KATHON™ PFM

Printing Fluid Microbiocide

Over the decades the use of aqueous printing fluids in the United States has become widespread concurrently with the growth of graphic arts photography, high-quality offset printing, and water-based printing ink products. However, nutrient-rich aqueous printing fluids provide an excellent environment for the growth of bacteria and fungi. If left unchecked, these organisms lower the pH of printing fluids, causing machinery to corrode, and they can cause severe viscosity problems, objectionable odors and emulsion breakdown. Additionally, fungi can form large clumps which can clog machinery and necessitate more frequent shutdowns for cleaning.

The U.S. Graphic Arts Industry has continued to search for ways to minimize the damage caused by bacteria and fungi, and KATHON™ PFM microbicide is offered as a single solution to these problems.

Features

Listed below are several features of KATHON™ PFM microbicide which make it a most effective and versatile printing ink microbicide.

- EPA Registered for many fluids: KATHON™ PFM microbicide's registration (EPA Reg. No. 707-209) allows its use in a wide variety of printing fluids such as water based printing inks, printing ink components, fountain solutions and photoplate processing chemicals. KATHON™ PFM microbicide will preserve some fluids which other biocide products cannot.
- Broad spectrum activity: Controls a wide variety of bacterial and fungal microorganisms which may be found in printing fluids.
- Survives repeated challenges: One dose of KATHON™ PFM microbicide not only eradicates existing vegetative microbial growth, it also preserves fluids against colonization after multiple reinoculations.
- Effective at low doses: As little as six ppm active ingredient (approximately six ounces per 100 gallons of fluid) can provide effective preservation. This allows printing fluids to be preserved economically with minimal safety, health, or environmental concerns when used in accordance with the label, MSDS, and technical literature.
- Easily decontaminated and readily biodegradable: Refer to deactivation procedures in Table 13 of this document.
- Excellent compatibility: KATHON™ PFM microbicide is compatible with acid, neutral, and mildly alkaline solutions. It does not impart color, odor, or foaming characteristics. It is compatible with most printing fluids, regardless of their ionic nature, and it performs well in the presence of heavy organic loading.
- Water miscible liquid product: KATHON™ PFM microbicide is easy to dose and easy to blend; furthermore, in oil/water systems the active ingredient is expected to partition to the aqueous phase where bacteria and fungi are likely to grow.

Directions for use

Printing inks and printing ink components

KATHON™ PFM microbicide is recommended for the preservation of aqueous printing inks, such as those used in flexographic, gravure, screen and ink-jet printing. It is also recommended as a preservative for printing ink components such as resins, plasticizers, water-soluble dyes, pigments, gelling agents, waxes, surfactants and thickeners.

To preserve printing inks and printing ink components, add 0.4 to 1.67 pounds (181 to 756 grams) of KATHON™ PFM microbicide to every 1,000 pounds of fluid. This will provide 400 to 1,670 ppm of product as supplied (6 to 25 ppm active ingredient). The actual required concentration of preservative depends on the particular printing fluid, the expected frequency of microbial contamination and the necessary degree of protection.

Fountain solutions and photoplate processing chemicals

To preserve fountain solutions (etches) and photoplate processing chemicals, KATHON™ PFM microbicide should be added at a level to ensure that the final use-dilution fluid will contain between 400 and 1,670 ppm of product as supplied (6 to 25 ppm active ingredient). The actual concentration of preservative depends on the particular printing fluid, the expected frequency of microbial contamination, and the necessary degree of protection.

Please note: Because KATHON™ PFM microbicide will cause allergic contact dermatitis at the high dose levels required for fountain solution concentrates, the concentrates must not be manually diluted by the user. Federal law requires automated mechanical dilution of the etch concentrate into the fountain solution distribution system. Concentrate manufacturers who use KATHON™ PFM microbicide should use the following statement on their labels: "This product contains a skin sensitizer. Skin which contacts this fountain solution concentrate should immediately be rinsed with water. KATHON™ PFM microbicide is not registered for press-side dosing."

Physical and chemical properties

The physical and chemical properties of KATHON™ PFM microbicide are presented in Table 1. These do not constitute specifications.

Table 1

Appearance	Pale yellow to green liquid
Active ingredient typical value	1.5%
Odor	Mild, aromatic
Specific gravity	1.02
Density, lbs./gal.	8.4
pH	3 to 5
Viscosity, cp s., 25° C	3
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 and most organic and inorganic compounds normally used in printing fluids. However, the active ingredient may be inactivated by high alkalinity and nucleophiles such as primary and secondary amines, mercaptans, and sulfides. Inactivation is concentration related.
Stability	Store as supplied at least one year at ambient temperatures and at least six months at 50° C.

Antimicrobial Properties

KATHON™ PFM microbicide is an outstanding antimicrobial agent. It is initially microbiostatic due to the extremely rapid inhibition of macromolecular synthesis (e.g., protein, RNA and cell wall). Cell membrane integrity is not immediately affected. KATHON™ PFM microbicide is ultimately microbicidal within a few hours to a few days of contact time. All data obtained to date suggest that KATHON™ PFM microbicide kills prokaryotic (bacteria) and eukaryotic (algae and fungi) microbes via a similar mechanism.

Table 2 gives the minimum levels of active ingredient which inhibited growth of various microorganisms in test tube cultures. These data demonstrate broad spectrum activity. The methods used to obtain the data are useful tools for screening antimicrobial materials under standardized laboratory conditions in nutrient-rich growth media. The data are intended only to indicate the activity of KATHON™ PFM microbicide and do not represent a claim for recommended use concentrations nor list microorganisms necessarily involved in the contamination and deterioration of water-based printing fluids.

Table 2: Minimum inhibitory concentrations of KATHON™ PFM microbicide

Bacteria[1]		
Organism	ATCC No.	Active Ingredient ppm
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

Bacteria[1]		
Organism	ATCC No.	Active Ingredient ppm
Gram-Negative		
Salmonella typhosa	6539	5
Shigella sonnei	9292	2
Organism	ATCC No.	Active Ingredient ppm
Gram-Positive		
Bacillus cereus var. mycoides	(R&H L5)	2
Bacillus subtilis	(R&H 82)	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[1]		
Organism	ATCC No.	Active Ingredient ppm
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 stolonifera	10404	5
Rhototorula rubra (yeast)	9449	2
Saccharomyces cerevisiae (yeast)	2601	2
Trichophyton mentagrophytes (interdigitale)	9533	5

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

The data in this bulletin were obtained with KATHON™ PFM microbicide or with a technical grade of the active ingredient used as an intermediate in its manufacture.

Evaluation of preservatives

The efficacy of a microbicide can be evaluated by incubating samples of infected material containing a microbicide for periods of between six weeks and six months with periodic reinoculations of microbial cultures. Counts of colony-forming units per milliliter (CFU/ml), obtained by an agar plating method or standard streak test, indicate the degree of control provided by the microbicide.

General testing procedures

A cell suspension is made by mixing 19 cultures of bacteria, yeasts and filamentous fungi isolated from contaminated printing fluids or related products and two additional pseudomonad cultures. If it is available, a sample of naturally contaminated printing fluid is used as a second inoculum. Fifty-gram aliquots of printing fluid in screw-capped bottles are treated with a designated level of KATHON™ PFM or other microbicide, 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 six weeks to six months. Microbial populations are determined biweekly or monthly prior to each reinoculation by means of an agar streak test. The rating scale used to describe microbial growth is presented below.

Rating scale

Colony-Forming units/ml (Bacteria)	Rating
< 10	0
10 to 100	T
100 to 1,000	1+
1,000 to 10,000	2+
10,000 to 100,000	3+
> 100,000	4+
Fungal growth	(F)
Sample Dropped Due to High Counts	*

Following are the results of microbicidal tests conducted in nine different printing fluids. It is important to note that all treatment levels listed in the following tables are shown as ppm of active ingredient, not as product supplied.

Fountain solutions

The use of properly formulated fountain solutions (etches) is critical to achieving the high-quality printing that is expected of offset lithography. Many fountain solutions, however, are excellent sources of nutrients for bacteria and fungi, including yeasts. As a result, the rollers that apply the fountain solution to the plate can become fouled with biomass. The data in Table 3 show that as little as 5 ppm active KATHON™ PFM microbicide prevented microbial growth in acidic and neutral solutions. Table 4 compares the stability of KATHON™ PFM microbicide in acidic and neutral concentrates to its stability in an alkaline concentrate.

The data in Tables 3 and 4 suggest that the instability of KATHON™ PFM microbicide at high pH levels precludes its use in alkaline fountain solutions, unless the maximum allowable dose of microbicide is added to the solution concentrate and the concentrate is diluted and used within a week.

Safety note: KATHON™ PFM microbicide should only be used in those fountain solutions which are mechanically diluted prior to use.

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Table 3: Microbial control in dilute fountain solutions

	KATHON™ PFM active ppm	Microbial growth rating		Active KATHON™ PFM (ppm)[1] found after		
Solution	Nominal concentration)	1 week	2 weeks	1 week	2 weeks	3 weeks
Acid etch (1:50 dilution) pH = 3.6	0	4+	4+	*	*	*
	5	0	0	5.6	6.1	6.0
	15	0	0	17.0	17.0	16.6
	25	0	0	28.8	27.9	28.1
Neutral etch (1:50 dilution) pH= 7.7	0	4+	4+	*	*	*
	5	0	0	5.6	5.7	5.6
	15	0	0	16.5	16.7	16.9
	25	0	0	27.4	27.5	26.9
Alkaline etch (1:100 dilution) pH = 8.5	0	4+	4+	*	*	*
	5	1+	1+	3.1	2.7	2.7
	15	0	0	9.8	9.3	8.6
	25	0	0	17.7	16.3	15.6

[1]Analysis done by HPLC/UV detector

Table 4: KATHON™ PFM stability in fountain solution concentrates

	KATHON™ PFM active ppm	Active KATHON™ PFM (ppm)[1] found after			
Concentrate	(Nominal concentration)	Initial	1 week	2 weeks	4 weeks
Acid etch pH = 2.0	250	250	260	247	250
	750	760	770	760	750
	1250	1220	1250	1230	1240
Neutral etch pH = 7.0	250	250	250	241	242
	750	740	740	720	700
	1250	1230	1210	1190	1160
Alkaline etch pH = 10.6	500	390	< 120	< 120	< 120
	1500	1190	< 371	< 360	< 350
	2500	1960	720	< 600	< 570

[1]Analysis done by HPLC/UV detector

Pigments and pigment extenders

Titanium dioxide (TiO:2) is a pigment widely used in printing inks to improve opacity. Clay is often used as a pigment extender and as a body enhancer. The data presented in Table 5 show that KATHON™ PFM microbicide provided excellent microbial control in both TiO_2 and clay slurries.

Table 5: Microbial control in titanium dioxide and clay slurries

		Microbial growth rating		
Microbicide	Active ppm	2 weeks	4 weeks	6 weeks
Titanium dioxide slurries				
Untreated	0	4+	4+	*
KATHON™ PFM	10	0	0	0
KATHON™ PFM	20	0	0	0
Clay slurries				
Untreated	0	4+	4+	4+
KATHON™ PFM	10	T	T	T

Pigment dispersion resins

By providing excellent pigment dispersion, acrylic and acrylic/styrene-based resins maximize color strength and inhibit settling and flocculation in printing inks. They also have the proper rheology to enhance grinding efficiency and provide desirable drink, transfer, and printability properties. Table 6 shows that KATHON™ PFM microbicide, at 20 ppm of active ingredient, prevented mixed-culture microbial growth in different types of pigment dispersion resins.

Rating scale

Colony-Forming units/ml (Bacteria)	Rating
< 10	0
10 to 100	T
100 to 1,000	1+
1.000 to 10,000	2+
10,000 to 100,000	3+
> 100,000	4+
Fungal growth	(F)
Sample Dropped Due to High Counts	*

Table 6: Microbial control in pigment dispersion resins

		Microbial growth rating					
Microbicide	Active ppm	4 weeks	8 weeks	12 weeks	16 weeks	20 weeks	24 weeks
Resin A							
Untreated	0	4+	4+	4+	*	*	*
KATHON™ PFM	20	0	0	0	0	0	0
Formaldehyde	500	2+	2+	3+	2+	3+	3+
Resin B							
Untreated	0	1+ (F)	4+ (F)	3+ (F)	3+	4+	4+
KATHON™ PFM	20	0	0	0	0	0	0
Formaldehyde	500	0	0	0	0	0	0
Resin C							
Untreated	0	4+	4+ (F)	*	*	*	*
KATHON™ PFM	10	0	0	0	1+	3+	4+
KATHON™ PFM	20	0	0	0	0	0	0

Aqueous dispersants

The aqueous dispersant evaluated below is used for dispersion of inorganic pigments in water-based inks. The data in Table 7 show that the sodium salt of this carboxylated polyelectrolyte pigment dispersant supported such heavy microbial growth that sample counts of the untreated control were dropped after eight weeks. KATHON™ PFM microbicide, at 20 ppm active ingredient and at a pH of 9.8, prevented microbial growth for 12 weeks and held fungal growth at the trace level for an additional 12 weeks.

Table 7: Microbial control in an aqueous dispersant

		Microbial growth rating					
Microbicide	Active ppm	4 weeks	8 weeks	12 weeks	16 weeks	20 weeks	24 weeks
Untreated	0	4+	4+	*	*	*	*
KATHON™ PFM	20	0	0	0	T (F)	T (F)	T (F)

Solvents

Diethylene glycol is used in moisture set letter press inks and in other glycol inks as a water-miscible solvent. When contaminated with fungi from a sample of water used for dilution, the solvent (10% solution) easily supported fungal growth during a six-week preservation test. The data presented in Table 8 show that as little as 5 ppm of active KATHON™ PFM microbicide inhibited growth.

Table 8: Microbial control in diethylene glycol

		Microbial growth rating		
Microbicide	Active ppm	2 weeks	4 weeks	6 weeks
Untreated	0	3+ (F)	3+ (F)	4+ (F)
KATHON™ PFM	5	0	0	0
KATHON™ PFM	10	0	0	0

Waxes

Waxes are used in printing fluids to control tack and to improve abrasion resistance. A 24-week performance test with KATHON™ PFM was performed. The untreated control supported extreme microbial growth throughout the entire test. The data in Table 9 show that out of the four microbicides evaluated, KATHON™ PFM microbicide was the only product that prevented microbial contamination for the full 24-week period.

Table 9: Microbial control in a polyethylene wax emulsion

		Microbial growth rating					
Microbicide	Active ppm	4 weeks	8 weeks	12 weeks	16 weeks	20 weeks	24 weeks
Untreated	0	4+	4+	*	*	*	*
KATHON™ PFM	20	0	0	0	0	0	0
Formaldehyde	500	0	0	0	0	4+	4+

Thickeners

The data in Table 10 show that an alkali soluble thickener, which upgrades the transfer properties of aqueous inks, resisted microbial contamination through 16 weeks. Only ten ppm of active KATHON™ PFM microbicide were needed to extend this protection for another eight weeks.

Table 10: Microbial control in alkali soluble thickener

		Microbial growth rating					
Microbicide	Active ppm	4 weeks	8 weeks	12 weeks	16 weeks	20 weeks	24 weeks
Untreated	0	0	0	0	0	3+ (F)	4+ (F)
KATHON™ PFM	10	0	0	0	0	0	0

Dilution aids

Dilution aids, such as hydroxyethylcellulose, can be added to publication gravure inks to improve the resin-to-solvent ratio. Test results, presented in Table 11, show that as little as 5 ppm of active KATHON™ PFM microbicide prevented microbial growth for 24 weeks in a 7.5% solution of hydroxyethylcellulose.

Table 11: Microbial control in hydroxyethylcellulose

		Microbial growth rating					
Microbicide	Active ppm	4 weeks	8 weeks	12 weeks	16 weeks	20 weeks	24 weeks
Untreated	0	4+	4+	4+	4+	*	*
KATHON™ PFM	5	0	0	0	0	0	0

Rating scale

Colony-Forming units/ml (Bacteria)	Rating
< 10	0
10 to 100	T
100 to 1,000	1+
1,000 to 10,000	2+
10,000 to 100,000	3+
> 100,000	4+
Fungal growth	(F)
Sample Dropped Due to High Counts	*

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Overprint varnish resin

The data in Table 12 show that an acrylic resin used as an overprint varnish vehicle in water-based inks supported such heavy microbial growth that it could not be controlled with 1,000 ppm of formaldehyde. KATHON™ PFM microbicide, however, prevented microbial growth for the entire 24-week period of the test at a concentration of 20 ppm active ingredient.

Table 12: Microbial control in letdown and overprint varnish resin

		Microbial growth rating					
Microbicide	Active ppm	4 weeks	8 weeks	12 weeks	16 weeks	20 weeks	24 weeks
Untreated	0	4+	4+	*	*	*	*
KATHON™ PFM	20	0	0	0	0	0	0
Formaldehyde	500	4+	4+	*	*	*	*
Formaldehyde	1000	4+	4+	*	*	*	*

Rating scale

Colony-Forming units/ml (Bacteria)	Rating
< 10	0
10 to 100	T
100 to 1,000	1+
1,000 to 10,000	2+
10,000 to 100,000	3+
> 100,000	4+
Fungal growth	(F)
Sample Dropped Due to High Counts	*

Safe handling information

KATHON™ PFM microbicide as supplied is corrosive and can cause irreversible eye damage and skin burns. These effects may be delayed for hours after exposure. The microbicide can cause allergic skin reactions in susceptible individuals and can be harmful if inhaled and fatal if swallowed.

Personnel handling KATHON™ PFM microbicide must follow proper safety procedures. Protective eyewear (goggles or face shield), impervious apron, and impervious rubber gloves should be worn when handling the microbicide. Anyone handling KATHON™ PFM microbicide should avoid inhaling its vapors or mists and should wash thoroughly after handling. Avoid contamination of food and do not ingest KATHON™ PFM microbicide. Like all microbicides, KATHON™ PFM should be kept out of the reach of children.

First aid measures

Eye Contact

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

Skin Contact

FLUSH IMMEDIATELY with plenty of water for at least 15 minutes. Shower with soap and water. Decontaminate and then launder decontaminated clothing before wearing again.

If Inhaled

Move victim immediately to fresh air. If the victim is not breathing, initiate artificial respiration. If breathing is difficult, give oxygen. Call a physician.

If Swallowed

If victim is conscious, dilute the microbicide by giving the victim two glasses of water to drink and then call a physician immediately. If the victim is unconscious, call a physician immediately. Never give an unconscious person anything to drink.

Note to Physician

If the microbicide is swallowed, mucosal damage may contraindicate the use of gastric lavage. Measures against circulatory shock, respiratory depression, and convulsions may be needed.

Material safety data sheets

DuPont maintains Material Safety Data Sheets (MSDS) on all its products. These sheets contain pertinent information that you may need to protect your employees and customers against any known health or safety hazards associated with our products.

We recommend that you obtain from your local DuPont representative the Material Safety Data Sheets for our products before using them in your facilities. We also suggest that you contact your suppliers of other materials recommended for use with our products for appropriate health and safety precautions before using them.

Deactivation procedure

KATHON™ PFM microbicide can be deactivated by sulfite decontamination solutions. Instructions on preparing decontamination solutions are presented in Table 13.

Table 13: Preparation of decontamination solution (10 lbs.)

Ingredient (lbs.)	Sodium bisulfite / $NaHSO_3$	Sodium metabisuflite / $Na_2S_2O_5$
Decontamination agent	1.0	0.9
Water	9.0	9.1
	--	--
TOTAL	10.0	10.0

NOTE: Decontamination solution must be slightly acidic (pH = 4.0 to 5.0) for maximum effectiveness.

Cleanup of spills

Personnel engaged in cleanup of chemical spills should wear protective clothing: chemical splash goggles, plastic rain jacket and pants, rubber boots or other impervious overshoes, and impervious rubber gloves. For large spills of KATHON™ PFM microbicide in poorly ventilated areas, cleanup personnel should also wear air-purifying respirators with organic vapor cartridges. Prepare fresh decontamination solution as instructed in Table 13. The spilled material should be diked and absorbed in an inert solid such as sand, sawdust, clay, or vermiculite. The absorbent and surface soil, to a depth sufficient to remove all microbicide, should then be shoveled into a polyethylene-lined pail or drum and treated with enough decontaminant solution to wet the solid thoroughly. For each volume of KATHON™ PFM microbicide, use at least two volumes of decontamination solution. All protective clothing and equipment used during cleanup must be decontaminated thoroughly and cleaned before reuse or decontaminated and put into the drums containing the decontaminated absorbent solid. Let the containers stand open for 48 hours to avoid buildup of pressure, then seal and dispose of them according to local, state, and federal regulations.

The decontaminated area should be washed with additional decontaminant solution (30-minute contact time) and then flushed with large amounts of water into a chemical sewer. Do not discharge spills or cleaning runoff into municipal sewers, lakes, streams, ponds, or public water unless in accordance with a NPDES permit. For guidance, contact your Regional Office of EPA. Do not contaminate public waters by cleaning equipment or disposal of wastes.

KATHON™ PFM microbicide is toxic to fish and wildlife unless it is either diluted or decontaminated. A study of the effectiveness of decontamination procedures showed that all bluegill sunfish test subjects died within 24 hours when exposed to 2 ppm of active ingredient. However, no bluegills died during a 96-hour exposure to 0.2 ppm of active ingredient or to a solution of 2 ppm active ingredient and 100 ppm sodium bisulfite. The products of decontamination were judged to be slightly irritating to the eyes of rabbits.

Environmental impact and biodegradability

KATHON™ PFM microbicide has minimal environmental impact because it is a high-performance product used at very low levels, and it is readily biodegradable. Radioassay studies were conducted to follow the biodegradation of the active ingredient 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, 1060-1075 (1975); reprints are available on request.

Product stewardship

When considering the use of any DuPont product in a particular application, review the latest Safety Data Sheet (SDS) and country-specific product label to ensure the intended use is within the scope of approved uses. DuPont 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 DuPont products – from the initial concept and research, to manufacture, use, sale, disposal, and recycle of each product.

Customer notice

DuPont strongly encourages its customers to review both their manufacturing processes and their applications of DuPont products from the standpoint of human health and environmental quality to ensure that DuPont products are not used in ways for which they are not intended or tested. DuPont personnel are available to answer your questions and to provide reasonable technical support. DuPont product literature, including Safety Data Sheets (SDS), should be consulted prior to use of DuPont products. Current Safety Data Sheets are available from DuPont.

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PB 00118-0 E L 11.2020