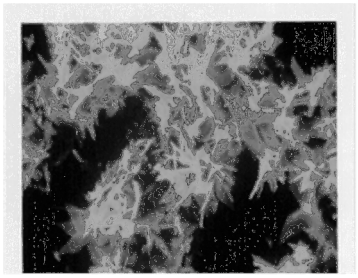
ZI-CHEM 9110
Heat Exchanger Process Scale Control

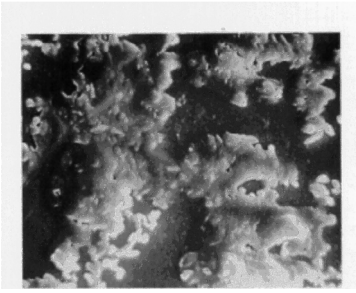
HIGHLIGHTS



ZI-CHEM 9110 is a specially prepared formulation of low molecular weight synthetic polymers designed to give maximum protection against most common types of scale, throughout a wide range of temperatures experienced in many food processing applications.

ZI-CHEM 9110 prevents scale formation by a "threshold" mechanism, ie: a small amount of treatment when added to the water and process streams prevents precipitation of a large amount of hardness salts.

As a result ZI-CHEM 9110 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. With non-alkaline hardness such as calcium sulphate, ZI-CHEM 9110 gives a stabilising effect to the supersaturated solution, resulting in up to two times the normal solubility of calcium sulphate being achieved.



The current state-of-the-art for scale and sludge control utilizes various polymerized salts of alone or in combination. These function by distorting crystalline scale lattice and breaking it up into smaller, lighter, amorphous particles. By imparting a negative charge to each particle, they are kept dispersed by mutual charge repulsion.

We have made studies with Electron Scan Microscopes that have proven this mechanism of control. An untreated scale has a small, adherent crystalline structure.
After treatment with an effective inhibitor, this same scale is amorphous, large and deformed. More importantly, it is non-adherent. Thus, heat exchange tube surface and distribution piping remain free of scale.

FEEDDING & CONTROL

ZI-CHEM 9110 should be diluted at least 20 times, preferably using fresh water injected continuously to the feed line. Overdosing is not detrimental.
ZI-CHEM 9110 should be added using a chemical metering pump with liquid end constructed of suitable materials. These include PVC, polypropylene, Viton, Teflon and stainless steel.

PRIMARY APPLICATION

ZI-CHEM 9110 is normally dosed at a rate of 1 – 3 mg/L of recirculating or once through water. 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. ZI-CHEM 9110 should be diluted at least 20 times, preferably using fresh water injected continuously to the feed line. Overdosing is not detrimental.

TYPICAL PROPERTIES

- Appearance: Clear amber liquid
- Density: 1.1 – 1.3
- pH <2.0
- Freeze point: -5 oC
- Flash point: Not flammable

COMMON APPLICATIONS

- Process water heat exchangers
- Pasteurizers &cooling or heating tunnels
- Vacuum tubes in paper processing application

PACKAGING

- 28kg pails
- 230kg drums
- 1,150kg IBC's or in bulk

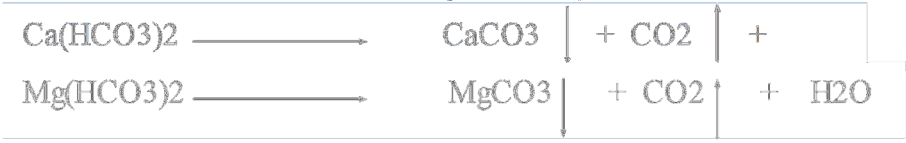
HANDLING & SAFETY

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.

ISO 9001:2008 Certificate No.SG12/04040 ISO 14001:2004 Certificate No.SG12/04041

BACKGROUND TO SCALE DEPOSITION

Two of the primary types of scale that occur in heat exchange surfaces in heated water systems in food industries 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 80oC. Therefore scales formed in evaporators operating at temperatures below 80oC will consist essentially of calcium carbonate. As the temperature of operation is increased from 80oC to 100oC 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 100oC 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.

SCALE DEPOSITION PREVENTION OPTIONS

1- Acid Dosing

There are two main chemical methods available for scale control food processing 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 that corrosion can take place because of excess chloride ions present the large quantities of carbon dioxide liberated. Also, altering the pH with acid may be unacceptable to the actual process. Hydrochloric acid treatment also 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 tripolyphosphate, 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 90oC 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.