OPTIDOSE™ 4210 Traceable Polymeric Acid
Scale Inhibitor and Dispersant

Regional Product Availability
North America

Description
OPTIDOSE™ 4210 traceable polymaleic acid polymer is a scale inhibitor designed to eliminate calcium carbonate scale formation in industrial water treatment applications. The presence of OPTIDOSE 4210 homopolymer can be accurately monitored in process water with the use of our OPTIDOSE traceable polymer test kit.

Benefits
Performance
- General purpose scale inhibitor/dispersant - effective on a variety of foulants and scale formers (calcium phosphate, calcium carbonate, calcium sulfate and silt).
- Free polymer levels detected accurately at ppm levels with the use of the OPTIDOSE™ test kit.
- Excellent calcium carbonate inhibition, performs in high alkalinity/hardness and high total dissolved solids systems.
- Enhances inhibition properties in blends with high performance dispersant polymers (e.g., OPTIDOSE 2000 and OPTIDOSE 3100).
- "Smart Polymer" - used in high hardness waters that have side stream softening allowing hardness removal in the softener.

Polymer Characteristics
- Phosphorus Free - Can replace phosphonates as scale control agents. No phosphorus discharge problems.
- Stable at all pH levels.

General
- U.S. Food and Drug Administration (FDA) Cleared -
  Under 21CFR173.310 (Boiler Water Additives)\(^{(a)}\)
  Under 21CFR173.45 (Polymaleic Acid and its Sodium Salt)\(^{(b)}\) for sugar processing.
- Manufactured in an ISO 9002 certified manufacturing plant.

\(^{(a)}\) As a boiler water additive in the preparation of steam that will contact food provided the level of this product does not exceed 1 ppm in boiler feed water.

\(^{(b)}\) Provided the level of this product does not exceed 4 ppm (calculated as the acid) by weight of the beet or cane sugar juice or liquor process steam.
**Typical Physical Properties**

<table>
<thead>
<tr>
<th>Properties</th>
<th>Values</th>
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</thead>
<tbody>
<tr>
<td>Appearance</td>
<td>Clear, amber liquid</td>
</tr>
<tr>
<td>Total solids, (%)</td>
<td>50</td>
</tr>
<tr>
<td>pH</td>
<td>1.0-2.0</td>
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<tr>
<td>Molecular weight</td>
<td>500-1000</td>
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<tr>
<td>Specific gravity</td>
<td>1.16</td>
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</tbody>
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(1) Measured by subtracting Karl Fischer water from 100.

**Mechanism of Action**

OPTIDOSE™ 4210 polymer can be used to inhibit scale buildup on surfaces through at least three mechanisms:

- Solubility enhancement or threshold effect, which reduces precipitation of low solubility inorganic salts.
- Crystal modification, which deforms the growing inorganic salt crystals to give small, irregular, readily fractured crystals that do not adhere well to surfaces.
- Dispersing activity, which prevents precipitated crystals or other inorganic particles from agglomerating and depositing on surfaces.

In addition to the above mechanisms which are common to many types of inhibitors and dispersants, OPTIDOSE 4210 functions by a unique crystal growth mechanism. In the presence of OPTIDOSE 4210, calcium salt crystals grow to uniform intermediate sizes and do not form large crystals. These crystals do not strongly adhere to surfaces and are readily removed by flowing water. Other inhibitors allow the formation of nonuniformly sized crystals. The small crystals in this distribution redissolve and incorporate on large crystals. This process, called Ostwalds ripening, causes large crystals to grow at the expense of small crystals due to the difference in their surface to volume ratio. The largest crystals are often found on equipment surfaces, and ordinary inhibitors can accelerate their growth. OPTIDOSE 4210 is an exceptional scale inhibitor because it prevents the formation of these large crystals.
Mechanism of Action (Cont’d)

Performance Data

Calcium Carbonate Inhibition

Under high pH and alkalinity conditions, calcium carbonate scale formation is a potential problem that can be prevented by threshold inhibition and crystal modification. Figure 2 shows that from 10 to 15 ppm polymer solids the performance of OPTIDOSE™ 4210 polymer is equivalent to a competitive polymaleic acid. OPTIDOSE 4210 polymer is only slightly less effective than HEDP (1-hydroxyethylidene-1,1-diphosphonic acid) and approaches the performance of HEDP at the 15 ppm level.
Performance Data (Cont’d)

Test Conditions

400 ppm Ca, as CaCO₃
100 ppm Mg, as CaCO₃
400 ppm M-Alk, as CaCO₃
2000 ppm NaCl, as NaCl
3 ppm PO₄, as PO₄
65°C, 44 hours, pH 9.0
% CaCO₃ Inhibition = (Ca²⁺) sample
(Ca²⁺) initial

pAA is a good general purpose scale inhibitor.

OPTIDOSE™ 4210 is excellent at controlling calcium carbonate on mild steel heat transfer surfaces. The reason being that the pH on a cornered steel surface is >10.
Performance Data (Cont’d)

Dispersing Activity

Industrial cooling water contains particulate matter such as silt, clays and calcium-based precipitates. The particles can deposit on heat transfer surfaces and produce excessive sediment in regions of low water velocity.

Kaolin clay was used to represent particles commonly found in many waters. At low polymer levels (5-20 ppm) OPTIDOSE™ 4210 polymer demonstrates effective kaolin clay dispersancy compared to a competitive polymaleic acid polymer and the phosphonate HEDP. Figure 3 shows the performance of OPTIDOSE 4210 as a dispersant.
Dispersing Activity (Cont’d)

Test Conditions

1000 ppm Hydrite UF Kaolin
200 ppm Ca, as CaCO₃
pH 7.5
2-hour settling time
measure turbidity of top 20 ml of 100 ml sample

ISO 9002 Certification

All OPTIDOSE™ products are produced in ISO 9002-certified manufacturing facilities.
Handling Precautions

Before using this product, consult the Material Safety Data Sheet (MSDS)/Safety Data Sheet (SDS) for details on product hazards, recommended handling precautions and product storage.

Storage

Store products in tightly closed original containers at temperatures recommended on the product label.

Disposal Considerations

Dispose in accordance with all local, state (provincial) and federal regulations. Empty containers may contain hazardous residues. This material and its container must be disposed in a safe and legal manner.

It is the user's responsibility to verify that treatment and disposal procedures comply with local, state (provincial) and federal regulations. Contact your Dow Technical Representative for more information.

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