium and magnesium bicarbonates in the water to soluble calcium and magnesium salts with liberation of carbon dioxide. Hydrochloric acid is normally used for this purpose though sulphuric acid can be used.

The main disadvantage of this method is the corrosion that takes place in the vapour space because of the large quantities of carbon dioxide liberated. There is also some corrosion in the brine feed lines and brine space. Hydrochloric acid treatment has no effect on calcium sulphate formation and sulphuric acid will encourage its formation. Acid dosing also requires very careful control.

2- Polymer Dispersants

Typical chemical additives, which have been used as scale preventatives, are starches, tannins, organic lignin sulphonates, polyphosphates and, more recently, synthetic polymers. These additives are used at low concentrations to inhibit crystallisation of the scale and to disperse the suspended solids so that they may be removed by blowdown.

Until recently the most successful additive was a mixture containing sodium triphosphosphate, lignin sulphonate and an antifoaming agent. When dosed at 2 – 5 mg/L this effectively controls alkaline hardness scales by a "threshold" mechanism. However, the treatment is limited to plant operating at temperatures below 90°C because at this temperature and above, there is significant hydrolysis of the polyphosphate to orthophosphate. Orthophosphate is ineffective as a scale preventative and indeed encourages the formation of calcium and magnesium phosphate scales.

The most significant recent development in additives for scale control is a class of compounds called organic synthetic polymers.

ZI-CHEM 4150 POLYMER SEAWATER EVAPORATOR ANTISCALANT

ZI-CHEM 4150 is a specially prepared synergistic formulation of low molecular weight synthetic polymers and organo-phosphorous compounds designed to give maximum protection against all common types of scale, throughout the entire temperature range of existing evaporators. It is equally effective for flash or submerged element types.

ZI-CHEM 4150 prevents scale formation by a "threshold" mechanism, ie: a small amount of treatment when added to the seawater prevents precipitation of a large amount of hardness salts. As a result ZI-CHEM 4150 delays the precipitation of all alkaline hardness and when precipitation does occur, the normal crystalline structure is so distorted that a fine sludge occurs, which does not compact but remains in suspension. This can be easily removed using the brine blowdown or deconcentrator.

With non-alkaline hardness such as calcium sulphate, ZI-CHEM 4150 gives a stabilising effect to the supersaturated solution, resulting in up to two times the normal solubility of calcium sulphate being achieved.