Dow Microbial Control

AQUCAR™ DB 5 Water Treatment Microbiocide

Fast-acting, broad-spectrum biocide with low environmental impact

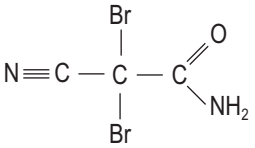
General

AQUCAR™ DB 5 Water Treatment Microbiocide is a formulation containing 5% DBNPA (2,2-dibromo-3-nitrilopropionamide, CAS Reg. No. 10222-01-2). This product provides broad-spectrum control of bacteria, fungi, yeast, and algae.

Key Benefits

- AQUCAR™ DB 5 Water Treatment Microbiocide is a fast-acting biocide.
- Rapid decomposition in aquatic environments with only carbon dioxide, ammonia, and bromide ions remaining as end products
- AQUCAR DB 5 is chlorine compatible
- AQUCAR DB 5 is completely miscible with water and easily dispersed upon introduction into your system.
- AQUCAR DB 5 is a broad spectrum antimicrobial, effectively controlling fungi, yeast, bacteria, and algae

Structure



MW = 242

Physical Properties

The following are typical properties of AQUCAR™ DB 5 Water Treatment Microbiocide; **they are not to be considered product specifications.**

Appearance:	Liquid
Active ingredient:	2,2-dibromo-3-nitrilopropionamide
Percent active ingredient:	5%
Inert ingredients:	Polyethylene glycol/water
Color:	Colorless to yellow
Boiling point:	> 70°C (158°F)
Specific gravity:	1.134 g/mL @ 23°C (73°F)
Vapor pressure:	2 x 10^{-5} mmHg @ 25°C (77°F)
Flash point:	> 95% after 12 months
Storage stability:	93°C (199°F)

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Antimicrobial Activity

AQUCAR™ DB 5 Water Treatment Microbiocide has been extensively tested against numerous microorganisms under a variety of conditions. Rate of kill by the active ingredient of AQUCAR DB 5 against bacteria over time in a range of pH conditions has been determined (Table 1 and Figure 1). Also, the efficacy against algae (Table 2), and the effective concentrations of AQUCAR DB 5 needed to control bacteria in pulpstock of various pH (Table 3) have been determined and are highlighted below.

Table 1: Rate of Kill Caused by Dow 2.2-dibromo-3-nitrilopropionamide (DBNPA) (% Reduction After 1, 3, 24 Hrs. Exposure) against bacteria

E. aerogenes												
PPM	**1-Hour pH**				**3-Hour pH**				**1-Day pH**			
	5	6	7	9	5	6	7	9	5	6	7	9
5	99.85	99.99	100	100	100	100	100	100	100	100	100	100
10	100	100	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
25	↓	↓										
50												
100												
Control Bacterial Counts per mL x 10^6												
	3.7	4.7	3.9	2.2	3.1	5.1	5.0	2.9	17.9	21.7	18.3	10.5

	***Pseudomonas aeruginosa* pH = 8**			***Bacillus subtilis* pH = 8**		
PPM	**1-Hour**	**3-Hour**	**1-Day**	**1-Hour**	**3-Hour**	**1-Day**
5	100	99.99	100	99.94	99.93	99.99
10	↓	100	↓	99.89	99.86	↓
25		↓		99.99	99.94	
50				99.94	99.86	
100				99.95	99.97	
	Control Bacterial Counts per mL x 10^6					
	8.0	13.0	23.0	1.1	72	2.2

Table 2: Algistatic and Algicidal Properties of Dow DBNPA Against *Chlorella pyrenoidosa* (Wis. 2004) and *Phormidium retzii* (Wis. 1094)

		300,000 Cells/mL 7-8 Days Incubation				**Gorham's Medium (minus EDTA) – Subcultured After 4 Hours**			
		Percentage Inhibition of Cultures				**Growth in Subcultures[1]**			
	Conc.	***Chlorella***		***Phormidium***		***Chlorella***		***Phormidium***	
	PPM	1	2	1	2	1	2	1	2
Chemical DBNPA	1/16	–	0	–	0	–	100	–	100
	1/8	0	0	0	0	100	100	100	100
	1/4	0	0	0	0	100	100	100	100
	1/2	0	0	0	0	100	100	100	100
	1	50	90	0	0	100	100	100	50
	2	100	100	50	0	100	100	50	50
	4	100	100	100	100	50	50	0	0
	6	100	100	100	100	0	10	0	0
	8	100	100	100	100	0	0	0	0

[1]Growth in subcultures as percentage of controls: 0 indicates conc. which was algicidal with 4 hours treatment.

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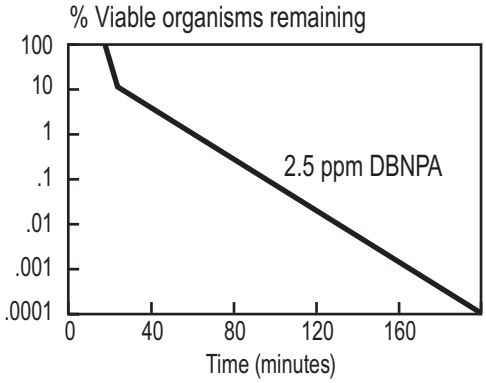
Figure 1: Rate of Microorganism Kill by 2.5 ppm Dow DBNPA in High pH (8.5) System



100 ppm Alkalinity *pH = 8.5*
500 ppm Hardness *2.2E8 Initial CFU/mL*

Table 3: Biocide Concentrations Required for 99.999% Kill of *Klebsiella pneumoniae* in Aspen Groundwood Pulpstock, Three-hour Test

Biocide	pH	Concentration Necessary for a 99.999% Kill (ppm)
Dow DBNPA	5.55	1
	7.00	5
	8.35	10
Supplier A	5.55	>60
	7.00	100
	8.35	75
Supplier B	5.55	>300
	7.00	200
	8.35	300

Applications/ Directions for Use

Note: Due to differences in regulatory jurisdictions, it is up to the user to confirm with regional and local regulatory authorities that all approvals are in place prior to product use.

RECIRCULATING WATER COOLING TOWERS

AQUCAR™ DB 5 Water Treatment Microbiocide is best added to the basin of the system and should be made with a metering pump. As shown in Table 4, AQUCAR DB 5 can be added on a continuous basis or intermittently, as necessary to maintain control.

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Table 4: Treatment Levels of Industrial Recirculating Water Cooling Towers with AQUCAR™ DB 5 Water Treatment Microbiocide

		Use This	or	This	or	This
		fl. oz. per 1000 gallons		mL per 1000 gallons		gallons per 1000 gallons
Bacterial Control	Intial[a] Dose	2.4 to 4.9		72 to 144		0.019 to 0.038
	Subsequent[b] Slug Doses	1.2 to 4.9		36 to 144		0.0095 to 0.038
	or					
	Subsequent[c] Continuous Feed Doses	0.49 to 2.4		14.4 to 72		0.0038 to 0.019
Fungal/Algal Control	Initial[a] Dose	25 to 49		730 to 1440		0.192 to 0.380
	Subsequent[d] Slug Doses	15 to 49		440 to 1440		0.116 to 0.380
	or					
	Subsequent[c] Continuous Feed Doses	15 to 49		440 to 1440		0.116 to 0.380

[a]Badly fouled systems must be cleaned before treatment is begun.
[b]Treat every 4 days or as needed.
[c]Treat daily.
[d]Treat daily or as needed.

PULP, PAPER, AND PAPERBOARD MILLS

For the control of bacterial, fungal, and yeast growth in pulp, paper, and paperboard mills, add AQUCAR™ DB 5 Water Treatment Microbiocide at the rates given in Table 5. Typical addition points are the beaters, jordan inlet or discharge, broke chests, furnish chests, save-alls, and/or white-water tanks.

Table 5: Treatment Levels in Pulp and Paper Systems[a] with AQUCAR™ DB 5 Water Treatment Microbiocide

		Use This	or	This	or	This
		gal. per ton of paper (dry basis)		fl. oz. per ton of paper (dry basis)		mL per ton of paper (dry basis)
Heavily Fouled[b] Systems	Dose After Boiling Out	0.06 to 0.15		7.7 to 19.2		227.1 to 567.8
Moderately Fouled System	Initial Dose	0.15 to 0.21		19.2 to 26.9		567.8 to 794.9
	Subsequent Dose	0.06 to 0.15		7.7 to 19.2		227.1 to 567.8
Slightly Fouled Systems	Initial Dose	0.06 to 0.15		7.7 to 19.2		227.1 to 567.8
	Subsequent Dose	0.06 to 0.15		7.7 to 19.2		227.1 to 567.8

[a]Choice of continuous or intermittent addition will depend on observed results.
[b]Heavily fouled systems should be cleaned before treatment is begun.

INDUSTRIAL AIR WASHER SYSTEMS

AQUCAR™ DB 5 Water Treatment Microbiocide should be added to the air washer sump with the use of a metering pump. AQUCAR DB 5 can be added on a continuous basis or intermittently, as necessary to maintain control. For the control of bacteria and fungi in industrial air washer systems, add AQUCAR DB 5 at the rates given in Table 6.

Note: For use only in industrial air washer systems that maintain effective mist-eliminating components.

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Table 6: Treatment Levels in Industrial Air Washer Systems with AQUCAR™ DB 5 Water Treatment Microbiocide

		Use This	or This	or This
		gal. per 1000 gal. water in system	fl. oz. per 1000 gal. water in system	mL per 1000 gal. water in system
Intermittent or Slug Method	Initial[a] Dose	0.156 to 0.250	20.0 to 32.0	590.0 to 946.0
	Subsequent[b] Dose	0.0078 to 0.125	1.0 to 16.0	29.5 to 473.0
Continuous Feed Method	Initial[a] Dose	0.156 to 0.250	20.0 to 32.0	590.0 to 946.0
	Subsequent[b] Dose	0.0078 to 0.125	1.0 to 16.0	29.5 to 473.0

[a]Badly fouled systems must be cleaned before treatment is begun.
[b]Treat every 2 days or as needed to maintain control.

ENHANCED OIL RECOVERY SYSTEMS

For microbial control in oilfield water, add AQUCAR™ DB 5 Water Treatment Microbiocide with a metering pump either continuously or intermittently. Additions may be made at the free water knockouts, before or after the injection pumps and injection well headers. For controlling slime-forming bacteria, sulfide-producing bacteria, yeasts, and fungi in oilfield water, polymer or micellar floods, or other oilfield water systems, add AQUCAR DB 5 at the rates given in Table 7.

Table 7: Treatment Levels in Oilfield Water Systems with AQUCAR™ DB 5 Water Treatment Microbiocide

		Use This	To Equal	This
		gal. per 2400 bbl oilfield water		ppm based on system volume
Intermittent or Slug Method	Initial[a] Dose	3.6 to 28.6		40 to 320
	Subsequent[a] Dose	3.6 to 28.6		40 to 320
Continuous Feed Method	Initial[b] Dose	3.6 to 28.6		40 to 320
	Subsequent[c] Dose	0.4 to 5.4		4 to 60

[a]Add intermittently for 4 to 8 hours per day, and from 1 to 4 times per week, or as needed depending on the severity of contamination.
[b]Add continuously until the desired degree of control is achieved.
[c]Add continuously or as needed to maintain control.

Use with Biopolymers

Add 60-320 ppm of AQUCAR™ DB 5 Water Treatment Microbiocide (5.4-28.6 gal of AQUCAR DB 5 per 2400 barrels of water).

Additions should be made with a metering pump immediately after preparation of the aqueous biopolymer solution to control the organisms that cause viscosity loss, or odor, or that are potential corrosive agents.

Food Additive Regulations

The product meets the requirements of the Food Additive Regulations listed below. Uses are subject to good manufacturing practices and any limitations which are part of the regulations. The information given here is for use as a general guideline. The regulations should be consulted for complete details. In some cases a product formulation may meet an FDA clearance and the use is not on the product label.

Regulation Number (21 CFR)

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21 CFR 175.105 (c)(5) Adhesives

21 CFR 176.170 (a)(5) Cleared for use as antimicrobial agent in pigment and filler slurries used in manufacture of paper and paperboard. (max 2000 ppm product)

21 CFR 176.170 (b)(2) Cleared for use in components of paper and paperboard in contact with aqueous and fatty foods (max 2000 ppm product)

21 CFR 176.180 (b)(1) Cleared for use in components of paper and paperboard in contact with dry food (max 2000 ppm product)

21 CFR 176.300 Slimicides (max 0.1lb product/ton dry wt fiber)

Toxicology

Please refer to the product Safety Data Sheet (SDS).

Handling

Table 8: Summary of Materials Acceptable for Bulk Handling and Shipping of AQUCAR™ DB 5 Water Treatment Microbiocide

Storage Tank and Tank Truck	Pipe Linings and Hosing
Titanium Hastelloy[1] C-276 alloy Glass-lined steel 316 Stainless steel, preferably with a protective coating DERAKANE™ 411-45 resin or DERAKANE 470-45 resin (coated fiberglass) Polyethylene Polypropylene	Polypropylene Kynar[2] resin Teflon[3] resin SARAN™ resin Braided reinforced hosing of Teflon (stainless steel on outside)
Pumps	**Gasket Materials**
Titanium 316 SS Solid Kynar resin Solid Teflon resin	Chlorinated polyethylene (CPE) Viton[4] resin Teflon resin Asbestos

[1]Trademark of Haynes International Corporation
[2]Trademark of Pennwalt Corporation
[3,4]Trademark of E.I. DuPont de Nemours & Co., Inc.

Routine handling and protective equipment

Personnel working with this product and any chemical need to understand the hazards and practice good work habits. Studies have shown that enforcement of good work practices prevents skin reactions, respiratory and eye problems which can be attributed to chemical exposure. The hazards associated with this product are as follows:

Product hazards:
Eye: Can cause severe eye irritation and corneal injury
Skin: Prolonged contact is irritating with skin, allergic reactions can occur in some individuals
Inhalation: Mist from product may cause severe irritation of upper respiratory tract
Ingestion: Harmful if swallowed.

Minimum PPE requirements
Always wear personal protective equipment (PPE) when handling the product. While the selection of PPE depends on the task to be performed, the environment and the engineering controls that are in place the following is the minimum PPE to be worn when handling containers of the product:

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- Splash proof chemical goggles
- Chemical resistant gloves which extend above the wrist
- Long sleeve shirt and long pants
- Socks and chemical resistant footwear

Storage guidance

- Product must be stored in closed, but vented, containers in an area with good general ventilation and out of direct sunlight to prevent build up of vapors over time
- Product must not be stored at T >35ºC
- Avoid adiabatic conditions in pumps which have caused accidents; CO_2 evolution and pressure release
- Aqueous solutions in plastic containers should not be left in direct sunlight

Please read the Safety Data Sheet (SDS) for this product and understand the potential hazards before using the product.

DISPOSAL

Excess product and the empty product containers should be cleaned and disposed of by personnel trained in working with this product and chemicals. Disposal of excess product and empty containers must be in compliance with all rules and regulations in the respective jurisdiction. The following is intended as general guidance.

Disposal of Unused Product

If excess product cannot be used according to use directions, it should be sent to an approved waste disposal facility for disposal. The waste disposal facility should be familiar with disposal of chemical waste. Disposal regulations can vary by location therefore, customers need to contact the regulatory authority for waste disposal in their location. Regardless of the location, this product should never be disposed of by discharging into lakes, streams, ponds, estuaries, oceans, or other bodies of water. It should not be dumped into sewers, ditches, or into soil at any time.

Disposal of Empty Product Containers

AQUCAR™ DB 5 Water Treatment Microbiocide is supplied in non refillable containers that are not to be reused or refilled. Empty containers should be triple rinsed with water or pressure rinsed promptly after emptying to remove excess product. Rinse water should be collected and sent to an approved waste handling facility. The waste handling facilities should be familiar with disposal of chemical waste. Once cleaned, the containers can be offered for recycling or reconditioning for pesticides. If not recycled or reconditioned for pesticides, the containers should be punctured and sent to a sanitary landfill or disposed of by incineration or other methods approved by regional and local authorities.

For assistance in emergencies, call Dow, (989) 636-4400.

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.

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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.

For further information visit our website:
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