AQUCAR™ GA 30 LT Water Treatment Microbiocide
CAS Reg. No. 111-30-8

General
AQUCAR™ microbiocides are glutaraldehyde-based biocides that have found wide-spread use in the treatment of water for a variety of oil and gas applications. AQUCAR GA 30 LT is a freeze-protected blend of glutaraldehyde. This product is specially formulated for use in cold weather climates where freezing of a biocide is a concern.

Structure

Physical Properties
The following are typical properties of AQUCAR™ GA 30 LT Water Treatment Microbiocide; they are not to be considered product specifications.

- Appearance: Transparent colorless
- % Glutaraldehyde (w/w): 30
- % Acetone: 40
- pH @ 25°C: 5.0
- Solubility in Water, 20°C: Miscible
- Boiling Point: 70.5°C / 159°F
- Freezing Point: -43°C / -45°F
- Specific Gravity, @ 20/20°C: 0.987
- Flash point: -7.8°C / 18°F

Applications/
Directions for Use
AQUCAR™ GA 30 LT Water Treatment Microbiocide is an aqueous solution of glutaraldehyde containing 30% active ingredient. This broad-spectrum biocide is effective over a wide range of pH and temperature conditions and is well-suited for use in the following applications.

Water Flood Injection Water
Glutaraldehyde exhibits outstanding stability in oilfield injection waters, which ensures that its antimicrobial activity will not be diminished in long pipelines. Hard waters or brines do not adversely affect its biocidal efficacy, and glutaraldehyde is non-ionic so it won’t interfere with the action of demulsifiers, corrosion inhibitors, or surfactants. AQUCAR™ GA 30 LT Water Treatment Microbiocide is typically slug dosed into the injection water on a daily or weekly basis at 33-833 ppm product for up to 4 hours, although the exact treatment regimen will depend on the condition of the system, the amount of water being treated, and so forth.

Drilling, Completion, Workover, and Fracturing Fluids
Glutaraldehyde functions as a biocide over a broad pH range and its efficacy is much faster at neutral to alkaline pH levels than at acidic pH levels. Therefore, AQUCAR™ GA 30 LT Water Treatment Microbiocide is an excellent choice for use in preserving drilling muds and other oilfield fluids that are typically alkaline in pH. The combination of rapid alkaline efficacy at the typical use rates of 90 to 1665 ppm product, and proven stability and effectiveness in high salinity matrices ensures microbial protection of these important fluids.
Oil and Gas Transmission lines

Biofilms can cause major problems in oil and gas production systems and pipelines are often afflicted with biofilm-related problems. Microbiologically Influenced Corrosion (MIC) is often associated with the presence of a biofilm. The control of biofilms is crucial in ensuring that corrosion events, due to microorganisms, are minimized. Glutaraldehyde has been shown to penetrate a biofilm and kill the microorganisms that are contained within it. The penetrating ability of glutaraldehyde, along with its long-term stability in oilfield waters, makes it an effective product to control established biofilms in pipelines and prevents the formation of new ones. Pipelines are typically dosed weekly at 840-8340 ppm product in the water phase of the system. For pigging and scraping operations, AQUCAR™ GA 30 LT Water Treatment Microbiocide is administered in a small volume (ideally contained between the scraper and a trailing pig) at 0.15 to 1.7% product, depending on the length of the pipeline and severity of biofouling.

The efficacy of glutaraldehyde is demonstrated by the following experiments. Field isolates of seawater and produced water SRBs were grown to high levels in the laboratory and then challenged with glutaraldehyde. The following results were obtained.

<table>
<thead>
<tr>
<th>Biocide (ppm a.i.)</th>
<th>1</th>
<th>2</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>GA, 25</td>
<td>4</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>GA, 50</td>
<td>6</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>GA, 100</td>
<td>8</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>108</td>
<td>108</td>
<td>108</td>
</tr>
</tbody>
</table>

The experimental protocol allowed for the growth of both high populations of SRBs as well as the accumulation of bacterial metabolites such as sulfide. As these results show, glutaraldehyde was effective against these field isolates.
Increasing regulation of the discharge of chemicals into the environment requires that there be careful monitoring and control over the use of biocides. The active concentration of glutaraldehyde in all of the AQUCAR™ microbiocide blends can easily be determined by a glutaraldehyde field test kit. There are several different kits that are commercially available and all allow for the rapid on-site determination of glutaraldehyde concentrations, discharge levels, half-life, and biocide/system compatibility. By regularly monitoring the active concentration of biocide in the system, the cost effectiveness of the treatment program can be maximized by accurately regulating biocide additions.

Compatibility

While glutaraldehyde is compatible with most commonly used system additives (scale and corrosion inhibitors), there are some incompatibilities that should be noted. Glutaraldehyde is incompatible with primary amines and ammonia. Secondary amines are not as problematic as primary amines, but if a secondary amine is present at high concentrations (>1000 ppm), then care should be taken to add the glutaraldehyde at a distance from the addition point of the secondary amine. Information is available which predicts the loss of glutaraldehyde from systems that contain ammonia. This information is helpful in anticipating the expected decrease in active glutaraldehyde concentration in systems that contain ammonia. Please contact your Dow representative for copies of this data.

Glutaraldehyde is also incompatible with bisulfite-based oxygen scavengers. This interaction can most easily be managed by temporarily shutting off the bisulfite feed during the addition of glutaraldehyde. If shutting off the bisulfite feed is not an option, then it is important to realize that the ratio of reaction of glutaraldehyde with the oxygen scavenger is approximately 1:2. That is, 1 ppm of glutaraldehyde will react with and consume 2 ppm of oxygen scavenger.

The following are recommended uses for AQUCAR™ microbiocide products. For specific directions for use, please refer to the EPA approved labels for these products.

<table>
<thead>
<tr>
<th>Application</th>
<th>Purpose of a Biocide</th>
<th>Recommended Product</th>
<th>Typical Dosage Rate (product)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waterfloods</td>
<td>To prevent the introduction of harmful bacteria into the formation and to control MIC in the injection system</td>
<td>AQUCAR™ GA 30 LT</td>
<td>33-8333 ppm</td>
</tr>
<tr>
<td>Drilling, Completion and Workover Fluids</td>
<td>To control microbial contamination of the fluids and prevent the introduction of bacteria into the formation</td>
<td>AQUCAR GA 30 LT</td>
<td>90-1665 ppm</td>
</tr>
<tr>
<td>Packer Fluids</td>
<td>To control microbial contamination of the fluids and prevent the introduction of bacteria into the formation</td>
<td>AQUCAR GA 30 LT</td>
<td>90-1005 ppm</td>
</tr>
<tr>
<td>Hydrotreating</td>
<td>To prevent the introduction of potentially harmful bacteria into the pipeline</td>
<td>AQUCAR GA 30 LT</td>
<td>165-6660 ppm</td>
</tr>
<tr>
<td>Pipeline Pigging and Scaling Operations</td>
<td>To treat the inner surfaces of the pipeline in order to kill bacteria on freshly exposed (pigged) areas</td>
<td>AQUCAR GA 30 LT</td>
<td>1500-17000 ppm</td>
</tr>
</tbody>
</table>

Glutaraldehyde and the Environment

Many studies have been performed on glutaraldehyde to determine its potential to the biodegrade in the environment. The details of two of the many biodegradation studies that have been performed on glutaraldehyde are detailed below.
The OECD 301 series of biodegradation protocols are designed to determine the biodegradation potential of substances under stringent conditions. In one such biodegradation test, glutaraldehyde met and exceeded the OECD ready biodegradability classification criteria and thus was found to be readily biodegradable.

The OECD 306 test determines the potential for a substance to biodegrade in seawater. This test is unique in that seawater is both test medium and the sole source of microorganisms. Although this test is not a test for ready biodegradability, substances that pass this test are considered to have the potential for biodegradation in the marine environment. When glutaraldehyde was evaluated in the OECD 306 test, a high rate of biodegradation was achieved, and thus it met the pass criteria of the OECD 306 test. It should be noted that glutaraldehyde is one of the few commonly used oilfield biocides that passes this test.

A study of the aquatic metabolism of glutaraldehyde in river water sediment under aerobic and anaerobic conditions was performed. The results indicate that the metabolism of glutaraldehyde is rapid. Under aerobic conditions, the metabolism proceeds to complete...
mineralization with carbon dioxide as the principal metabolite. Under anaerobic conditions, only primary degradation is observed with the production of 1,5-pentanediol as the major metabolite. Both pathways of degradation are shown in the adjacent column.

**Aerobic Aquatic Metabolism**

T<sub>1/2</sub> in river water – 10.6 hr. Carbon dioxide was major metabolite, with glutaric acid as intermediate.

\[
\text{Glutaraldehyde} \rightarrow \text{Glutaric Acid} \rightarrow \text{Carbon Dioxide}
\]

**Anaerobic Aquatic Metabolism**

T<sub>1/2</sub> in river water – 7.7 hr. 1,5-Pentanediol was major metabolite.

\[
\text{Glutaraldehyde} \rightarrow \text{5-Hydroxypentanal} \rightarrow \text{1,5-Pentanediol}
\]

The compiled ecotoxicology data indicate that glutaraldehyde is a readily biodegradable compound which has little environmental impact when handled properly. Due to its rapid metabolism and biodegradation under both aerobic and anaerobic conditions, it has a favorable ecotoxicology profile. Complete details on the biodegradation tests mentioned above, as well as many other environmental fate and ecotoxicology tests that have been performed on glutaraldehyde, are summarized in a Dow publication entitled “Ecotoxicology of Glutaraldehyde” (253-01418).

**Toxicology**

Please consult the Safety Data Sheet (SDS) for further information and Toxicological data.

**Toxicity of Glutaraldehyde**

<table>
<thead>
<tr>
<th>Test</th>
<th>Animal</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oral Acute Toxicity</td>
<td>Rat – male</td>
<td>LD&lt;sub&gt;50&lt;/sub&gt; = 1.30 mL 50% a.i./kg body wt.</td>
</tr>
<tr>
<td>Dermal Acute Toxicity</td>
<td>Rabbit</td>
<td>LD&lt;sub&gt;50&lt;/sub&gt; = 2.54 mL 50% a.i./kg 24 hour occluded. Necrosis at application site</td>
</tr>
<tr>
<td>Inhalation</td>
<td>Rat – male and female</td>
<td>Dynamic generation of vapor, 4 hour = 16.3 ppm, room temperature. Mortality: 0/5</td>
</tr>
<tr>
<td>Eye Irritation</td>
<td>Rabbit</td>
<td>The no-effect concentration for eye irritation with glutaraldehyde based solutions is 0.1%. The threshold for conjunctival irritation if 0.2 to 0.5%, and for corneal injury 0.5 to 1.0%. Eye injury is moderate at 2% and severe at 5% and above. Alkalinization may slightly enhance the degree of eye injury.</td>
</tr>
<tr>
<td>Fish Toxicity</td>
<td>Rainbow Trout</td>
<td>96Hr LC&lt;sub&gt;50&lt;/sub&gt; 12 mg/L</td>
</tr>
<tr>
<td></td>
<td>Bluegill Sunfish</td>
<td>96Hr LC&lt;sub&gt;50&lt;/sub&gt; 11 mg/L</td>
</tr>
<tr>
<td></td>
<td>Sheepshead Minnow</td>
<td>96Hr LC&lt;sub&gt;50&lt;/sub&gt; 32 mg/L</td>
</tr>
<tr>
<td>Avian</td>
<td>Bobwhite Quail</td>
<td>LC&lt;sub&gt;50&lt;/sub&gt; &gt;5000 mg/L</td>
</tr>
</tbody>
</table>

See SDS for full safety information.

**Storage, Handling and Disposal**

Minimum Personal Protective Equipment includes proper gloves, splash-proof monogoggles or both safety glasses with side shields and a wrap-around full-face shield, coveralls, and when necessary, respiratory equipment or air ventilation. Please consult the product SDS for further information.

Please refer to the product label for specific precautions and use directions. Further information and precautions regarding the handling, storage, and disposal of AQUCAR™ microbiocides can be obtained by consulting the latest Dow Safety Data Sheet (SDS) and
the Glutaraldehyde Safe Handling and Storage Guide (Form No. 253-01338), available from your Dow representative.

The AQUCAR™ microbiocides line of products are effective biocides that can help protect various water sources used in gas and oil applications. Dow offers the combination of proven efficacy of our glutaraldehyde-based products, along with both technical and customer service that ensures success in the use of our products.

References


Product Stewardship

Dow has a fundamental concern for all who make, distribute, and use its products, and for the environment in which we live. This concern is the basis for our product stewardship philosophy by which we assess the safety, health, and environmental information on our products and then take appropriate steps to protect employee and public health and our environment. The success of our product stewardship program rests with each and every individual involved with Dow products – from the initial concept and research, to manufacture, use, sale, disposal, and recycle of each product.

Customer Notice

Dow strongly encourages its customers to review both their manufacturing processes and their applications of Dow products from the standpoint of human health and environmental quality to ensure that Dow products are not used in ways for which they are not intended or tested. Dow personnel are available to answer your questions and to provide reasonable technical support. Dow product literature, including Safety Data Sheets (SDS), should be consulted prior to use of Dow products. Current Safety Data Sheets are available from Dow.
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