BIOCIDES
POLYMER LATEX PRESERVATION

KATHON® LX MICROBICIDE

EPA Reg. No. 707-129

KATHON® LX 1.5% MICROBICIDE

EPA Reg. No. 707-134

KATHON LX and KATHON LX 1.5%
Polymer Latex Preservatives

Kathon LX and Kathon LX 1.5% microbicides are registered with the EPA and offered for use as preservatives in synthetic polymer latices, such as acrylic, polyvinyl acetate, styrene / butadiene, ethylene / vinyl acetate, silicone, polyethylene, etc., and natural biopolymers intended for industrial use, such as xanthan gum, gum arabic, guar gum, protein-derived polymers, starches, and casein-derived polymers.

These biocide products are also effective in controlling bacteria and fungi in the manufacture and storage of dispersed pigments, such as kaolin clays, titanium dioxide, calcium carbonate, and others; water-based paints and coatings used on paper or wood, or as architectural finishes, product finishes, and special purpose coatings; building materials, such as mastics, caulks, joint cements, spackling, and grouting; water-soluble and water-dispersed adhesives, such as animal or vegetable glues, natural rubber latices, and synthetic polymer latices, and tackifiers derived from rosin and hydrocarbon resins; and in alkaline, acid, and emulsion-based metal-cleaning fluids used in electroplating, phosphatizing, galvanizing, and general metal-cleaning operations. (See CS-549 for Kathon LX industrial preservative performance data.)

The active ingredients of Kathon biocides are effective at low concentrations against fungi and bacteria and are highly resistant to the inhibitory effects of most organic and inorganic compounds.

FEATURES AND BENEFITS

Kathon LX and Kathon LX 1.5% microbicides exhibit the following performance advantages over the most often recommended preservatives:

- Economical—use concentrations generally more cost effective than other commercial preservatives
- Broad-spectrum activity—control bacteria, and fungi such as yeasts and molds
- Effective against both aerobic and anaerobic bacteria
- Low use levels
- Safe at use concentrations when used as directed
- Compatible with surfactants and emulsifiers, regard less of their ionic nature
- Readily incorporated into formulations (Kathon biocides are supplied as aqueous solutions)
- Do not adversely affect product physical properties or performance
- Impart no odor or color
- Formaldehyde free, i.e., do not contain or generate formaldehyde
- EPA-registered for a wide variety of industrial applications
- FDA-cleared for adhesives and paper coatings
- Readily available in pail, drum, or bulk quantities

Kathon LX and Kathon LX 1.5% microbicides have been cleared by the Food and Drug Administration (FDA) for use in the applications listed in Table 1.

TABLE 1. FDA CLEARANCES FOR KATHON LX AND KATHON LX 1.5% MICROBICIDES

CFR No.	Title	Application	Limitation
175.105	Adhesives	Substances for use only as components of adhesives intended for use in packaging, transporting, or holding food.	For use only as antimicrobial agent in polymer latices.
176.170 176.180	Paper and Paperboard Coatings	Substances for use only as components of paper and paperboard in surface contact with, and intended for use in manufacturing, packaging, holding, and transportation of aqueous and fatty foods (176.170) and dry foods (176.180).	For use only as antimicrobial agents for polymer latices in coatings at a level not to exceed 50 ppm (based on isothiazolone active ingredients) in the coating formulation.
176.300	Paper Slimicides	Antimicrobial agents used to control slime in the process water used in the manufacture of paper and paperboard that contact food.	For use at a level of 1.4 pounds of isothiazolone active ingredients per ton of dry fiber weight.

PHYSICAL AND CHEMICAL PROPERTIES OF KATHON MICROBICIDES

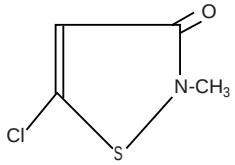
(These do not constitute specifications)

	KATHON LX Microbicide	KATHON LX 1.5% Microbicide
Appearance	amber to gold, slightly viscous liquid	pale yellow to green liquid
Odor	mild, aromatic	mild, aromatic
Specific Gravity	1.32 (weight of active ingredients 1.17 lb/gal minimum)	1.02
Density, lbs/gal	10.9	8.4
pH	2 to 4	3 to 5
Viscosity, cP	19.0 @ 15°C 3.0 @ 25°C	16.0 @ 25°C 14.5 @ 35°C
Miscibility	Miscible with water, methanol, ethanol, isopropyl alcohol, acetic acid, and 3.5 parts n-butanol. Immiscible with acetone.	
Compatibility	Biologically and physically compatible with anionic, nonionic, and cationic surfactants, halogens at use dilutions, and most organic and inorganic compounds normally used in chemical specialty products. The active ingredients are subject to nucleophilic attack and may be inactivated by primary and secondary amines, mercaptans, sulfides, and other nucleophiles through chemical reaction. Compatibility is concentration-related.	
Stability	Stable as supplied for at least one year at ambient temperatures and at least six months at 50°C.	

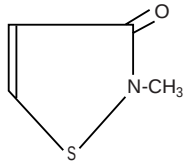
CHEMICAL IDENTIFICATION

The active ingredients are the compounds identified according to IUPAC nomenclature as 5-chloro-2-methyl-4-isothiazolin-3-one and 2-methyl-4-isothiazolin-3-one.

Structural Formulas



5-chloro-2-methyl-4-isothiazolin-3-one
CAS Registry Number 26172-55-4



2-methyl-4-isothiazolin-3-one
CAS Registry Number 2682-20-4

CHEMICAL COMPOSITION (as supplied)

	KATHON LX Microbicide	KATHON LX 1.5% Microbicide
Active ingredients, %		
5-chloro-2-methyl-4-isothiazolin-3-one	8.6 (min.)	1.15 (min.)
2-methyl-4-isothiazolin-3-one	2.6 (min.)	0.35 (min.)
Minimum Value	11.2	1.50
Typical Value	14.0	1.50
Inert ingredients (approximate values), %		
Magnesium chloride	9.0	1.10
Magnesium nitrate	16.0	1.70
Cupric nitrate	—	0.15
Organic impurities	1.3	—
Water	62.5	95.55
Total Inert Ingredients	88.8 max.	98.50

MICROBISTATIC PROPERTIES

The data in this bulletin were obtained with Kathon LX microbicide as supplied or with a technical grade of the active ingredients used as an intermediate in its manufacture.

Table 2 lists the minimum concentration in ppm of isothiazolones (or Kathon LX microbicide active ingredient) that inhibits the growth of various microorganisms in test tube cultures. The data are intended only to indicate the activity of Kathon LX microbicide in laboratory microbiological media and do not represent a claim for recommended use concentrations; the microorganisms listed are not necessarily involved in the contamination and deterioration of the products discussed in this bulletin.

TABLE 2 . MINIMUM INHIBITORY CONCENTRATIONS OF KATHON LX AND KATHON LX 1.5% MICROBICIDES

ORGANISM	ATCC NO.	ACTIVE INGREDIENT ppm
BACTERIA[a]		
Gram-Negative		
Achromobacter parvulus	4335	2
Alcaligenes faecalis	8750	2
Azotobacter vinelandii	12837	5
Enterobacter aerogenes	3906	5
Escherichia coli	11229	8
Flavobacterium suaveolens	958	9
Nitrobacter agilis	14123	0.1
Proteus vulgaris	8427	5
Pseudomonas aeruginosa	15442	5
Pseudomonas cepacia	Gibraltar 165	0.75
Pseudomonas fluorescens	13525	2
Pseudomonas oleoverans	8062	5
Salmonella typhosa	6539	5
Shigella sonnei	9292	2
Gram-Positive		
Bacillus cereus var. *mycoides*	(R&H L5)	2
Bacillus subtilis	(R&H B2)	2
Brevibacterium ammoniagenes	6871	2
Cellulomonas sp.	21399	6
Sarcina lutea	9341	5
Staphylococcus aureus	6538	2
Staphylococcus epidermidis	155	2
Streptococcus pyogenes	624	9
Streptomyces albus	3004	1
FUNGI[a]		
Aspergillus foetidus	16878	8
Aspergillus niger	9642	9
Aspergillus oryzae	10196	5
Aureobasidium pullulans	9348	5
Candida albicans (yeast)	11651	5
Chaetomium globosum	6205	9
Cladosporium resinae	11274	5
Gliocladium fimbriatum	(QM7638)	9
Lentinus lepideus	12653	4
Lenzites trabea	11539	6
Mucor rouxii	(R&H L5-83)	5
Penicillium funiculosum	9644	5
Penicillium variabile (glaucum)	(U.S.D.A.)	2
Phoma herbarum (pigmentivora)	12569	2
Rhizopus stolonifer	10404	5
Rhototorula rubra (yeast)	9449	2
Saccharomyces cerevisiae (yeast)	2601	2
Trichophyton mentagrophytes (interdigitale)	9533	5

[a]Bacteriostatic and fungistatic tests performed by serially diluting test compounds in trypticase soy broth and 1:100 inoculation 24-hour broth cultures of test bacterium or a fungal spore suspension prepared from 7–14 day culture slants washed with 7 ml of deionized water. Minimum inhibitory concentration levels determined visually after 2–4 days incubation at 30°–37°C for bacteria and 7 days incubation at 28°–30°C for fungi.

EVALUATION OF PRESERVATIVES

Polymer latices are susceptible to spoilage caused by microbial growth. Uncontrolled growth may affect the color, odor, viscosity, pH, and other properties of the latex. Extremely heavy growth may even result in coagulation or clumping and may necessitate filtration of the latex. Formulated products based on polymer latices and additive mixtures used in formulating are also subject to microbial attack.

Biocides are used to prevent or overcome microbial growth. Their efficacy can be evaluated by incubating samples of infected material containing a biocide for periods between 6 weeks and 6 months and periodic reinoculations with microbial cultures. Counts of colony-forming units per milliliter (CFU / ml) obtained by an agar plating method or a standard streak test indicate the degree of control afforded by the biocide. In addition, heat-aging tests at 60°C for 10 days can provide an indication of long-term preservative effectiveness.

GENERAL TESTING PROCEDURE

A cell suspension is made by mixing 19 cultures of bacteria, yeasts, and filamentous fungi isolated from contaminated polymer latices and two additional pseudomonad cultures. A sample of naturally contaminated polymer latex is used as a second inoculum. Fifty-gram aliquots of latex or formulation in screw-capped bottles are treated with a designated level of Kathon LX or other biocide, inoculated at two-week or monthly intervals with the cell suspension and / or inoculum to provide at least one million CFU / ml of sample and held for 6 weeks to 6 months. Microbial populations are determined biweekly or monthly prior to each re-inoculation by means of a standard Agar Streak Test. The rating scale used to describe microbial growth is presented below.

RATING DESCRIPTION

Rating	Colony-Forming Units/Ml (Bacteria)
0	<10
T	10 to 100
1+	100 to 1,000
2+	1,000 to 10,000
3+	10,000 to 100,000
4+	>100,000
F	fungal growth

INTERPRETING TEST RESULTS

When several preservatives protect a particular latex emulsion equally well for the duration of a test, only a cost / performance comparison gives the potential user direction in selecting the preservative of choice. It is important to note that all of the preservative treatment levels in this bulletin are shown as ppm active ingredient (AI), not as product supplied, unless otherwise noted.

The table at the bottom of this page, which translates active ingredient to product basis for the Kathon preservatives, may be useful in calculating cost / performance. The active ingredient concentrations of competitive products mentioned in this bulletin are given for comparison.

ACTIVE INGREDIENT TO PRODUCT EQUIVALENTS FOR KATHON PRESERVATIVES

KATHON Microbicide AI, ppm	=	KATHON LX as supplied, ppm	=	KATHON LX 1.5% as supplied, ppm
6.25		45		417
10.0		72		667
12.5		89		833
15.0		107		1,000
20.0		143		1,333
25.0		179		1,667
30.0		214		2,000
40.0		286		2,667
50.0		357		3,333

COMPETITIVE PRESERVATIVES	
Bioban CS-1135 (77% AI)	Angus Chemical Company
Dowicil 75 (67.5% AI)	Dow Chemical Corporation
Giv-Gard DXN (92% AI)	Givaudan Corporation
Proxel CRL (30% AI)	Imperial Chemical Industries, Ltd.
Proxel GXL (17% AI)	Imperial Chemical Industries, Ltd.
Tektamer 38 (98% AI)	Merck & Company, Inc.
Tektamer 38 A.D. (25% AI)	Merck & Company, Inc.

POLYMER LATICES

Preservation of an Ethylene/Vinyl Acetate

Table 3 compares the preservative effect of Kathon LX microbicide and Proxel CRL in an ethylene/vinyl acetate copolymer latex (pH 4-5). Both biocides gave complete control over 6 months. A cost/performance calculation, however, will show a significant advantage for Kathon LX microbicide.

TABLE 3. PRESERVATION OF AN ETHYLENE/VINYL ACETATE COPOLYMER LATEX (Acid pH, 6-Month Test)

			Microbial Growth Rating[a] Incubation Period, weeks					
Preservative	**AI, ppm**	**Latex, pH**	**4**	**8**	**12**	**16**	**20**	**24**
None	—	4–5	4+	4+	4+	4+	4+	4+
Proxel CRL	150.00	4–5	0	0	0	0	0	0
Kathon LX	6.25	4–5	0	0	0	0	0	0
	12.50		0	0	0	0	0	0
	25.00		0	0	0	0	0	0

[a]See Rating Description, page 4.

Preservation of Styrene/Butadiene Copolymer Latices

Table 4 shows the preservative effects of Kathon LX and Proxel CRL in a neutral (pH 7) styrene/butadiene copolymer latex (additive for cement, asphalt) and in an alkaline (pH 8–10) carboxylated styrene/butadiene copolymer latex used in carpet backing. Kathon LX microbicide was effective at all levels for the full test period, but the competitive material failed after 4 months and 2 months in the respective latices, even though used at a much higher level.

TABLE 4. PRESERVATION OF STYRENE/BUTADIENE COPOLYMER LATICES (Neutral-Alkaline pH, 6-Month Test)

		Microbial Growth Rating[a] Incubation Period, weeks					
Preservative	**AI, ppm**						
Non-Carboxylated Copolymer		**4**	**8**	**12**	**16**	**20**	**24**
None	—	4+	4+	4+	4+	4+	4+
Proxel CRL	150.00	0	0	0	1+	2+	2+
Kathon LX	6.25	0	0	0	0	0	0
	12.50	0	0	0	0	0	0
	25.00	0	0	0	0	0	0
Carboxylated Copolymer							
None	—	4+	3+	3+	3+	3+	3+
Proxel CRL	150.00	0	4+	4+	3+	2+	2+
Kathon LX	6.25	0	0	0	0	0	0
	12.50	0	0	0	0	0	0
	25.00	0	0	0	0	0	0

Preservation of Styrene/Acrylonitrile Copolymer Latex

Combinations of biocides are often used to enhance their protective effect or to reduce cost. Table 5 is based on a study of a styrene/acrylonitrile copolymer latex (pH 7–8) offered for use as a nonwoven binder. Kathon LX microbicide was completely effective in the test at ambient temperature as well as in the heat-aging test. By contrast, the competitive biocides failed when used alone or in combination.

TABLE 5. PRESERVATION OF STYRENE/ACRYLONITRILE COPOLYMER LATEX (Neutral pH, 6-Month Test)

		Microbial Growth Rating[a] Incubation Period						
Preservative	**AI, ppm**	**4**	**8**	**12**	**16**	**20**	**24**	**Heat-Aged 10 days at 60°C**
None	—	TF	1+F	4+	4+	NA[b]	NA[b]	4+
Formaldehyde	1,000	0	0	TF	4+	4+	NA[b]	3+
Formaldehyde/ Proxel CRL	500 75	0	0	0F	4+	4+	NA[b]	0
Proxel CRL	75	0	T	4+	4+	NA[b]	NA[b]	4+
Kathon LX	30	0	0	0	0	0	0	0

[a]See Rating Description, page 4.
[b]Sample dropped because of heavy growth.

Preservation of a Polyethylene Latex

In latices that may be difficult to preserve, the addition of cupric nitrate trihydrate (or other soluble copper salt) may increase the effectiveness of Kathon LX microbicide (Table 6). Traces of microbial growth observed in a neutral (pH 7–8) polyethylene latex preserved with Kathon LX microbicide were eliminated by adding the copper salt. No other biocide tested was effective in this latex, which is offered for use in formulating floor polishes.

TABLE 6. PRESERVATION OF POLYETHYLENE LATEX (Neutral pH, 6-Month Test)

		Microbial Growth Rating[b] Incubation Period					
Preservative	**AI, ppm**	**4**	**8**	**12**	**16**	**20**	**24**
None	—	4+	4+	NA[b]	NA[b]	NA[b]	NA[b]
Formaldehyde	500	0	0	0	0	4+	4+
	750	0	0	0	0	4+	4+
	1000	0	0	0	0	0	4+
Giv-Gard DXN	250	0	0	0	4+	4+	4+
Proxel CRL	75	4+	4+	NA[b]	NA[b]	NA[b]	NA[b]
Kathon LX	20	0	0	0	0	0	0
	30	0	0	0	0	0	T
	40	0	0	0	0	T	0
Kathon LX/$Cu(NO_3)_2$	20/20	0	0	0	0	0	0
	30/30	0	0	0	0	0	0
	40/40	0	0	0	0	0	0

[a]See Rating Description, page 4.
[b]Sample dropped because of heavy growth.

Preservation of a Styrene/Acrylic Copolymer Latex

In general, Kathon LX microbicide performs best when used alone or with copper. Table 7 shows the results of a study in a neutral (pH 7) styrene/acrylic copolymer latex offered for use in industrial coatings. Kathon LX microbicide added with another biocide improved the effectiveness of the latter, but the same level of Kathon LX microbicide by itself was superior. Cupric nitrate was needed to pass the heat-aging test with Kathon LX microbicide.

TABLE 7. PRESERVATION OF STYRENE/ACRYLIC LATEX (Neutral pH, 6-Month Test)

		Microbial Growth Rating[a] Incubation Period						
Preservative	**AI, ppm**	**4**	**8**	**12**	**16**	**20**	**24**	**Heat-Aged 10 days at 60°C**
None	—	4+	4+	NA[b]	NA[b]	NA[b]	NA[b]	4+
Proxel CRL	75	T	T	4+	4+	4+	NA[b]	4+
	120	T	T	3+	4+	4+	NA[b]	4+
Giv-Gard DXN	500	0	2+	4+	4+	NA[b]	NA[b]	3+
+ Kathon LX	500/30	0	0	0	0	1+	4+	3+
Kathon LX	30	0	0	0	0	0	0	4+
	50	0	0	0	0	0	0	4+
Kathon LX + $Cu(No_3)_2$	30/30	0	0	0	0	0	0	0
Kathon LX + $Cu(No_3)_2$	50/30	0	0	0	0	0	0	0

[a]See Rating Description, page 4.
[b]Sample dropped because of heavy growth.

Preservation of Acrylic Polymer Latices

Table 8 presents the results of side-by-side evaluations of Kathon LX microbicide and a series of other biocides in slightly alkaline (pH 8) acrylic polymer latices used in adhesives. Only Kathon LX microbicide gave good protection of the latex.

TABLE 8. PRESERVATION OF ACRYLIC LATEX (Alkaline pH, 6-Month Test)

		Microbial Growth Rating[a] Incubation Period						
Preservative	**AI, ppm**	**4**	**8**	**12**	**16**	**20**	**24**	**Heat-Aged 10 days at 60°C**
None	—	3+	4+	4+	NA[b]	NA[b]	NA[b]	4+
Dowicil 75	1,000	0	0	4+	4+	NA[b]	NA[b]	4+
	2,000	0	0	4+	4+	NA[b]	NA[b]	4+
Formaldehyde	500	4+	4+	NA[b]	NA[b]	NA[b]	NA[b]	4+
	1,000	3+	3+	3+	3+	3+	4+	1+
Giv-Gard DXN	500	0	1+	4+	4+	NA[b]	NA[b]	4+
Bioban CS-1135	500	0	4+	4+	NA[b]	NA[b]	NA[b]	1+F
	1,000	0	0	4+	4+	NA[b]	NA[b]	4+F
	2,000	0	0	4+	4+	NA[b]	NA[b]	4+F
Proxel CRL	75	0	0	1+F	1+F	4+	4+	1+F
Kathon LX	20	T	0	0	0	0	0	0
	30	0	0	0	0	0	0	0
Kathon LX + $Cu(NO_3)_2$	20/20	0	0	0	0	0	0	0
Kathon LX + $Cu(NO_3)_2$	30/30	0	0	0	0	0	0	0

[a]See Rating Description, page 4.
[b]Sample dropped because of heavy growth.

Preservation of Acrylic Latices

Table 9 gives the results of preservative tests on two acrylic polymer latices (pH 8, 6) containing Kathon LX microbicide or Dowicil 75 microbicide. Trypticase soy broth was added to the acid latex (0.3% based on latex) after four weeks to increase the growth rate. All levels of Kathon LX microbicide were effective in controlling growth although trace contamination was noted at 10 ppm AI in the alkaline latex. Dowicil 75 failed completely in both latices at the level tested. When combined with an equal level of cupric nitrate trihydrate, Kathon LX microbicide was effective at all levels.

TABLE 9. PRESERVATION OF ACRYLIC LATICES

		Microbial Growth Rating[a]		
Preservative	**AI, ppm**	**2 weeks**	**4 weeks**	**6 weeks**
Alkaline Latex (pH ≈8)				
None	0	4+	4+	4+
Kathon LX	10	0	0	T
	25	0	0	0
	40	0	0	0
Kathon LX + $Cu(NO_3)_2$	10	0	0	0
	25	0	0	0
	40	0	0	0
Dowicil 75	675	3+	3+	2+
Acid Latex (pH ≈6)				
None	0	0	2+	4+
Kathon LX	10	0	0	0
	20	0	0	0
	40			
Kathon LX + $Cu(NO_3)_2$	10/10	0	0	0
	25/25	0	0	0
	40/40	0	0	0
Dowicil 75	675	0	0	3+

[a]See Rating Description, page 4.

Table 10 summarizes another study based on an alkaline (pH 9–9.8) acrylic polymer latex designed for use in industrial coatings. A cost/performance comparison will show that of the three biocides that provided effective preservative action, Kathon LX microbicide was by far the best choice.

TABLE 10. PRESERVATION OF ACRYLIC LATEX (Alkaline pH Six-Month Test)

		Microbial Growth Rating[a] Incubation Period						Heat-Aged
Preservative	**AI, ppm**	**4**	**8**	**12**	**16**	**20**	**24**	**10 days at 60˚C**
None	—	0	4+	4+	4+	NA[b]	NA[b]	4+
Formaldehyde	500	0	0	3+	4+	NA[b]	NA[b]	0
	750	0	0	0	0	3+	4+	0
	1,000	0	0	0	0	4+	4+	0
Formaldehyde + Proxel CRL	500/75	0	0	0	0	0	0	0
Tektamer 38	100	0	3+	4+	NA[b]	NA[b]	NA[b]	4+
	200	0	3+	4+	NA[b]	NA[b]	NA[b]	4+
	400	0	4+	4+	NA[b]	NA[b]	NA[b]	4+
Proxel CRL	75	0	0	0	0	0	0	0
Proxel GXL	75	0	0	0	0	0	0	0
	100	0	0	0	0	0	0	0
Kathon LX	15	0	0	0	0	0	0	0
	30	0	0	0	0	0	0	0
Kathon LX + $Cu(NO_3)_2$	15/15	0	0	0	0	0	0	0
	30/30	0	0	0	0	0	0	0

[a]See Rating Description, page 4.
[b]Sample dropped because of heavy growth.

Preservation of Polyvinyl Acetate Latices

Table 11 presents the results of preservative tests on two polyvinyl acetate latices at pH 4–6 containing Kathon LX microbicide, Proxel CRL, or Tektamer 38 AD microbicides. Kathon LX microbicide provided complete protection at 15–40 ppm AI in both latices. Proxel GXL at 255 ppm AI was also effective, but Tektamer 38 AD failed. A cost/performance comparison will show Kathon LX microbicide to be the preservative of choice.

TABLE 11. PRESERVATION OF ACRYLIC LATICES

		Microbial Growth Rating[a]			
Preservative	**AI, ppm**	**2 weeks**	**4 weeks**	**6 weeks**	**8 weeks**
Acid Latex					
None	0	4+	4+	4+	4+
Kathon LX	15	0	0	0	0
	25	0	0	0	0
	40	0	0	0	0
Proxel GXL	255	0	0	0	0
Tektamer 38 AD	500	4+	4+	4+	4+
Neutral Latex					
None	0	0	2+	4+	4+
Kathon LX	15	0	0	0	0
	25	0	0	0	0
	40	0	0	0	0
Proxel GXL	255	0	0	0	0
Tektamer 38 AD	500	2+	0	T	4+

[a]See Rating Description, page 4.

ERADICATION OF MICROBIAL GROWTH IN FIELD-CONTAMINATED LATICES

Kathon LX microbicide is very effective in eradicating microbial growth in field-contaminated polymer latices. Two such latices were treated with 30 ppm AI of Kathon LX microbicide and the microbial populations were measured after 4 and 7 days. Table 12 shows the results of this study. As can be seen, control was achieved within 4 days in the less heavily contaminated latex and within 7 days in the heavily infected one.

TABLE 12. ERADICATION OF MICROBIAL GROWTH IN CONTAMINATED ACRYLIC LATICES (pH 9–9.5)

		Microbial Population Colony-Forming Units/ml		
		Days After Treatment		
Test Material	**Level, ppm AI**	**0**	**4**	**7**
Latex A	0	32,000	526,000	1.86×10^6
	30	—	<10	<10
Latex B	0	624,000	296,000	131,000
	30	—	69,000	<10

DIRECTIONS FOR USE

Polymer Latices

Treat 1,000 pounds (453 kilograms) of latex with 0.056 to 0.45 pound (25–204 grams) of Kathon LX microbicide or 0.43–3.3 pounds (195–1500 grams) of Kathon LX 1.5% microbicide to provide a level of 6.25 to 50 ppm active isothiazolones. The actual required concentration of preservative depends on the particular latex, the expected frequency of repeated microbial contamination, and the necessary level of protection.

To insure uniform distribution of preservative and to prevent local coagulation of polymer caused by shock during the addition, treat the latex with a dilute solution of Kathon LX microbicide while using adequate agitation. Kathon LX 1.5% microbicide as supplied should generally not require further dilution to prevent coagulation.

Universal Kathon LX Solution for Latex Emulsion Manufacture

To reduce the possibility of gel formation, the following solution (0.45% active isothiazolinones) is frequently used to preserve Rhoplex® acrylic emulsions:

Ingredient	Weight (lb)
Deionized water	91.100
Kathon LX microbicide (as supplied)	3.230
Cupric nitrate trihydrate	0.016
Triton® X-405 surfactant (70%)	4.900

Add the ingredients to the water in the listed order with agitation.

KATHON PRESERVATIVE CHEMICAL STABILITY

Kathon LX microbicide is compatible with most organic and inorganic compounds; however, certain conditions are detrimental to stability. These are:

- Excessively high pH
- Presence of reducing agents
- Long exposure to high temperature (>50°C)

If formulating considerations make it impossible to avoid these conditions, chemical stability of Kathon biocide can be enhanced by the use of soluble copper (II) salts (such as cupric nitrate or citrate) and/or formaldehyde. In general, we recommend the use of copper nitrate or CH20 from pH 8.8–9.2; above pH 9.2, both stabilizers may be needed. For additional information on this subject, see separate literature Maximizing Kathon LX Performance in Emulsions (CS-548). Excellent biological control has been observed in systems having no analytically detectable Kathon LX active ingredient (i.e., <0.5 ppm AI). For this reason, chemical tests alone cannot be relied upon to predict preservative efficacy.

TOXICOLOGICAL PROPERTIES

(Bulletin CS-472 contains a more complete toxicity profile)

Animal Studies

In rats, the acute oral toxicity (LD_{50}) of Kathon LX microbicide as supplied is 457 mg/kg body weight. In rabbits, the acute dermal toxicity (LD_{50}) is 660 mg/kg under an impervious cuff in continuous 24-hour contact with closely shaved skin. The corresponding oral and dermal values for Kathon LX 1.5% microbicide are 3.80 g/kg and >5g/kg, respectively.

The acute inhalation toxicity (LC_{50}) of Kathon LX microbicide as supplied for rats exposed to the vapor for 4 hours is >9.7 mg product/liter of air (nominal concentration). The animals showed no untoward behavioral reactions during exposure or in the following 14-day observation period. Weight gains were normal and necropsy at the end of this time showed no gross pathologic alterations.

In primary skin and eye irritation studies in rabbits, Kathon LX microbicide as supplied showed severe skin irritation and was corrosive to the eyes. The primary skin irritation index was 8.0 (primary skin irritant). Kathon LX 1.5% microbicide as supplied is also a primary skin irritant (index 7.5).

Studies on Humans

A combined repeat patch and arm dip test was conducted on 10 human volunteers who were exposed to an aqueous solution containing 56 ppm active ingredients of Kathon LX microbicide. In the patch test, the solution was applied 24 hours per day, 5 days/week, for 4 consecutive weeks (20 exposures). After a rest period of 2 weeks, each volunteer was challenged with the same solution for 24 hours.

Arm-immersion tests were run simultaneously on the same volunteers. They dipped their arms into the test solutions twice daily for 15 minutes, 5 days/week, for 4 weeks. After the rest period, they immersed their arms once more. No visible changes characteristic of irritation or sensitization were observed in the skin of any individual subjected to the tests.

In another repeat patch test with 18 volunteers, an aqueous solution containing 25 ppm active ingredient of Kathon LX microbicide was applied under occluded conditions 24 hours a day, 3 days a week, for 3 consecutive weeks. After a 2-week rest, each subject was challenged for one day by another patch containing the same concentration of the preservative. One subject showed a response suggesting sensitization.

Repeat insult patch tests were also conducted on humans by exposing them to metalworking fluids and emulsions containing a nominal concentration of 56 ppm active ingredients. No irritation or sensitization was observed.

To minimize the possibility of allergic skin reactions in susceptible individuals from contact with Kathon LX or Kathon LX 1.5% microbicide, we recommend that careful attention should be paid to determining the minimum effective level of these preservatives in specific formulations. This level should not exceed the maximum label claim of 50 ppm active isothiazolinones in the applications shown in this bulletin. Good industrial hygienic practices should be recommended to downstream users of biocide-containing emulsions to reduce exposure to the extent feasible. Repeated dermal contact with emulsions containing >15 ppm active isothiazolinones could result in allergic skin reactions in susceptible individuals.

SAFE HANDLING INFORMATION

The safe handling precautions given below must be observed and are also published on the package labels.

The following bulletins, available on request, contain additional information on safety and health matters:

CS-469	Handling and Equipment Decontamination Procedures
CS-472	Toxicity Profile
CS-474	General Medical Procedures

Material Safety Data Sheets on the products are also available.

EFFECTS OF EXPOSURE

DANGER

CORROSIVE. CAUSES IRREVERSIBLE EYE DAMAGE AND SKIN BURNS. THESE EFFECTS MAY BE DELAYED FOR HOURS. MAY CAUSE ALLERGIC SKIN REACTIONS. MAY BE HARMFUL IF INHALED. MAY BE FATAL IF SWALLOWED OR ABSORBED THROUGH THE SKIN OR FROM LARGE EXPOSURES.

HANDLING PRECAUTIONS

KEEP OUT OF REACH OF CHILDREN

Do not get in eyes, on skin, on clothing. Wear goggles or face shield and rubber gloves when handling. Avoid breathing vapor or mist. Avoid contamination of food. Do not take internally. Wash thoroughly after handling.

FIRST AID MEASURES

AFTER EYE CONTACT, FLUSH IMMEDIATELY with copious amounts of water at least 15 minutes with the eyes held open. Get prompt medical attention, but FLUSH FIRST!

AFTER CONTACT WITH THE SKIN, FLUSH IMMEDIATELY with plenty of water at least 15 minutes. Shower with soap and water. Launder contaminated clothing before rewearing.

IF SWALLOWED, and victim is conscious, dilute by giving two glasses of water to drink and call a physician at once. Never give anything by mouth to an unconscious person.

NOTE TO PHYSICIAN: After swallowing, mucosal damage may contraindicate the use of gastric lavage. Measures against circulatory shock, respiratory depression, and convulsions may be needed.

IF INHALED: Remove victim immediately to fresh air. If not breathing apply artificial respiration. If breathing is difficult, give oxygen. Call a physician.

CLEANUP OF SPILLED KATHON LX AND KATHON LX 1.5% MICROBICIDES

Deactivate spilled material immediately by adding sodium bisulfite solution (about 10% active $NaHSO_3$) which rapidly decontaminates Kathon LX and Kathon LX 1.5% microbicides. Instructions on preparing decontamination solutions are presented in the following table.

TABLE 13. PREPARATION OF DECONTAMINATION SOLUTION (10 POUNDS)

pH (Final Solution)	4.0	4.0	4.0–5.0
Ingredient (lb)	Sodium Sulfite Na_2SO_3	Sodium Bisulfite $NaHSO_3$	Sodium Metabisulfite $Na_2S_2O_5$
Decontamination agent	1.2	1.0	0.9
Water	7.9	9.0	9.1
Hydrochloric acid, 37%	0.9	—	—
TOTAL	10.0	10.0	10.0

NOTE: Decontamination solution must have pH on the acid side, since it is much less effective when alkaline.

Personnel engaged in cleanup of spills should wear protective clothing, including splash goggles and face shield, plastic rain jacket and pants, rubber boots, or other impervious overshoes, and impervious rubber gloves. All protective clothing and equipment used during cleanup must be decontaminated thoroughly and cleaned before reuse or put into the drums containing the absorbent solid, decontaminated, and disposed of. For more detailed information concerning cleanup procedures, see technical bulletin CS-469.

Kathon LX and Kathon LX 1.5% microbicides are toxic to fish and lower aquatic creatures unless they are either diluted or contaminated. The decontaminated products are judged to be slightly irritating to the eyes of rabbits.

ENVIRONMENTAL IMPACT

Kathon LX and Kathon LX 1.5% microbicides have minimal environmental impact, because they are high-performance products used at very low levels and are readily biodegradable. Radioassay studies were conducted to follow the biodegradation of the active ingredients in natural river water, in activated sludge, and in soil. The results of these studies were published in the *Journal of Agricultural and Food Chemistry* 23 (1975): 1060–1075; reprints are available on request.

CS-462c March 2002 Printed in U.S.A.