



Microbial Control

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



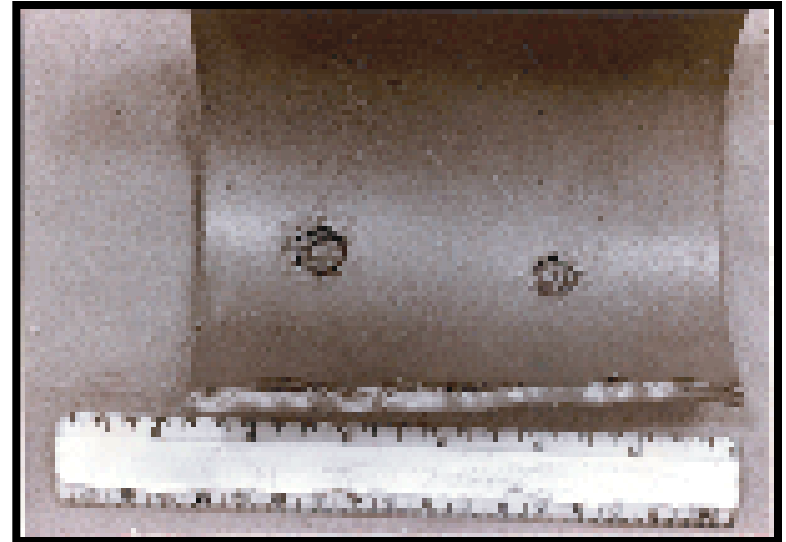
Why are biocides used in gas and oil production?

- Reduce corrosion
- Combat souring
- Promote optimum production rates
- Protect functional fluids from spoilage

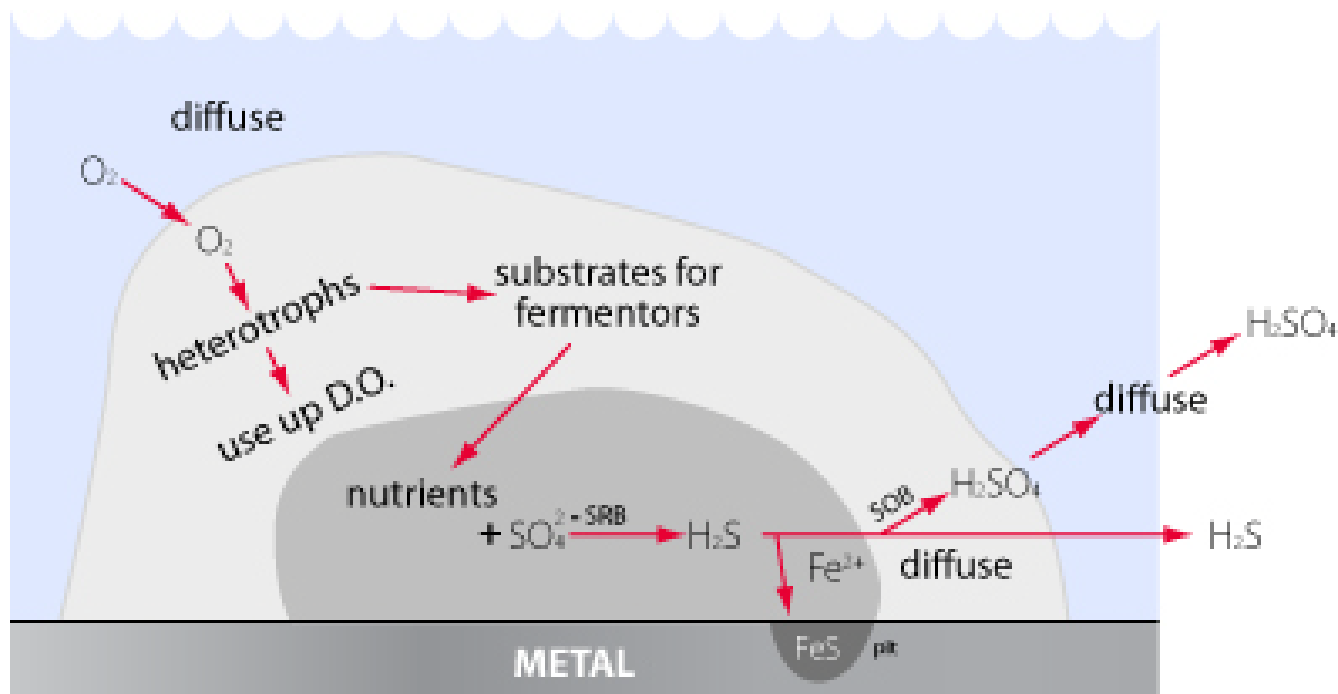


Why are biocides used in gas and oil production?

- 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



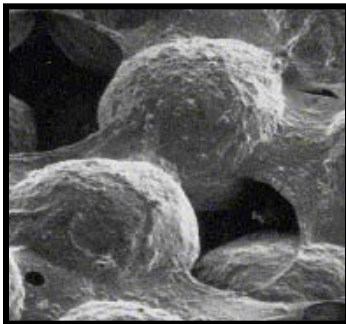
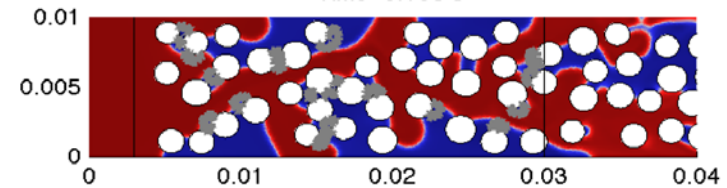
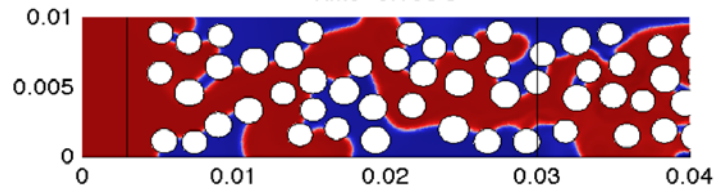
Why are biocides used in gas and oil production?

- Bacteria in some wells and storage areas produce hydrogen sulfide (H_2S)
 - H_2S smells like rotten eggs, can be flammable and possibly explosive
- Biocide treatments control the bacteria that produce H_2S



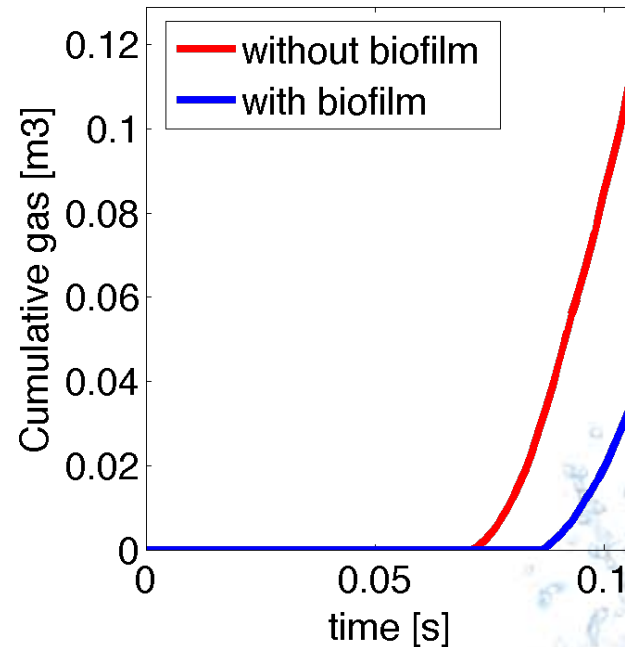
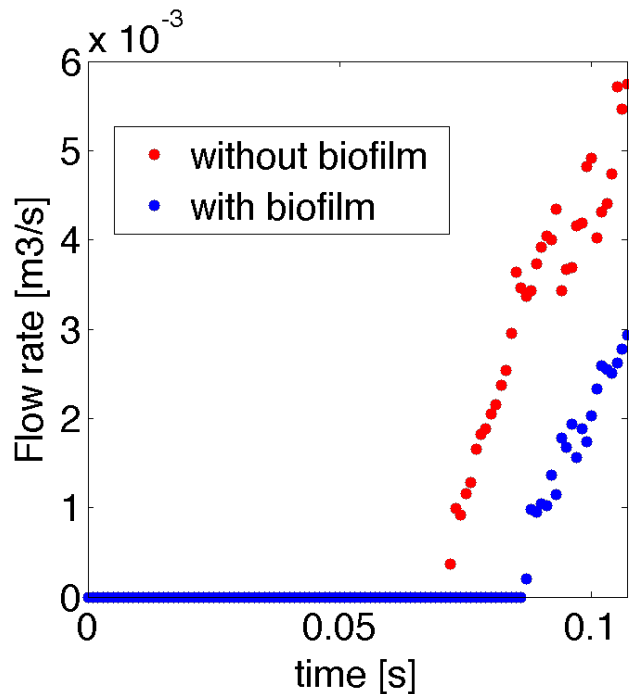
Why are biocides used in gas and oil production?

- 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



Who makes biocides?

- Biocide manufacturers are major companies



LONZA



- 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

PRECAUTIONARY STATEMENTS
HAZARDS TO HUMANS AND DOMESTIC ANIMALS
DANGER
KEEP OUT OF REACH OF CHILDREN
 Corrosive. Causes reversible eye damage. Causes skin irritation. Harmful if inhaled. Harmful if swallowed. Harmful if absorbed through skin. Prolonged or frequently repeated skin contact may cause allergic reactions in some individuals. Causes asthma-like signs and symptoms in hyper-reactive individuals.

Do not get in eyes, on skin, or on clothing.
 Avoid breathing vapor. Do not swallow.
 Wear goggles, protective clothing, and a buff or nitrile gloves.
 Wash thoroughly with soap and water after handling.
 Remove contaminated clothing and wash before reuse.

ENVIRONMENTAL HAZARDS
 This pesticide is toxic to fish. Do not discharge effluent containing this product into lakes, streams, ponds, estuaries, oceans or other waters unless in accordance with the requirements of a National Pollutant Discharge Elimination System (NPDES) permit and the permitting authority has been notified in writing prior to discharge. Do not discharge effluent containing this product to sewer systems without previously notifying the local sewage treatment plant authority. For guidance, contact your State Water Board or Regional Office of the EPA.

STORAGE AND HANDLING
 AQUICAR GA 25 Water Treatment Microbiocide is incompatible with many commonly used materials of construction such as steel, galvanized iron, aluminum, tin, and zinc. AQUICAR GA 25 Water Treatment Microbiocide can be stored and handled in metal drums, polyethylene, stainless steel, reinforced epoxy-plastic equipment. This product freezes at about 14°F (-10°C). Therefore, unless the storage tanks inside or underground, heating and insulation may be required. If heating is provided, exposure to high temperatures should be avoided. For short storage times (up to about 1 month), temperatures of up to 100°F (38°C) can be tolerated but the pre-labeled maximum storage temperature is about 80°F (26.7°C).

A stainless steel centrifugal pump is suggested for transfer service. Spiral-wound stainless steel with TEFLON® Polymer seals are for gaskets and packing.
 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.

LIMITED WARRANTY AND DISCLAIMER
 Seller warrants that the product conforms to its chemical description as contained on this label and is reasonably fit for the purposes stated on this label when used in accordance with directions under normal conditions of use. THE WARRANTIES MADE IN THIS PARAGRAPH ARE SELLER'S SOLE WARRANTIES WITH RESPECT TO THE PRODUCT AND ARE MADE EXPRESSLY IN LIEU OF AND EXCLUDE ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE AND ALL OTHER EXPRESS OR IMPLIED REPRESENTATIONS AND WARRANTIES.

BEFORE HANDLING OR USING THIS PRODUCT, SEE YOUR EMPLOYER AND READ CURRENT MATERIAL SAFETY DATA SHEET.

STORAGE AND DISPOSAL
PESTICIDE DISPOSAL: Do not contaminate water, food or feed by storage or disposal. Open dumping is prohibited. Pesticide wastes are toxic. Inappropriate disposal of excess pesticide, spray mixture or residue 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.
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.

NOTICE
 Do Not Ship or Store with Food, Feeds, Drugs, or Clothing

AQUICAR™ GA 25 Water Treatment Microbiocide

A highly effective Microbiocide for use in controlling Bacteria Including Slime Forming Bacteria and Sulfate-Reducing Bacteria, Fung (Yeast and Molds) and Algae In Air Washers and Industrial Scrubbing Systems, Recirculating Cooling and Process Water Systems including those that contain Reverse Osmosis Membranes and Service Water and Auxiliary Systems, Heat Transfer Systems, Wastewater Systems Including Wastewater Sludge and Holding Tanks, Paper Mills and Paper Mill Process Water Systems, Pigments and Filler Slurries for Paper and Paperboard, Water Based Coatings for Paper and Paperboard and in Oil Well Drilling, Oil Field Processing Applications, Oil Field Water Systems, Gas Production and Transmission Pipelines and Systems, and Gas Storage Fields and Equipment; such as Steam-Injection Water Holding Tanks, Flood Water, Injection Water, Holding Pond Water, Disposal-Well Water, Water Holding Tanks, Fuel Storage Tanks and related Refinery and Oil Field Closed, Industrial Recirculating Water Handling Systems.

Active Ingredient: Glutaraldehyde 25%
 Inert Ingredients: 75%
 Total 100%

KEEP OUT OF REACH OF CHILDREN
DANGER
FIRST AID

If swallowed:
 • Call a poison control center or a doctor immediately for treatment advice.
 • DO NOT INDUCE VOMITING.
 • Do not give anything to drink.
 • If in eyes:
 • Wash immediately and continuously with flowing water for at least 30 minutes.
 • Remove contact lenses after the first 5 minutes and continue washing. Obtain prompt medical consultation, preferably from an ophthalmologist.
 • Call a poison control center or a doctor immediately for treatment advice.
 • If on skin or clothing:
 • Take off contaminated clothing.
 • Rinse skin immediately with plenty of water for 15-20 minutes.
 • Call a poison control center or a doctor for treatment advice.
 • If inhaled:
 • Move person to fresh air.
 • If person is not breathing, call 911 or an ambulance, and then give artificial respiration, preferably mouth-to-mouth if possible.
 • Call a poison control center or a doctor for further treatment advice.

NOTE TO PHYSICIAN: Aspiration may cause lung damage. Probable mucosal damage may contraindicate the use of gastric lavage.
 Have the MSDS and, if available, the product container or label with you when calling a poison control center or a doctor, or going for treatment.

SEE SIDE PANEL FOR ADDITIONAL PRECAUTIONARY STATEMENTS

EPA Reg. No. 484-688
 EPA Est. No. 10312-WW-214, 464-WV-1 #
 (A) 5 gallon plastic pail; all drums, bulk
 (B) Sample, 3 gallon plastic less than full pail

The Dow Chemical Company
 Midland, Michigan 48674 U.S.A.
 (989) 636-1400
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 ("Dow") or an affiliated company of Dow
 Made in U.S.A.

Net Contents: 5, 55 gallons or bulk

CONTAINER SIZE	CONTAINER SIZE	CONTAINER SIZE
5 GALLONS	55 GALLONS	TOTE
44 POUNDS NET WEIGHT	455 POUNDS NET WEIGHT	2,235 POUNDS NET WEIGHT

IN CASE OF AN EMERGENCY endangering life or property involving this product, call collect (989) 636-4400.

DIRECTIONS FOR USE

Read the entire label and follow the directions on the label. Do not use this product in a manner inconsistent with the label.

AIR WASHERS AND INDUSTRIAL SCRUBBING SYSTEMS/ RECIRCULATING COOLING AND PROCESS WATER SYSTEMS
 This product may be used in industrial washers and air washer systems with fan and spray-nozzle systems.

AQUICAR GA 25 Water Treatment Microbiocide should be added at the application rate indicated below to service treatment systems at a constant rate of about 1 mgal per 100 gallons of water. Additive rate for pulse treatments (30-60 DDIS) is continuous.
 Daily batch control can be used instead with AQUICAR GA 25 Water Treatment Microbiocide. Under normal conditions, this treatment is classified as 1 ppm (100 mgal). AQUICAR GA 25 Water Treatment Microbiocide can be used in industrial process water systems for controlling scale and iron/calcium contamination. Follow the label directions for application with the constant rate method and scheduled clean-up program.

INTERMITTENT (BULK DRAIN) METHOD
Initial Dose: When the system is initially being added, apply 20 to 40 times the rate of AQUICAR GA 25 Water Treatment Microbiocide per 1,000 gallons of water in the system. Repeat at 24-hour intervals.
Subsequent Dose: When re-treated control is evident, add 6 to 8 times the rate of AQUICAR GA 25 Water Treatment Microbiocide per 1,000 gallons of water in the system weekly, or as recommended on label.
 Daily batch control can be chosen based on treatment logs.

CONTINUOUS FEED METHOD
Initial Dose: When the system is initially being added, apply 20 to 40 times the rate of AQUICAR GA 25 Water Treatment Microbiocide per 1,000 gallons of water in the system. Repeat at 24-hour intervals.
Subsequent Dose: When re-treated control is evident, add 6 to 8 times the rate of AQUICAR GA 25 Water Treatment Microbiocide per 1,000 gallons of water in the system weekly, or as recommended on label.
 Daily batch control can be chosen based on treatment logs.

SERVICE WATER AND AUXILIARY SYSTEMS
 AQUICAR GA 25 Water Treatment Microbiocide should be used at the same application rate, and in the same manner as described above. Initial treatment should be given at a particular rate depending on the system.

HEAT TRANSFER SYSTEMS
Propylene Glycol, Glycerin, Seawater, Synthetic Oils, Air, Steam, and Water
 AQUICAR GA 25 Water Treatment Microbiocide should be used at the same application rate, and in the same manner as described above. Initial treatment should be given at a particular rate depending on the system. Apply once or other means of controlling scale and iron/calcium contamination.

INDUSTRIAL WASTEWATER SYSTEMS
Wastewater Systems, Wastewater Sludge and Wastewater Holding Tanks
 AQUICAR GA 25 Water Treatment Microbiocide should be added to wastewater systems at a rate of 1 to 2 times the rate of application rate of the system. Add 10 to 15 times the rate of AQUICAR GA 25 Water Treatment Microbiocide per 100 gallons of water in the system weekly.

PAPER MILLS AND PAPER MILL PROCESS WATER SYSTEMS
 AQUICAR GA 25 Water Treatment Microbiocide should be added to the paper making system at a rate of about 1 mgal per 100 gallons of water in the system.

Initial Dose: When the system is initially being added, apply 20 to 40 times the rate of AQUICAR GA 25 Water Treatment Microbiocide per 1,000 gallons of water in the system. Repeat at 24-hour intervals.
Subsequent Dose: When re-treated control is evident, add 6 to 8 times the rate of AQUICAR GA 25 Water Treatment Microbiocide per 1,000 gallons of water in the system weekly, or as recommended on label.

PIGMENTS AND FILLER SLURRIES FOR PAPER AND PAPERBOARD
 (For use in food and non-food contact polymers and filler slurries)
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DRILLING, COMPLETION, AND WORKOVER FLUIDS

AQUICAR GA 25 Water Treatment Microbiocide should be added to drilling mud systems at a rate of about 1 mgal per 100 gallons of water in the system.
Initial Treatment: Add 10 to 15 times the rate of application rate of the system. Add 10 to 15 times the rate of application rate of the system. Add 10 to 15 times the rate of application rate of the system. Add 10 to 15 times the rate of application rate of the system.
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FRACKING FLUIDS
 AQUICAR GA 25 Water Treatment Microbiocide should be added to a frack fluid at a rate of about 1 mgal per 100 gallons of water in the system. Add 10 to 15 times the rate of application rate of the system. Add 10 to 15 times the rate of application rate of the system. Add 10 to 15 times the rate of application rate of the system. Add 10 to 15 times the rate of application rate of the system.

GAS PRODUCTION AND TRANSMISSION PIPELINES AND SYSTEMS
 AQUICAR GA 25 Water Treatment Microbiocide should be added to gas production systems at a rate of about 1 mgal per 100 gallons of water in the system.

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CONTINUOUS FEED METHOD
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PIGMENTS AND FILLER SLURRIES FOR PAPER AND PAPERBOARD
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Example of EPA Approved Label

PRECAUTIONARY STATEMENTS
HAZARDS TO HUMANS AND DOMESTIC ANIMALS
DANGER
KEEP OUT OF REACH OF CHILDREN

Corrosive. Causes irreversible eye damage. Causes skin irritation. Harmful if inhaled. Harmful if swallowed. Harmful if absorbed through skin. Prolonged or frequently repeated skin contact may cause allergic reactions in some individuals. Causes asthma-like signs and symptoms in type-reactive individuals.

Do not get in eyes, on skin, or on clothing.
 Avoid breathing vapor. Do not swallow.
 Wear goggles, protective clothing, and bulky or nitrile gloves.
 Wash thoroughly with soap and water after handling.
 Remove contaminated clothing and wash before reuse.

ENVIRONMENTAL HAZARDS

This pesticide is toxic to fish. Do not discharge effluent containing this product into lakes, streams, ponds, estuaries, oceans or other waters unless in accordance with the requirements of a National Pollutant Discharge Elimination System (NPDES) permit and the permitting authority has been notified in writing prior to discharge. Do not discharge effluent containing this product to sewer systems without previously notifying the local sewage treatment plant authority. For guidance, contact your State Water Board or Regional Office of the EPA.

STORAGE AND HANDLING

ACUCAR GAS 25 Water Treatment Mercuric Chloride is incompatible with many commonly used materials of construction such as steel, galvanized iron, aluminum, tin, and zinc. ACUCAR GAS 25 Water Treatment Mercuric Chloride can be stored and handled in metal, plastic, and steel, polyethylene, stainless steel, reinforced epoxy-plastic equipment. This product freezes at about 14°F (-10°C). Therefore, unless the storage tanks inside or underground heating and insulation may be required. If freezing and exposure to high temperatures should be avoided. For short storage times (up to about 1 month), temperatures of up to 100°F (38°C) can be tolerated but the permitted maximum storage temperature is about 80°F (26.7°C).

A stainless steel centrifugal pump is suggested for transfer service. Spin around stainless steel with TEFLO™ Polymer saccharide for gaskets and packing.
 Handle in a well-ventilated area. If vapors are irritating to the nose or eyes, special ventilation or respiratory protection (MSHA/NIOSH approved purifying respirator equipped with an organic vapor cartridge) may be required.

LIMITED WARRANTY AND DISCLAIMER

Seller warrants that the product conforms to its chemical description as contained on this label and is reasonably fit for the purposes stated on this label when used in accordance with directions under normal conditions of use. THE WARRANTIES MADE IN THIS PARAGRAPH ARE THE SELLER'S SOLE WARRANTIES WITH RESPECT TO THE PRODUCT AND ARE MADE EXPRESSLY IN LIEU OF AND EXCLUDE ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE AND ALL OTHER EXPRESS OR IMPLIED REPRESENTATIONS AND WARRANTIES.

BEFORE HANDLING OR USING THIS PRODUCT, SEE YOUR EMBROIDERED SAFETY DATA SHEET.

STORAGE AND DISPOSAL

PESTICIDE DISPOSAL: Do not contaminate water, food or feed by storage or disposal. Open dumping is prohibited. Pesticide wastes are toxic. Inappropriate disposal of excess pesticide, spray mixture or residue 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 nearest Hazardous Waste representative at the nearest EPA Regional Office for guidance.

CONTAINER DISPOSAL: Metal 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.

NOTICE

Do Not Ship or Store with Food, Feeds, Drugs, or Clothing

160069-04/10/00/08

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.

The Dow Chemical Company
 Midland, Michigan 48674 U.S.A.
 (989) 636-1400
 ©TM Trademark of The Dow Chemical Company
 "Dow" or an affiliated company of Dow
 Made in U.S.A.

Net Contents: 5, 55 gallons or bulk

CONTAINER SIZE	CONTAINER SIZE	CONTAINER SIZE
5 GALLONS	55 GALLONS	TOTE
44 POUNDS	455 POUNDS	2,235 POUNDS
NET WEIGHT	NET WEIGHT	NET WEIGHT

IN CASE OF AN EMERGENCY endangering life or property involving this product, call collect (989) 636-4400.

EPA Reg. No. 464-698
 EPA Est. No. 10152-WW-21A-464-WV-1 #
 (A) 5 gallon plastic pails; all drums, bulk
 (B) Samples; 5 gallon pails less than full
 pallet
 (H0207)
 (PE038)

WATER FLOODS

ACUCAR GAS 25 Water Treatment Mercuric Chloride should be added to a water flood system in a proportion of 1:1000.

Initial Treatment: Mercuric Chloride is extremely corrosive. Therefore, it should be added to ACUCAR GAS 25 Water Treatment Mercuric Chloride in a ratio of 1:1000. Repeat until control is obtained.

Subsequent Dosing: When control is obtained, add 40 to 1000 ppm ACUCAR GAS 25 Water Treatment Mercuric Chloride to the water. ACUCAR GAS 25 Water Treatment Mercuric Chloride (as 1,000 gallon stock water) to the system weekly, or as needed to maintain control.

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

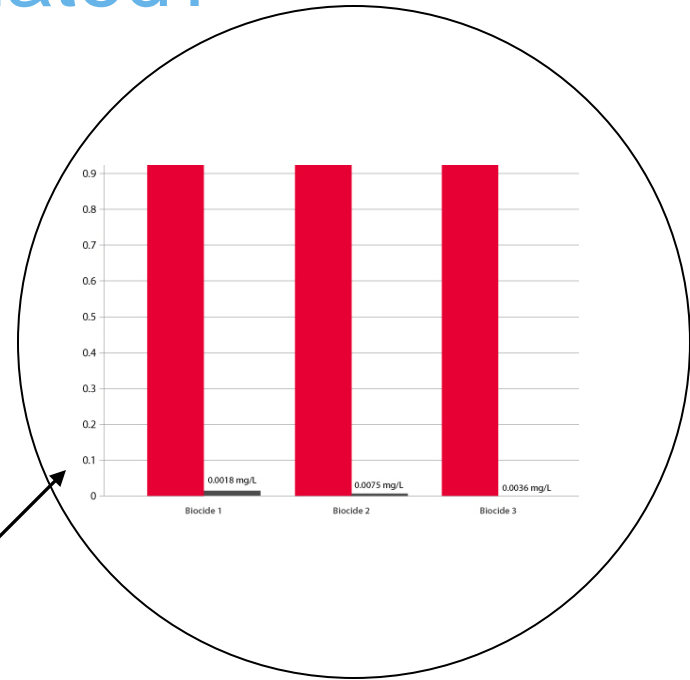
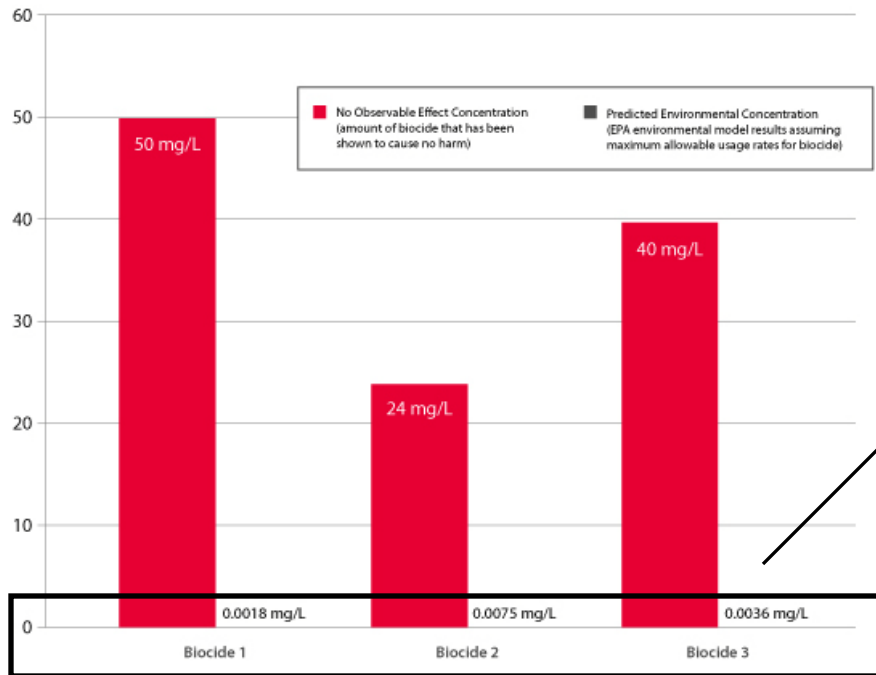


How are biocides evaluated?

- 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

Product	Rating
AQUCAR™ IG-E 50	Gold
SUMP BUDDY* WT	Silver
UCARCIDE™ 24	Gold
ANTIMICROBIAL 7287	Silver
UCARCIDE™ 50	Gold

UK Hazard Quotient Key

HQ Range	Rating
<1	Gold
1-30	Silver
30-100	White
100 – 300	Blue
300 – 1000	Orange
>1000	Purple

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





Microbial Control

Thank You!

