Understanding Biocides

Biocides: What they are, what they do and why they matter
What are biocides?

- Biocides are a common part of everyday life
- They are chemical agents used to kill harmful microorganisms in order to:
  - Preserve health
  - Protect product integrity
- Also known as antimicrobials, pesticides or algicides
What are biocides?

- Many familiar products have biocidal properties and uses:
  - Bleach
  - Ethyl alcohol
  - Iodine
  - Peroxide
  - Salt
Where can biocides be found?

• Biocides are used in:
  – Household cleaners
  – Personal care products
  – Paint
  – Plastics
Why are biocides used in everyday products?

• To fight mold
• To prevent spoilage
• To keep people and their surroundings healthy
Why are biocides used in gas and oil production?

• Reduce corrosion
• Combat souring
• Promote optimum production rates
• Protect functional fluids from spoilage
Why are biocides used in gas and oil production?

• To combat Microbially Influenced Corrosion (MIC)
  – Helps protect the integrity of equipment and pipelines
  – Ensures that human and environmental health and safety are maintained
Biofilm Microenvironments

![Diagram of biofilm microenvironments showing the interaction between oxygen, heterotrophs, substrates, nutrients, and metal.]
Why are biocides used in gas and oil production?

• Bacteria in some wells and storage areas produce hydrogen sulfide (H$_2$S)
  - H$_2$S smells like rotten eggs, can be flammable and possibly explosive

• Biocide treatments control the bacteria that produce H$_2$S
Why are biocides used in gas and oil production?

- To promote optimum production rates
  - Biofilm can cause plugging
  - Small amounts of biofilm can greatly affect flow paths
Why are biocides used in gas and oil production?

Flowrate comparisons

![Graph showing flowrate comparisons with and without biofilm](Image)

- **Flowrate [m^3/s]**
  - Red dots: without biofilm
  - Blue dots: with biofilm

- **Cumulative gas [m^3]**
  - Red line: without biofilm
  - Blue line: with biofilm
Who makes biocides?

• Biocide manufacturers are major companies

• They are responsible for federal registration of:
  – Chemical properties
  – Degradation data
  – Environmental impact assessments
Who applies biocides?

• Biocides are applied by
  – Professional service companies
  – Rigorously trained engineers

• They are applied per EPA-approved instructions

• Dow customers must display robust stewardship practices
Who regulates biocides?

• The federal laws that govern the use of herbicides and insecticides on food crops also apply to biocides
• EPA registration is required
• EPA-approved label instructions are required for use and dosage
• Registration with state agencies under state laws is required
Example of EPA Approved Label

AQUACR™ GA 25
Water Treatment Microicide

Active ingredient: Gratamidine 25%

Storage and Handling:
AQUACR™ GA 25 Water Treatment Microicide is compatible with many chemicals and is intended for use in water treatment systems. However, it is recommended to avoid contact with strong oxidizing agents, strong acids, and bases. Contact with some chemicals may result in the formation of hazardous gases.

Directions for Use:
AQUACR™ GA 25 Water Treatment Microicide is designed for use in water treatment systems to control and reduce microbial growth. It is particularly effective in controlling biofilm formation on surfaces such as pipes, tanks, and equipment. The recommended dosage depends on the specific application and the water quality.

In case of an emergency, contact the nearest emergency response center or call the Poison Control Center.

PRECAUTIONARY STATEMENTS
HAZARDS TO HUMANS AND DOMESTIC ANIMALS
DANGER
KEEP OUT OF REACH OF CHILDREN
Consumers, laborers, service people, and maintenance personnel should take precautions to keep the product out of the reach of children. If concentrated, this material is harmful to humans and animals and must be handled with care. Keep the product in its original container and store it in a cool, dry place.

ENVIRONMENTAL HAZARDS
This product may be hazardous to the environment. Take precautions to prevent spillage and contamination. If the product is spilled, do not wash with water. Dispose of the contaminated material in accordance with local regulations.

LIMITED WARRANTY AND DISCLAIMER
The manufacturer warrants the product to be free from defects in material and workmanship. However, the warranty does not cover any loss or damage resulting from improper use or storage. The warranty is void if the product is altered or modified without the manufacturer's consent.

Before handling or using the product, consult your employer and read the current Material Safety Data Sheet.
DRILLING, COMPLETION, AND WORKOVER FLUIDS

AQUCAR GA 25 Water Treatment Microbiocide should be added to a drilling fluid system at a point of uniform mixing such as the circulating mud tank.

**Initial Treatment:** Add 100 to 2,000 ppm AQUCAR GA 25 Water Treatment Microbiocide (0.4 to 7.9 gallons AQUCAR GA 25 Water Treatment Microbiocide per 100 barrels of fluid) to a freshly prepared fluid depending on the severity of contamination.

**Maintenance Dosage:** Maintain a concentration of 100 to 2,000 ppm AQUCAR GA 25 Water Treatment Microbiocide by adding 0.4 to 7.9 gallons of AQUCAR GA 25 Water Treatment Microbiocide per 100 barrels of additional fluid.
Example of EPA Approved Label

STORAGE AND DISPOSAL
Handle in a well-ventilated area. If vapors are irritating to the nose or eyes, special ventilation or respiratory protection (MSHA/NIOSH approved air purifying respirator equipped with an organic vapor cartridge) may be required.

PESTICIDE DISPOSAL: Do not contaminate water, food, or feed by storage or disposal. Open dumping is prohibited. Pesticide wastes are toxic. Improper disposal of excess pesticide, spray mixture or rinsate is a violation of Federal law. If these wastes cannot be disposed of by use according to label instructions, contact your State Pesticide or your Environmental Control Agency, or the Hazardous Waste representative at the nearest EPA Regional Office for guidance.

STORAGE AND HANDLING

CONTAINER DISPOSAL: Metal Containers or Plastic Containers: Triple rinse (or equivalent). Then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill, or other procedures approved by state and local authorities. Plastic Containers: May be incinerated, or, if allowed by state and local authorities, by burning. If burned, stay out of smoke. Metal Containers: Must not be incinerated. Do not cut or weld on or near metal containers.
How are biocides evaluated?

• Different models exist for different organizations
  – EPA, FDA, European and Asian regulators
  – Personal Care Products Council
  – Many more government and industry groups

• Multiple factors include:
  – Usage rates
  – Degradation profile
  – Exposure levels

• Models replicate “real world” conditions
How are biocides evaluated?

- U.S. EPA evaluates risk by calculating the margin of exposure
- Usage levels, degradation and safety factors are applied
  - Possible exposure levels must fall below levels of concern
How are biocides evaluated?

Residual biocide levels after treatment in gas and oil applications are greater than 2,500 times less than the no observable effect concentrations.
How are biocides evaluated?

- HOCNF uses similar modeling techniques
  - Emphasizes protecting marine life
  - The rating system is not limited to biocides
  - Many biocides perform well due to inherent degradability

Ratings of Dow Microbial Control Products for North Sea Gas Production by UK

<table>
<thead>
<tr>
<th>Product</th>
<th>Rating</th>
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<tbody>
<tr>
<td>AQUCAR™ IG-E 50</td>
<td>Gold</td>
</tr>
<tr>
<td>SUMP BUDDY* WT</td>
<td>Silver</td>
</tr>
<tr>
<td>UCARCIDE™ 24</td>
<td>Gold</td>
</tr>
<tr>
<td>ANTIMICROBIAL 7287</td>
<td>Silver</td>
</tr>
<tr>
<td>UCARCIDE™ 50</td>
<td>Gold</td>
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UK Hazard Quotient Key

<table>
<thead>
<tr>
<th>HQ Range</th>
<th>Rating</th>
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<tbody>
<tr>
<td>&lt;1</td>
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</tr>
<tr>
<td>1-30</td>
<td>Silver</td>
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<tr>
<td>30-100</td>
<td>White</td>
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<tr>
<td>100 – 300</td>
<td>Blue</td>
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<tr>
<td>300 – 1000</td>
<td>Orange</td>
</tr>
<tr>
<td>&gt;1000</td>
<td>Purple</td>
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Summary

• Biocides play a key role in everyday life
• They serve an important function in safe and efficient hydrocarbon production
• They are strictly regulated by federal, state and international authorities
• Dow Microbial Control follows strict rules of stewardship, focusing on safety, human health and environmental sustainability
Thank You!