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HAJCIL QK-20 Antimicrobial

A fast-acting, broad-spectrum biocide for treating raw materials, processing water, and contaminated products

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HAJCIL QK-20 Antimicrobial is a fast-acting, broad-spectrum biocide that is ideal for reducing microbiological contamination in raw materials or products such as aqueous paints and coatings, polymers, slurries, adhesives, latex and resin emulsions, sizing, caulk, process water and specialty industrial products including inks, polishes, waxes, detergents, and cleansers.

Many manufacturers who use biocides for in-can preservation of finished products use the same biocide to treat stored raw materials, wash water, recycle water, and contaminated finished product. Although long-term preservatives may eventually get the job done, they may take too long to work—resulting in costly production delays. In addition, the cost of long-term preservatives can be quite high.

Now, Haj Exports offers a targeted, customized biocide that is faster acting and less expensive in these applications.

HAJCIL QK-20 Antimicrobial quickly and economically cleans up these potential sources of contamination without requiring you to shut down or delay production.

In finished products, HAJCIL QK-20 can be used effectively in combination with long-term preservatives to reduce the bio-burden on the long-term preservative and minimize the likelihood of organism tolerance. This can lower the chances for field failure, product recall, product rework, and downtime. In some cases overall preservative costs may also be reduced.

HAJCIL QK-20 also serves as a fast-acting, low cost preservative for aqueous formulations such as adhesives where short-term protection ranging from several days to several weeks is desired. When liquid raw materials such as latex and slurries are stored in bulk tanks, sometimes a heel of material can remain in the tank and become a source of contamination. HAJCIL QK-20 offers a fast, economical way to clean up these stored materials and provide short-term protection.

Fast, broad-spectrum antimicrobial action

HAJCIL QK-20 Antimicrobial is a formulation containing 20% of the active ingredient 2,2-dibromo-3-nitropropionamide, commonly referred to as DBNPA.

Effective at low concentrations, HAJCIL QK-20 provides broad-spectrum control of bacteria, fungi, and yeast. HAJCIL QK-20 is completely miscible with water and easily dispersed upon introduction into your system. Effective control is often achieved within minutes

Decomposition

In aqueous environments, HAJCIL QK-20 decomposes quickly. Ultimately, only carbon dioxide, ammonia, and bromide ion remain as end products. The entire process may take place with a half-life of less than one-half hour, depending on system conditions.

The instantaneous antimicrobial activity of HAJCIL QK-20, combined with rapid chemical breakdown, presents one of the most cost-effective ways of eliminating microbiological contamination with diminished environmental concern and effect on the final product.

HAJCIL QK-20 typically yields a 99.999 percent kill before it degrades sufficiently to lose effectiveness.

Excellent compatibility with formulation components and other preservatives

HAJCIL QK-20 Antimicrobial is compatible with formulation components and both oxidizing and nonoxidizing preservatives except for tetrahydro-3,5-dimethyl-2H-1,3,5-thiadiazine-2-thione. .

Excellent formulation compatibility means that you can solve or prevent contamination problems without shutting down or delaying production and without undesirable effects on your finished product. HAJCIL QK-20 is also formaldehyde-free.

HAJCIL QK-20 time kill test procedure

1. Weigh 10 grams of contaminated material into sterile test tubes. Fifty gram samples may be required if material is viscous. This volume allows for improved mixing.
2. Material is acclimated to room temperature prior to beginning the test.
3. Add varying levels of HAJCIL QK-20 Antimicrobial to the samples.
4. Vortex (or stir) and streak each sample immediately on Tryptic soy agar after the addition of biocide and typically at the following time intervals thereafter: 10 min., 20 min., 30 min., 1 hour, 3 hours, 5 hours, 24 hours, 48 hours, 4 days and 7 days. Samples are stored in a 30°C room constant temperature between streaks. (Streak times were modified.)
5. Allow all plates to incubate 48 hours at 30°C.
6. Count the number of colonies per streak and record. Report data as Colony Forming Units per milliliter (CFU/mL).
7. A serial dilution of the contaminated starting matrices is plated as well to determine the number of organisms present before the addition of any biocide. The dilutions are 1/10 in 0.85% sterile saline. 0.1 mL of each dilution is plated on Tryptic Soy Agar using a sterile glass spreader. From this test, an accurate estimate of beginning microorganism counts is obtained.

Data interpretation

Assume a streak is 10₁ or 1/100 of a milliliter. For determination of CFU/mL: The number of colonies counted x 100 = CFU/mL. Method detection limit based on this volume is 99 CFU/mL. Any sample with no colonies observable on the streak is recorded as 9.9 x 10¹ CFU/mL. Example: An observed streak resulted in 15 colonies. Therefore, 15 x 100 = 1.5 x 10³ CFU/mL

Laboratory Test Results

Table 1: Minimum inhibitory concentrations for Hajcil QK-20 Antimicrobial

Organism	ATCC#	Solution ppm pH 6.8
BACTERIA		
<i>Bacillus subtilis</i>	8473	125
<i>Enterobacter aerogenes</i>	13048	125
<i>Escherichia coli</i>	11229	125
<i>Klebsiella pneumoniae</i>	8308	125
<i>Proteus vulgaris</i>	881	125
<i>Pseudomonas aeruginosa</i>	10145	125
<i>Pseudomonas aeruginosa PRD10</i>	15442	125
<i>Salmonella choleraesuis</i>	10708	125
<i>Staphylococcus aureus</i>	6538	125
FUNGI		
<i>Aspergillus niger</i>	16404	1250
<i>Fusarium oxysporum</i>	48112	1250
<i>Penicillium chrysogenum</i>	9480	1250
<i>Pullularia pullulans</i>	16622	1250
<i>Trichoderma viride</i>	8678	1250
YEAST		
<i>Candida albicans</i>	10231	1250
<i>Saccharomyces cerevisiae</i>	4105	500

Minimum Inhibitory Concentration test method

MIC test results are determined by incorporating the test compound in either nutrient agar at pH 6.8, or malt yeast agar at 5.5. The agar is then poured into plates and inoculated with nine bacteria or seven fungi/yeast, respectively. Nutrient agar at pH 6.8 was prepared by adding 23 g of Difco nutrient agar to each liter of deionized water. Malt yeast agar (MYA) was prepared by adding 3 g of Difco yeast extract and 43 g of Difco malt agar to each liter of deionized (DI) water. Thirty mL aliquots of the agar were then dispensed into 25 X 200 mm test tubes, capped and autoclaved for 15 minutes at 121°C. The tubes were cooled to 48°C in a water bath.

Stock 1% active solution of DBNPA was prepared using DI water. Appropriate amounts of the stock solutions were added to the 30 ml of agar in the test tubes to achieve final concentrations of solution 50, 125, 250, 500, 1250 and 2500 ppm of HAJCIL QK-20 Antimicrobial. The agar was mixed and poured into plastic disposable petri plates. After drying and aging at room temperature for 24 hours, the plates were inoculated with microorganisms.

Bacteria used in these tests and their ATCC numbers are listed in Table 1. Stock cultures of the bacteria are maintained in cryovials stored at -78°C. Nutrient broth cultures are prepared from the cryovials weekly, transferred daily, and stored at 30°C on an Eberbach shaker set at low speed.

Dilutions of the 24-hour bacterial cultures were made in sterile 0.85% saline to achieve suspensions containing 10⁸ colony forming units (CFU) of each organism (determined through plate counts). Three 0.3 ml aliquots of each bacterial suspension were placed in a Steer's Replicator. Using this inoculating technique, 0.005 mL of each of the nine bacteria are placed in triplicate on agar plates containing different concentrations of DBNPA. Nutrient agar control plates at pH 6.8 were also inoculated in this manner. Each inoculated spot contained approximately 5 x 10⁵ CFU. The plates were incubated at 30°C and read after 48 hours to determine if the biocide incorporated into the agar prevented the growth of this inoculum. The plates were rated with a (+) for growth, a (R) for resistant growth, and a (-) for no growth. The MIC was defined as the lowest concentration that prevented growth.

Fungal and yeast cultures were maintained on malt yeast agar slants and stored at 4°C. Spore forming cultures were harvested by washing the slant with a solution of 10 µl of Triton X100 surfactant in 9.9 mL of 0.85% sterile saline. Non-spore forming cultures were harvested by washing the slant with 9.9 mL of 0.85% sterile saline. To aid in the loosening of the organisms, the slants were rubbed gently with a sterile cotton swab. The resulting suspensions were diluted 1/10 into 0.85% sterile saline. These dilutions were placed into the wells of the Steer's Replicator. The malt yeast agar plates containing the test compounds and the malt yeast agar control plates were inoculated. The plates were incubated at room temperature for 72 hours, read and rated with the (+), (R), and (-) system described. Again, the MIC was defined as the lowest concentration which prevented growth.

Physical and Chemical Properties

Active ingredient: The compound 2,2-dibromo-3-nitrilopropionamide (DBNPA) is the active ingredient in HAJCIL QK-20 Antimicrobial

Chemical name:

2,2-dibromo-3-nitrilopropionamide

Structural formula:

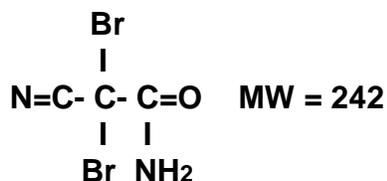


Table 2: Physical properties of HAJCIL QK-20 Antimicrobial

Active Ingredient 2,2-dibromo-3-nitrilopropionamide

CAS Number of DBNPA	1022-01-2
Percent Active Ingredient	20%
Inert Ingredients	Polyethylene glycol/water
Color	Clear to amber
Appearance	Liquid
Odor	Low, mildly antiseptic
Freezing Point About	-50°C (per ASTM D97)
Pour Point	About -45°C (per ASTM D97)
Free Flowing	About -30°C (per ASTM D97)
Freeze-Thaw Stability	Passed 7 cycles at -15° to +20°C
Boiling Point	>120°C for solution, but active ingredient decomposes
Specific Gravity	1.24-1.27 g/mL @ 23°C
Miscibility	Miscible with water in all proportions
Vapor Pressure (DBNPA)	2 x 10 ⁻⁵ mmHg @ 25°C
Flash Point	None detected (COC)
Partition Coefficient	P=0.1 for mineral oil/water
Storage Stability	Analysis shows that 95% of the original concentration of the active ingredient in HAJCIL QK-20 is maintained when stored in appropriate containers after 9 months.

Safe Use and Handling

Routine Handling and Protective Equipment

As with all chemicals, handle HAJCIL QK-20 Antimicrobial only after hazards are thoroughly understood.

Always use safe chemical handling procedures and appropriate protective equipment.

Please read the Material Safety Data Sheet for this product and understand the potential hazards before using HAJCIL QK-20 Antimicrobial. Personnel should avoid eating, drinking, and smoking while handling HAJCIL QK-20 Antimicrobial.

Eye protection – Chemical workers’ goggles must be worn to minimize the possibility of eye exposure. The most significant handling concern with HAJCIL QK-20 Antimicrobial is eye contact. Laboratory studies show the potential for very serious eye damage, including the possibility of permanent impairment or loss of vision, should HAJCIL QK-20 Antimicrobial contact the eyes.

Protective clothing – Short-term contact, even with concentrated solutions, is not likely to cause injury to the skin. However, even accidental short-term contact should be avoided if possible. Prolonged contact or contact with abraded skin may result in a chemical burn. For these reasons, clean, long-sleeved and long legged clothing should be worn at all times when handling concentrated solutions. If there is a chance of repeated or extended exposure to HAJCIL QK-20 Antimicrobial, impervious gloves and foot protection should also be worn.

Ventilation – To minimize the possibility of exposure to vapors in the container headspace, drums should be opened and stored in an area with adequate general ventilation. If HAJCIL QK-20 Antimicrobial is stored in large tanks, the headspace should be vented or scrubbed in accordance with local air regulatory requirements.

Bulk handling

HAJCIL QK-20 Antimicrobial is temperature sensitive. Therefore, all external sources of heat or energy must be eliminated or controlled to ensure product stability and safety. The following are potential sources of heat or energy: sunlight, radiation, warehouse lights and heaters, agitators and pumps, and steam used to thaw a frozen line or drum. Remember that the storage temperature has a direct effect on the rate of product decomposition. Customers should examine their operations carefully and consider these points. Screening tests have established suitable materials of construction for handling HAJCIL QK-20 Antimicrobial. The formulation contains DBNPA, water and polyethylene glycol. Polyethylene glycol is essentially noncorrosive; therefore, the corrosion potential of the two formulated products is a function of increasing DBNPA concentration.

Container labeling – All containers of HAJCIL QK-20

Antimicrobial, including dilutions and formulations, must be clearly labeled in accordance with the standards set by the U.S. Environmental Protection Agency (EPA).

Temperature/decomposition rates

HAJCIL QK-20 Antimicrobial is effective and environmentally safe as a biocide when properly administered. However, the active component, dibromonitripropionamide (DBNPA), is temperature sensitive and will decompose exothermically (liberate heat) at elevated temperatures. In addition, its decomposition rate increases with increasing temperature once the exothermic reaction begins.

If HAJCIL QK-20 Antimicrobial is stored under adiabatic conditions, that is, where the heat cannot be removed or dissipated rapidly enough, the liquid temperature in the container will increase with decomposition, and this in turn will increase the decomposition rate.

To ensure safe handling and product quality, it is important to determine which storage systems are nearly adiabatic, and once identified, to monitor the temperature within those storage containers. In relation to tank size, heat transfer from a bulk liquid decreases as its total volume increases. When volume increases relative to a surface area, there is a “self-insulating” effect, allowing temperature to build up within the storage facility. It is for this reason that adiabatic conditions exist most commonly in large storage tanks and tank

trucks. Also, adiabatic conditions can be found in large pumps or pumps made of (or coated with) Teflon Resins, such as those used to unload tank trucks.

Field experience indicates that HAJCIL QK-20 Antimicrobial can be stored safely and shipped in uninsulated tanks and tank trucks with maximum capacities up to 4,000 gallons (15,000 liters).

- When filling bulk containers, keep the loading temperature of the HAJCIL QK-20 product at 30°C (86°F) or less. Use a side-arm heat exchanger if necessary to maintain this temperature.
- Do not store HAJCIL QK-20 products in tank trucks for more than 6 days from the time of filling because of potential temperature rise and subsequent decomposition.
- Use gravity flow or air pressure transfer wherever possible.
- If pumping is necessary, be certain there are interlocks to prevent operation of the pump when valves are closed or when a line is plugged. This can be accomplished by installing a temperature probe in the pump.

A high temperature alarm should be set at 50°C (122°F) to indicate any malfunction.

- Avoid the use of pumps lined with Teflon Resins for large volume transfer. These pumps are unacceptable for large volume transfer because the lining tends to separate over time, and there is the potential for overheating of the entrapped DBNPA product. Small pumps lined with Teflon Resins or pumps with solid Kynar resin, and used for metering the product into a storage handling system, are acceptable.
- Do not recirculate HAJCIL QK-20 Antimicrobial in bulk storage tanks unless a source of cooling is provided.

The mechanical energy is transformed into heat and the tank may increase in temperature because of the adiabatic conditions within.

- Install pressure-relief devices in all pumps and vessels handling HAJCIL QK-20 Antimicrobial.

Storage and materials compatibility

As a class of materials, non-metals such as polypropylene, polyethylene, Kynar resin, Teflon resins, and fiberglass reinforced plastic (FRP) are superior to metallic materials. Hastelloy C-276 alloy, titanium, and 316 SS (short-term storage or shipping), however, are satisfactory metallic materials for storage and shipment containers.

In general, mild steel, aluminum, 304 SS, and nickel 200 are unsatisfactory primarily because of excessive corrosion or pitting. Prolonged storage of the formulations of HAJCIL QK-20 Antimicrobial in 316 SS, especially at elevated temperatures, can discolor the product and cause pitting of the metal. This can be prevented by keeping the residence time in the tank or vessel to a minimum, and then thoroughly flushing with water after usage. If flushing is not possible, a protective coating should be applied to the stainless steel, especially if longer term storage is necessary. There are two acceptable coatings for the manufacture and storage of formulations of HAJCIL QK-20 Antimicrobial: Heresite P-403 high bake phenol-formaldehyde resin Plasite 4005 protective coating. These coatings provide excellent protection when properly applied, but should be inspected periodically for damage. If an FRP tank or tank lining is required for product storage or transfer, check with **Haj Exports** to be sure that the resin being used is acceptable. Resins that have performed well are DERAKANE* 411-45 vinyl ester resin and DERAKANE 470-45 resin. Rubber-lined vessels are not acceptable because the rubber swells excessively and discolors the product. Glass-lined vessels are generally acceptable.