These ACUMER polymers are a series of Low Molecular Weight (LMW) Polyacrylic Acids and their corresponding sodium salts. These products have weight average molecular weights of approximately 2000 and 4500. ACUMER polymers contain no phosphorus, making their use acceptable where legislation requires that discharge waters contain low or no phosphorus.

ACUMER polymers are highly effective scale inhibitors in industrial water treatment and oil production applications where they inhibit the deposition of calcium carbonate, calcium sulfate, barium sulfate, and other low solubility salts on surfaces. These polymers show good activity over a wide range of pH, water hardness, and temperature conditions. The choice among the members of the series depends on the application, formulation, use conditions, and required performance characteristics. These materials show excellent freeze-thaw stability.

**TYPICAL PROPERTIES**

This ACUMER series consists of polymers as unneutralized, partially neutralized (20%) and fully neutralized forms as shown in Table 1. Molecular weights are measured by aqueous gel permeation chromatography (GPC). Representative data for ACUMER 1000/ACUMER 1020 polymers are depicted in Figure 1.

Figure 2a is a plot of the degree of neutralization vs. pH for the ACUMER polymers. Figures 2b-e show the effect of caustic additions to ACUMER 1000 and ACUMER 1100 on product pH.
<table>
<thead>
<tr>
<th>Polymer</th>
<th>Molecular Weight M&lt;sub&gt;n&lt;/sub&gt;, M&lt;sub&gt;n&lt;/sub&gt;</th>
<th>Form</th>
<th>Appearance</th>
<th>Spindle Speed</th>
<th>Brookfield Viscosity 25°C, cps</th>
<th>Density 25°C lbs/gal</th>
<th>pH</th>
<th>% Total Solids</th>
<th>Appearance</th>
<th>pH</th>
<th>Brookfield Viscosity 25°C, cps</th>
<th>Density 25°C lbs/gal</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACUMER 1000</td>
<td>2000</td>
<td>Partial Na Salt</td>
<td>Colorless to straw colored, clear to homogenous solution.</td>
<td>#2 @ 30</td>
<td>100-400</td>
<td>10.3</td>
<td>4.7-4.9</td>
<td>70</td>
<td>Colorless to straw colored, clear to homogenous solution.</td>
<td>4.7-4.9</td>
<td>100-400</td>
<td>10.3</td>
</tr>
<tr>
<td>ACUMER 1020</td>
<td>2000</td>
<td>Partial Na Salt</td>
<td>Colorless to straw colored, clear to homogenous solution.</td>
<td>#1 @ 60</td>
<td>2000</td>
<td>10.1</td>
<td>3.2-4.0</td>
<td>47</td>
<td>Colorless to straw colored, clear to homogenous solution.</td>
<td>3.2-4.0</td>
<td>2000</td>
<td>10.1</td>
</tr>
<tr>
<td>ACUMER 1100</td>
<td>4500</td>
<td>Partial Na Salt</td>
<td>Colorless to straw colored, clear to slightly hazy homogenous solution.</td>
<td>#3 @ 60</td>
<td>4500</td>
<td>10.2</td>
<td>3.2-4.0</td>
<td>44</td>
<td>Colorless to straw colored, clear to slightly hazy homogenous solution.</td>
<td>3.2-4.0</td>
<td>4500</td>
<td>10.2</td>
</tr>
<tr>
<td>ACUMER 1110</td>
<td>4500</td>
<td>Na Salt</td>
<td>Colorless to straw colored, clear to slightly hazy homogenous solution.</td>
<td>#2 @ 12</td>
<td>4500</td>
<td>11.1</td>
<td>6.5-8.0</td>
<td>44</td>
<td>Colorless to straw colored, clear to slightly hazy homogenous solution.</td>
<td>6.5-8.0</td>
<td>4500</td>
<td>11.1</td>
</tr>
</tbody>
</table>

1 Weight Average (M<sub>n</sub>) and Number Average (M<sub>n</sub>) Molecular Weight expressed as polyacrylic acid (PAA).

2 Requires 0.30-0.35 lbs. NaOH/lb. product solids for 95% neutralization.
FIGURE 1 — MOLECULAR WEIGHT DISTRIBUTION FOR ACUMER 1000/ACUMER 1020 BY AQUEOUS GPC

![Molecular Weight Distribution](image)

\[ \bar{M}_w = 2000 \]
\[ \bar{M}_n = 1425 \]

FIGURE 2a — NEUTRALIZATION OF ACUMER POLYMERS

![Neutralization Curve](image)

Neutralization (%)

`pH`

Neutralization (%) at 1% Polymer Content
FIGURE 2b — NEUTRALIZATION OF ACUMER 1000/ACUMER 1100 (PRODUCT) WITH KOH (45%)

FIGURE 2c — NEUTRALIZATION OF ACUMER 1000/ACUMER 1100 (PRODUCT) WITH NaOH (50%)
FIGURE 2d — NEUTRALIZATION OF ACUMER 1000/ACUMER 1100 (SOLIDS) WITH KOH (45%)

FIGURE 2e — NEUTRALIZATION OF ACUMER 1000/ACUMER 1100 (SOLIDS) WITH NaOH (50%)
SOLUBILITY

The effects of Ca\(^{2+}\) concentration and temperature on the solubility of the ACUMER polymers are illustrated in Figure 3. Increasing Ca\(^{2+}\) concentration and temperature will lead eventually to some degree of insolubility. The solubility of these polymers tends to decrease with increasing calcium levels and temperature. ACUMER 1000 and ACUMER 1020 are more soluble than the higher molecular weight polymers, ACUMER 1100 and ACUMER 1110. All of the ACUMER polymers, however, show some solubility and provide activity at points above the curves, since these are merely the start of insolubility, and much of the polymer remains soluble in the temperature/concentration regions above those represented by the areas above the curves.

![Figure 3 — Polymer Solubility as a Function of Hardness and Temperature](image)

ACUMER polymers also exhibit good solubility in brine solutions. The following Table showing percent transmittance as a function of salinity indicates that the solubility of a given polymer actually increases with increasing salinity. In experiments, clarity of the solution measured as % transmittance is used as an indicator of solubility.

<table>
<thead>
<tr>
<th>Polymer</th>
<th>% Transmittance at 60°C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0% NaCl</td>
</tr>
<tr>
<td>ACUMER 1000/</td>
<td>46</td>
</tr>
<tr>
<td>ACUMER 1020</td>
<td></td>
</tr>
<tr>
<td>ACUMER 1100/</td>
<td>Insoluble</td>
</tr>
<tr>
<td>ACUMER 1110</td>
<td></td>
</tr>
</tbody>
</table>

All solutions contain 100 ppm polymer solids and 3000 ppm Ca\(^{2+}\) as CaCO\(_3\) (1200 mg/l Ca\(^{2+}\)).

---

TABLE 2

SOLUBILITIES AS A FUNCTION OF SALINITY
ACUMER polymers exhibit exceptional stability in the presence of hypochlorite as compared with other commercially available polyacrylic acids (Table 3).

<table>
<thead>
<tr>
<th>Polymer</th>
<th>14 days</th>
<th>21 days</th>
<th>42 days</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>4.3</td>
<td>10.3</td>
<td>20.2</td>
</tr>
<tr>
<td>ACUMER 1100/ACUMER 1110</td>
<td>7.1</td>
<td>11.1</td>
<td>18.6</td>
</tr>
<tr>
<td>ACUMER 1000/ACUMER 1020</td>
<td>7.8</td>
<td>11.3</td>
<td>—</td>
</tr>
<tr>
<td>Polymer G</td>
<td>21.5</td>
<td>26.9</td>
<td>34.1</td>
</tr>
<tr>
<td>Polymer AC</td>
<td>19.5</td>
<td>26.8</td>
<td>—</td>
</tr>
<tr>
<td>Polymer C</td>
<td>42.3</td>
<td>54.1</td>
<td>—</td>
</tr>
<tr>
<td>Polymer A</td>
<td>39.7</td>
<td>48.2</td>
<td>—</td>
</tr>
<tr>
<td>Polymer M</td>
<td>51.0</td>
<td>57.6</td>
<td>—</td>
</tr>
</tbody>
</table>

*STABILITY IN HYPOCHLORITE SOLUTIONS

**TABLE 3**

STABILITY OF POLYACRYLIC ACIDS IN HYPOCHLORITE SOLUTIONS<sup>a</sup>

<sup>a</sup>Solutions contain 10% NaOH/2% polymer (solids)/2% NaOCl.
APPLICATIONS

ACUMER polymers 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 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.

Low molecular weight polyacrylic acids are widely used to inhibit scaling in industrial water treatment and in oil production applications. The activity of the ACUMER polymers in cooling tower, boiler, and oil field applications is illustrated by the following data.

SCALE INHIBITION AT HEAT TRANSFER SURFACES

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

1. Laboratory Test on Immersion Heater (Table 4, Figures 4 and 5)

Test water was recirculated past an immersion heater and over baffles exposed to upward air flow; Table 4 lists the test parameters. During the 3-hour run, the calcium ions remaining in solution as evaporation proceeded and the rate of heat transfer (time the heater was on) were monitored. The amount of scale deposited on the heater at the end of the test was also measured. ACUMER 1000/ACUMER 1020 (Mw 2000) were the most effective under these conditions by all three measurements of scaling tendency. The highest molecular weight analogs ACUMER 1100/ACUMER 1110 (Mw 4500) and a competitive sodium polyacrylate (Mw 2800) were less effective.

<table>
<thead>
<tr>
<th>TABLE 4 IMMERSION HEATER TEST PARAMETERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration</td>
</tr>
<tr>
<td>Temperature</td>
</tr>
<tr>
<td>Alkalinity</td>
</tr>
<tr>
<td>Total Hardness</td>
</tr>
<tr>
<td>Polymer Dosage</td>
</tr>
<tr>
<td>Water Volume (initial)</td>
</tr>
<tr>
<td>pH (initial)</td>
</tr>
<tr>
<td>Air Flow</td>
</tr>
<tr>
<td>Water Flow</td>
</tr>
<tr>
<td>Langelier Saturation Index</td>
</tr>
<tr>
<td>Ryznar Index</td>
</tr>
</tbody>
</table>
FIGURE 4 — IMMERSION HEATER TEST PERFORMANCE
TOTAL HARDNESS VS. CONCENTRATION FACTOR

![Graph showing total hardness vs. concentration factor for different ACUMER products and 100% scale inhibition.](image-url)
IMMERSION HEATER TEST PERFORMANCE

**FIGURE 5A—ANTI-PRECIPITATION ACTIVITY**

- ACUMER 1000/ACUMER 1020
- Competitive Acrylate “D”
- ACUMER 1100/ACUMER 1110

**FIGURE 5B—SCALE INHIBITION**

- ACUMER 1000/ACUMER 1020
- Competitive Acrylate “D”
- ACUMER 1100/ACUMER 1110

**FIGURE 5C—HEAT TRANSFER EFFICIENCY**

- ACUMER 1000/ACUMER 1020
- Competitive Acrylate “D”
- ACUMER 1100/ACUMER 1110
2. Simulated Cooling Tower Test (Tables 5 and 6)

The relative performance of the ACUMER polymers was evaluated in simulated cooling tower devices under stressed conditions. Water containing 625 mg/l hardness (as CaCO$_3$) and 150 mg/l alkalinity was circulated past a copper heat transfer coupon at 0.4 to 2 ft./sec. in an apparatus designed to give a range of flow rates over a single heat transfer surface; Table 5 lists the test parameters. Heat transfer coefficients were monitored daily for 5 days; the polymer levels were 2.5, 7.5, and 15 ppm. Table 6 lists the average retained heat transfer coefficient at each polymer concentration. Like the immersion heater study, ACUMER 1000/ACUMER 1020 were the most effective polymers in maintaining a constant, high heat transfer coefficient and ACUMER 1100/ACUMER 1110 were almost as good.

| TABLE 5 |
| SIMULATED COOLING TOWER TEST PARAMETERS |
| Duration | 5 days |
| Total Hardness (as CaCO$_3$) | 625 mg/l |
| Ca/Mg ratio | 4/1 |
| Na$^+$ content | 250 mg/l |
| Alkalinity (as CaCO$_3$) | 150 mg/l |
| pH | 8.1-8.5 |
| Heat flux | 10,000-15,000 btu/hr./ft.$^2$ |
| Average water temperature | 120°F (50°C) |

| TABLE 6 |
| RETAINED HEAT TRANSFER COEFFICIENT, %$u_c$ $^1$ |
| Polymer | Initial | 1 Day | 5 Days |
| ACUMER 1000/ACUMER 1020 | 100 | 85.5 | 85.7 |
| ACUMER 1100/ACUMER 1110 | 100 | 83.8 | 71.9 |

$^1$ %$u_c = (u_f / u_c) \times 100$

where $u_f$ = fouled heat transfer coefficient

$u_c$ = clean heat transfer coefficient

DISPERSE ACTIVITY (Figure 6)

Industrial cooling water and many oil-field brines contain particulate matter such as silt, clays, and calcium-based precipitates. The particles can be deposited on heat transfer surfaces, produce excessive sediments in regions of low water velocity, and interfere with the flow of drive water through oil-field formations.

Kaolin clay was used to represent particles commonly found in many waters. At low polymer levels (<5 mg/l), ACUMER 1100/ACUMER 1110 and ACUMER 1000/ACUMER 1020 polymers are very effective. The ACUMER polymers are all better dispersants than the commercially used phosphonate (HEDP – 1-hydroxyethylidene-1,1-diphosphonic acid).
Most oil-field waters are brines, containing large amounts of divalent cations which commonly form mineral scales. Scale can be encountered on the formation face, in the production tubing, on surface vessels, injection pumps, lines, etc.

The scales of greatest concern in oil production are calcium sulfate, calcium carbonate, and barium sulfate. Laboratory screening tests are useful for comparing the effectiveness of inhibitor candidates. Details of the test procedures are given in the Appendix.

1. Inhibitor of CaSO₄ Precipitation (Figure 7)

ACUMER polymers are all highly effective inhibitors of CaSO₄ precipitation. Virtually complete inhibition is achieved with 0.5 ppm polymer under the NACE test conditions. No significant difference in activity among the polymers in the ACUMER series is noted during this test.

2. Inhibition of CaCO₃ Precipitation (Figure 8)

ACUMER 1100/ACUMER 1110 (\(M_w 4500\)) and ACUMER 1000/ACUMER 1020 polymers (\(M_w 2000\)) are equally effective inhibitors of CaCO₃ precipitation.
FIGURE 7 — CaSO₄ ANTI-PRECIPITATION ACTIVITY

FIGURE 8 — CaCO₃ ANTI-PRECIPITATION ACTIVITY
3. Inhibition by Blends of ACUMER Polymers and Phosphonates (Figure 9)

In some instances, blends of phosphonates or phosphate esters with ACUMER polymers are better anti-precipitants than either alone. Figure 9 demonstrates the synergistic behavior of ACUMER 1100/ACUMER 1110 and phosphate for calcium carbonate inhibition; the dotted lines plot the additive effects and the solid lines the actual effects of the blends.

4. Inhibition of BaSO₄ Precipitation (Figure 10)

BaSO₄ scale is particularly difficult to remove and consequently prevention is critically important, especially in off-shore oil wells and papermaking applications. ACUMER 1000/ACUMER 1020 polymers (Mₘ 2000) are particularly effective in a typical 16-hour duration test and show more efficient inhibition than ACUMER 1100/ACUMER 1110 (Mₘ 4500) polymers. ACUMER 1000/ACUMER 1020 polymers also show better inhibiting activity than a competitive sodium polyacrylate, a phosphonate, or a phosphate ester.

If longer times (64 hours) are allowed for precipitation, ACUMER 1100/ACUMER 1110 (Mₘ 4500) are more effective than ACUMER 1000/ACUMER 1020 (Mₘ 2000).

5. Overall Anti-Precipitation Performance

The actual choice between the two molecular weight polymers depends on the test conditions, although generally ACUMER 1000/ACUMER 1020 (Mₘ 2000) are the most effective polymers. At high Ca⁺² concentration and high temperature, ACUMER 1000/ACUMER 1020 would be expected to perform better than ACUMER 1100/ACUMER 1110 considering the comparative solubilities versus Ca⁺² concentration and temperature in Figure 3.

MODIFICATION OF CaSO₄ AND CaCO₃ CRYSTALS (Figures 11 and 12)

The photomicrographs in Figures 11 and 12 show the dramatic crystal distortion effects of ACUMER 1000/ACUMER 1020 and ACUMER 1100/ACUMER 1110 on CaSO₄ and CaCO₃. The normally long and regular CaSO₄ crystals are fractured and distorted when formed in the presence of ACUMER 1000/ACUMER 1020 polymers. CaCO₃ crystals are normally large and well formed, but are smaller and more irregular when formed in the presence of ACUMER 1100/ACUMER 1110.

POLYMER STABILITY AT HIGH TEMPERATURE

ACUMER polymers 1000, 1020, 1100 and 1110 are very stable at high pressures and temperatures typical of boilers up to at least 1200 psig/298°C. The chart below contains data on the hydrothermal stability of ACUMER 1000.

<table>
<thead>
<tr>
<th>TEMP/PRESS</th>
<th>Mₘ</th>
<th>HYDROTHERMAL STABILITY¹</th>
<th>TGA ANALYSIS</th>
<th>WEIGHT LOSS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mₙ</td>
<td>% Mₙ LOSS</td>
<td>S.I.²</td>
</tr>
<tr>
<td>ACUMER 1000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initial</td>
<td>2090</td>
<td>1660</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>249°C/560 psig³</td>
<td>2010</td>
<td>1490</td>
<td>10.2</td>
<td>0.1</td>
</tr>
<tr>
<td>294°C/1142 psig</td>
<td>1850</td>
<td>1370</td>
<td>17.5</td>
<td>0.2</td>
</tr>
<tr>
<td>323°C/1686 psig</td>
<td>1180</td>
<td>717</td>
<td>56.8</td>
<td>1.3</td>
</tr>
<tr>
<td>340°C/&gt;2000 psig</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

¹Test Conditions: 5000 ppm active ACUMER 1000/ pH 11, purged with hydrazine, 24 hours.
²S.I. = scission index = no. of C-C bonds broken/molecule; (Mₙ initial/Mₙ after heating)⁻¹.
³1 psi = 0.0689 kg/cm² (Bar).
FIGURE 9 — CALCIUM CARBONATE ANTI-PRECIPITANT ACTIVITY OF BLENDS

Test Conditions:
- Water - 250 ppm CaCO₃; 30,000 ppm NaCl
- Temperature - 85°C
- Time - 24 hours

Graph showing percent inhibition with different concentrations of anti-precipitants.

1 ppm anti-precipitant
0.5 ppm anti-precipitant
FIGURE 10 — BaSO₄ ANTI-PRECIPITATION ACTIVITY (136 mg/l Ba²⁺, 70°C)

% Inhibition

Polymer Concentration, mg/l (Solids)

Product Concentration, mg/l (Solids)
FIGURE 11 — CaSO₄ CRYSTAL MODIFICATION (500X)

No Additives

ACUMER 1000
10 ppm

ACUMER 1000
25 ppm
APPENDIX

ANTI-PRECIPITATION TESTS

1. CaSO₄ Test - NACE STANDARD TM-03-74
   1. Prepare supersaturated solution of 5450 mg/l CaSO₄ in brine containing 0-0.5 mg/l (solids) scale inhibitor.
   2. Store in capped 4-oz. jar in 70°C oven for 72 hours without agitation.
   3. Remove sample, draw off supernatant, test for Ca⁺² using standard EDTA titration.

2. CaCO₃ Test (Modified NACE Test)
   1. Prepare supersaturated solution of 850 mg/l CaCO₃ in brine with 0-50 mg/l (solids) scale inhibitor.
   2. Store in capped 4-oz. jar in rolling oven at 70°C for 16 hours.
   3. Remove sample, filter through 0.45-μm Millipore filter, determine Ca⁺² with standard EDTA titration.

3. BaSO₄ Test
   1. Prepare supersaturated solution of BaSO₄ in brine containing 136 mg/l Ba⁺² and 2500 mg/l SO₄⁻² and 0-30 mg/l (solids) scale inhibitor.
   2. Store in capped 4-oz. jar in rolling oven at 70°C for 16, 24, or 64 hours.
   3. Remove sample, filter through 0.45-μm Millipore filter, determine concentration of Ba⁺² using atomic absorption technique.

Calculation:

\[
\% \text{ Inhibition} = \left( \frac{[M^{+2}]_{\text{final}}}{[M^{+2}]_{\text{initial}}} \right) \times 100
\]

Dispersancy Test

1. Prepare solution containing 1000 mg/l kaolin clay, 200 ppm Ca⁺² (as CaCO₃), and 0-5 mg/l scale inhibitor; adjust to pH 7.5.
2. Agitate 1 minute in Waring Blender. Transfer to 100-ml graduate. Let stand undisturbed two hours.
3. Remove top 20 ml of supernatant. Measure turbidity in nephelometric turbidity units (NTU) with standard nephelometer. Higher values indicate better dispersancy.
**FDA CLEARANCE**

ACUMER polymers comply with the FDA Food Additives regulations indicated below provided that the final formulation meets the extractive limitations and other conditions prescribed by the regulation.

<table>
<thead>
<tr>
<th>Number</th>
<th>Regulation Title of Application</th>
<th>ACUMER 1000, 1020, 1100</th>
<th>ACUMER 1110</th>
</tr>
</thead>
<tbody>
<tr>
<td>173.310</td>
<td>Boiler water additives</td>
<td>X&lt;sup&gt;a&lt;/sup&gt;</td>
<td>X</td>
</tr>
<tr>
<td>175.105</td>
<td>Adhesives</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>176.170</td>
<td>Components of paper, paperboard in contact with aqueous and fatty food</td>
<td>X&lt;sup&gt;b&lt;/sup&gt;</td>
<td>X&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>176.180</td>
<td>Components of paper, paperboard in contact with dry food</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

<sup>a</sup>Only if converted to sodium salt.

<sup>b</sup>Only if used as a sodium salt as:

1. a pigment dispersant in coatings at a level not to exceed 0.25% by weight of the pigment.
2. a thickening agent for natural rubber coatings, provided it is used at a level not to exceed 2% by weight of the total coating solids.

**GENERAL PRODUCT HANDLING INFORMATION**

ACUMER 1000/ACUMER 1020 polymers can develop a slightly hazy appearance after long-term cold storage. This change in appearance is due to intramolecular hydrogen bonding, and does not impair performance. ACUMER 1000/ACUMER 1020 that has become hazy can be made clear again by warming it to 60°C or by diluting the polymer to <30% solids.

Freezing or long-term cold storage of the ACUMER polymers may cause some separation of the components. Although product performance is not impaired, it is recommended that the ACUMER polymers not be frozen in order to avoid remixing the product.
SAFE HANDLING INFORMATION

**CAUTION:** CONTACT MAY CAUSE EYE IRRITATION AND SLIGHT SKIN IRRITATION

FIRST AID MEASURES

**Contact With Skin:** Wash skin thoroughly with soap and water. Remove contaminated clothing and launder before rewearing.

**Contact With Eyes:** Flush eyes with plenty of water for at least 15 minutes and then call a physician.

**If Swallowed:** If victim is conscious, dilute the liquid by giving the victim water to drink and then call a physician. If the victim is unconscious, call a physician immediately. Never give an unconscious person anything to drink.

TOXICITY (Range-Finding Studies — Table 7)

<table>
<thead>
<tr>
<th>TOXICITY AND IRRITATION OF ACUMER POLYMERS*</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="https://example.com/table.png" alt="Table" /></td>
</tr>
</tbody>
</table>

**AQUATIC TOXICITY (LC₅₀-ppm)**

| ![AQUATIC TOXICITY Table](https://example.com/table.png) |

---

*Although toxicity data has not been generated for ACUMER 1000, a 1000 Mₜ homolog polyacrylic acid and its corresponding sodium salt has been studied in range-finding acute mammalian and acute aquatic toxicity tests. Results of these tests (rats, oral LD₅₀; rabbit, skin/eye irritation; 48-96 hour LC₅₀’s in daphnia magna, bluegill sunfish, and rainbow trout) indicate toxicity quite similar to that generated for ACUMER 1100. Therefore, it is expected that ACUMER 1000, which has a Mₜ between 1000 and 4500, will have an acute toxicity profile similar to both the 1000 Mₜ species as well as the 4500 Mₜ species. For ACUMER 1020 we would expect similar toxicity results except for eye irritation. We would expect moderate eye irritation due to the low pH of our product.*
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.

Under the OSHA Hazard Communication Standard, workers must have access to and understand MSDS on all hazardous substances to which they are exposed. Thus, it is important that the appropriate training and information be provided to all employees and that MSDS be available on any hazardous products in their workplace.

Rohm and Haas Company sends MSDS on non-OSHA-hazardous as well as OSHA-hazardous products to both "bill-to" and "ship-to" locations of all our customers upon initial shipment (including samples) of all of our products. Updated MSDS are sent upon revision to all customers of record. In addition, MSDS are sent annually to all customers of record.

ISO 9002 CERTIFICATION

All ACUMER polymers are manufactured in an ISO-9002 certified plant.
To order Rohm and Haas products and to obtain purchasing assistance, technical information, Material Safety Data Sheets, samples, or literature, write or call the nearest Rohm and Haas Branch office:

**UNITED STATES**
Philadelphia, PA 19106  
100 Independence Mall West  
1-800-223-3897

**Sales Office**
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Technology Park I  
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