ACUMER™ 2200 High Performance Scale Inhibitor

Description

ACUMER 2200 is a highly effective scale inhibitor in industrial water treatment. ACUMER 2200 is a low molecular weight carboxylate copolymer that offers superior precipitation inhibition for calcium carbonate and other sparingly soluble salts. It shows good activity over a wide pH range, water hardness and temperature conditions.

ACUMER 2200 contains no phosphorus, making its use acceptable where legislation requires that discharge waters contain low or no phosphorus.

Typical Properties

These properties are typical but do not constitute specifications.

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appearance</td>
<td>Clear light amber solution</td>
</tr>
<tr>
<td>Chemical nature</td>
<td>Carboxylate copolymer</td>
</tr>
<tr>
<td>Molecular Weight</td>
<td>2,000</td>
</tr>
<tr>
<td>Total solids (%)</td>
<td>55</td>
</tr>
<tr>
<td>pH as is (at 25°C)</td>
<td>4</td>
</tr>
<tr>
<td>Density (at 25°C)</td>
<td>1.3</td>
</tr>
<tr>
<td>Brookfield viscosity (mPa.s/cps at 25°C)</td>
<td>500</td>
</tr>
</tbody>
</table>

Solubility

ACUMER 2200, due to its chemistry, is extremely tolerant of calcium ions. Its solubility in calcium containing aqueous solutions is notably higher than acrylic homopolymers. The table below compares calcium tolerance of acrylic homopolymers and ACUMER 2200.

<table>
<thead>
<tr>
<th>Product</th>
<th>Calcium Tolerance (mg CaCO₃/g polymer)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acrylic homopolymer Mw 4500</td>
<td>1300</td>
</tr>
<tr>
<td>Acrylic homopolymer Mw 2000</td>
<td>3100</td>
</tr>
<tr>
<td>ACUMER 2200</td>
<td>&gt; 8000</td>
</tr>
</tbody>
</table>

0.08 M NaCl, 300 ppm polymer, pH 10, titrated with 15 mg Ca/ml, 5 NTU end point

Application

ACUMER 2200 inhibits scale build up on surfaces through at least three mechanisms:

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

The activity of ACUMER 2200 is illustrated by the following data.

Scale Inhibition at Heat Transfer Surfaces

In evaluating scale inhibition at heat transfer surfaces, ACUMER 2200 was used alone under stressed conditions.
Note that its relative effectiveness may change in formulated water treatment systems, or under less stressed conditions.

1. Accelerated Scaling Test

Scale inhibition performance of ACUMER 2200 has been evaluated in a laboratory by chronoelectrogravimetry (method described in paper N° 114 of NACE corrosion 99).

The method involves a three electrode electrochemical cell. The working electrode is composed of a gold coated quartz plate, a microbalance and a potentiostat. A potential is applied to the electrodes and water dissolved oxygen is reduced to OH-. The pH increase at the working electrode surface induces an accelerated scaling. The deposit weight is continuously measured over time.

![Comparison of the Anti-Scaling Effect of Some Polymers by Chronoelectrogravimetry](image)

Operating conditions were:

- Water hardness: 600 ppm (as CaCO₃)
- Water Alkalinity: 600 ppm (as CaCO₃)
- Temperature: 60°C

ACUMER 2200 exhibits a much longer induction time than a classical PAA (almost double) and an even longer induction period than a sulfonated copolymer (which is not designed as a calcium carbonate scale inhibitor).

2. Simulated Cooling Tower Test

Scale inhibition performance of ACUMER 2200 has also been evaluated on a pilot cooling circuit.

The trial conditions, indicated below, were chosen particularly severe in order to shorten the trial duration.
Test Conditions:

- Heat exchanger inlet temperature: 25°C
- Heat exchanger outlet temperature: 38°C
- Heat transfer tubes: Stainless steel
- Holding time index: 6 hours
- Circuit water pH: 8.5 - 9.0
- Make up water hardness: 300 ppm (as CaCO₃)
- Make up water alkalinity: 280 ppm (as CaCO₃)

Treatment Program:

Product as solids in circuit water: 5 ppm

Operating Conditions

The trial objective was to gradually increase the concentration factor until CaCO₃ precipitation occurs.

Conditions were those indicated in the table below:

<table>
<thead>
<tr>
<th>Time Duration</th>
<th>Concentration Factor</th>
<th>Ryznar Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 2 days</td>
<td>1.2</td>
<td>4.0</td>
</tr>
<tr>
<td>2 - 4 days</td>
<td>2.0</td>
<td>2.7</td>
</tr>
<tr>
<td>4 - 6 days</td>
<td>3.0</td>
<td>1.7</td>
</tr>
<tr>
<td>6 - 8 days</td>
<td>4.5</td>
<td>0.7</td>
</tr>
<tr>
<td>8 - 10 days</td>
<td>6.0</td>
<td>0.1</td>
</tr>
</tbody>
</table>

Products Tested:

- Acrylic homopolymer Mw 4500
- Maleic homopolymer
- ACUMER 2200
- Phosphonate (HEDP)
The following graph summarizes trials results. It gives values of heat exchange coefficient versus calculated Ryznar index.

The graph clearly demonstrates that in difficult cases (e.g. high pH, high temperature, or high concentration factor), when classical acrylic homopolymers fail, ACUMER 2200 can be used.

ACUMER 2200 exhibits a better scale inhibition than maleic homopolymer and a comparable efficacy with a phosphonate such as HEDP.

It was also observed at the end of trials that, as opposed to the other products tested, calcium carbonate deposit formed during the treatment with ACUMER 2200 was neither sticky nor hard but had the appearance of a wet mud which was easy to remove.

**Thermal and Chemical Stability**

ACUMER 2200 has excellent thermal and chemical stability and can be used over a broad range of temperature and pH.

However, products containing ACUMER 2200 should be formulated between pH 2 and 9 to maintain product stability.

**Neutralization**

ACUMER 2200 is supplied as a partially neutralized aqueous solution. The next figure plots pH versus percentage of caustic soda added to the polymer.
Storage Recommendation

Under long term cold storage, freezing of ACUMER 2200 may cause some separation of the components.

Although product performance is not impaired as long as the whole container is heated and well mixed, it is recommended to keep ACUMER 2200 from freezing.

Material Safety Data Sheets

Rohm and Haas Company maintains Material Safety Data Sheets (MSDS) on all of its products. These contain important information that you may need to protect your employees and customers against any known health and safety hazards associated with our products. We recommend you obtain copies of MSDS for our products from your local Rohm and Haas technical representative or the Rohm and Haas Company. In addition, we recommend you obtain copies of MSDS from your suppliers of other raw materials used with our products.

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